UNDERSTANDING EXTERNAL STRUCTURES, TEACHERS' BELIEFS, PROFESSIONAL DISPOSITIONS, ORIENTATION TOWARDS TECHNOLOGY AND TECHNOLOGY USE IN SOUTH AFRICAN SECONDARY SCHOOLS: A LONGITUDINAL MICRO-, MESO- AND META-THEORY PERSPECTIVE

by
Suzanne Lee Sackstein
19345438

Submitted in fulfilment of the requirements for the degree
PhD in Information Systems

in the

FACULTY OF ENGINEERING, BUILT ENVIRONMENT & IT

at the

UNIVERSITY OF PRETORIA

Study leaders
Prof M Matthee
Dr L Weilbach

Date of submission
20th of July 2021

Declaration regarding Plagiarism

The Department of Informatics emphasises integrity and ethical behaviour with regard to the preparation of all written assignments.

Although the lecturer will provide you with information regarding reference techniques, as well as ways to avoid plagiarism, you also have a responsibility to fulfil in this regard. Should you at any time feel unsure about the requirements, you must consult the lecturer concerned before submitting an assignment.

You are guilty of plagiarism when you extract information from a book, article, web page or any other information source without acknowledging the source and pretend that it is your own work. This doesn't only apply to cases where you quote verbatim, but also when you present someone else's work in a somewhat amended (paraphrased) format or when you use someone else's arguments or ideas without the necessary acknowledgement. You are also guilty of plagiarism if you copy and paste information directly from an electronic source (e.g., a web site, e-mail message, electronic journal article, or CD ROM), even if you acknowledge the source.

You are not allowed to submit another student's previous work as your own. You are furthermore not allowed to let anyone copy or use your work with the intention of presenting it as his/her own.

Students who are guilty of plagiarism will forfeit all credits for the work concerned. In addition, the matter will be referred to the Committee for Discipline (Students) for a ruling. Plagiarism is considered a serious violation of the University's regulations and may lead to your suspension from the University. The University's policy regarding plagiarism is available on the Internet at *http://upetd.up.ac.za/authors/create/plagiarism/students.htm*.

I (full names & surname):	Suzanne Lee Sackstein
Student number:	19345438

Declare the following:

1. I understand what plagiarism entails and am aware of the University's policy in this regard.
2. I declare that this assignment is my own, original work. Where someone else's work was used (whether from a printed source, the Internet, or any other source) due acknowledgement was given and reference was made according to departmental requirements.
3. I did not copy and paste any information directly from an electronic source (e.g., a web page, electronic journal article or CD ROM) into this document.
4. I did not make use of another student's previous work and submitted it as my own.
5. I did not allow and will not allow anyone to copy my work with the intention of presenting it as his/her own work.

Signature

20th of July 2021

Date

ACKNOWLEDGMENTS

The journey towards achieving a PhD is arduous and cannot be completed on one's own, it requires the support of and/or guidance of so many to whom I have enormous gratitude.

Hashem, thank you for all the blessings in my life. I pray that I only continue to use my abilities to sanctify your name and make the world a better place.

My husband and soul mate, Shaul. Words cannot express my gratitude. Not only have you listened to my ideas, helped me clarify my thoughts, and assisted me in designing tables and diagrams to simplify the dense information in this report, but you have constantly encouraged and motivated me not to give up and to reach my goal and complete this degree. You really are the most important person in my life and I would not have been able to achieve what I have without you by my side.

Our special children Eli and Temima, Meir and Nechama, Yoni and Elisheva, Aaron, Rachel and Gadi, and of course our beautiful granddaughter Adina Tova. You have been amazing in the last two and half years, always so interested in my research and proud of what I was doing. I honestly could not have completed this without you all. I hope that I will be able to be there for you, standing by your side and supporting you in achieving your dreams and goals. I can honestly say, I have great kids.

During the time of this report being examined my mother, who I loved dearly, passed away. Mom, I know you were so proud of me in achieving this lifelong ambition. Throughout my life you sacrificed so much to make sure your 'girls' were okay. I hope you knew how much we appreciated all that you did for us, it was not taken for granted. Your passing has left a huge void in our lives and your presence is sorely missed.

My sisters, Linda, Debbie and their families, you are my biggest fans. Thank you for always being there for me and encouraging me every step of the way. I am truly blessed to have you all in my life.

Rachel who helped me at home and ensured that I took some well-deserved breaks.

The teachers who took part in the study, you gave of your time in the midst of the pandemic, when there was so much else that needed your attention. Your personal stories, thoughts, and ideas have enriched my understanding of the complexities involved in adopting technology in your daily teaching practices. To the principals, thank you for allowing me to collect data at your schools, and for the time spent organising all the interviews, I am forever grateful. I hope that the findings of this study will benefit your schools to achieve even greater heights.

Linda, who is my co-researcher in the umbrella research project which provided the impetus for this study. You are really a special person and a true friend. It has been a pleasure working alongside for these last 23 years and look forward to many more years.

Slo, who supervised my masters, although you have not been involved in this journey, I constantly reflect on all the lessons that I learned working under you and have tried to weave them into this report. Hope you enjoy reading this extension of our work together.

My friends, thank you for your constant care and support, and for tolerating my disappearance while completing this research.

Lorinda, thank you for the painstakingly editing of over six hundred pages, it is really appreciated. You really have made this report so much more readable.

Dr Lizette Weilbach, the co-supervisor for this study, you have literally helped me ‘navigate’ my way through this PhD. Your attention to detail and insights have only assisted me in writing this report.

Prof Machdel Matthee who agreed to take on supervising this research even though your supervision and workload was over capacity, thank you. You have been a constant guide throughout this process. Not only have you have shared with me your vast knowledge about research, provided me with valuable insights into my ideas and writing, offered clarity when I could not make sense of Structuration Theory, but above all you have shown me patience and care along this journey. You are a true educator and I am privileged to have been given this opportunity to learn from you.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

UNDERSTANDING TEACHERS' BELIEFS, PROFESSIONAL DISPOSITIONS, ORIENTATION TOWARDS TECHNOLOGY AND TECHNOLOGY USE IN SOUTH AFRICAN SECONDARY SCHOOLS: A MICRO-, MESO- AND META-THEORY PERSPECTIVE

Background: Those advocating for technology integration within education claim that teachers need to reform their pedagogic practices to make learning more engaging and relevant. Within South Africa, not only is incorporating technology seen as a way to better equip learners, but technology integration is also being promoted as a way to address issues around quality of education, shortage of teachers, and current inequalities between private and public schools in the country. Notwithstanding large investments in technology resources by the South African government, it appears as if many technology initiatives have failed to address the current issues. In addition, while technology played a pivotal role in supporting remote and hybrid educational approaches during the COVID-19 pandemic, within South Africa the move to greater use of technology was fraught with multiple challenges. While educational technology researchers claim teachers are primarily responsible for these failures, it seems as if teachers do not embrace technology unquestionably, even in well-resourced schools, and thus more balanced research aimed at understanding the critical role teachers play in the complex process of technology integration is needed.

Objective: To develop a theoretically-based understanding of teachers' technology use within different social and educational contexts by exploring the relationship between technology infrastructure, teachers' beliefs, professional dispositions, and orientation towards technology.

Methods: Literature on external (ES) and internal barriers and beliefs (IB), Hoadley and Ensor's conception of Professional Disposition (PD), prominent educational technology theories on Orientation towards Technology (OTT), and Bernstein's view of Context (C), alongside Stones' Strong Structuration Theory (SST) were utilised to construct the theoretical framework for this study, Teachers' Technology Use - Strong Structuration Theory (TTU-SST). Using an interpretivist paradigm with a qualitative case study research approach, a set of three interviews were conducted at four South African secondary schools with vastly different social contexts, over different conjunctures i.e., combination of events over a period of time. Micro and meso analyses were conducted using within-case

and cross-case directed-content analysis; while a meta-theory perspective was provided by examining teachers' technology use regarding Stones' notion of the duality of structure modelled in the quadripartite nature of structuration by External Structures (ES), Internal Structures (IS), Agents' Practices (AP), and Outcomes (O).

Micro and Meso Findings: Findings suggest that teachers' incorporation of technology into their pedagogic practice is a complex process. Firstly, while the provision of technology (ES) is essential, it does not seem to guarantee integration as use varies even amongst teachers within technology-rich schools. Secondly, teachers with more positive Internal Beliefs (IB) of technology seem to focus less on External Structures (ES) barriers and utilise technology in more varied ways as well as to enhance and transform their pedagogic practices. Thirdly, contrary to much educational technology research, teachers' Professional Dispositions (PD) exist on a continuum and do not appear to be the sole influence on teachers' Orientation towards Technology (OTT). Lastly, the Context (C) alongside the school's technology policy and related External Structures (ES) seems to influence teachers Internal Beliefs (IB) and resulting Orientation towards Technology (OTT).

Meta-Theory Perspective: Firstly, findings indicate technology use is not only determined by the objective characteristics of the structures (ES) with which teachers interact, but also by the subjective nature of the teachers themselves (IS) and the Context (C) in which they teach. Secondly, the duality of structure is evident as teachers' actions (AP) appear to either reproduce, modify or transform External Structures (ES), while concurrently a shift in External Structures (ES) and Context (C) modifies and transforms teachers' Internal Structures (IS). Thirdly, it seems as if External Structures (ES) cannot be classified as either independent causal influences over which there is no control, or irresistible causal influences with some degree of control, as degrees of control shift in response to the surrounding Context (C). Similarly, the dimensions of structuration teachers draw on do not appear static.

Contribution: This research provides a balanced, theoretically-based understanding of the external and internal structures and complex relationships influencing teachers' technology choices, whilst considering different school and educational contexts over a period of time. Furthermore, the meta-theory perspective demonstrates the ability of the theoretical framework developed for this study, TTU-SST, to serve as a guide for future empirical work focused on understanding teachers' technology use.

Keywords: Technology, Teachers, External barriers, First-order barriers, Internal barriers, Second-order barriers, Beliefs, Professional Disposition, Orientation towards Technology, Structuration Theory, Strong Structuration Theory, SST, Quadripartite nature of structuration, External structures, general dispositions, South Africa

1 INTRODUCTION

1.1 BACKGROUND INFORMATION

1.1.1 Prior to COVID-19

Technology is not simply being used to support traditional ways of life but rather is challenging, and in many cases, transforming accepted practice (De Wet, Koekemoer & Nel, 2016). While effective technology integration can potentially benefit education by making learning more relevant and engaging (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur & Sendurur, 2012), Van Der Ross and Tsibolane (2017) claim that South African initiatives to integrate technology are also being driven by the possibilities of improving the quality of education in the country (Adukaite, van Zyl, & Cantoni, 2016); preparing learners[1] for the twenty-first century (South African Department of Education, 2004; Motshekga, 2015); addressing the shortage of teachers (South African Department of Education, 2005); and resolving the country's educational challenges due to technology infrastructure issues (Adukaite et al., 2016; Padayachee, 2017). Despite large investments, with an estimated 15 billion rand having been spent on technology integration efforts in 2019 (Communications Directorate, 2019), many initiatives within the country are still in pilot phases; have not met initial goals; or have failed to address the issues around poor-quality education in the country (Ford & Botha, 2010; Sherman & Howard, 2012; Adukaite et al., 2016; Van Der Ross & Tsibolane, 2017). According to Vandeyar (2014) and Avidov-Ungar and Forkos-Baruch (2018), simply providing schools with technology with the expectation that it will be used to enhance education, devalues the importance of the critical and central role teachers play in the success of technology integration initiatives.

1.1.2 During COVID-19

Following the declaration of a global pandemic in March 2020 and in an attempt to "flatten the curve", many countries temporarily closed schools (Giovannella, Passarelli, & Persico, 2020; Le Grange, 2020; Mailizar, Almanthari, Maulina, & Bruce, 2020) leaving an estimated 1.6 billion learners out of school (The World Bank Education Global Practice, 2020). As technology offered the best way to shift from face-to-face to remote education, and facilitate online and hybrid teaching and learning (Bergdahl & Nouri, 2020; Callahan, 2020), many teachers were forced to embrace technology in order to continue with the

[1] The term learner has been used throughout as this is the convention in South Africa when one refers to secondary school students.

academic project (Giovannella et al., 2020; Le Grange, 2020; Hodges, Moore, Lockee, Trust, & Bond, 2020). However, Williamson, Eynon, and Potter (2020) claim that the need to move online only amplified current inequalities in relation to technology access due to differing social, economic, and personal contexts. In addition, Giovannella et al. (2020), Mailizar et al. (2020), and Bergdahl and Nouri (2020) argue that many teachers have been unable to exploit the full range of technology affordances due to a lack of skills, limited time, and a belief that face-to-face teaching is important.

Within a South African context, Davids (2020) and Le Grange (2020) contend that more advantaged schools have been able to move almost seamlessly to emergency online mediums, whereas in most public secondary schools initially the academic project was virtually suspended due to learners' and teachers' lack of appropriate technology and infrastructure (Mhlanga & Moloi, 2020) and has since progressed to a staggered attendance model to avoid overcrowding (Government of South Africa, 2020; SABC, 2020a). While the DoE has utilised television and radio stations to enable teachers to deliver live lessons and offered learners free access to educational websites (Mhlanga & Moloi, 2020; SABC, 2020b; Government of South Africa, 2020), and private enterprise has rallied to provide a free digital school, accessible on social media platforms, the shift to remote education has only amplified the large digital and educational divide within the country (Le Grange, 2020).

1.2 PROBLEM STATEMENT

Advocates claim that technology can only enhance education and are thus frustrated by the current lack of technology integration (Bladergroen & Buckley, 2016; Chigona & Chigona, 2010; Chigona, Chigona & Davids, 2014). Many researchers claim teachers are responsible for the lack of technology integration due to misalignment between beliefs and associated pedagogic practices (Ertmer, Ottenbreit-Leftwich, & Tondeur, 2015), perceived external and internal barriers to technology integration (Ertmer, 1999; Sherman & Howard, 2012), and the inability to respond to current educational requirements (Cuban, 2001; Prensky, 2010). However, Vandeyar (2014) contends that technology initiatives which undervalue the importance of teachers' beliefs are ineffective.

According to Tondeur, van Braak, Ertmer, and Ottenbreit-Leftwich (2017), teachers do not unquestioningly embrace technology, as teachers' beliefs about what constitutes "good"

education are not based on technology use, but rather on their beliefs and perceived values which guide their pedagogic practice (Borg, 2001).

Altan, Lane, and Dottin (2019) claim one's disposition, which is influenced by a person's motivation and internal beliefs and describes subsequent behaviour and professional conduct, may be one of the reasons for this misalignment as some teachers' dispositions may promote technology integration while others may act as inhibitors (Vannatta & Fordham, 2004) and thus for technology initiatives to be successful Altan et al. (2019), Dottin (2009), Hoadley and Ensor (2009), contend that it is essential to understand the relationship between teachers' professional dispositions and their resulting pedagogic practice. So too, Earle (2002) argues that incorporating technology in the classroom does not automatically occur when technology is present, but rather requires teachers to possess positive orientations towards technology, evidenced by active incorporation of technology into their pedagogic practices (Chen, 2008; Tondeur et al., 2017). However, Ertmer, Gopalakrishnan and Ross (2001) state that even when teachers believe using technology is valuable, their espoused beliefs do not always align with their observed pedagogic practice due to external and internal constraints.

While concerted efforts have almost eliminated external constraints in many developed countries (Ertmer et al., 2012), in emerging economies like South Africa technology initiatives tend to mainly focus on removing or reducing external constraints by providing access to technology, training and technology support (Fanni, Rega, van Zyl, Tardini & Cantoni, 2010; Van Der Ross & Tsibolane, 2017) as vast digital inequalities exist (Padayachee, 2017; Adukaite et al., 2016). With the recent shift to remote education due to the COVID-19 pandemic, not only have these differences been amplified (Mhlanga & Moloi, 2020; Le Grange, 2020), but Howard and Sherman (2012), Adukaite et al. (2016), Padayachee (2017) contend simply focusing on providing teachers with technology without considering internal constraints, may also hamper technology initiatives.

1.3 KNOWLEDGE GAP

Although research on technology integration within education spans many decades, Mama and Hennessy (2013) contend that much of the findings are inconsistent, contradictory, or unconvincing. Possible reasons, which include positions of advocacy, primary focus on

convincing teachers to integrate technology, differing disciplines of education and technology, contextual issues within South Africa and the shifting educational situation, are detailed below.

Firstly, many educational technology studies are presented from an advocacy position claiming technology can only benefit education (Lim, Zhao, Tondeur, Chai, & Tsai, 2013; Nkula & Krauss, 2015; Vandeyar, 2014) and improve teachers' pedagogic practices (Avidov-Ungar & Forkos-Baruch, 2018; Cuban, 1993; 2001; Ertmer et al., 2015; Prensky, 2010). However, Van Der Ross and Tsibolane (2017) state that technology integration does not automatically result in better teaching and improved education (Hennessy, Harrison & Wamakoteet, 2010) and thus a more balanced research approach is needed.

Secondly, educational technology research is primarily aimed at exploring ways in which to persuade teachers to integrate technology in the classroom (Cuban, 1993; 2001; Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2010; Lim et al., 2013), with little attention given to the underlying reasons for teachers' choices (Lawrence & Tar, 2018). Thus, a more in-depth exploration of teachers' complex technology integration choices, not simply focused on encouraging teachers to integrate technology, is needed.

Thirdly, studies focused on technology integration within education draw from two different disciplines i.e., education and technology. According to Lim et al. (2013), literature focusing on educational issues around technology integration in the classroom is mainly anecdotal and lacks explicit theoretical grounding, with findings often limited and unclear (Hennessy, Ruthven & Brindley, 2005). Whereas literature focussed on the technology integration in different contexts, with education being one, most often utilises technology-driven theories, aimed at explaining how and why people should make use of technology in their lives. Therefore, research utilising an explicit theory in which education, not technology is prioritised, is needed to explore the critical role teachers play in relation to the success of technology integration efforts (Vandeyar, 2014).

Fourthly, in an emerging economy like South Africa's, where access to basic technology resources such as appropriate hardware and software as well as internet and technology support are lacking, literature tends to focus on first-order barriers as these are crucial in previously disadvantaged or underresourced schools (Sherman & Howard, 2012;

Padayachee, 2017). However, Nkula and Krauss (2015) found that although a disparity exists between teachers at technology-rich schools and teachers at underresourced schools within South Africa, even teachers within technology-rich schools are not effectively integrating technology into their pedagogic practice. Simply addressing external constraints, even when first-order barriers are significant, does not automatically result in technology integration in the classroom (Hennessy et al., 2010; Sherman & Howard, 2012; Adukaite et al., 2016). Therefore, research aimed at understanding technology integration in South African education needs to consider teachers' beliefs and attitudes in relation to technology use at the same time as issues related to access to technology and training teachers are being considered.

Lastly, Mailizar et al. (2020) claim that although research is starting to emerge, as COVID-19 is relatively new, there is a scarcity of literature dealing with technology integration within an educational context during a pandemic (Ash & Davis, 2009; Mhlanga & Moloi, 2020) as the majority of studies are based on the premise of teachers' optional and voluntary use (Mailizar et al., 2020), and thus there are many unanswered questions and areas to explore involving the complexities encountered when moving to a remote setting where technology use is almost mandatory.

Along with the gaps identified in the literature, as an interpretivist researcher I believe it is necessary to explain my personal rationale briefly, based on my previous experience with research into teachers' technology integration journeys.

1.4 PERSONAL RATIONALE

Due to the abundance of claims based on anecdotal and undertheorised evidence advocating that teachers are the main obstructers to technology improving education (Cuban, 1993, 2012; Prensky, 2010), in 2013 I conducted research at advantaged secondary schools within South Africa, drawing on Bernstein's theoretical lens of instructional and regulative discourse (Bernstein, 1996; 2000) along with Hoadley and Ensor's (2009) work on pedagogical discourses, and Hooper and Rieber's (1995) description of technology integration, to develop an educationally focussed framework to assist in exploring teachers' technology adoption in relation to their invested pedagogic practice (Sackstein & Slonimsky, 2017). While findings indicate teachers have principled reasons for choices made in relation to technology use within their pedagogic practice and

the lack of use by teachers does not necessarily equal failure of technology initiatives or lack of progression for educational contexts (Sackstein & Slonimsky, 2017), reasons for these choices appear not to be simply related to their pedagogic practice or technology orientation, but rather seem to be a fusion of complex relationships and teachers' invested personal pedagogic beliefs and practices. Therefore, I concluded this research with questions remaining.

Firstly, how do teachers' beliefs about external and internal technology factors and their pedagogic practice influence their orientation towards technology? Secondly, how does the social context, which was not considered in the previous study, influence technology integration? Thirdly, why do inconsistencies exist between teachers' espoused beliefs and practices and their subsequent technology use?

1.5 RESEARCH QUESTIONS

Based on the gaps in the current educational technology literature, specifically within a South African context and my rationale, I have embarked on a journey to understand the complexities of relationships between teachers' beliefs, pedagogical practices, and technology integration more deeply — within the South African context.

Based on the argument that a more balanced and nuanced understanding of teachers' technology choices is crucial to successful technology integration within South Africa, the following research question has been formulated: *What relationships exist between external structures, teachers' beliefs, professional dispositions, and orientation towards technology in relation to their integration of technology within South African secondary schools in different school and educational contexts?*

To answer the main question and to guide the research, the following subquestions have been constructed:

1. What are the external technology structures at different schools?
2. What are different teachers' beliefs around the external technology structures in their school?
3. What are different teachers' internal beliefs about technology?
4. What are different teachers' professional dispositions?

5. What are different teachers' orientation towards technology?
6. How do different teachers use technology?
7. What is the context at different schools?
8. How do the external technology structures differ between technology-rich and technologically disadvantaged schools?
9. How does technology use differ between teachers at technology-rich and technologically disadvantaged schools?
10. How do different school contexts influence teachers' use of technology?
11. How do external structures, beliefs, professional dispositions, and orientation towards technology influence technology use in the classroom?

1.6 RESEARCH OBJECTIVES

The objectives for the research are as follows:

- To describe the nature of the relationship between external technology structures; teachers' technology beliefs, both about external structures and those internal to individual teachers; their professional dispositions; their orientation towards technology in the classroom; and their subsequent use of technology in the classroom over a period of time.

- To explain in what way social context influences the relationship between teachers' technology beliefs, their professional disposition, their orientation towards technology, and their subsequent use of technology in the classroom.

1.7 ASSUMPTIONS

In conducting this research it is firstly assumed that teachers are aware of their internal and external beliefs in relation to technology and can articulate these clearly. Secondly, it is assumed teachers can describe their pedagogic practice in relation to the conception of professional disposition as defined in this study i.e., instructional and regulative discourses.

1.8 DELINEATIONS

This research aims to explore teachers' technology journeys, hence learners' perspectives of teachers' technology integration and the subsequent influence on their learning are not addressed.

1.9 CONTRIBUTION OF THE RESEARCH

1.9.1 Theoretical

- **Non-advocacy and theory-based research**

As much of the current educational technology literature is undertaken from an advocacy position (Lim et al., 2013) and is undertheorised (Anyon, 1982), research simply aimed at understanding teachers' choices using a theoretical framework as a guide is valuable as it promises to provide more robust, rigorous, and relevant research (Stewart & Klein, 2016; Straub, 2009) and ultimately will contribute to a greater understanding of the research phenomenon and an appreciation for the importance of using theories within educational technology research.

- **Application of SST to IS field**

As SST does not specifically consider technology integration, to date it has not been used extensively within empirical educational technology studies (Stones, 2005; Jack & Kholeif, 2007; Greenhalgh & Stones, 2010). However, it is a sociological theory aimed at studying human activity with a particular focus on the duality of structures, social relations, agents' practices, and contexts (Stones, 2005) and thus using SST empirically for a technology study within an educational context offers a powerful and novel way of addressing this research phenomenon.

- **Research during a pandemic**

As COVID-19 is a fairly recent occurrence and therefore there is a lack of literature dealing with mandatory technology incorporation within an educational context (Ash & Davis, 2009; Mhlanga & Moloi, 2020), thus research exploring the complexities encountered when moving to a remote setting during a pandemic will greatly contribute to the growing body of knowledge in this area.

1.9.2 Practical

- **Government**

As huge investments in technology are being made with the hope of improving education in the country (Motshekga, 2015; Communications Directorate, 2019), understanding the complexities of teachers' technology integration choices is essential in order for government technology initiatives to be successful. Furthermore, due to the recent COVID-19 pandemic, findings from this study can be used to inform digital educational policies and address current barriers being faced by teachers and schools.

- **Schools**

As technology does not automatically result in improved education (Vandeyar, 2014; Adukaite et al., 2016), an understanding of teachers' technology integration choices will enable schools to tailor their technology integration policies accordingly, whilst catering for remote and hybrid teaching and learning.

- **Teachers**

Criticisms are being directed at teachers for not utilising technology to enhance or transform their pedagogic practices (Cuban, 2001), therefore, by understanding their technology choices, teachers will be empowered to make sound pedagogic decisions whilst considering technology use.

- **Technologists**

Technologists lack insight into the role teachers play in technology integration efforts as they believe incorporating technology is simply a mechanical operation (Vandeyar, 2014), and thus an understanding of the teachers' role is critical for the human element to be appreciated.

1.10 ACRONYMS AND ABBREVIATIONS

Technology Acceptance Theories

TRA - Theory of Reasoned Action

TPB - Theory of Planned Behaviour

TAM - Technology Acceptance Model

UTAUT - Unified Theory of Acceptance and Use of Technology

TTF - Task Technology Fit

Social Theories

AT - Activity Theory

DIT - Diffusion of Innovation Theory

TPACK - Technological Pedagogical Content Knowledge

ANT - Actor Network Theory

PBT - Pedagogical Beliefs Technology

Structuration Theories

ST - Structuration Theory

AST - Adaptive Structuration Theory

SST - Strong Structuration Theory

Educational Technology Models

HTMA - Hierarchical Model of Technology Adoption

ACOT - Apple Classroom of Tomorrow

SAMR - Substitution Augmentation Modification Redefinition

Application of Strong Structuration Theory

ES - External Structures

IS - Internal Structures

AP - Agent's Practices

O - Outcomes

C - Context

1.11 BRIEF CHAPTER OVERVIEW

1.11.1 Part B Literature Review

- **Chapter 2 Literature Review**

This chapter provides a review of the literature in relation to technology use within education, specifically in South Africa. Firstly, technology research in relation to levels of enquiry, theories and common technology adoption theories is presented. Secondly, literature related to barriers to technology use, both first order and second order, is discussed. Thirdly, teachers' beliefs about technology, professional dispositions, and orientation towards technology within the South African educational context are discussed separately and the relationship between them is elucidated.

1.11.2 Part C Theoretical Framework and Research Methodology

- **Chapter 3 Selecting Theories and Developing the Theoretical Framework**

Drawing on the literature reviewed, this chapter begins with an overview of the Theory of Planned Behaviour (TPB) considered for this study. Next the chosen theory, SST is presented in detail, along with reasons for selection. Thereafter, referring to the main research question and subquestions posed, the theoretical framework Teachers Technology Use-Strong Structuration Theory (TTU-SST) is developed in relation to the research phenomenon being studied. First, each of the constructs of SST and other related theories is applied at a micro- and meso-level, thereafter a diagram illustrating the overall framework is presented. Lastly, a table of initial codes, drawn from the literature and the TTU-SST framework is presented to provide a meta-theory perspective.

- **Chapter 4 Research Methods**

This chapter justifies the choices of the research paradigm, methodology, population, sampling, research instrument and coding to be employed. The chapter further provides a description of the data collection methods, data analysis, ethical considerations, and issues in relation to the validity and reliability of the research.

1.11.3 Part D Micro- and Meso-Perspectives, Within-Case Analysis of Schools

- **Chapters 5 to 8 Findings and Discussions of School 1 to 4**

These chapters provide an analysis of data collected in relation to teachers' beliefs, professional disposition, and orientation towards technology within the South African educational context. Furthermore, an analysis of context is also presented and discussed.

1.11.4 Part E Cross-Case Analysis of Schools and Meta-Theory Perspective

- **Chapter 9 Utilising TTU-SST the Theoretical Framework**

This chapter provides an analysis of the micro and meso findings across schools in relation to the theoretical framework, TTU-SST, and then a meta-theory perspective aimed at understanding how the duality of structure and other components of the framework provide insight into teachers' technology adoption choices.

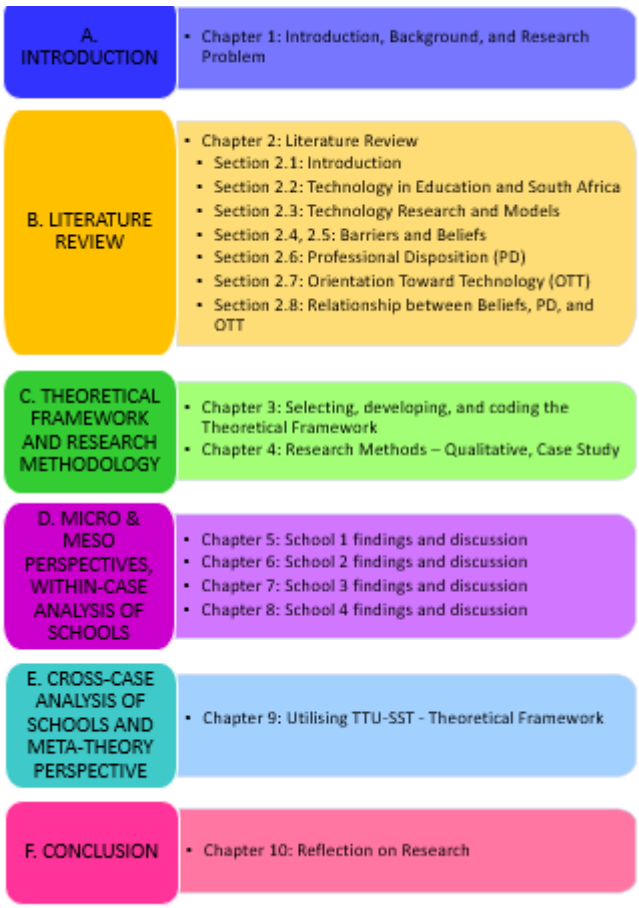
1.11.5 Part F Conclusion

- **Chapter 10 Reflections on Research**

This chapter answers the subquestions and main research question by providing a holistic overview of the findings and implications gained from this study. Limitations and contributions to both academia and practice are detailed, followed by recommendations for future research.

Figure 1 provides a graphical representation of the different parts this study and the associated chapters.

Figure 1: Chapter Map



1.12 CONCLUSION

This chapter provided a brief overview of the research area, problem, knowledge gap, and personal motivation for this study. Next, research questions, objectives, and assumptions were presented. Areas of focus, limitations, and significance of the study for both academics and practitioners were then discussed. Lastly, acronyms and abbreviations used throughout the report, an outline of chapters, and a diagrammatic representation of the chapters of the report were presented.

In the next chapter, in order to understand current literature in relation to technology and education, a review of technology use within education, different technology theories, barriers to technology integration, beliefs, professional dispositions, orientation towards technology, and the relationship between these factors is discussed in detail. In addition, to situate the review, the South African context is explored.

2 LITERATURE REVIEW

2.1 INTRODUCTION

As this study aims to understand teachers' technology integration in relation to their beliefs, professional dispositions and technology orientation within South Africa, literature relevant to these areas is needed. Firstly, a review of the increasing impact of technology and its transformation on every aspect of society is presented. Following this, the influence of technology within an educational context is explored with a specific focus on South Africa, with the benefits and barriers also presented. Next, as this study was conducted amid the COVID-19 pandemic, which resulted in most schools around the world turning to online teaching, literature discussing the shift, both within the global and the South African educational context is detailed. Thereafter, to situate the study in relation to technology adoption theory, levels of enquiry and theories are also presented. In addition, seminal and popular meso- and macro-level technology adoption theories are then discussed. Furthermore, barriers to technology integration are identified and linked to a discussion on teachers' first- and second-order beliefs. Following this, a review of the meaning of professional disposition is provided, specifically related to instructional and regulative discourses. Next, orientation towards technology integration as regards teachers' levels, manner and adoption activities is presented along with relevant micro-level technology orientation theories. Then, existing literature detailing the relationship between beliefs, professional disposition and technology use is presented. Using the literature reviewed, theories considered for this study are then presented, with the chosen theory SST being discussed in detail. SST is then applied to the study's research question and subquestion, with relevant codes being deduced from the literature, explained and shown in a table and graphic representation. Finally, a conclusion is provided.

2.2 TECHNOLOGY IN EDUCATION

2.2.1 Technology in education prior to COVID-19

The move to integrate and make greater usage of technology within education is not a novel idea. As technology evolves and its use becomes more ubiquitous and prolific, educators face growing demands to integrate technology in the classroom, with the expectation that technology will improve the quality of education they provide (Sackstein & Slonimsky, 2017). Desy, Reed and Wolanskyj (2017) propose that current learners, commonly known as millennials or alpha-millennials are different to past generations as

they are “deeply and permanently technologically enhanced and connected to their peers and the world in ways no generation has been before” (Prensky, 2010, pg 2). Due to the explosion of technology during their lifetime, millennials are technologically literate as they have grown up in an interconnected world without any recollection of the world before the Internet and mobile technology devices came into being (Desy et al., 2017; Hadijah & Shalawati, 2017). Therefore, current learners have a unique attitude to education with different inclinations and expectations concerning their learning environments than learners in the past (Desy et al., 2017). Monaco and Martin (2007) contend that millennials no longer fit the profile of a student that the educational system intends to teach, as they prefer to work collaboratively through various mediums that enable active participation both inside and outside the classroom as well as online. Woodbridge (2003) claims that technology integration occurs when technology is used to do something that could not otherwise be done and allows learners to make real-life associations to what is being learnt. Thus, technology use within an educational context has the potential to positively influence education by “enriching, enhancing, and extending student learning experiences” (Steel & Levy, 2009, pg1013); making classroom activities more stimulating and challenging (Hadijah & Shalawati, 2017); and improving knowledge, skills and utlimately the standard of education (Smeda, Dackich, Sharda, 2014; Nkula & Krauss, 2015).

However, Woodbridge (2003) and Padayachee (2017) argue technology is not simply a subject area but rather is an instructional tool and strategy used by teachers to impart knowledge, thus making it a complex process (Tondeur et al., 2017). Pierson (2001), Mishra and Koehler (2006) state that integration can only occur and benefit learning when teachers utilise their technological skills to integrate their subject knowledge with their pedagogical expertise, as teachers need to consider how their teaching strategies, administration, and management of a certain subject can be enhanced through using technology in the classroom. According to Liu (2011) and Cuban (2001; 2012), for real technology integration to take place teachers need to reform their pedagogic practices by developing teaching strategies that complement the use of technology to address current learners’ needs.

2.2.2 Technology in the South African educational context prior to COVID-19

Within the South African educational context, to address concerns as to the quality of education within the country (Department of Education, 2004) and the shortage of well-

qualified teachers (South African Department of Education, 2005), the government has invested enormous amounts of money into numerous technology integration projects in the country. For example, the Khanya project in the Western Cape (Western Cape Department of Education, 2011) and the Gauteng online project which distributed tablets and other technology devices to both teachers and learners (2015). However, Sherman and Howard (2012) and Adukaite et al. (2016) argue much of this investment is underutilised and that the implementation of e-Education has not delivered on the promises made (Ford & Botha, 2010; Padayachee, 2017). According to Vandeyar (2014), national educational policies encourage technology integration but do not provide schools with guidelines on how the integration is to be achieved. Without specific pedagogic guidelines, schools are being left to their own devices and therefore it is improbable that teachers will be capable of integrating technology effectively into their classrooms (Vandeyar, 2014; Ndlovu, 2016). To address this concern, in 2007 the DoE created a teacher development framework in order "to provide direction in addressing the ICT training needs of teachers and attempts to move away from imposing a narrow vision of the appropriate use of ICT in teaching and learning" (Department of Education, 2007, pg1).

Despite large investments into technology and policy interventions, Sherman and Howard (2012), Chigona et al. (2014), Bladergroen and Buckley (2016), Padayachee (2017) state South Africa is still grappling with many barriers to technology integration such as poor technical capabilities of teachers and learners; unreliable infrastructure with limited or no access to computers and the internet; inadequate training and technical support; and inappropriate or nonexistent school policies (Wilson-Strydom, Thomson, & Hodgkinson-Williams, 2005; Fanni et al., 2010; Chigona & Chigona, 2010; Ford & Botha, 2010).

2.2.3 Technology in education during COVID-19

Following the declaration by the World Health Organisation (WHO) of COVID-19 being a global pandemic in March 2020, many countries around the world temporarily closed schools to contain the spread of the COVID-19 pandemic (Giovannella, Passarelli, & Persico, 2020; Le Grange, 2020; Mailizar et al., 2020) leaving an estimated 1.6 billion learners out of school (The World Bank Education Global Practice, 2020). While teachers could decide whether or not they would utilise technology before the COVID-19 pandemic (Hadijah & Shalawati, 2017), the total closure of schools during this time forced teachers to embrace and integrate technology to continue with the academic project since technology

offered the best and most immediate way to move from face-to-face classes to remote teaching and learning (Giovannella et al., 2020; Le Grange, 2020; Hodges et al., 2020). While these extreme measures were initially intended to be short-lived, as the pandemic continued to rage, countries began to relax lockdown restrictions in an attempt to return to a “new normal” with many schools using technology to offer a hybrid approach to connect both on-site and remote learners through synchronous teaching (Bergdahl & Nouri, 2020; Callahan, 2020).

Setting aside the immense benefits of using technology, Giovannella et al. (2020) caution the move to technology has not been a panacea, as many schools have not been able to exploit the full range of affordances offered by technology and views as to the technology limitations may have also been clouded due to the rush in moving online. Furthermore, Williamson et al. (2020) claim the need to move online has only amplified current inequalities pertaining to education access amongst learners from differing social, economic, and personal contexts.

2.2.4 Technology in the South African educational context during COVID-19

Mhlanga and Moloi (2020) claim that in South Africa, not only were schools unprepared for the sudden shift to remote education, but in rural and townships areas many schools and learners are not equipped with appropriate technology and infrastructure to support remote education, and thus at such schools teaching activities were completely suspended at the start of lockdown in the country. While more affluent and middle-class schools were able to move almost seamlessly to emergency online mediums, according to Davids (2020), the COVID-19 pandemic has exposed the uncomfortable reality of the digital divide within South Africa, as most public secondary schools were ill-equipped for such a disruption. Access to any type of online education remains elusive for the majority of learners within the country (Le Grange, 2020). However, in an attempt to save the academic year and make virtual learning a reality for all learners in the country, the DoE used television and radio stations to enable teachers to deliver live lessons and offered learners free access to educational websites (Mhlanga & Moloi, 2020; SABC, 2020b; Government of South Africa, 2020). In addition, the Sasol Foundation (SF) and African Teen Geeks developed a free digital school, accessible on social media platforms, focused on science, engineering, technology, and mathematics (STEM) and in partnership with mobile network providers

free access was given to Siyavula[2] for mathematics and science support (Department of Education, 2020). Similar to the global picture, as it became a reality that the pandemic was not disappearing, the South African government employed a staggered attendance model for the academic project to continue, while avoiding the over-crowding of learners in classrooms (SABC, 2020a).

Notwithstanding these efforts, Mhlanga and Moloi (2020) claim the move to online and hybrid education in South Africa is fraught with multiple challenges due to poor technology facilities in many schools, coupled with widespread poverty which prevents disadvantaged learners from purchasing data, accessing the internet, and having appropriate technology to support remote learning (Le Grange, 2020) and thus digitally transforming the sector in the near future may be impossible.

While much has been published about technology integration in the classroom, and more research is constantly emerging due to technological and contextual changes, to understand more about teachers' technology adoption, literature focused on past technology research and the importance of using theories is needed.

2.3 TECHNOLOGY RESEARCH

According to Karasavvidis (2009), while many educational technology studies are conducted unsystematically and thus do not provide a holistic view of the research phenomenon, as they do not employ appropriate frameworks, Reeves, Albert, Kuper and Hodges (2008) claim that utilising theories are essential as they can be applied at different levels of inquiry and "provide complex and comprehensive conceptual understandings of things that cannot be pinned down: how societies work, how organisations operate, why people interact in certain ways" (pg949).

As regards technology, adoption theories have been developed to answer questions, explain, predict, and assess people's technology usage in a wide range of contexts (Taherdoost, 2018). However, as the field of IS draws on disciplines such as computer science, operations, sociology, and psychology, no specific theory or perspective

[2] Siyavula provides e-textbooks to assist learners in gaining maths and science skills. In addition, Siyavula has a mobile app for learners to practise maths and provides more challenging questions as the learner progresses (Siyavula - Technology Powered Learning , n.d.).

dominates (Halawi & McCarthy, 2006) and many technology adoption theories exist. According to Orlikowski and Baroudi (1991), while the plurality of perspectives may be complex to navigate, they facilitate investigation into varied questions and thus enhance the breadth and depth of knowledge generated within the IS discipline. To appreciate the nature and applicability of some of the most popular theories used within IS research, a discussion of levels of inquiry at which research can take place, and the range of theories that can be used is provided.

2.3.1 Levels of Inquiry

IS research, which generally aims to understand why people accept or reject new technologies and how this affects the social context, does not focus either on the technology or the social context, states Lee (2001) but rather explores the phenomena that emerge when the two interact. While social theories aim to explore and understand human activity, the level of inquiry upon which the researcher focuses (Blackstone, 2012) influences the questions posed and choices of theory by researchers. Levels of inquiry are: micro, meso and macro (Blackstone, 2012). According to Blackstone (2012), while some research problems are suited to one level of inquiry, it is not uncommon that a topic can be studied at all three levels.

At a *micro level*, Blackstone (2012) states researchers focus on the smallest level of interaction, for example, one-on-one interactions between a small group of people within a specific context, the person in their social context, or how a person's perceptions have been influenced by their social context. Within this study, examples of a micro-level of inquiry could include a focus on an individual teacher's beliefs, pedagogic practice as regards their technology integration, a group of teachers' technology use for a specific grade within a specific school, or a particular teacher's use of technology within their school context.

Meso-level inquiry, which falls between micro and macro levels, involves the study of groups and their interactions, with a focus on communities or organisations (Blackstone, 2012). For this study, examples of meso-level research may include research into technology integration across a range of teachers within a specific school, and a comparison of teachers' beliefs and pedagogic practices at various schools — to ascertain how they differ.

Macro-level inquiry involves the study of specific research phenomena at a broad level across national and global contexts and can also include an evaluation of differences between different provinces or countries (Blackstone, 2012). For this study, examples of a macro level of inquiry could include research into teachers' technology integration in a specific region within South Africa, a comparison of different regions within South Africa, or globally across similar or diverse nations.

According to Reeves et al. (2008), different levels of inquiry provide diverse lenses by which researchers can explore the complexity of a variety of issues. Just as there is no single way to understand issues, there is no single theory that can explain the complexity of social issues, with levels of inquiry informing the appropriate range of theory needed to address the research phenomenon.

2.3.2 Range of Theories

Burns (2010) states that social science research has traditionally been characterised by two opposing research approaches: grand theorising and empiricism. According to Burns (2010), grand-theorising refers to the overarching system of logically interconnected propositions from which empirical generalisations may be construed; while empiricism utilises primary data to confirm or falsify aspects of particular social contexts. In response to these opposing views, Merton (1967) conceptualised middle-range theories which facilitate empirical work to be theoretically informed while at the same time enabling theory to be empirically grounded. The range of theories most commonly referred to is Micro-, Meso-, or Middle-Range, or Grand or Meta-Range (Reeves et al., 2008; Mueller & Urbach, 2013).

Micro theories focus on individual interactions within a specific context and thus have a narrow range of interests with a focus on specific research phenomena and concepts (Reeves et al., 2008). Ayres (2012) states that micro-level theories, which are also referred to as partial or situational theories, can be tested with limited empirical studies as they are restricted to a particular research phenomenon or situational context.

Meso or mid-range theories address specific research phenomena and aim to integrate grand or meta-theories with empirical research (Reeves et al., 2008). Mueller and Urbach (2013) contend that due to the recognition of the importance of contextual differences,

mid-range theories involve a small number of specific concepts, as well as offer some level of generalisation either through their empirical design or connection to established theoretical descriptions (Boudon, 1991; Merton, 1967).

Grand or Meta-theories, often referred to as conceptual frameworks or models (Ayres, 2012) are constructed from relatively abstract concepts and thus are often difficult to operationalise and utilise for empirical research (Reeves et al., 2008). Mueller and Urbach (2013) claim that while micro and meso theories deal with specific research phenomena that can be observed empirically, grand, or meta-theories do not aim to specify each instance of any given research phenomenon, rather, meta-theories are "theories about theories of the empirical world" (pg8) as they offer guidelines for constructing context specific theories which facilitate advancement and deeper understanding of theory (Gregor 2006; Ritzer 2001). Bostrom, Gupta and Thomas (2009) claim a good meta-theory needs to offer overarching perspectives; enable the development of theory; and provide an advancement of existing theories. An example of a meta-theory is Structuration Theory (Giddens 1984).

Ayres (2012) claims while grand theories have been criticised for being too broad they can be used to develop frameworks of knowledge or can serve as the foundation for mid-range theory development. However, in practice disciplines such as Information Systems, Ayres (2012) argues the use of mid-range theories is essential as they are more abstract and inclusive than micro theories while still remaining verifiable.

Irrespective of the range of the theory, to be considered useful Lewin (1951), claims the theory needs to offer an understanding of the research phenomenon and be applicable to the specific discipline. To provide an understanding of theories used to study technology-related issues within Information Systems, an overview of common technology adoption theories, sociological theories, structuration theories, and educational technology theories is presented.

2.3.3 Technology Acceptance Theories

Admiral, Louws, Lockhorst, Paas, Buynsters, Cviko, Janssen, de Jonge, Nouwens, Post, van der Ven, and Kester (2017) contend while much research has been conducted in relation to the central and critical role that teachers play in the integration of technology

into the classroom, the focus of technology acceptance theories is not on the teacher but rather on technology-related factors. Over the last few decades, various technology acceptance theories founded on psychosocial principles (Taherdoost, 2018), have been developed to explore the relationships between beliefs, attitudes, and technology use (Chien, Wu & Hsu, 2014). The most utilised and well-known models are described.

- **Theory of Reasoned Action (TRA)**

The Theory of Reasoned Action (TRA) (Fishbein & Azjen, 1975; Azjen & Fishbein, 1980), states that people's intention is constructed from *Attitude to Act* and *Perceived Social Norms,* as people act in a certain way once they evaluate the behaviour as positive and believe significant people in their life think they should behave in the given manner. According to Sugar, Crawley and Fine (2004), attitude evolves from a person's individual disposition and evaluation of individual beliefs regarding the specific behaviour's effectiveness in producing desirable outcomes. TRA has mainly been criticised for its assumption that people have the power to choose to act or not to act in a certain manner i.e., volitional control (Knabe, 2009). Madden, Ellen and Azjen (1992) contend volitional control is not always possible and thus a separate measurement of beliefs is needed relative to the necessary resources and opportunities that people have or perceive they have for accomplishing a specific behaviour.

- **Theory of Planned Behaviour (TPB)**

In response to the criticisms levelled at TRA, the Theory of Planned Behaviour (TPB) developed by Azjen (1991), addresses the social context and attitudes towards behaviour by incorporating both internal and external factors that influence a person's behavioural intention. Within TPB, measures of attitude are the subjective norm, perceived behaviour control, and attitude toward the behaviour – with each measure related to a set of beliefs. *Normative beliefs* explain significant others' approval of one's behaviour; *control beliefs* describe resources and opportunities that facilitate or hinder the behaviour; and *behavioural beliefs* are the personal beliefs one has towards the behaviour (Chien et al., 2014).

While TPB captures the complexity of the relationship between beliefs, attitudes, intention, and behaviour, Chien et al. (2014) claim that TPB does not specify types of beliefs, which makes the categorisation of beliefs challenging. In response to this criticism, Taylor and

Todd (1995) combined TAM and TPB to form the Decomposed Theory of Planned Behaviour (DTPB) in which beliefs are categorised into different components. Behavioural beliefs consist of perceived usefulness, ease of use, and compatibility (Kriek & Stols, 2010; Taylor & Todd, 1995); normative beliefs include the influence of peers and superiors; and control beliefs consist of self-efficacy, technology and resource facilitating conditions (Smarkola, 2008; Taylor & Todd, 1995). According to Smarkola (2008), the hierarchical nature of DTPB enables researchers to simultaneously identify external conditions and personal beliefs considered by teachers when choosing whether to integrate technology into their classroom. In addition, as DTPB regards beliefs as a system and subsystems of people's attitudes and values (Pajares, 1992; Rokeach, 1968), Chien et al. (2014) claim it is a powerful theory that can be used to explore teachers' past experiences with technology and the connections between different types of beliefs.

- **Technology Acceptance Model (TAM)**

The Technology Acceptance Model (TAM), developed by Davis and Venkatesh (1996) which has been used to research technology adoption for the last thirty years, provides a framework in which to study how people's beliefs around perceived usefulness and ease of use, and intentions influence their technology use. *Perceived usefulness* refers to the degree to which a person believes that using technology improves their job performance, while *ease of use* refers to the belief that using the technology will be effortless (Davis, 1989).

According to Chien et al. (2014), the lack of inclusion of additional personal beliefs and the non-consideration of context, severely limit the explanatory power of TAM. While Davis and Venkatesh (1996) acknowledge that other personal beliefs and external factors may influence technology use these are not included in TAM and thus, argues Taylor and Todd (1995) and Smarkola (2008), TAM is not comprehensive enough to be used to study the effects of external variables or social factors.

- **Unified Theory of Acceptance and Use of Technology (UTAUT)**

The Unified Theory of Acceptance and Use of Technology (UTAUT) developed by Venkatesh, Morris, Davis and Davis (2003), is a synthesis of previous technology acceptance theories. According to Venkatesh et al. (2003), the four antecedents of IS

acceptance are performance expectancy, effort expectancy, social influence, and facilitating conditions. *Performance expectancy* describes the degree to which using the technology will enable and benefit one's work success (Venkatesh et al., 2003; Blackwell, Lauricella, Wartella, Robbet & Schomburg, 2013). *Effort expectancy* is the perceived ease of use of the technology (Venkatesh et al., 2003). *Social influence* is the subjective norm related to technology use within a particular social context (Blackwell et al., 2013) as it describes the degree to which significant others are perceived to influence technology use (Venkatesh et al., 2003). *Facilitating conditions* refer to the perception of resources and support available to utilise the technology (Venkatesh et al., 2003) such as training and access to technology (Blackwell et al., 2013). Four moderating variables, according to Venkatesh et al. (2003) that also influence technology use are gender, experience, age, and voluntariness of use.

While UTAUT can explain most behavioural intentions variances in relation to the technology use (Venkatesh et al., 2003), Blackwell et al. (2013) argue that it has not been applied extensively within an educational context. Therefore, an extension of UTAUT is needed to include personal limitations such as beliefs, perceived value, and comfort with technology (Blackwell et al.,2013).

- **Task technology Fit (TTF)**

Task Technology Fit (TTF), which was derived from the Technology-to-Performance Chain (TPC), was developed by Goodhue and Thompson (1995) on the premise that technology can only positively impact performance when the tasks being performed are a good fit with the technology being used. Goodhue and Thompson (1995) claim prior research into user attitudes and beliefs in relation to technology use is limited as it focuses either on utilisation (Davis, 1989; Fishbein & Ajzen, 1975) or fit (Benbasat, Dexter & Todd, 1986; Dickson, DeSanctis & McBride, 1986). However, Goodhue (1988) and Goodhue and Thompson (1995) contend utilisation is not always voluntary and is complex by nature, and performance improvements can only be realised once the technology is utilised, therefore a model addressing both fit and utilisation simultaneously and in parallel is needed to provide a richer understanding of technology use.

According to Goodhue and Thompson (1995), while TTF is similar to DeLone and McLean's (1992) theory of Information Systems Success, the inclusion of the construct of

task-technology fit and the explicit focus on relationships between the constructs provides a stronger theoretical basis. The primary components of TTF are tasks, technology, task-technology fit, utilisation, and performance impacts (Goodhue & Thompson, 1995). *Tasks,* which can vary according to routineness, interdependence, and time criticality (Goodhue, 1988), describes the actions carried out by people when transforming inputs into valuable outputs (Goodhue & Thompson 1995). *Technology* refers to the tool used to carry out the task (Goodhue & Thompson 1995), which can be hardware or software or a combination of support from users (Lin & Huang, 2008). *Task-technology fit* describes the degree to which the technology being utilised meets the needs of the tasks being performed by an individual. Goodhue and Thompson (1995) define eight factors that measure task-technology fit: quality, locatability, authorization, compatibility, training, production timeliness, system reliability, and relationship with users. *Utilisation* refers to the application of the technology in order to achieve objectives or goals (Goodhue & Thompson, 1995). *Performance impacts* describes an individual's belief that utilising the technology will change their task execution, with a positive perception of performance resulting from a high task-technology fit (Goodhue & Thompson, 1995).

According to McGill and Klobasb (2009), TTF has been used extensively in many different fields to research the key role technology-fit plays in individual performance and use of IS. In the educational context TTF has been used to study a variety of topics such as adoption of e-books by academics (D'Ambra, Wilson & Akter, 2013), learning management systems (McGill & Klobasb, 2009), e-learning comparisons for learners and teachers (McGill & Hobbs, 2006), and the acceptance of MOOCS in developing countries (Khan, Hameed, Yu, Islam, Sheikh & Khan, 2018). However, while Sackstein, Spark and Turner (2019) utilised TTF to research teachers' technology use for content creation and distribution, almost no other empirical studies using TTF to explore teachers' technology adoption have been found. A possible reason is that TTF simply assesses how technology affects performance by matching the task and technology characteristics (Khan et al., 2018) without considering teachers' internal constraints that may limit technology use.

While TTF considers the relationship between task and technology, Rai and Selnes (2019) argue it does not provide a clear explanation as to how the task environment affects technology use in multifaceted, inherently complex contexts. According to Fuller and Dennis (2009) fit is only useful in assessing an individual's performance due to initial

exposure to technology as the ability to predict performance wavers as people transform or acclimatise to technology use, and thus TTF is not an appropriate theory to study contexts where there is ongoing exposure and extended use of technology.

A summary of the technology acceptance theories presented, that have been constructed based on psychosocial theories (Taherdoost, 2018) and focus primarily on technology related factors (Admiral et al., 2017) is provided in Table 1.

Table 1: Summary of Technology Adoption Theories

Theory	*Description*	*Criticisms*
Theory of Reasoned Action (TRA)	Peoples' intention is constructed from attitude to act and perceived social norms (Fishbein & Ajzen, 1975; Azjen & Fishbein, 1980)	Assumes people have the power to choose to act or not to act i.e., volitional control (Knabe, 2009)
Theory of Planned Behaviour (TPB)	Addresses the social context by incorporating the internal and external factors that influence behavioural intention (Azjen, 1991)	Does not specify types of beliefs which makes the categorisation very challenging (Chien et al., 2014)
Technology Acceptance Model (TAM)	Studies how peoples' beliefs around perceived usefulness, ease of use, and intentions influence technology use (Davis & Venkatesh, 1996)	Does not take into consideration the personal beliefs and context of people (Chien et al., 2014)
Unified Theory of Acceptance and Use of Technology (UTAUT)	Synthesizes previous technology acceptance theories with performance expectancy, effort expectancy, social influence and facilitating conditions (Venkatesh et al., 2003)	Fails to consider beliefs, perceived value and comfort with technology (Blackwell et al., 2013)
Task Technology Fit (TTF)	Based on the premise that technology can only positively impact tasks when they are a good fit (Goodhue & Thompson, 1995)	Does not explain how the task environment affects technology use in complex and multifaceted contexts (Rai & Selnes, 2019)

2.3.4 Social Theories

According to Schütz (1962), social science theories do not differ in form from natural science theories but rather they diverge in the way empirical work is conducted, with the social scientists subjectively interpreting observed human behaviour as it relates to shared meanings, context, and history. Lee (2004) contends for some researchers the term "social" in relation to theory describes any theory that researches individuals, while for others "social" means theories that explore shared, socially constructed institutions. Common social theories used in IS and educational research such as Activity Theory (AT);

(Engeström, 1987; 2001), Diffusion of Innovation (DIT) (Rogers, 1995; 2003); Actor-Network Theory (ANT) (Callon, 1986; Law, 1987; Latour, 1992;1993); Technological Pedagogical Content Knowledge (TPACK) (Mishra & Koehler, 2006); and Pedagogical Beliefs-Technology Model (PBT) (Tondeur, 2020), which align to either of these conceptions of social theory, are presented.

- **Activity Theory (AT)**

Activity Theory (AT), more recently known as the Cultural-Historical Activity Theory (CHAT), was originally developed by Leont'ev (1978), later incorporating Vygotsky's (1978) work on human agency. The second and third generation of AT, constructed by Engeström (1987; 2001), has advanced previous generations of AT to develop a theoretical tool that facilitates the exploration of an activity system along with the identification and explanation of inconsistencies and points of conflict within the system (Karasavvidis, 2009). Karasavvidis (2009) claims while most technology theories dismiss the importance of teachers' perspectives and beliefs relating to technology integration and simply focus on the technology alone, AT is a unique theory that enables researchers to holistically and systematically study teachers' concerns in relation to technology integration in the classroom. Hashim and Jones (2007) state that AT provides a powerful way in which human activity, which is influenced by the social context, can be explored through multiple dimensions with regard to technology.

According to Hasan and Kazlauskas (2014) in simple terms AT "is all about 'who is doing what, why and how (pg9). Karasavvidis (2009) states an activity that always occurs in specific contexts and consists of one or more actions that when complete, satisfies the original reason for the activity. First-generation AT utilises the concept of mediation which according to Vygotsky's (1978) theory occurs when human agents react to and act on facilitating objects within a particular environment, which results in a specific outcome (Nussbaumer, 2012). Second-generation AT also considers the relationships between the individual agent, the community, historical context, and interactions between the situation and activity (Engeström, 1987). Third-generation AT includes additional relationships to account for tensions and contradictions that promote change (Engeström, 2001) and influence interaction with the environment (Nussbaumer, 2012).

According to Kaptelinin and Nardi (2006) AT enables researchers to focus on understanding technology in relation to human activity and shift away from the dominating technocentric approach used to study the integration of technology as it facilitates an understanding of how technology promotes change within specific contexts (Bellamy, 1996). Within AT, claims Bannon and Kaptelinin (2000) technology is not central, but simply just one of the tools that mediate the relationship between humans and their environment. Therefore, argues Murphy and Rodriguez-Manzanares (2008), AT is an appropriate theory for educational technology research in which the focus is not solely on the technology. To date, AT has been used extensively in educational technology research for a variety of studies with teachers as the core focus, for example, Buell (2004) conducted a study to explore how the integration of technology results in change for teachers' practices; and Lim and Hang (2003); Russell and Schneiderheinze (2005) utilised AT to explain conflicts that occur between teachers' beliefs and their actual practices when new technology is introduced.

The elements of the activity system, which are graphically represented in a set of inter-related triangles, can be broken down into: subject, object, tools, rules, community, division of labour (Engeström, 1987; 2001). According to Engeström (1987; 2001), the *subject* is the individual or group of individuals involved in the activity; *object* explains the motivation behind the activity; *tools*, which can be physical or psychological and change over time (Anthony, 2012), are symbols, signs, and conceptual understandings that mediate the activity between the subject and the object; *rules* describe the conditions that influence how and why individuals act in a certain manner (Kaptelinin & Nardi, 2006); *community* refers to the explicit rules or social norms within a subject's social context or culture that control and influence behaviour; and *division of labour* describes how tasks are shared among the members of the activity system. *Contradictions*, which are a fundamental principle of AT (Engeström, 2001) and exists continuously in all activity systems, are cumulative structural tensions that generate disruptions in order to bring about change (Engeström, 1987; 2001).

While Toomela (2000; 2008) argues that the use of AT is limited as it assumes a unidirectional relationship between the individual and culture and primarily focuses on the activity rather than the individual involved, Engeström (2009) claims AT is not a static theory but rather is an evolving theory of object-driven activity characterised by change.

- **Diffusion of Innovation Theory (DIT)**

Diffusion of Innovation Theory (DIT) is a popular theory aimed at exploring factors that influence an individual's adoption of new technology (Al-Jabri & Sohail, 2012). Developed by Rogers (1995), innovations are things perceived as new by an individual; while diffusion is the "process by which an innovation is communicated through specific channels over time within a particular social system" (pg5). Originally developed to understand innovations within farming, DIT is a mature theory that has been applied extensively to technological innovations (Halawi & McCarthy, 2006) to explain how and why innovations proliferate within a specific social context (Al-Jabri & Sohail, 2012).

The four critical elements that influence the extent of diffusion of any innovation are the new idea itself, what about and how the innovation is communicated from one individual to another, the social system in which is it being introduced, and the time over which the diffusion of the innovation takes place (Rogers, 1995; Taherdoost, 2018). Rogers (2003) claims diffusion is an ordered process that involves five steps: the acquisition of knowledge about the innovation, the formation of an attitude towards the innovation, the decision whether to reject or make use of the innovation, the implementing of the innovation in practice, and searching for support for the adoption decision (Sahin, 2006).

In addition to these elements, Rogers (2003) identified various attributes of an innovation that influences adoption behaviour: relative advantage, complexity, compatibility, trialability, and observability. According to Rogers (2003) *relative advantage*, which results in improved efficiency, financial advantages, and superior status of an individual because of use, describes the extent to which an innovation is perceived to provide more benefits than its precursor (Moore & Benbasat, 1991). Rogers (2003) and McCloskey (2006) claim that the greater the perceived relative advantage a technological innovation has over the old technology, the more likely it is to be adopted. The next attribute, *complexity*, describes how difficult or easy the innovation is to understand and utilise (Cheung, Chang & Lai, 2000). According to Venkatesh and Davis (2000) complexity and the flip side, perceived ease of use, play a significant role in the adoption of new technology, with complexity being negatively associated with diffusion of the innovation (Rogers, 2003). *Compatibility* is the next attribute, which describes the extent to which the innovation is perceived consistent with existing beliefs, habits, and experiences (Chen, Gillenson & Sherrell, 2004). Rogers (2003) claims the more compatible the innovation is with one's everyday

life, the more diffusion will occur. *Trialability*, the next attribute, describes the ability to experiment with innovation before adoption (Al-Jabri & Sohail, 2012). Rogers (2003) claims that people feel more comfortable when they have been able to test or trial an innovation as it dispels unknown fears (Tan & Teo, 2000). The last attribute, *observability* is the degree to which the benefits of the innovation are observed, communicated, and visible to the members of a specific social system (Rogers, 2003). Al-Jabri and Sohail (2012) propose that when using technology, the more visible and immediate the benefits are, the easier it is to communicate these to others and the more people will be willing to adopt or integrate the technology into their daily lives.

While used extensively to study individual technology adoption, major limitations of DIT exist. Firstly, MacVaugh and Schiavone (2010) claim DIT's single focus on the reasons for adoption or non-adoption without any consideration as to the nature and influence that the relationships between these reasons have on technology adoption does not enable the study of the social context. Secondly, the DIT's emphasis on the innovation itself, does not facilitate the understanding and exploration of the complexity of cultural norms (Deligiannaki & Ali, 2011) and socio-cultural differences (Meyer, 2010). Lack of consideration of these factors may lead to failed technology integration initiatives. Finally, Meyer (2010) claims that DIT's bias towards technology adoption and the blaming of individuals for non-adoption is based on the assumption that the only valid choice for people is to adopt the innovation. Beal and Rogers' (1960) advocacy approach that all adoption is equal in benefit, limits DIT's ability to consider other external factors and internal barriers faced by teachers (Meyer, 2010).

- **Technological Pedagogical Content Knowledge (TPACK)**

Technological Pedagogical Content Knowledge (TPACK), developed by Mishra and Koehler (2006), draws on Shulman's (1986) model of Technological Content Knowledge (PCK) to offer a theory in which the essential components needed to effectively teach with technology can be explored (Hilton, 2016). Cox and Graham (2009) contend that the integration of components within TPACK motivates teachers to reassess their technology use in relation to their ability to deliver meaningful content through an engaging pedagogy. TPACK is circular and consists of three domains: *Technology Knowledge* refers to the teacher's knowledge of how to use the technology; *Pedagogical Knowledge* refers to the teacher's general pedagogic practice; and *Content Knowledge* refers to the teacher's

knowledge of their subject matter (Mishra & Koehler, 2006). These domains then intersect to create *Pedagogy and Content Knowledge* describing the teacher's knowledge of the most effective manner in which to teach their subject; *Technology and Pedagogy Knowledge* describing the teacher's knowledge of how best to integrate technology into their pedagogic practice; and *Technology and Content Knowledge* (TCK) describing the teacher's knowledge of how the technology impacts and is used within their subject (Koehler & Mishra, 2009; Hilton, 2016). In the centre, Technological Pedagogical Content Knowledge (TPACK) is the point at which the teacher's understanding emerges from intersections across and interactions within all three domains (Mishra & Koehler, 2006). Each of the domains functions separately and in conjunction with each other, claim Archambault and Barnett (2010), as all are needed to ensure that teachers meaningfully and effectively integrate technology into the classroom.

TPACK has been used extensively to study education and technology integration as it is constructed exactly for that purpose (Hilton, 2016). Cox and Graham (2009) contend that TPACK is an extremely useful theory that facilitates teachers' ability to effectively incorporate technology in the classroom, as it constantly shifts due to technology advances and innovative ways in which technology can be utilised.

According to Harris and Hofer (2011), TPACK is only effective in researching teachers who possess strongly defined pedagogic practices and well-developed content related to their subject area. Hilton (2016) contends that this may be due to TPACK's preference for teacher-centred instruction. Furthermore, as TPACK suggests constant effort is required to integrate technology into the classroom, Hilton (2016) claims that TPACK does not fully reflect actual classroom practices in which daily routine dominates. In addition, Harris and Hofer (2011); Hilton (2016) argue TPACK is overly complex and thus challenging to apply within practical classroom situations. Finally, while Kim, Kim, Lee, Spector & DeMeester (2013) agree TPACK is an appropriate theory enabling teachers' integration of technology, it does not explain the varied utilisation of technology by teachers.

- **Actor Network Theory (ANT)**

Actor Network Theory (ANT) which originates from the sociology of science discipline (Cressman, 2009) was developed by Callon (1986) and Law (1987) and later advanced by Latour (1992;1993) to understand the relationship between technology and individuals "the

place where science and technology come into being" (Cressman, 2009, pg2). The focus of ANT, states Greenhalgh and Stones (2010), is not the properties of human and nonhuman actors but rather the emphasis of the theory is the position of actors in the network and the power that emerges from the dynamic configuration of the network. While ANT is ontologically complex, Cressman (2009) states ANT has been used across a wide range of disciplines. A possible reason claims Monteiro (2000), is that ANT avoids technological determinism and social reductionism as it facilitates research without preconceived notions and pays attention to the formation, operation and dissolution of actor-networks structures. However, according to Fenwick and Edwards (2011), while ANT provides a powerful lens through which the complexity, diversity and inconsistencies present in an educational context can be studied, it has not yet been used extensively for educational technology research. Law (1997) claims ANT is a theory of performance and thus simply summarising its concepts or thinking about ANT in the abstract (Cressman, 2009), confuses those wishing to make use of it.

According to Latour (1996) *actors*, which can be human or nonhuman, describe any object that acts or an object to which an activity is granted by other actors. While the *actor-network* is attained through a collective process for actors enrolled in the network (McLean & Hassard, 2004). Law (1997) states that an actor always exists within a network due to the relationship that occurs between humans and objects. Callon (1986) proposes that actor-networks, which are dynamic and fundamentally unstable (Greenhalgh & Stones, 2010) can be stabilised to a degree when alignment between the different components of the actor-network is achieved. Stability within the actor-network claims Greenhalgh and Stones (2010), occurs through "black boxes" as actors in the network no longer question the ways things are, and simply accept. Alignment, which is almost always some sort of negotiation or truce (Greenhalgh & Stones, 2010) is achieved through "translation". *Translation* involves a four stage process of *problematisation* in which the problem is defined with a specific technology as a solution, *interessement* which requires getting other actors in the network to accept the proposed solution to the problem, *enrolment* which defines the crucial roles and practices of actors in the network, and *mobilisation* which describes engaging other actors in fulfilling their roles and connecting with other actors in the network (Callon, 1986; Greenhalgh & Stones, 2010).

Criticisms of ANT relate to the lack of power considerations and inclusion of nonhuman actors. Greenhalgh and Stones (2010) claim ANT is based on a flat ontology as it assumes that actors within the network are equal and therefore power imbalances, for example, a lack of access to resources and knowledge constraints (which are present in almost any system) are not considered. Secondly, ANT has been criticised for assigning agency to nonhuman actors. According to Mutch (2002), this is not only ethically questionable as it reduces humans to the same level as technology, but also limits ANT as it does not account for human motivation and other human traits.

- **Pedagogical Beliefs – Technology Model (PBT)**

Pedagogical Beliefs-Technology (PBT) developed by Tondeur (2020) draws on the research by Ertmer (1999; 2005) on first- and second-order barriers and Tondeur et al.'s (2017) systematic review of the relationship between pedagogical beliefs and technology use within education to define the different factors one needs to consider when exploring teachers' technology use. According to Tondeur (2020), individual and institutional characteristics, and context influence teachers' technology use. At an *individual level* pedagogical beliefs shape teacher characteristics and are mediated by perceived barriers and enablers; while at an *institutional level* the belief profile of the school alongside the barriers and enablers of school culture, technology support, and requirement to utilise technology are used to construct the institutional characteristics, with *school context* either supporting or hindering integration efforts (Tondeur, 2020).

Tondeur (2020) utilises a set of expanding circles for PBT to illustrate the multifaceted and bidirectional relationships that exist between individual and institutional characteristics and context (Tondeur et al., 2017). To encourage technology use, Tondeur (2020) states schools need to develop a shared vision of meaningful integration and supports "good education", otherwise teachers may resist adopting technology as their pedagogical beliefs may be in conflict and challenge the incorporation of technology into the classroom.

While Tonduer's (2020) PBT model offers a valuable way to focus on the role teachers play in integration efforts by categorising and conceptualising the different factors and relationships that influence teachers' technology use integration, the composition of each factor and the relationships between them are not explicitly defined and the context focuses on professional development. As PBT is a new model (Tondeur, 2020) it is has

not yet been used to conduct primary data collection studies, and thus it is possible these factors and relationships may become less conceptual and more specific when used to conduct empirical research[3].

A summary of the common social theories, within an education and Information Systems context, that explore individual as well as shared, socially constructed realities (Lee, 2004) is provided in Table 2.

[3] Tondeur's (2020) Pedagogical-Beliefs Technology (PBT) model offers a depiction of the factors considered in relation to teachers' technology use and thus PBT is shown at the end of section 2.8 to provide the reader with a graphical view of the literature reviewed.

Table 2: Summary of Social Theories

Theory	*Description*	*Criticisms*
Activity Theory (AT)	Concerned with how the social context and tools influence human activity (Hashim & Jones, 2007) with subject, object and tools as areas of primary focus (Engeström, 1987)	Assumes relationship between individuals and culture is unidirectional, focus on activities not individuals (Toomela, 2000; 2008)
Diffusion of Innovation (DIT)	Explores factors that influence individual people's adoption of new technology (Al-Jabri & Sohail, 2012). Considers new technology, communications about the new technology, the social system, and time period (Rogers, 1995; Taherdoost, 2018)	Focus on adoption or non-adoption, not social context (MacVaugh & Schiavone, 2010). Variations in socio-cultural contexts not considered, with advocacy or biased view of technology adoption (Meyer, 2010)
Technological Pedagogical Content Knowledge (TPACK)	Studies education and technology integration (Hilton, 2016), consists of domains: technology knowledge, pedagogical knowledge, content knowledge, intersection describe teachers' understanding of technology use within their pedagogic practice (Mishra & Koehler, 2006)	Only effective for researching teachers that possess strongly defined pedagogic practices and well-developed content related to their subject area (Harris & Hofer, 2011)
Actor Network Theory (ANT)	Understands relationships between technology and individuals (Latour, 1992; 1993), focusing on power that emerges from the dynamic configuration (Greenhalgh & Stones, 2010)	Flat ontology not including power considerations (Greenhalgh & Stones, 2010) reduces actors to same level as technology (Mutch, 2002)
Pedagogical Beliefs-Technology (PBT)	Incorporates the relationship between pedagogical beliefs and teachers' technology use, with individual and institutional characteristics and contexts (Tondeur, 2020)	Relatively new model with focus on professional development, composition of factors and relationships not explicitly defined

2.3.5 Structuration Theories

Structuration theories, which originate from Giddens' (1984) work, aim to move past the single-phased and sequenced model approach (DeSanctis & Poole, 1994) to explain the inherent complexities in all social contexts. Gidden's (1984) Structuration Theory (ST) and its theoretical advancements of Adaptive Structuration Theory (AST) (DeSanctis & Poole, 1994) and Strong Structuration Theory (SST) (Stones, 2005) are briefly presented.

- **Structuration Theory (ST)**

Structuration Theory (ST) is a social theory developed by Anthony Giddens in response to extreme views of objectivism/functionalism and subjectivism (Stones, 2005) with a central focus on the relationship and linkage between individuals and society (Jones & Kartsen, 2008).

ST includes the concepts of structure and agency. Giddens (1984) developed the concept of *duality of structure* in which humans through their interactions, draw on social structures while at the same time transforming and reproducing the social structures (Walsham & Han, 1990). Structure, according to Giddens (1984), consists of three dimensions: signification, domination, and legitimation. For *agency*, Giddens (1984) proposes humans are purposeful agents that constantly reflect on the consequences of their actions in relation to their daily practices. For Giddens (1984) agency, which consists of communication, power, and sanction, occurs when agents follow or reject rules within a social system and exercise control over resources. The relationships between structures and human agency are not static and are mediated via interpretive schema, facilities, and norms (Giddens, 1984; Walsham & Han, 1990; Feeney & Pierce, 2016).

According to Archer (1995) and Bostrom et al. (2009), even though ST offers a way in which reproduction and transformation of social structures can be explored, it conflates the concepts of structure and agency. Furthermore, ST has been criticised as being too philosophical and challenging to implement empirically (Thrift, 1985; Stones, 2005). Despite these criticisms, the duality of structure defined in ST offers a powerful way in which society can be studied and has been used by DeSanctis and Poole (1994) in AST and Stones (2005) in SST.

- **Adaptive Structuration Theory (AST)**

To specifically study the application and use of technology – within groups and organisations within group decision support systems (GDSS) – DeSanctis and Poole (1994) (drawing on Giddens (1984) structuration concepts of human agency and duality of structure and Orlikowski's (1992) structural model of technology), developed Adaptive Structuration Theory (AST). According to Gopal, Bostrom & Chin (1992), AST provides insights into varying research results in relation to technology integration within organisations, as it enables researchers to study changes to the nature of structures provided by technology and the structures that emerge as a result of human action as they interact with the technologies (Calloway, n.d.). Furthermore, AST facilitates an understanding of why identical technologies can enable similar interactions while resulting in dissimilar structural outcomes (Turner, Morris & Atamenwan, 2019). According to Walsham (2002) shared meanings, power arrangements, and group norms need to be taken into account, otherwise structures embedded in technical systems could possibly be unsuitable for users within another social context.

Elements of AST include *the structure of the technology*, the organisation, the task, the social context (i.e., group's internal system), the *appropriation of structures* and *decision processes*, *emergent sources of structures* including the technology, task, and organisational outputs; and *decision outcomes and new social structures* encompassing rules and resources (DeSanctis & Poole, 1994; Niederman, Briggs, de Vreede & Kolfschoten, 2008).

According to Bostrom et al. (2009), because AST was originally constructed to study the introduction and use of technology within an organisational context, it is not an appropriate theory to study technology adoption amongst individuals. Kort and Gharbi (2013) argue that a further criticism of AST is that it does not utilise the power of Giddens' (1984) concepts of structuration and therefore cannot explain reality, as the analysis of agents' unconscious actions is omitted, and the duality of structure is replaced with the narrow concept of appropriation of structures.

- **Strong Structuration Theory (SST)**

SST advances Gidden's Structuration Theory (ST) to facilitate empirical research by retaining core elements while "incorporating conceptual and methodological links between the abstract and the particular" (Stones, 2005, pg7). Firstly, Stones (2005) argues *ontology-in-situ* is needed because in reality structure and action are observed through concrete complexities of day-to-day activities and dispositions and practices of agents. Secondly, Stones (2005) adds a *sliding ontological scale* with conduct and context analysis on which researchers can position a specific study, which may vary from detailed and concrete to an abstract view of past phenomenon (Jack & Kholeif, 2007; Feeney & Pierce, 2016). Thirdly, Stones (2005) constructs the *quadripartite nature of structuration* to depict the duality of structure in (1) external structures, (2) internal structures, (3) active agency, and (4) outcomes.

While SST has not been used extensively in empirical studies, and not at all within an educational context, it provides a powerful and structured theory in which the depth and strength of Giddens' duality of structure and human agency can be explored (Stones, 2005). Additionally, although SST does not especially account for technology, according to Jones and Kartsen (2008) as structuration occurs in all social contexts, SST is an appropriate framework for IS research studies.

A summary of the structuration theories presented is provided in Table 3.

Table 3: Summary of Structuration Theories

Theory	*Description*	*Criticisms*
Structuration Theory (ST)	Central focus on the relationship between individuals and society (Jones & Kartsen, 2008) with key concepts of the duality of structure and agency and dimensions of signification, domination and legitimation (Giddens, 1984)	Is too philosophical (Stones, 2005) as well as conflates the concepts of structure and agency (Bostrom et al., 2009)
Adaptive Structuration Theory (AST)	Studies the application and use of technology within groups and organisations with the elements of structure of technology, appropriation of the structures and decision processes, emergent sources of structures, and decision outcomes and new social structures (DeSanctis & Poole, 1994)	Not appropriate to study individual technology use (Bostrom et al., 2009) and the power of structuration concepts are not used resulting in unconscious action being ommitted (Kort & Gharbi, 2013)
Strong Structuration Theory (ST)	Retains core structuration concepts while including a sliding ontological scale and the quadripartite nature of structuration with external structures, internal structures, active agency, and outcomes (Stones, 2005)	While structuration occurs in all social contexts (Jones & Karsten, 2008), it has not been used within educational contexts and does not specifically account for technology

2.3.6 Educational Technology Models

Technology integration is a complex process and therefore educational technology models play an important role as they provide discourse and structure by which the different facets can be explained (Misirli, 2016). To research the integration of technology in the classroom, researchers such as Rieber and Welliver (1989); Rogers (1993); Marcinkiewicz (1994); Hooper and Rieber (1995); Sandholtz, Ringstaff and Dwyer (1997); and Puentedura (2006) devised theories to explain teachers' levels of technology integration and the ways and activities in which teachers utilise technology. The most common

educational technology models Hierarchical Model of Technology Adoption (Hooper & Rieber, 1995); Apple Classroom of Tomorrow (ACOT) model (Standholtz et al., 1997) and the Substitution Augmentation Modification and Redefinition (SAMR) model (Puentedura, 2006) are presented.

- **Hierarchical Model of Technology Adoption (HTMA)**

The model proposed by Hooper and Rieber (1995) is a five-step hierarchical model in which teachers' stages of technology adoption are explained by the progressive integration of technology into their pedagogic practice. According to Hooper and Rieber (1995) teachers need to progress upward through each stage to effectively integrate technology into the classroom. Stages include *familiarisation*, where the teacher becomes acquainted with the technology; *utilisation*, where the teacher experiments with the technology; *integration* is where the teacher incorporates the technology into parts of their pedagogic practice; *reorientation,* where teachers reassess their pedagogic practice in relation to technology and *evolution*, where teachers constantly evolve their pedagogic practice to integrate technology.

In addition to the stages of technology adoption that teachers go through, Hooper and Rieber (1995) propose that teachers' conception of how technology can be used in the classroom determines whether technology is viewed as a product or idea technology. *Product* technologies describe contemporary uses of the technology; while *idea* technologies provide teachers with activities not possible previously (Hooper & Rieber, 1995).

- **Apple Classroom of Tomorrow (ACOT)**

Research conducted by Sandholtz et al. (1997), which was funded by Apple™ for almost a decade from the mid-1980s, resulted in the construction of the Apple Classroom of Tomorrow (ACOT) model. Initially, Apple™ placed desktop computers and other related hardware in five elementary and secondary classrooms across the country, providing both learners and teachers with technology. Over time, as the study grew to incorporate thirty-two teachers in several schools across four states within the United States, Sandholtz et al. (1997) gathered evidence through observations and interviews with teachers and learners aimed at describing the process and stages of teachers' integration of technology into the classroom. The progressive stages of integration in the ACOT model are *entry*,

where the teacher has little experience with the technology; *adoption* occurs as teachers become more comfortable with the technology and are using it for traditional tasks; *adaptation* describes when teachers integrate the technology into their current pedagogy; *appropriation* occurs when teachers are comfortable with using the technology which results in a shift of beliefs and attitudes; and *invention* is when teachers begin to try novel ways of using the technology (Dwyer, Ringstaff & Sandholtz, 1991; Sandholtz et al., 1997; Yucel, Acun, Tarman & Mete, 2010; Cuban, 2012).

- **Substitution Augmentation Modification and Redefinition (SAMR)**

SAMR is a four-level model developed by Puentedura (2006) to explain ways in which teachers integrate technology in the classroom. Levels are: *substitution* where teachers do not change their pedagogic practice through their use of technology; *augmentation* occurs when improvements in pedagogic practice are realised due to the use of technology; *modification* is when teachers redesign activities in ways not possible without using technology; and *redefinition* occurs when teachers use technology for new tasks that were not previously possible (Puentedura, 2006).

According to Kirkland (2014) and Hilton (2016), Puentedura's (2006; 2013) SAMR level of substitution is where existing tools are simply replaced with digital tools; the level of augmentation is where technology is used by teachers to improve teaching and learning through an enhancement of tasks; the levels of modification and redefinition both provide the means through which tasks can be transformed as new possibilities for teaching activities, that are not easily attainable without the use of technology tools, can be created.

- **Educational Technology Models Concerns**

According to Cuban (2012), educational technology models are constructed with a technocentric focus, as teachers need to increasingly adopt technology to remain relevant for the current educational context. While educational technology models are prescriptive (Hilton, 2016) and are not grounded on solid academic theories (Hamilton, Rosenberg & Akeaoglu, 2016), Hilton (2016) claims they provide important ways through which teachers can consider when and how to integrate technology into the classroom as well as structured frameworks by which researchers can explore and describe teachers' levels and manner of technology integration and resulting technology activities.

A summary of the educational technology models reviewed, and general criticisms is provided in Table 4.

Table 4: Summary of Educational Technology Models

Theory	*Description*
Hierarchical Model of Technology Adoption (HTMA)	Hierarchical model with five steps that teachers need to progress through, steps are: familiarisation, utilisation, integration, reorientation, and evolution (Hooper & Rieber, 1995)
Apple Classroom of Tomorrow (ACOT)	Progressive staged model of technology integration: entry, adoption, adaptation, appropriation, and invention (Dwyer et al., 1991)
Substitution Augmentation Modification Redefinition (SAMR)	Four-level model that explains ways in which teachers integrate technology into the classroom, levels are: substitution, augmentation, modification, and redefinition (Puentedura, 2006; 2013)
Criticisms	Constructed solely with a technocentric focus (Cuban, 2012) Prescriptive about the use of technology (Hilton, 2016) Not grounded on solid academic theories (Hamilton et al., 2016)

While the theories presented provide varied ways in which technology use or non-use can be better understood, many researchers claim that the blame for the lack of technology integration is solely due to technology problems experienced and teachers' perceptions of technology within their pedagogic practice (Hooper & Rieber, 1995; Cuban, 2012; Hilton, 2016; Hamilton et al., 2016). Therefore, literature related to barriers relative to teachers' technology integration needs to be explored.

2.4 BARRIERS TO TECHNOLOGY INTEGRATION

Many researchers claim that the benefits of using technology within an educational context are yet to be realised (Lui, 2011; Gorder, 2008; Cuban, 2001). Criticism has been levelled at governments, educational institutions and educators claiming the lack of progression is placing current learners at a disadvantage (Cuban, 2001; Mama & Hennessy, 2013; Munro, 2010). Much of the educational technology literature, which is built around a strong belief in technology benefits, claims teachers who are stuck in past pedagogic practices

serve as major inhibitors to the possibilities offered by technology transformations (Cuban, 2001). A possible reason claims Vandeyar (2014) is that teachers are not acknowledged or respected for the knowledge they bring into the classroom and therefore are often not consulted on their beliefs around technology integration (Cuban, 2001). Ertmer (1999) proposes that it is crucial to consider the vision teachers strive for in the classroom in order to make sense of teacher technology integration choices.

Furthermore, most teachers currently in the classroom have had limited experience with, or exposure to, a technology-integrated classroom during their formal education (Kerr, 1996; Zhao & Bryant, 2006; Lawless & Pellegrino, 2007; Johnson, Jacovina, Russell & Soto, 2016). Therefore, teachers may have inadequate models on which to construct their vision of a classroom integrated with technology. Ertmer (1999) argues that unless teachers have pedagogic goals rooted in preparing current millennial learners for the present as well as the future they will inherit, technology integration will continue to focus on the "number of computers available or the number of hours they get used" (pg49) rather than qualitative changes in teaching and learning.

Cuban (1993; 2012) proposes within education, both first-order and second-order change needs to occur in order for teachers to embrace technology. First-order changes, states Brickner (1995), are incremental adjustments to current practice that address efficiency and effectiveness without challenging core beliefs, whereas second-order changes contest fundamental beliefs about existing practice which may result in new goals, structures and roles. According to Ertmer (1999) both first-order and second-order changes influence teachers' technology utilisation in the classroom and can be related to barriers that are external to the teacher, barriers that are internal to the teacher, and the interaction and relationship between these barriers. Therefore, literature discussing the nature of these external and internal barriers and the relationship between them is presented.

2.4.1 First-Order Barriers

Ertmer (1999) states first-order barriers, which present significant challenges in effectively incorporating technology in the classroom, are external to teachers and include resources, training, support, and time (Rogers, 2000; Hew & Brush, 2007; Ertmer et al., 2012).

- **Resources**

The most common resource barriers mentioned in the literature relate to the accessibility of hardware and software by teachers and learners (Rogers, 2000; Johnson et al., 2016), the quality and current suitability of the technology for carrying out the teaching or learning activity (Becta, 2004; Toprakci, 2006; du Plessis, 2014), and the physical and spatial arrangements of the technology in schools and in the classroom (Becta, 2004; Tondeur, Van Keer, van Braak & Valcke, 2008).

Johnson et al. (2016) state that if teachers do not have ***access*** to technology, integration is not possible. Access, according to Johnson et al. (2016), does not only include the provision of necessary resources but also relates to the *extent of time* technology is available to teachers and learners. While the South African government has committed large funds towards providing technology-poor schools with a 1:1 model (Communications Directorate, 2019), according to du Plessis (2014), many disadvantaged schools in the country do not have the money to purchase any form of technology, while other schools in the country still rely on computer laboratories, at best. Schools still operating with computer laboratories, provide teachers with limited times in which to access the technology, which does little to encourage and motivate teachers towards integrating the technology into their existing pedagogic practices (du Plessis, 2014). In addition to the extent of time, Johnson et al. (2016) claim that *routine access* to hardware, software and internet connections is also essential in promoting technology use amongst teachers, as inconsistent access makes it extremely challenging for teachers to integrate and incorporate the technology.

Another major resource barrier reported by teachers is ***poor resource quality*** which results in disturbances that limit a teacher's capability to use the technology more effectively than doing an activity manually (Toprakci, 2006). Disturbances include *slow internet connections*, *hardware not working or malfunctioning*, and *outdated technology* (Sicilia, 2005). According to du Plessis (2014), many schools within South Africa only have access to ageing and inadequate technology, as they are unable to purchase new equipment or upgrade existing resources due to budget constraints.

Poor organisation of resources can also serve as an external constraint to technology integration (Becta, 2004). Tondeur et al. (2008) claim that the *placement of technology*

within a specific school or classroom can either promote or limit teaching and learning activities. Zandvliet (2006) proposes the physical technology arrangements of the traditional computer laboratory are incongruent with current educational goals. While the availability of technology within classrooms enables the use of technology as a learning tool, Mercier, Higgins, and Joyce-Gibbons (2014) argue the specific location and placement of the technology in the classroom also influences teacher's ability to effectively use the technology. Therefore, Tondeur et al. (2008) claim that effectively installing technology is not simply providing technology and securing a connection to the Internet, it also requires one to consider the most *suitable layout* of the classroom along with the most suitable placement of the technology, in order to motivate teachers to utilise the technology.

- **Training/Professional Development**

Training consists of education and ongoing instruction to enable teachers to utilise the technology to teach as well as for administrative tasks (Ertmer et al., 2012). According to Ertmer et al. (2012), teachers' most commonly reported reason for lack of technology integration is the insufficiency of preservice and professional training. Gess-Newsome, Bloche, Clark, Menasco & Willis (2003) state that there has been a shift from using the term "training" to professional development, as training assumes teaching is simply the practice of technical ability and skills; while professional development recognises teaching as a profession that requires teachers to constantly mediate the relationship between their subject knowledge, method of instruction and the needs of their learners.

Tondeur, van Braak, Sang, Voogt, Fisser & Ottenbreit-Leftwich (2011) propose that for training to be effective in assisting ***preservice or new teachers*** in integrating technology into their pedagogic practices, the following structure and content must be included: provision for ways in which teachers can utilise technology for educational purposes, a scaffolded approach in which preservice teachers observe model educators utilising the technology, and more continuous and practical assessments would be useful.

However, as technology constantly evolves at a rapid rate, Johnson et al. (2016) claim that experienced teachers also require ***professional development*** in relation to technology so that they can keep their skills current and effectively incorporate technology into their pedagogic practice. The International Society for Technology in Education (ISTE) outlines

ways in which technology professional development can be carried out: direct instruction, online courses, communities of practice and peer mentoring (King, 2002). According to Schrum (1999), there is little indication that traditional professional development involving theoretical workshops by experts with limited opportunities for practice opportunities are effective. Therefore, claims Joyce and Showers (1983) a progression of models which include theoretical workshops on their own, workshops with the addition of expert demonstrations, workshops, expert demonstrations with the addition of opportunities for practice feedback outside of real-world context; and workshops, demonstrations, practice feedback with the addition of coaching, need to be used to train experienced teachers.

As learning about technology is significantly different from other skills and knowledge (Bradshaw, 1997), Schrum (1993, 1999) claim that for technology training to be effective, attention must not only be given to the content and structure of the programmes, but teachers also need to be given ***access to the technology*** when they are away from work so that they can practice extensively in order to become confident in using the technology in the classroom. Only once teachers have had time to learn and master the basic "how to" technology skills (Snoeyink & Ertmer, 2001), can teachers acquire the necessary skills and knowledge to explore the value of technology for their individual pedagogic practice. This can be achieved through *intensive training sessions*, *mentorships*, *observations,* and *continuous and extended follow-up support* (Hawkins, 1997). Without this time, Schrum (1993, 1999) argues that teachers may choose not to integrate technology as they will be concerned their lack of technological expertise will make them appear ignorant in front of the learners.

While Garet, Porter, Desimone, Birman, and Yoon (2001) contend that it is more important to focus on the features included in training programmes and not the structure, to ensure the content is most suited to assisting teachers, Johnson et al. (2016) argue that there is no "single best way" in which to facilitate technology integration and thus schools need to identify the content and structure of training that best fits their particular needs of their teachers and school.

- **Support**

Rogers (2000) differentiates between ***two types of support***: technical and institutional. *Technical support* refers to the specialist who assists in effectively using and maintaining

technology, while *institutional support* relates to the encouragement and funding from school administration or government (Rogers, 2000; Hew & Brush, 2007; Hadijah & Shalawati, 2017). While Rogers (2000) separates these two types of support in order to define them, in reality, they are interdependent due to the nature of technical support being reliant on institutional structures and finances and thus insufficiency in either the quantity and/or quality of either technical or institutional support will severely inhibit technology integration.

In addition to types of technical support, Ertmer et al. (2012) propose the ***nature of support*** may be technological or pedagogical. Ertmer (1999) claims that the nature of technical support changes as teachers' technology integration matures. During the initial phases of technology integration teachers require *technological support* simply to make use of new technology; while as teachers become more capable in using the technology, *pedagogical support* may be needed from their peers or department heads to develop and apply the technology in new and novel ways (Johnson et al., 2016). Furthermore, state Johnson et al. (2016) in the beginning the ***types of support personnel*** required are *educational technology professionals* and *technology support staff*, whereas later *peer-discussions* and *professional learning communities* may be sufficient.

- **Time**

According to Rogers (2000), Cuban (2001), and Ertmer et al. (2012), teachers need enough time to effectively plan for and integrate technology into the classroom. Karasavvidis (2009) claims that time in relation to teachers' technology integration has two dimensions: familiarity and feasibility.

Familiarity not only relates to the time teachers need to learn new skills and create new course material in order to effectively make use of the technology in the classroom (Rogers, 2000) but also includes the time needed to explore the affordances of technology; time to plan and experiment with technology both before and during classes; and time to reflect upon their use of technology to consolidate knowledge for the future (Condie, Munro, Seagraves, & Kenesson, 2007; Smeets, Mooij, Bamps, Bartolome, Lowyck & Redmond, 1999; Conlon, 2004; Karasavvidis, 2009).

Feasibility on the other hand centres around teachers' concerns of integrating technology into their daily pedagogic practice given current educational structures such as lesson times and curriculum (Cuban, 2001; Karasavvidis, 2009). Cuban (2001) states that not only does becoming familiar and proficient with using technology take time, but also making use of technology in the classroom is often more time consuming, and therefore the timing of the school day with – forty-five-minute lessons being the norm – is often not sufficient for teachers to use technology effectively during class time.

- **First-Order Barrier Initiatives**

According to Fisher, Dwyer, and Yocam (1996), the majority of early integration programmes concentrated on eliminating first-order barriers due to them being somewhat easy to evaluate, and once funds were allocated to address access issues, fairly easy to handle. While this focus has reduced many first-order barriers in developed countries, Ertmer et al. (2012) claim that the lack of resources, poor administrative support, technology issues, and the reliance on standardised testing are still areas of concern, in both developing and developed countries, with teachers frequently having to deal concurrently with several first-order barriers.

Although first-order barriers are viewed by some teachers as having a larger influence on the incorporation of technology in their teaching, Ertmer et al. (2012) argue that when asked to describe the barriers, reasons given indicate second-order barriers also need to be considered. Sandholtz et al. (1997) claim that the reduction or elimination of first-order barriers often allows second-order barriers to appear.

2.4.2 Second-Order Barriers

Ertmer (1999) claims that past educational changes assumed sufficient access to equipment in the classroom, coupled with appropriate training would result in technology integration. However, according to Ertmer et al. (2015) with ubiquitous access to computer technology, this is no longer a valid assumption. Technology integration claim Ertmer et al. (2012), does not only require access to technology but also necessitates change on a personal, organisational, and pedagogical level, as teachers' beliefs and attitudes around technology influence the effective incorporation of technology in the classroom. These second-order barriers are intangible, personal, and deeply entrenched (Ertmer, 1999) and are often believed to present a greater challenge than first-order barriers to technology

integration efforts (Dede, 1998; Fisher et al., 1996; Ertmer, 1999) as they cannot be objectively identified and described.

Second-order barriers that obstruct change are internal to the teacher (Bricker, 1995) and thus are often not apparent to those around them or even to the teacher themselves (Kerr, 1996). These barriers include: ***pedagogy*** which relates to the teacher's personal views and experiences about teaching and learning (Denessen, 2000); ***norms*** which are shaped by cultural, societal and organisational contexts in which the teacher lives and works (Somekh, 2008; Windschitl & Sahl, 2002); ***knowledge*** which includes beliefs about the nature of knowledge (Shulman, 1986), utilisation knowledge (Ertmer & Ottenbreit-Leftwich, 2010), and types, source and stability of knowledge (Howard & Maton, 2011)*;* ***value of technology*** which depends on the teacher being confident technology can assist them in achieving their goals (Watson, 2006)*;* and ***self-efficacy*** which relates to the teacher's belief in their ability to effectively make use of the technology (Hew & Brush, 2007; Ertmer, 1999; Ertmer et al., 2015).

As second-order barriers are mainly constructed from, and inextricably tied to teachers' beliefs, a detailed review of the literature related to second-order barriers is presented in section 2.5.2, titled Beliefs about Internal Barriers.

2.4.3 Relationship between First and Second-Order Barriers

The relationship between first-order and second-order barriers is not simple as it operates bidirectionally and at multiple levels (Ertmer, 1999), as teachers' willingness to integrate technology is often influenced by multiple factors at the same time (Van Der Ross & Tsibolane, 2017). Dwyer (1996); Ritchie and Wiburg (1994) claim utilising technology can influence second-order changes in teachers' beliefs and pedagogic practices as it necessitates teachers reconsidering their views of teaching and learning. Therefore Kerr (1996), Hannafin and Savenye (1993) argue second-order barriers need to be considered and dealt with before, or at least in parallel to first-order barriers if greater levels of technology integration are to be achieved. However, within a South African context, Sherman and Howard (2012) claim studies focused on second-order barriers are limited, due to the urgency and prevalence of first-order barriers in the country.

Irrespective of which the direction of the relationship operates in, Ertmer at al. (2012) claim that simply addressing first-order barriers, for example, increasing access to technology, is insufficient as teachers' technology use is influenced by a combination of both first-order and second-order barriers. Even though second-order barriers may not be easy to notice or be apparent, their existence is frequently evident in teachers' beliefs and explanations of their frustrations in relation to first-order barriers (Ertmer, 1999).

A summary of the literature in relation to first and second-order barriers to technology integration is provided in Table 5.

Table 5: Summary of First and Second-Order Barriers

Barriers	Obstruct and challenge technology integration in the classroom (Brickner, 1995; Ertmer, 1999)
First-Order	*External, tangible, objective (Ertmer, 1999)*
Resources: sufficient, routine access to hardware and software (Rogers, 2000; du Plessis, 2014; Johnson et al., 2016); quality and suitability of the technology (Becta, 2004; Sicilia, 2005; Toprakci, 2006; du Plessis, 2014); physical and spatial arrangements of the technology in schools and classes (Becta, 2004; Tondeur, Van Keer, van Braak & Valcke, 2008; Mercier et al., 2014) **Training:** amount of training and access time to practice using the technology is key (Schrum, 1993; 1999; Snoeyink & Ertmer, 2001); quality and type differs depending on whether preservice training (Tondeur et al., 2011) or professional development (Johnson et al., 2016); can be focused on administration or teaching tasks (Ertmer et al., 2012); and can include a combination of direct instruction, online courses, communities of practice and peer mentoring (King, 2002) **Support:** types of support are technical or institutional (Rogers, 2000); nature of support progresses from technological and pedagogical (Ertmer et al., 2012) as technology integration matures; needs for support staff changes from technology professionals to peer discussions and learning communities (Johnson et al., 2016) **Time:** to plan and integrate technology (Rogers, 2000; Cuban, 2001; Ertmer et al., 2012); to become familiar with the affordances of technology (Rogers, 2000); also needs to be feasible by the teachers given time constraints (Cuban, 2001; Karasavvidis, 2009)	
Second-Order	*Internal, intangible, personal, related to beliefs (Ertmer et al., 2015)*
Pedagogy: teacher's personal views, experiences about education (Denessen, 2000) **Norms:** cultural, societal and organisational contexts in which the teacher lives and works (Somekh, 2008; Windschitl & Sahl, 2002) **Knowledge:** nature of knowledge (Shulman, 1986), technology utilisation knowledge (Ertmer & Ottenbreit-Leftwich, 2010); types, source and stability of knowledge (Howard & Maton, 2011) **Value of technology:** teacher's confidence that technology can assist them better than manually doing the task (Watson, 2006) **Self-efficacy:** teacher's belief in their ability to effectively make use of the technology for teaching and administrative tasks (Hew & Brush, 2007; Ertmer, 1999; Ertmer et al., 2015)	

2.4.4 Link between Barriers and Beliefs

The consideration of the underlying rationale behind teachers' reasons for first-order frustrations claims Ertmer (1999), provides an explanation as to how teachers' aims and beliefs around the role of technology in the classroom may influence their opinions and responses to first-order barriers experienced. It is not the barriers themselves, but rather the relative importance given to them by the teachers that influence the incorporation of technology in the classroom (Ertmer, Addison, Lane, Ross & Woods, 1999). Therefore, even when first-order and second-order barriers exist, if teachers place little importance on these barriers due to their strong beliefs about technology integration in the classroom, these barriers will have less influence (Ertmer et al., 2015).

Simply paying attention to first- and second-order barriers ignores the influence teachers' beliefs about these barriers play with regard to technology integration, and thus it is necessary to review the literature relevant to teachers' beliefs about first- and second-order barriers.

2.5 BELIEFS

While classification may facilitate a better understanding of what beliefs entail, according to Galvis (2012) as there is little consensus as to where the scope of beliefs begin and end, it is best to seek out commonalities within definitions of beliefs to provide a plausible explanation. To understand what the concept "belief" means within this study, seminal and common definitions of beliefs are provided below.

Richardson (2003) defines beliefs as "psychologically held understandings, premises, or propositions about the world that are felt to be true" (pg2). Beliefs are "cognitive structures that an individual develops after collecting, processing and synthesising information" (Lewis, Agarwal, Sambamurthy, 2003, pg658). However, Sherman and Howard (2012) maintain beliefs are not constructed from a single entity and do not exist in isolation, but rather are formed within a specific context shaped by particular cultural and societal factors. Rokeach (1968) contends a comprehensive belief system that consists of beliefs related to oneself and the physical and social world, is used to guide individuals in making sense of oneself as well as of the world around them (Pajares, 1992). According to Van Der Ross and Tsibolane (2017), belief systems influence individual attitudes and

assessments of feelings and beliefs towards an object or behaviour (Vahdati, Mousavi & Tajik, 2015), which in turn influences acceptance or resistance of technology (Chien et al., 2014).

Furthermore, Steel and Levy (2009) propose that beliefs vary according to depth and complexity with some beliefs being core (Ertmer, 2005), and others being peripheral (Fives & Gill, 2015). According to Ertmer (2005), core beliefs are formed over many years and have multiple connections to other beliefs and thus are hard to change; whereas peripheral beliefs are recently formed and thus are more flexible and inclined to change (Fives & Gill, 2015). While core beliefs are most often associated with factors intrinsic to the teacher, and peripheral beliefs with extrinsic factors, Mama and Hennessy (2013) state that teachers' external and internal beliefs simultaneously influence technology integration. Therefore, literature dealing with teachers' beliefs about extrinsic and intrinsic barriers needs to be reviewed.

2.5.1 Beliefs about External Barriers

While the nature of external barriers is well established in existing educational technology literature, teachers continue to report resources, training, support, and time as issues hindering their technology use in the classroom (Taylor & Todd, 1995; Chien et al., 2014; Hsu, 2016). Norris, Sullivan, Poirot, and Soloway (2003) claim a possible reason may be that a connection exists between teachers' technology use in the classroom and their beliefs about external barriers. Although Rogers (2000) argues that as teachers become more familiar with technology their focus on external barriers is reduced, Karasavvidis (2009) contends that teachers' beliefs about these external barriers is still an important area of research, as these barriers are often cited by teachers as the primary reasons for not integrating technology within the educational context. While Kopcha (2012) states the link between teachers' beliefs about external barriers and actual barriers is not yet well understood, Tondeur et al. (2017) argue that more research is needed as the relationship is complex, bidirectional, and multifaceted. Rogers (2000) cautions even though these beliefs about external barriers are often mentioned and discussed as separate issues, it is important to remember there is a complex and overlapping relationship between beliefs, which results in them collectively influencing teachers.

- **Resources**

Vongkulluksn, Xie, and Bowman (2018) claim that if a gap exists between what resources are provided by the school and teachers' perceptions or beliefs of what is available to them, only when teachers believe technology can benefit their classroom practice will they perceive resource barriers as minor and actively work around the constraints to integrate technology into their teaching. Voogt and Knezek (2013) contend that increasing access to technology does not automatically result in technology integration, rather it is the teachers' beliefs as to the suitability of access to resources that reduces or increases the prospect of teachers integrating technology into their pedagogic practice (Ertmer & Ottenbreit-Leftwich, 2010).

Teachers believe they lack ***access*** to resources when the technology malfunctions or does not work properly (Clark, 2006; Lim & Khine, 2006), is outdated or of poor quality and thus is not useful in facilitating their teaching goals (Norris et al.,2003), or does not facilitate their pedagogic goals (Vongkulluksn et al., 2018). Therefore, while increasing access is important, teachers must believe in the value of technology within their educational context for technology integration to occur, as teachers tend to amplify the access they have and place less emphasis on barriers when they believe that the technology being used facilitates better teaching and learning (Vongkulluksn et al., 2018). Examples include bringing their own devices to school and investing time in finding appropriate software applications that can work with the technology that exists (Ertmer et al., 2012; Kopcha, 2012).

For teachers to continue using technology in their classrooms, not only do they need to believe that they have access to the technology but they also need to believe that the technology will enable them to complete their lessons without any disturbances (Chigona et al., 2014) and facilitate them carrying them out classroom activities to achieve lesson objectives (Sicilia, 2005). If technology is of ***poor quality***, unreliable and needs troubleshooting, Kopcha (2012) and Rogers (2000) argue that teachers' perceptions of the resources available will be negative, which may result in them choosing not to integrate technology into their classroom practice.

The ***organisation*** of the technology within the school or the classroom also needs to be considered, claims Kopcha (2012) because if teachers believe the technology is too

complicated to set up for use; the placement of the technology is inconvenient for appropriate access; or the layout of the technology in the classroom is unsuitable to facilitate better teaching, teachers may choose not to integrate technology in the classroom.

Jung (2005) claims that since teachers are key to the success of technology initiatives, it is essential that governing bodies and schools meet the expectations and beliefs of teachers concerning resource access, quality, and organisation if they want teachers to effectively incorporate technology into their pedagogic practices.

- **Training/ Professional Development**

Teachers' technology skills have traditionally been seen to play a crucial role in facilitating effective technology integration in the classroom, based on the assumption that technological proficiency alone predicts and influences the enacted pedagogic practice of both preservice (Negishi, Elder, Hamil, & Mzoughi, 2003) and experienced teachers (Becker, 2000). However, Ertmer & Ottenbreit-Leftwich (2010) claim that “although knowledge of technology is necessary, it is not enough” (pg261) as teachers believe that training programmes that simply build technical skills are insufficient. Wells (2007) contends that teachers believe training is a barrier when ***training content*** lacks connection to classroom practice, as it focuses primarily on general technology utilisation skills without providing teachers with the necessary knowledge on how to make effective use of the technology for teaching and learning.

Agyei and Voogt (2011) claim a critical factor influencing ***preservice*** and ***new teachers’*** technology integration is their beliefs as to the content, quality and structure of technology education within their academic programmes. According to Lavonen, Lattu, Juuti, and Meisalo (2006), few preservice teachers believe infrequent, formal testing of theoretical educational technology knowledge assists them in applying or integrating technology into their classrooms. Rather, observing model educators utilising technology and continuous practical assessment would be more useful (Tondeur et al., 2011)

Similarly, ***professional development programmes*** for experienced teachers also play an essential role in shaping teachers’ beliefs as to the suitability of training provided, with active mentoring and communities of practice promoting positive beliefs about technology

and improving teachers' beliefs as to their ability to successfully plan and integrate technology into their pedagogic practice (Kopcha, 2012).

- **Support**

Ertmer and Ottenbreit-Leftwich (2010) claim teachers' decisions to integrate technology into their pedagogic practice relies heavily on the ***nature*** and ***level of support*** they receive from the institution, their peers, and technical support staff. According to Vongkulluksn et al. (2018), teachers' perceptions of support provided is filtered by their belief system of how technology can benefit their pedagogic practice and thus understanding teachers' beliefs as to support provided is crucial for actual support being perceived by teachers as sufficient and appropriate.

Hew and Brush (2007) and Rasheed, Kamsin, and Abdullah (2020) argue ***institutional support*** can either hinder or encourage teachers' technology integration. When principals simply push technology use without really understanding the relevance of technology to particular pedagogic actives, Vandeyar (2014) claims that teachers view the institutional support as constraining rather than motivating technology integration, due to the lack of a holistic and unified vision for classroom technology integration (Ertmer et al., 2012). Access and quality of ***technical support*** provided are also important as it not only shapes teachers' perceptions of support provided but also influences teachers' resulting pedagogic practices (Ertmer et al., 2012; Hadijah & Shalawati, 2017).

- **Time**

Kopcha (2012) claims that teachers believe time is the greatest external barrier when using technology for teaching as it is challenging to find the time to plan activities using the technology; frustrating to spend time with technical issues rather than teaching activities; and difficult to find time to learn new skills needed to teach with technology.

Karasavvidis (2009) argues that teachers often do not believe technology integration is ***feasible*** as they do not have the extra time needed to become proficient with the technology. However, interestingly Kopcha (2012) found as teachers' technology skills and knowledge of technology affordances improved, teachers' concerns about lack of time increased with complaints that more time was needed to plan for and implement lessons

using technology. Teachers' beliefs about the time needed to become ***familiar*** with the technology are greatly influenced by their beliefs around time pressures to complete the required syllabus for external standardised national assessments, with little time believed to be left for exploratory learning (Norton, McRobbie & Cooper, 2000). While in the foundation and intermediate phases learners are not required to pass national assessments, within secondary school this is the norm and so teachers are "racing against time to cover the curriculum material" (Karasavvidis, 2009, pg443).

In addition to syllabus demands, Lim and Khine (2006) claim the severity of technology issues experienced by teachers shape their beliefs about technology use in the classroom, with teachers who encounter repeated technology issues being more likely to complain about the time needed to make technology integration a reality in the classroom.

While teachers' external beliefs may hinder their integration of technology, according to Ertmer (2005) and Galvis (2012), simply addressing teachers' beliefs about external barriers is not sufficient, as it is frequently teachers' internal beliefs about technology that derail or delay government and school technology initiatives. Therefore, literature on teachers' beliefs about internal barriers is presented.

2.5.2 Beliefs about Internal Barriers

According to Liu (2011), teachers' internal beliefs around technology are no different to their beliefs about external barriers, as they are complex by nature and are not simply related to their beliefs about teaching or technology. Rather, they are constructed from a synergy of their beliefs in relation to: **Pedagogy** (Denessen, 2000; Tondeur et al., 2008; Ertmer et al., 2012); **Norms** (Azjen, 1991; Ertmer & Ottenbreit-Leftwich, 2010); **Knowledge** (Ertmer & Ottenbreit-Leftwich, 2010); **Value of IT** (Watson, 2006; Ertmer & Ottenbreit-Leftwich, 2010); and **Self-efficacy** (Bandura, 2000; Ertmer & Ottenbreit-Leftwich, 2010).

- **Pedagogical**

Pedagogical beliefs, which relate specifically to teachers' understanding, experience, or ideas about teaching and learning they hold to be correct (Denessen, 2000) are not dissimilar to general beliefs given that they are complex and multifaceted (Ertmer & Ottenbreit-Leftwich, 2010). Ertmer et al. (2012) state that pedagogical beliefs are

commonly core beliefs that have been developed by teachers over an extended period of time.

Although much of the educational technology literature tends to classify teachers' pedagogical beliefs and their resulting technology use as either ***learner- or teacher-centred*****,** Ertmer and Ottenbreit-Leftwich (2010) argue teachers' pedagogical beliefs are not one-dimensional as teachers may hold a variety of beliefs. Tondeur et al., (2008); Teo, Cha, Hung, and Lee (2008) concur that teachers do not hold either teacher-centred or learner-centred beliefs, but rather that teachers' pedagogical beliefs exist on a continuum. Furthermore, as teachers are often presented with a range of contexts in which they need to operate concurrently, Sadeck and Cronjé (2017) propose teachers may well need to move freely between the two extremes. Therefore, Teo et al. (2008) contend that teachers with learner-centred pedagogical beliefs do not automatically integrate technology more effectively or employ the technology in less traditional ways than teachers who hold more teacher-centred views.

Sadeck and Cronjé (2017) also claim that teacher's pedagogical beliefs influence their ***context of technology use***, which exists on a continuum with tasks such as personal, administrative, teaching and learning reported to influence how teachers choose to integrate technology into their pedagogic practice. Interestingly, while Sadeck and Cronjé (2017) found that teachers' personal use of technology may influence their choice to utilise technology in their pedagogic practice, the reverse is not true.

- **Norms**

Teachers' beliefs are shaped by the cultural, societal, and organisational environments in which they live and work (Somekh, 2008; Windschitl & Sahl, 2002). Sadaf, Newby and Ertmer (2012) contend that teachers are influenced regarding technology use by the ***school in which they teach***, as each school has a set of norms that direct teacher activities and practice (Ertmer & Ottenbreit-Leftwich, 2010). According to Hennessy et al. (2005), these norms encompass everything from which standards and objectives are supported, to which instructional approaches are favoured, and to which tools and resources to utilise. Given the strong cultural pressure that exists within schools (Brodie, 2004; Ponticell, 2003) teachers are unlikely to deviate from current school norms (Somekh, 2008). Therefore, Zhao and Frank (2003) and Hennessy et al. (2010) claim that

teachers in schools where beliefs around technology integration are not favourable, are less likely to be motivated to incorporate technology into their practice.

Teachers' ***peers*** and their beliefs about the value of technology and its use in the classroom may also influence teacher's technology use (Abbott & Faris, 2000; Hazzan, 2003). According to Azjen (1991) normative beliefs and teachers' motivation, which give rise to subjective norms, are shaped by the perceived expectation of how significant others would like one to behave. Hazzan (2003) claims that teachers who hold negative beliefs about technology use discourage their peers from integrating technology; whereas teachers may be motivated and pressured to use technology if their peers are already making use of the technology and encouraging them to do the same.

- **Knowledge**

Schommer (1990) contends knowledge beliefs include the structure of the knowledge, the source of knowledge, the stability of the knowledge base, the speed at which the knowledge can be learnt, and one's ability to learn.

Schommer-Aikins and Hutter (2002) claims that beliefs about the ***nature of knowledge*** play an essential role in shaping a person's thoughts and decisions within an educational context. Since the 1980's Shulman's (1986; 1987) conceptual framework has been used to define teaching knowledge. Shulman (1986) proposes teacher knowledge encompasses knowledge of the subject, teaching strategies and classroom management as well as how to teach specific content to learners within certain contexts. In addition to these, Shulman (1987) identifies curricular, learner, and context knowledge which together form the foundation of the "knowledge base of teaching" (Ertmer & Ottenbreit-Leftwich, 2010).

According to Kim et al. (2013), teachers' beliefs about ***types and classification of knowledge*** should be considered in relation to technology integration as they influence and shape teachers' technology choices. With the evolution and proliferation of technology, Angeli and Valanides (2009) contend that the types of knowledge related to technology also need to be considered, as technology integration requires teachers to understand not only how to utilise the technology tools available to them, but also how the possible affordances offered by the technology can benefit teaching and learning contexts. Therefore, concepts such as technological pedagogical content knowledge (Pierson, 2001,

Mishra & Koehler, 2006), pedagogical technology integration content knowledge (Brantley-Dias, Kinuthia, Shoffner, DeCastro & Rigole, 2007), and information and communications technology knowledge (Angeli & Valanides, 2009) have been added to Shulman's (1986; 1987) original conceptual framework to enable knowledge beliefs, relative to technology to be considered.

Ertmer and Ottenbreit-Leftwich (2010) claim that knowing how to ***utilise the technology*** is just the first step, and does not facilitate the effective incorporation of technology by teachers. Rather teaching with technology necessitates that teachers possess knowledge across numerous aspects, which constantly needs to adjust as the technology around them changes (Ertmer & Ottenbreit-Leftwich, 2010). Moreover, as learners now have access to vast amounts of information, Maton and Howard (2018) propose that teachers are no longer required to provide subject knowledge but rather need to relate knowledge to real-life experiences and facilitate learners' critical thinking to prepare current millennials for the technology-enabled future in which integrated diverse knowledge practices will be required.

In addition, to the different types of knowledge required, Howard and Maton (2011) claim that ***classification of knowledge*** within educational technology research as either psychological or sociological needs to be addressed. While *psychology* views knowledge merely as information within people's minds, with the emphasis on knowing; *sociology* defines knowledge as a socially constructed reality reflective of prevailing societal outlooks (Howard & Maton, 2011). These dichotomous views and separation of knowledge as either psychological or sociological, claim Howard and Maton (2011) result in knowledge-blindness with a focus on the characteristics of individuals rather than knowledge itself. Using Legitimation Code Theory (LCT), Howard and Maton (2011) differentiate between epistemic and social relations of knowledge by constructing knowledge and knower codes which change as the social context shifts. Knowledge codes are closely related to the epistemic view of knowledge and are characterised by the possession of specialised knowledge; whereas knower codes are closely linked with social relations emphasising the attributes of people, acquired either naturally or socially. Utilising these codes, Howard and Maton (2011) define the terms code clash and code match to describe when teachers' beliefs and ways of thinking are either in conflict or agreement with the educational policies and goals being pursued. Howard and Maton (2011) argue that technology integration is

not simply related to teaching knowledge, but also to knowers code that underlies the knowledge practices of teachers.

- **Value of Technology**

According to Anderson & Maninger (2007), value beliefs incorporate people's perceptions of the importance of specific goals and preferences. Ertmer & Ottenbreit-Leftwich (2010) claim that teachers make value judgments when presented with new tools, and thus the more value they believe the tool can afford them in achieving specific goals, the more probable it is they will utilise the tool. While Watson (2006) proposes that teachers' value beliefs around technology depend on whether they feel ***confident technology can facilitate their goals*** for instruction, Cheok, Wong, Mohd Ayub and Mahmud (2016); Taimalu and Luik (2019) claim that teachers also need to believe that the ***affordance of technology*** will assist their teaching and enable them to achieve the set learning objectives. This is particularly true of technology, claim Zhao, Pugh, Sheldon, and Byers (2002), as teachers often feel exposed due to the unpredictability of technology and their lack of technological competence. Therefore, for teachers to choose to incorporate technology into their classroom, perceived benefits associated with the technology must be significant (Ertmer & Ottenbreit-Leftwich, 2010).

According to van Braak, Tondeur & Valcke (2004), there are various ***ways in which teachers can utilise technology***: To instruct learners, to search or encourage learners to search the internet for content, to inspire learners, to encourage collaboration, to construct differentiated activities, to improve learners' skills, to demonstrate concepts, and to teach learners about the possibility of technology. In addition, Prestridge and de Aldama (2016) propose that technology can be used to complement and enrich the curriculum and contribute new methods of learning. However, the Becta (2004) report claims very few teachers are integrating technology into their instruction and even less are using technology to motivate learners, enhance learning experiences and inspire the shift towards higher-order thinking. Jimoyiannis and Vassilis (2007) concur that although many teachers are motivated to use technology in their pedagogic practice, most utilise technology in a limited and narrow way with the majority of usage for teaching support, personal tasks, and searching for information on the internet (Waite, 2004).

Johnson et al. (2016) claim that differences in technology use are shaped by the teachers' pedagogical beliefs as to how the transmission of knowledge takes place and how learning occurs. Likewise, Kim et al. (2013) maintain that teachers' technology integration is firmly connected to teachers pedagogical beliefs, for example, if the teacher holds more teacher-centred views, the classroom will be more frontal facing and less technology will be integrated by the teacher. However, Ertmer et al. (2012) argue that even teachers with learner-centred views do not always integrate technology effectively. A possible reason claim Hughes (2005), and Snoeyink and Ertmer (2001), is that even teachers with more learner-centric views will only incorporate technology into their pedagogic practice when they believe it will allow them to enhance their performance, more easily meet their classroom goals, relate directly with their particular content or subject areas, and is appropriate for the level of grade being taught.

While the way in which teachers make use of technology is important, Ertmer et al. (2012) contend that teachers' who believe the ***affordances of technology*** can support their current teaching practices, offer them possibilities of enhancing their professional practice, and assist them in providing more engaging learning contexts are more likely to integrate technology into the classroom.

- **Self-Efficacy**

Self-efficacy, which describes a person's belief in their ***own ability to perform a certain action*** to achieve a goal (Van Der Ross & Tsibolane, 2017), motivates and influences people's actions (Bandura, 2000). When one carries out a task successfully, Bandura (2004) claims that this strengthens our self-efficacy beliefs, while not being able to master the task can often weaken self-efficacy beliefs. According to Ertmer and Ottenbreit-Leftwich (2010), evidence suggests believing in one's own abilities to achieve instructional goals using technology may even be more significant than actual technological skills and knowledge. Ertmer and Ottenbreit-Leftwich (2010) argue that it is confidence, not competence that shapes a teacher's belief as to how confident they feel in managing and utilising technology in their teaching.

Regarding technology integration, Bandura (2000) states that self-efficacy determines whether an individual will think positively or negatively about technology use; the amount of effort they will expend in integrating technology into their pedagogic practice; the

benefits they expect to reap from their efforts; and their perseverance in dealing with the challenges presented by using technology in their classrooms. Therefore, argue Van Der Ross and Tsibolane (2017), it is more likely teachers with high technology self-efficacy will incorporate technology into their pedagogic practice. According to Slutsky (2016) while enhanced self-efficacy beliefs do not automatically translate into the actual use of technology among teachers, they are a necessary condition for technology integration.

Research in the last few decades has resulted in various scales, tools and measures of self-efficacy beliefs specifically related to teaching with technology (Murphy, Coover, & Owen, 1989; Compeau & Higgins, 1995; Compeau, Higgins, & Huff, 1999; Wang, Ertmer & Newby, 2004). While tools are available to measure self-efficacy, Teo (2009) claims that few empirical studies identify and describe the factors of self-efficacy beliefs particularly related to using technology for teaching. One of the most recent tools is the Computer Technology Integration Survey (CTIS) developed by Wang et al. (2004) that assists researchers in determining teachers' self-efficacy beliefs as relates to technology. According to Henson (2002), while measures of self-efficacy offer the potential to gauge more accurately a person's beliefs as to the ability to utilise technology effectively, they must be used within a specific context and that assessing general self-efficacy invalidates the value of such tools.

After conducting empirical research, Farah (2011) identified and categorised features that shape teachers' technology self-efficacy beliefs into work-related and outside- or personal-related factors. According to Farah (2011), ***work-related factors*** include a teacher's perception of local technology support, a teacher's beliefs about their subject area, the amount of time they use technology at work, and opportunities provided to them in the working context to gain technology skills. For ***outside or personal factors***, Farah (2011) includes personality traits, the extent of a teacher's home access and personal time to learn how to use the technology, the teacher's belief as to the value of the technology in the current educational environment, the teacher's perception of ease of use and convenience afforded by the technology, and the teacher's fears of using technology in their pedagogic practice.

A summary of beliefs about external and internal barriers is provided in Table 6.

Table 6: Summary of Beliefs about External and Internal Barriers

Beliefs	"Psychologically held understandings, premises, or propositions about the world that are felt to be true" (Richardson, 2003, pg2)
Beliefs about External Barriers	*Degree of importance given by teachers to external barriers (Rogers, 2000)*
Resources: less emphasis on barriers when believing that the technology facilitates better teaching and learning (Vongkulluksn et al., 2018); negative perceptions if resource quality poor, organisation and layout of technology is inconvenient (Kopcha, 2012). **Training:** content must be linked to teaching (Wells, 2007); preservice teachers believe formal, infrequent testing is inadequate (Lavonen et al., 2006); experienced teachers believe active mentoring promoting positive technology values is essential (Kopcha, 2012) **Support:** perceptions are filtered through teachers' belief systems (Vongkulluksn et al., 2018); institutional support needs to be holistic to be enabling (Hew & Brush, 2007); access and quality of technical support shape teachers' perceptions (Ertmer et al., 2012) **Time:** need to believe they have time to become familiar with technology (Karasavvidis, 2009); time in the curriculum to make integration feasible (Norton et al., 2000)	
Beliefs about Internal Barriers	*Constructed from a synergy of beliefs in relation to internal barriers (Lui & Johnson, 2000)*
Pedagogical: core beliefs about teaching and learning exist on a continuum (Denessen, 2000); influence utilisation for personal, administrative, and teaching tasks (Sadeck & Cronjé, 2017) **Norms:** teacher's belief of technology is influenced by their school (Sadaf et al., 2012) and their peer's views on technology (Hazzan, 2003) **Knowledge:** defined by beliefs as to nature (Shulman, 1986), type and classification of knowledge (Kim et al., 2013); utilisation (Ertmer & Ottenbreit-Leftwich, 2010); affordances (Maton & Howard, 2018) and classification of knowledge as either psychological or sociological (Howard & Maton, 2011) **Value of technology:** confidence whether technology can facilitate teaching goals (Watson, 2006) and affordances (Ertmer et al., 2012); shaped primarily by pedagogical beliefs (Johnson et al., 2016) **Self-efficacy:** beliefs in the ability to make use of the technology (Hew & Brush, 2007; Van Der Ross & Tsibolane, 2017); may be more important than actual skills (Ertmer & Ottenbreit-Leftwich, 2010) in work related, personal and outside factors (Farah, 2011)	

It is clear from the literature reviewed on beliefs about external and internal barriers, that a teacher's beliefs do not exist in isolation, but rather function as an interrelated and integrated system in which influences within and between beliefs are complex, multifaceted, and multilayered. Furthermore, teachers' beliefs are influenced, while at the same time shaped, by their view of pedagogy. Therefore, to understand more about a teacher's professional practice or disposition, literature related to the general meaning of professional disposition is presented first, thereafter literature specifically related to teachers.

2.6 PROFESSIONAL DISPOSITION

According to Katz and Raths (1985) and Welch and Napoleon (2015), teachers are most often described according to their disposition as these are essential in developing teachers' professional identity and facilitating pedagogic practice (Fonseca-Chacana, 2019). Definitions of dispositions include characteristics of teachers' actions (Katz & Raths, 1985), teachers' skills, values, knowledge, and beliefs (Diez, 2007), individual teacher's inclinations (Borko, Liston & Whitcomb, 2007), and a set of learnt habits and behaviours (Ritchhart, 2002). However, Fonseca-Chacana (2019) claims there appears to be no agreed-upon definition and thus it is unclear as to what the term disposition means (Altan et al., 2019; Diez & Raths, 2007). While Welch and Napoleon (2015) claim that this lack of consensus emanates from the different ways in which one views dispositions, Fonseca-Chacana (2019) argue that there is a scarcity of literature dealing with this area of focus as disagreements abound as to whether dispositions are innate or learnt (Nelsen, 2015), the scope of the term, the intangible and often invisible nature of dispositions, and the progression of dispositions over time (Altan & Lane, 2019; Diez, 2006) make dispositions hard to define and articulate. Additionally, Johnson and Reiman (2007) propose that the absence of a guiding framework contributes to the lack of clarity around teachers' dispositions and their subsequent pedagogic practice.

2.6.1 General definition of Disposition

Researchers using Dewey's (1922) conception of disposition, contend that dispositions refer to the underlying motivations of a person by which intelligent behaviour and subsequent professional conduct are organised (Altan et al., 2019). However, the distinction between disposition and habit is not clear and thus the terms are often used interchangeably (Dewey, 1922; Altan et al., 2019). However, Katz and Raths (1985) argue

that the term disposition is not interchangeable with attitudes, habits and traits because attitudes refer to a predisposition to behave in a certain way; habits imply a reduced level of conscious thought guiding one's actions; and traits describe one's emotional state. Dispositions, on the other hand, claim Katz and Raths (1985), refer to a summary of observed behaviour that can be used to describe current and future actions. Due to the lack of consensus as to whether the terms habits and disposition can be used interchangeably, Altan and Lane (2019) claim that many researchers have adopted the term "habits of mind" to describe a person's disposition of thoughtful behaviour and subsequent actions (Costa, 1991; Katz & Raths, 1985; Dottin, 2009; Fonseca-Chacana, 2019).

Thornton (2006) states that "habits of mind" consist of both cognitive and affective attributes that "filter one's knowledge, skills and beliefs and impact the action one takes in the classroom" (p62). Teachers' dispositions, which connect values and beliefs with actions (Carroll, 2012), are constructed from two orientations: intention, which describes the teachers' aims to bring about specific educational goals within the classroom; and attention, which describes the way teachers convey these goals through tasks (Tiilikainen, Toom, Lepola & Husu, 2019). Furthermore, Welch and Napoleon (2015) propose that teachers' dispositions encompass an awareness of their knowledge, as well as an understanding of their actions and therefore dispositions consist of both personal and interpersonal attributes evident in teachers' professional pedagogic practices (Fonseca-Chacana, 2019). According to Tichenor and Tichenor (2004; 2005), personal attributes are constructed from teachers' observable behaviours and professional characteristics, while interpersonal attributes are constructed from patterns of thinking alongside the predisposition to act in a certain way due to the social context or prior experiences (Ritchhart, 2001).

Using the theory of Experience, Dewey (1922; 1938) explains how dispositions develop through cognitive processes and are influenced by the social context and can be changed over time due to experiences (Burant, Chubbuck & Whipp, 2007). According to Bourdieu's (1974) concept of disposition, how people perceive and behave in the world is based on their social context. Thus, dispositions are not constructed within a vacuum but rather develop within communities of practice (Fonseca-Chacana, 2019) where habits of mind are based on beliefs and values that are constructed through the interactions with people,

the social context and teaching environment (Dottin, 2009). Teachers' ways of viewing the world, their inclinations and pedagogic practices are constructed from personal attributes and the social context in which they live and work (Hoadley & Ensor, 2009).

Welch and Napoleon (2015) propose that as teachers' dispositions manifest through their pedagogic practice in the classroom, a summary of teachers' pedagogic practice over time provides a means by which future behaviour and action can be predicted (Katz & Raths, 1985). However, Katz and Raths (1985) argue as not all dispositions are constructed from conscious and thoughtful habits of mind' it is possible that teachers may be unaware of their propensity to act in a certain way. Therefore, understanding the gap between what teachers do and what teachers would like to do (Fonseca-Chacana, 2019) may be difficult to articulate (Burant et al., 2007). According to Altan et al. (2019) and Dottin (2009), it is necessary to clarify the nature and meaning of teachers' disposition so that the relationship between teachers' professional dispositions and their resulting pedagogic practice can be made more explicit.

In response to the lack of clarity as to the nature and elements to be considered, Hoadley and Ensor (2009), drawing on Bernstein's (2000) language of description for curriculum and pedagogy in combination with Bourdieu's (1974) original conception of disposition, constructed a framework by which teachers' professional disposition can be explored and described. To provide an understanding of Hoadley and Ensor's (2009) conception of professional disposition, Bernstein's description of the pedagogic device and theory of instructional and regulative pedagogic discourse is presented.

2.6.2 Bernstein's Pedagogic Device

Bernstein's (1996; 2000) theory of pedagogic discourse offers a powerful language for methodically describing and exploring pedagogic matters. Bernstein's (2000) pedagogic device, which defines the nature of the pedagogic discourse, describes the complex relationship between where knowledge is produced, recontextualised and reproduced. Lim (2017) states the pedagogic device functions via a set of interrelated hierarchical rules: distributive rules inform recontextualising rules which in turn inform evaluative rules. Once distributive rules have established "who may transmit what to whom and under what conditions" (Lim, 2017, pg356), the rules of recontextualisation selectively appropriate, reposition and refocus the embedded discourses of skills and social order (Bernstein,

2000). Recontextualising rules produce the social fields of the official pedagogic recontextualising field (ORF) consisting of people from government pedagogic agencies and educational governing bodies; and the pedagogic recontextualising field (PRF) which consists of teachers in educational institutions and other people practically involved in an educational context (Bernstein, 2000; Morais, 2002), which according to Lim (2017) differ in their interpretations and implementation of the pedagogic device.

A teacher's pedagogic discourse is a specialised form of communication that transmits uncommon sense or school knowledge to learners (Hoadley, 2007) and consists of a collection of rules regulating the transmission and acquisition of knowledge by teachers and learners (Morais, 2002). Pedagogic discourse does not only describe the content conveyed by teachers, argues Hoadley (2007) but also includes how the teacher transmits content. According to Bernstein (1986), content can be described by the concepts of instructional and regulative discourse, while the transmission is explained by the rules of classification and framing.

2.6.3 Instructional and Regulative Discourse

The content of the pedagogic discourse states Bernstein (1986) consists of two analytically distinct but interrelated discourses, instructional and regulative. Bernstein (1996) contends it is the combination of these discourses which dictates the transmission of particular knowledge or skills rooted within a specific moral order that shapes teachers' pedagogic practices (Hoadley & Muller, 2010). The *instructional* discourse describes the rules of a specific discipline and its related content knowledge (Singh, 2002) refers to "what is being transmitted" (Morais, 2002, pg560). The *regulative* discourse, which describes "dominant values of society and regulates the form of how knowledge is transmitted" (Morais, 2002, pg560), consists of the rules for appropriate school behaviour as well as the approach of both teacher and learner within the classroom (Singh, 2002).

2.6.4 Classification and Framing

Bernstein (2000) contends that while all pedagogic discourses originate from similar basic rules, the strength of boundaries between knowledge and power dynamics in the classroom vary. Bernstein (1971) utilises the concepts of classification and framing to explain the nature of these boundaries. *Classification*, which exists on a continuum from strong to weak (Scott, 2008), describes the "what" of pedagogic discourse (Bernstein,

2000) with symbolic boundaries constructed by teachers as to what knowledge is considered valid (Wheelahan, 2005; Hoadley & Ensor, 2009). Strong classification results in strict boundaries being constructed between school and everyday knowledge; while weak classification is characterised by flimsy boundaries resulting in the integration between subject knowledge of different disciplines with everyday knowledge (Scott, 2008). *Framing*, which also exists on a continuum of strong to weak, is the "how" of the pedagogic discourse (Bernstein, 2000) and describes the control and power dynamics in the classroom. Control refers to the "way in which knowledge is selected, sequenced, paced and evaluated in the classroom" (Hoadley & Ensor, 2009, pg2), while power dynamics describe the manner and style and kind of communication between teachers and learners (Hoadley & Ensor, 2009). For example, strong framing occurs when teachers have greater control over the sequencing of information and time allocated to each learning unit, whereas teachers with weak framing have limited control over the pedagogic relationship (Scott, 2008).

Furthermore, Bernstein (2000) defines collection and integrated codes, using the concepts of classification and framing, to describe the strengths of boundaries of knowledge and power. *Collection codes*, which possess strong classification and framing, allow for the development of more specialised knowledge through the construction of solid boundaries (Morais, 2002) and the teacher controlling the content transmitted to learners (South African Institute for Distance Education, 2010). On the other hand, *integrated codes*, which possess weak classification and framing, allow for little separation between subjects through the blurring of boundaries (Morais, 2002) and with teachers organising and arranging the learning content primarily in relation to the learner (South African Institute for Distance Education, 2010). A teachers' instructional and regulative discourses i.e., pedagogic practice is constructed from their coding position within their pedagogic discourse (Morais, 2002). Even though defined as two dissimilar conceptual codes the distinction is not so simple, as classification and framing function independently and thus one may be strong while the other is weak (South African Institute for Distance Education, 2010).

As a teacher's chosen pedagogic practice is shaped by both instructional and regulative discourses, Bernstein's (1999; 2000) views of horizontal and vertical knowledge that

describe the “what”, and Bernstein’s (1996) pedagogic approaches of performance and competence that describe “how” are presented.

2.6.5 Horizontal and Vertical Knowledge

According to Bernstein (1999; 2000), the instructional discourse describes the teacher’s view of the knowledge structures and specific procedures needed to transmit their subject. To describe the structure of knowledge, Bernstein (1999; 2000) constructed the concepts of horizontal and vertical knowledge. Bernstein (1999; 2000) proposes *horizontal knowledge* consists of everyday, “common sense” knowledge which is weakly classified. This knowledge is typically given over orally and is “local, context-dependent, specific, tacit and multilayered” (Bernstein, 2000, pg157), with transmission occurring relative to experiences within a particular social context (Bernstein, 1999; 2000). *Vertical knowledge* consists of “specialised school” knowledge, which is strongly classified, usually transmitted in a written form (Bernstein, 1999; 2000).

Bernstein (2000) utilises the different knowledge structures to define two forms of discourses: horizontal and vertical. A *horizontal discourse* typically occurs in a personal setting, and involves the transmission of everyday knowledge; while a *vertical discourse* generally occurs in a formal, school setting and can involve either *horizontal or hierarchical knowledge structures.* According to Bernstein (1999; 2000), horizontal knowledge structures is formed from a collection of knowledge codes that do not need to build on each other, while hierarchical knowledge structures are characterised by systematic propositions and theories integrated at lower levels which need to be studied in sequence (Hoadley & Muller, 2010).

2.6.6 Performance and Competence Pedagogic Modalities

According to Bernstein (1996), two pedagogic modalities exist, namely performance and competence. *Performance* pedagogic modalities are strongly framed with the learner having little control over the content, timing, and situational context of the learning, whereas competence pedagogic modalities are weakly framed with the learner possessing greater control (Bernstein, 1996; Tan, 2019). While these pedagogic modalities are conceptually defined at opposite ends of a spectrum (Bernstein, 1996), in reality a blend of modalities can concurrently exist for a teacher or within a particular context (Morais, 2002; Bourne, 2004; 2006). Bourne (2006) claims that no pedagogic modality is by nature more

dominant but rather the context, circumstances and timing influences the nature of the pedagogic discourse.

Utilising Bernstein (1996) different pedagogic modalities as a foundation, Naidoo (2011) identifies three core rules that shape teachers' regulative discourse: hierarchical rules, sequencing and pacing rules; and criteria rules. Firstly, *hierarchical rules*, states Naidoo (2011) describe the natural power imbalance between teachers and learners. Within competence pedagogic modalities, learners possess more control with seemingly equal power present between teacher and learner. On the other hand, within performance pedagogic modalities the teacher possesses more control and an explicit power imbalance between teacher and learner is evident (Naidoo, 2011). Secondly, *sequencing and pacing rules* describe the control relative to the order in which knowledge is presented and the pace at which is learnt (Naidoo, 2011). According to Bernstein (1996) within a performance pedagogic modality, the locus of control for sequencing and pacing resides with the teacher, while within a competence pedagogic modality, sequencing and pacing depend strongly on the learners. Thirdly, the *criteria rules* describe what is regarded as valid in relation to the production and acquisition of knowledge (Naidoo, 2011). Within a performance pedagogic modality, the focus is on what is absent in the learner's specific output (Tan, 2019) which is graded to reflect the level of specialised knowledge acquired by the learner for a particular purpose (Bernstein, 1996). Whereas within a competence pedagogic modality the focus is on what is present in the learner's output, with the essential aim being active participation of learners and with differences in output viewed as opportunities for growth (Bernstein, 1996; Christie, 2008; Tan, 2019).

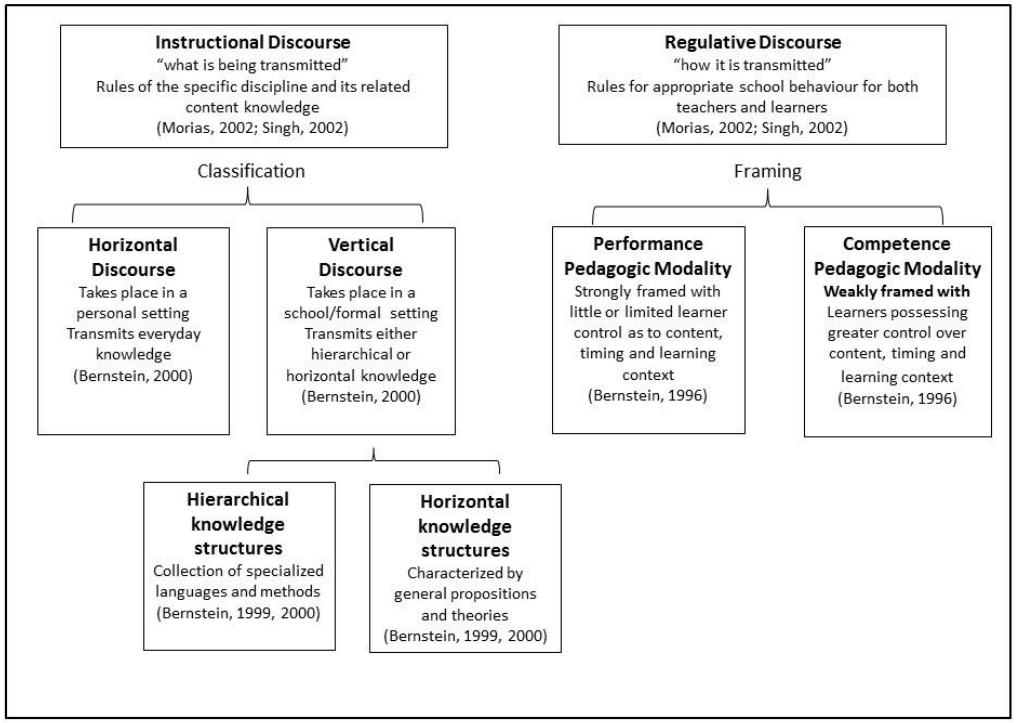
Having introduced Bernstein's language of description in relation to pedagogic practice and society and Bourdieu's (1974) conception of dispositions, Hoadley's and Ensor's (2009) conception of professional disposition and the social context are discussed.

2.6.7 Professional Disposition revisited

Utilising Bernstein's description of the pedagogic discourse and concepts of classification and framing, with regard to instructional discourses involving knowledge structures; and regulative discourses involving pedagogic modalities, Hoadley and Ensor (2009) provide a powerful framework in which teacher's professional dispositions can be empirically researched. To explore the instructional discourse, shaped by teachers' perspectives on

the nature and structure of the knowledge that needs to be transmitted and acquired for their subject as well as their view on how learners acquire information (Bernstein, 2000), Hoadley and Ensor (2009) propose analysing the way teachers speak about learners, learning and the structure and boundaries of knowledge (Bernstein, 2000). To explore the regulative discourse, which is shaped by the teacher's view as to the nature of the teacher-learner relationship which in turn informs the teacher's pedagogic modality of choice, an analysis of teachers' perception of control necessary to select, pace, sequence transmission and acquisition of knowledge, (Bernstein, 2000; Hoadley & Ensor, 2009) is needed. A graphical representation based on Bernstein's conception of pedagogic discourse (1996; 1999; 2000) is shown in Figure 2.

Figure 2: Bernstein's Conception of Pedagogic Discourse (1996, 1999, 2000)



2.6.8 Context

Bernstein's (1986; 1996; 2000) theory of curriculum, pedagogy and knowledge not only enables researchers to explore and describe the nature of teachers' pedagogic discourses but also facilitates an exploration of the sociology of education, relative to social class and educational access (Rousseau, 2014). Bernstein's concepts do not only provide a means to explore and describe teachers' identity but also offers a way to understand schools and society (South African Institute for Distance Education, 2010) in relation to how culture and

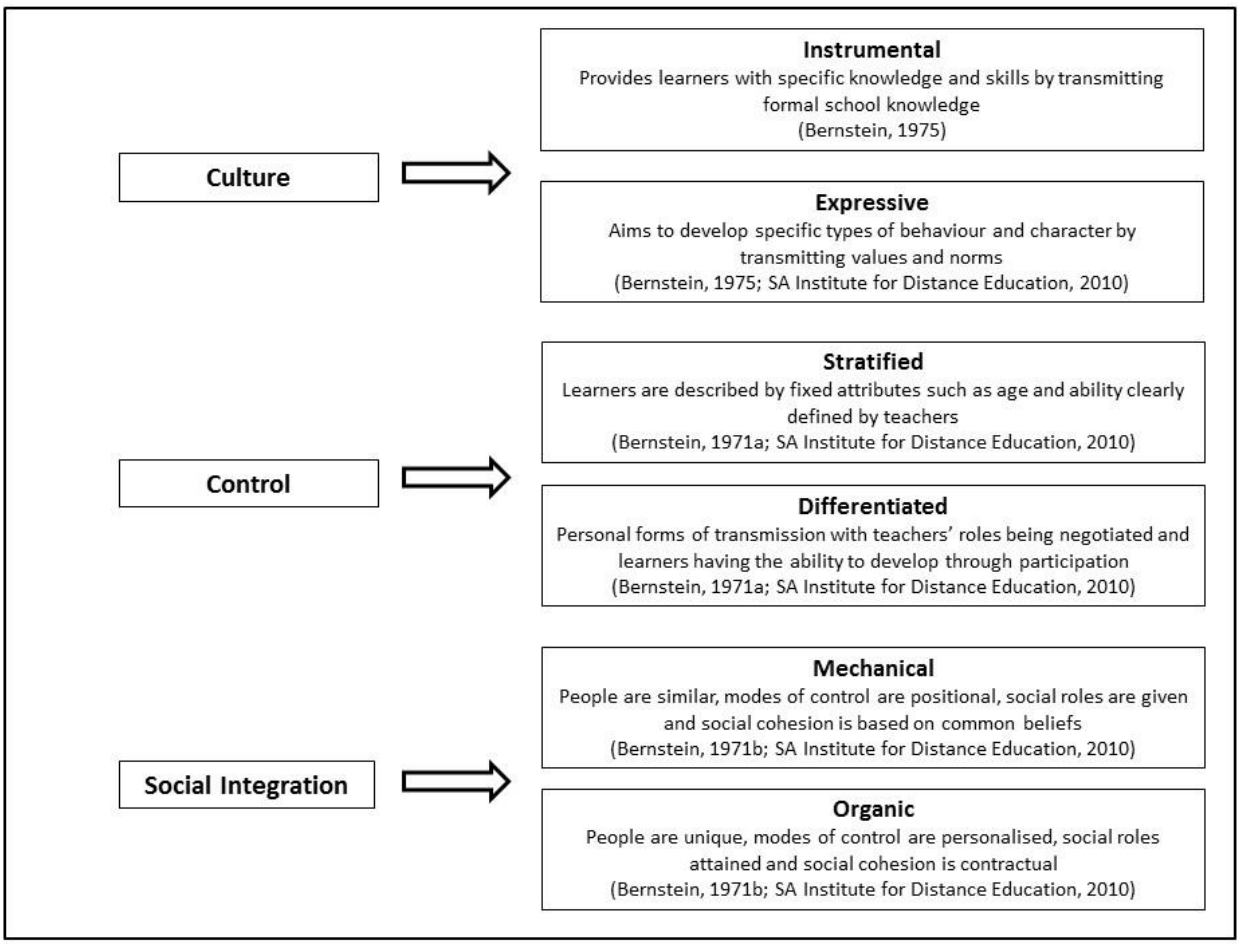
social class are reproduced within specific social contexts (Clark, 2005). According to Bernstein (1971, 1975), pedagogic practice is fundamentally shaped by the culture of the school, the school's locus of control, and the relationship between schools and society.

Bernstein (1975) claims that schools transmit two cultures: instrumental and expressive. The *instrumental* culture aims to provide learners with specific knowledge and skills by transmitting formal school knowledge, whereas the *expressive* culture aims to develop specific types of behaviour and character through transmitting values and norms (Bernstein, 1975; South African Institute for Distance Education, 2010). The nature of the culture influences the pedagogic discourse of teachers within a specific school, for example, in schools with a dominant instrumental culture the ranking of learners and success and failure are highlighted, while the aim of schools with dominant expressive cultures the aim is to create a consensus of learning (South African Institute for Distance Education, 2010). Bernstein (1971a) acknowledges schools are not classified as either instrumental or expressive, as school culture constantly shifts control depending on the dominant rituals.

For Bernstein (1971a) in schools with *stratified* control, learners are described by fixed attributes such as age and ability with positional relationships and clearly defined teacher roles (South African Institute for Distance Education, 2010). In schools with *differentiated* control, personal forms of transmission prevail (Bernstein, 1971a), teachers' roles are negotiated, and learners have the potential to develop through participation with the teacher and school (South African Institute for Distance Education, 2010).

Lastly, to explain the relationship between schools and society, Bernstein (1971b) identifies two forms of social integration: mechanical and organic. *Mechanical integration* (in which people are similar) occurs where modes of control are positional, social roles are given and social cohesion is based on a set of common beliefs (Bernstein, 1971b; South African Institute for Distance Education, 2010). *Organic integration*, on the other hand, occurs where modes of control are personalised, social roles are attained, people are unique and social cohesion is based on contractual relations (Bernstein, 1971b; South African Institute for Distance Education, 2010). A graphical representation of Bernstein's view of the social context (1971a, 1971b, 1975) is shown in Figure 3.

Figure 3: Bernstein's Conception of Social Context (1971a, 1971b, 1975)



While an understanding of teachers' professional dispositions pertaining to knowledge, pedagogic modality and society are essential in understanding teachers' pedagogic discourse, as stated in the aims and objectives for this study, I am interested in exploring teachers' technology integration in the classroom and therefore literature focusing specifically on technology integration within education is reviewed.

2.7 ORIENTATION TOWARDS TECHNOLOGY INTEGRATION

It is necessary to first define what technology integration and orientation mean to facilitate an understanding as to why the word orientation has been appended to technology integration within this study. According to the Cambridge Dictionary (2019) integration is "the action or process of combining two or more things in an effective way", thus any integration requires active engagement. Earle (2002) claims that technology integration in the classroom is no different, as it does not occur when technology simply exists in the

teaching space but rather when teachers actively bring their teaching and technology together to enhance their educational context. Additionally, it appears from the literature reviewed that one's behaviour or practice can be influenced by beliefs, thoughts, and actions as relates to particular issues, this is known as one's orientation towards something (Cambridge Dictionary, 2019). Therefore, affixing the word orientation to technology integration, provides a link by which teachers' levels and activities of teachers' technology integration in the classroom can be explored as regards to beliefs and pedagogical practices.

2.7.1 Micro Theories of Technology Integration

According to Trinidad, Newhouse, and Clarkson (2005) models specifically related to technology integration can be classified into Learning Micro Models and ICT-Oriented Micro Models. Learning Micro Models are often referred to as concerns-based models (CBAM), as stated by Trinidad et al. (2005), since many of them have been constructed to address teachers' concerns about technology innovation in the classroom in large-scale technology integration initiatives. Within the CBAM, the focus tends to be directed teachers' Levels of Use (LoU) and Stages of Concern (SoC) at an individual level. ICT-Oriented Micro Models or educational technology models like the Apple Classrooms of Tomorrow (ACOT) (Sandholtz et al., 1997); the Levels of Technology Implementation (LoTi) framework (Moersch, 1997) and the Instructional Transformational Model (ITM) initially developed by Rieber and Welliver (1989), then later by Marcinkiewicz (1994) and adapted by Hooper and Rieber (1995) draws on the CBAM concepts of LoU and SoC as well as Rogers (1993; 2003) theory of Diffusion of Innovation (DoI) to explore technology integration in schools and the role of teachers in such initiatives.

2.7.2 Teachers' Levels of Technology Integration

Two prominent ICT-Oriented Micro models discussed previously (see section 2.3.6): Hooper and Rieber's (1995) Hierarchical Model of Technology Adoption (HMTA), adapted from Rieber and Welliver's (1989) Instructional Transformational Model (ITM); and Sandholtz et al. (1997) Apple Classrooms of Tomorrow (ACOT) model which describe teachers' levels of technology use, are presented.

- **Hierarchical Model of Technology Adoption (HMTA)**

Hooper and Rieber (1995) five-step hierarchical model includes stages through which teachers must progress to integrate technology into their pedagogic practice.

In the first stage, *familiarisation*, teachers simply become acquainted with the technology due to an initial exposure, such as a lecture at a convention or an in-service workshop (Hooper & Rieber, 1995; Rogers, 2000). Hooper and Rieber (1995) claim that at this stage teachers take no further actions to integrate technology into their pedagogic practice as all that remains from this exposure is a memory of the experience. Possible reasons for this lack of action may be as they see no significance in using technology in their teaching or simply that the technology is inaccessible to them (Rieber & Welliver, 1989; Rogers, 2000).

The second stage, *utilisation*, occurs when the teacher experiments with the technology in the classroom. Rogers (2000) cautions that although teachers see the relevance of technology and acknowledge its usefulness, at this stage, because they are simply using it for routine functions and do not integrate it fully into their pedagogic practice, any minor technical or implementation issues experienced will cause them to discard or abandon technology usage.

According to Rogers (2000) teachers enter the third stage, *integration*, when technology is no longer utilised to simply use the technology, but rather conscious decisions are made to incorporate technology into parts of their pedagogic practice. At this stage, if the technology is removed or unavailable, teachers will be challenged to proceed or rework their lessons and thus minor technology malfunctions or technical issues will not dissuade teachers (Hooper & Rieber, 1995; Rogers, 2000).

The fourth and fifth stage, *reorientation* and *evolution*, represents the start of teachers understanding of education technology (Hooper & Rieber, 1995). Hooper and Rieber (1995); Rogers (2000) state to reach the reorientation stage, teachers are required to reassess and reconceptualise their pedagogic practices to enrich the learning context with a focus on how technology can improve student learning – while reaching the evolution stage requires teachers to constantly evolve and adapt their pedagogic practice to incorporate technology in relation to the changing context and learners' needs. According

to Rogers (2000), unless teachers receive the appropriate level and type of support at each stage in the technology adoption hierarchy, external or internal barriers experienced by the teachers will certainly lead to the failure of technology integration initiatives.

- **Apple Classroom of Tomorrow (ACOT) Model**

As discussed previously, the Apple Classroom of Tomorrow (ACOT) model, developed by Dwyer et al. (1991) propose five progressive stages of technology integration for teachers: entry, adoption, adaptation, appropriation, and invention (Sandholtz et al., 1997; Yucel et al., 2010; Cuban, 2012).

According to Dwyer et al. (1991) at the initial *entry* stage teachers have very little experience of teaching with technology and thus Cuban (2012) claims that the introduction of technology into these teachers' classrooms presents significant barriers to effective use, for example, increased behaviour management issues, technical breakdowns, software management, and the need to physically rearrange the classroom environment to cater for the integration of the technology. The next stage, *adoption*, occurs as teachers become more comfortable with using technology in their pedagogic practice for traditional tasks in the classroom (Dwyer et al., 1991) and thus initial issues with technology are not only reduced but also teachers are less focussed on the external barriers being experienced (Cuban, 2012).

The next stage, *adaptation*, occurs when teachers can fully integrate technology into their traditional pedagogic practice (Dwyer et al., 1991). During this phase Dwyer et al. (1991) found that teachers reported greater efficiency and productivity in the classroom for both themselves and the learners. According to Cuban (2012), the next stage, *appropriation*, is reached not only when teachers shift their beliefs and attitudes towards technology integration in the classroom but are also confident in their ability to use technology within their pedagogic practice (Dwyer et al., 1991). Yucel et al. (2010) claim that at this stage the unique capabilities and possibilities brought about through technology enables teachers to reconsider their current pedagogic practice to incorporate new teaching methods to build learners' competencies (Cuban, 2012). The final stage, *invention*, occurs when teachers try out new ways of teaching due to the possibilities offered by and the power of the technology (Cuban, 2012; Yucel et al., 2010).

According to Dwyer et al. (1991), the progression from the entry stage to invention is difficult as often teachers believe simply utilising technology will make their jobs easier. However, this is not always the case, as the integration of technology is a complex process, limited not only by the context within which teachers work which is often inflexible and unsupportive, but also requires teachers to reflect on their deeply held beliefs and invested pedagogic practices which are often in conflict with their awareness of the possibilities that technology offers (Dwyer et al., 1991).

- **Limitations of HMTA and ACOT**

Both HTMA and ACOT are prescriptive and progressive by nature. According to Hooper and Rieber (1995), teachers need to progress from familiarisation to evolution in a sequenced order to remain relevant, as ITM is founded on the belief that learner-centred pedagogic practice is preferable (Rieber & Welliver, 1989; Hooper & Rieber, 1995; Rogers 2000). Similarly within ACOT, Dwyer et al. (1991) and Cuban (2012) claim that teachers need to progress through each stage from entry to invention in order to respond to the changing needs of the current educational context.

As this study does not aim to provide evidence as to why certain pedagogic practices and uses of technology are preferable, the advocacy claims and hierarchical and prescriptive nature of both these models are viewed as limitations.

- **HMTA and ACOT Teachers' Level of Technology Integration**

Despite the limitations mentioned, both models provide a meaningful and structured way by which teachers can articulate and describe their levels of technology integration. A table showing similarities between the level of teachers' technology adoption according to HTMA and ACOT, is shown in Table 7.

Table 7: Teachers' Levels of Technology Integration – HTMA and ACOT

Hooper & Rieber, 1995; Sandholtz, Ringstaff & Dwyer, 1997)

Hierarchical Model of Technology Adoption (HMTA)	Apple Classroom of Tomorrow (ACOT)
Familiarisation teacher becomes aware of the technology and its importance	Entry teacher learns the basics of new technology
Utilisation teacher uses the technology but minor issues cause the teacher to discontinue use	Adoption teacher uses technology to support traditional instruction
Integration teacher sees the technology as essential for achieving educational goals within the classroom	Adaptation teacher integrates technology into traditional classroom practice
Reorientation teacher begins to rethink educational goals by making use of technology	Appropriation teachers incorporate technology as just one of the tools for learning
Evolution classroom becomes seamlessly integrated with the technology	Invention teacher discovers new uses for technology

2.7.3 Teachers' Manner of Technology Integration and Activities

While HTMA and ACOT are appropriate models by which teachers can describe their level of technology integration, Trinidad et al. (2005) contend that no single model can perfectly explain technology integration of any specific teacher. The reason being, claim Hamilton et al. (2016) that integrating technology is complex and multifaceted since incorporating technology integration is not an educational goal by itself, but rather aims to assist teachers in facilitating teaching and learning outcomes. Additionally, even for the same teacher, contexts may differ and thus while in one context teachers may be at a certain level of technology integration, within another context this may not be the case. Furthermore, Hilton (2016) contends that even in the same subject, one teacher may utilise technology in several ways depending on the teaching objectives and learning outcomes. To explain and understand this level of complexity, models dealing specifically with teachers' manner of technology integration and subsequent technology activities are also needed.

Puentedura's (2006) SAMR and Hooper and Rieber's (1995) HTMA are two such models that have been selected as the theoretical lenses through which teachers' manner of technology integration and subsequent activities in this study can be explored. The rationale for selecting these models is that they are specifically constructed to research the manner of technology integration (Rogers, 2000) and its associated activities (Hilton, 2016), and they also fit the criteria for a "good theory" because they use few concepts i.e.

parsimonious; provide a structure for identified concepts i.e., explicit; and provide meaningful reasons as to the inclusion of identified concepts i.e. plausible (Wacker, 1998). Furthermore, the SAMR model is a commonly used theoretical framework specifically aimed at exploring technology activities (Phillips, 2015; Cuban, 2012), and also provides teachers' with the possibility to reflect on the capacity to use technology for a particular activity (Hilton, 2016).

- **Substitution Augmentation Modification Redefinition (SAMR)**

Puentedura's (2006) SAMR is a four-level model describing ways in which teachers' make use of technology in the classroom. Levels are substitution, augmentation, modification, and redefinition.

At the *substitution* level, teachers simply replace traditional ways of teaching with technology, but no functional change occurs in their pedagogic practice (Puentedura, 2006, 2013; Hamilton et al., 2016; Hilton, 2016), whereas at the *augmentation* level the substitution of technology results in improved pedagogic practices (Puentedura, 2006, 2013; Hamilton et al., 2016). Hilton (2016) states that at both these levels the tasks can be accomplished just as easily without the technology. An example of substitution occurs when teachers simply replace printed books with digital books, while at augmentation learners will no longer use digital books just to follow along with the teacher but learners will use the digital books to read and listen to different stories according to their individual reading level (Hamilton et al., 2016).

The *modification* level enables teachers to significantly redesign preexisting tasks in ways that are impossible without the use of technology, while at the *redefinition* level technology is used to create previously unimaginable tasks (Puentedura, 2006; Hamilton et al., 2016; Hilton, 2016). For example prior to the use of technology, teaching of direction and location required the use of static maps. Now with technology at the modification level, teachers can utilise interactive maps for learners to engage with, and at the redefinition level, instead of asking learners to plot a geographical location and plan a route from a static map, teachers could task learners to create an interactive journey with geolocations using technology tools.

- **Limitations of SAMR**

Hamilton et al. (2016) claim that SAMR is not a rigorous model grounded in theory and prior literature and therefore has not yet been used extensively in empirical academic studies. Furthermore, contend Hamilton et al. (2016) that SAMR is limited as it does not consider the importance of context; is rigid in its structure; and places importance on the product of technology over the process of teaching.

Firstly, according to Berliner (2002), Rosenberg and Koehler (2015), within educational technology research, the consideration of contextual components such as technology resources (Ertmer, 1999), support, and teacher knowledge (Ertmer et al., 2012) is crucial. Hamilton et al. (2016) argue that the context in which the teacher works matters and thus the lack of attention given to the context within the SAMR model is an over-simplification of the process of technology integration.

Secondly, concerning the rigidity of the SAMR structure, Hamilton et al. (2016) claim that the inherent complexities of integrating technology into a teachers' pedagogic practice are dismissed by the hierarchical and prescriptive nature of the SAMR model in which progressive modes of technology integration are advocated as preferable. Hamilton et al. (2016) suggest the use of alternative frameworks such as Mishra and Koehler's (2006) Technological Pedagogical Content Knowledge (TPACK) since they are descriptive models rather than prescriptive requirements of tasks. However, Kirkland (2014) argues that TPACK does not describe technology adoption tasks and activities but rather focuses on the knowledge teachers require to integrate technology into their pedagogic practice. According to Hilton (2016), SAMR simply provides a means by which teachers can reflect on the capability to use technology to accomplish a specific teaching task or learning objective, with no level being seen as preferable, and thus the misconception of the SAMR model being progressive and prescriptive by nature, which stems from the common graphic representations of the model, is erroneous. Kirkland (2014) concurs that SAMR is not a hierarchical model but rather provides a critical framework by which each task can be examined by teachers, to determine the most appropriate level of technology integration.

Thirdly, according to Hamilton et al. (2016), education is a process and not a product of technology. Therefore, the SAMR's model focuses on the instructional activities of teachers and the product of technology use, rather than on the process of teaching and

the attainment of learning objectives and outcomes, is flawed (Reiser & Dempsey, 2012). Hamilton et al. (2016) claim that the focus on the product gives importance to the technological activity rather than good teaching.

To counter these limitations, Hamilton et al. (2016) suggest that context is specifically considered when using the SAMR model and that levels of technology adoption activity be used to describe rather than prescribe teachers' technology integration choices.

- **Hierarchical Model of Technology Adoption (HMTA) – Product and Idea Technologies**

Hooper and Rieber's (1995) HMTA can also be used to describe teachers' manner of technology integration. Hooper and Rieber (1995) state that technology can be used either as a "product" or an "idea" technology, depending on the skills and intentions of the teacher. According to Hooper and Rieber (1995), when teachers employ technology as a product this refers to the contemporary use of the functions of the hardware and software; whereas, when used as an idea technology, teaching and learning experiences such as simulations and virtual field trips are not possible without being enabled and facilitated by technology. Hooper and Rieber (1995) claim that most usage of technology focuses on technology as a product due to the historical beliefs and entrenched professional dispositions of teachers, which limits teachers' ability to consider how ideas i.e., learner-centred teaching could be supported by technology.

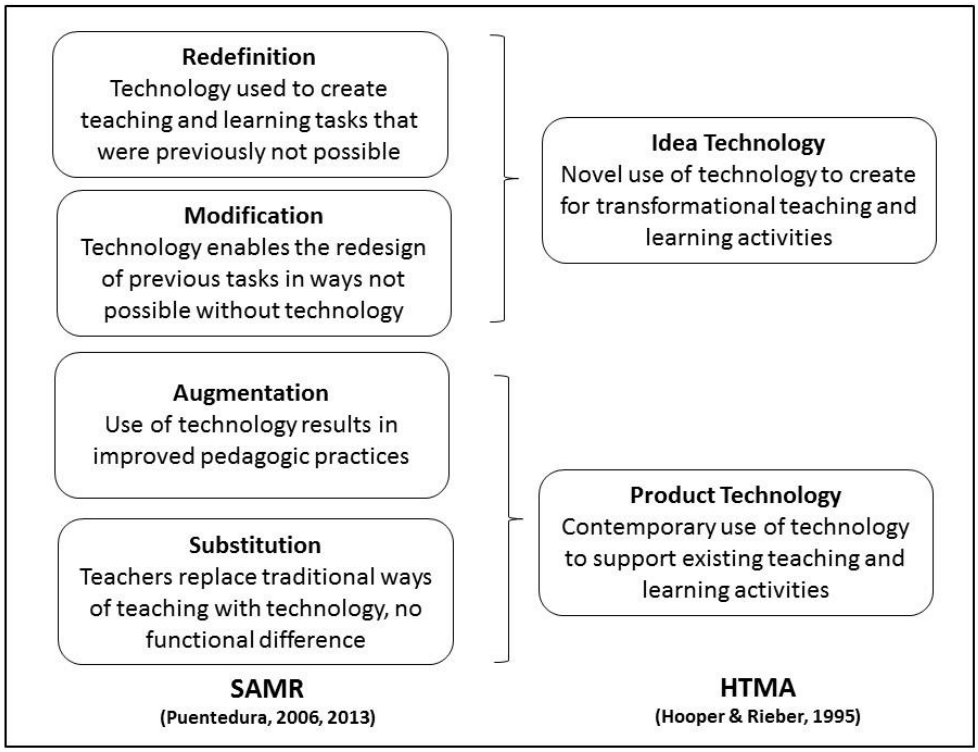
Hooper and Rieber (1995) clearly view the use of an idea technology as preferable and while an advocacy approach of technology adoption is not the aim of this study, the definition of these two ways in which technology can be used to provide a powerful means by which teachers' manner of technology use and subsequent technology activities can be described.

- **SAMR and HTMA Teachers' Manner of Technology Integration and Activities**

Hamilton et al. (2016) suggest that in order to use rigid and prescriptive models as a theoretical lens through which description and understanding (not advocacy) are the main objectives, the inherently hierarchical and upward progression of such models needs to be dismissed. By discounting the prescriptive nature of both these models, the terms of

product and idea technologies provide a means by which teachers can identify and articulate their manner of technology adoption, while the levels of the SAMR model provides teachers with a structured way in technology activities can be explained. A graphical representation combining Hooper and Rieber's (1995) "product" and "idea" technology terms with the SAMR model is shown in Figure 4.

Figure 4: Teachers' Manner of Technology Integration and Activities (Puentedura, 2006, 2013; Hooper & Rieber, 1995)



2.8 RELATIONSHIP BETWEEN BELIEFS, PROFESSIONAL DISPOSITION AND ORIENTATION TOWARDS TECHNOLOGY INTEGRATION

Vannatta and Fordham (2004) claim that while some teachers' dispositions may promote the use of technology, others may act as inhibitors and thus inconsistencies may exist between teachers' beliefs, their pedagogic practice and technology use. Chen (2008) proposes that these inconsistencies are due to external factors coupled with the complex nature of a teacher's belief system which is made up of many different facets. While much research has been conducted to understand this relationship Tondeur et al. (2017) claim that as this relationship is not only complex but multifaceted, a clear understanding remains elusive. To get a sense of these relationships Tondeur et al. (2017) conducted a meta-analysis of qualitative evidence between 2002 and 2012 to provide a holistic view of the literature, however Tondeur et al. (2017) caution that the simplification reduces the

complex relationship that contextual aspects such as the level of education being studied; geographical location; school culture; curriculum; societal characteristics of the educational context; and the time technology has been in use, have on teachers' beliefs, professional disposition and use of technology.

From the analysis Tondeur et al. (2017) found evidence to suggest that (1) teachers' pedagogical beliefs influence technology integration; (2) context is crucial; (3) the relationship is bidirectional; and (4) a multidimensional approach is necessary.

2.8.1 Teachers' beliefs influence technology integration

Teachers' personal and pedagogical beliefs around technology are crucial for teachers to decide if and how to integrate technology into their pedagogic practice (Deng, Chai, Tsai, Lee & Deng, 2014; Tondeur et al.,2017). Research suggests barriers occur when: the nature of the technology does not match teachers' pedagogical beliefs (Donnelly, McGarr, O Reily, 2011); most teachers' personal learning experiences are not similar to the current approach of teaching (Lim & Chan, 2007); time pressures and the demands of standards-based testing exist (Lim & Chan, 2007); and there is a lack of control in the classroom due to technology use (Windschitl & Sahl, 2002). According to Tondeur et al. (2017), these barriers result in teachers selecting technology that aligns with their existing beliefs as to what constitutes 'good' education. Those advocating for technology integration argue that teachers with constructivist pedagogic beliefs tend to have a more active and varied use of technology in the classroom (Ertmer et al., 2015) than teachers with teacher-centred (Becker, 2000). Ertmer (1999) claims that teachers who redefine their traditional role in the classroom may more willingly use technology ICT and conversely the incorporation of technology, may in turn, shift their beliefs about pedagogic practices.

However, Tondeur et al. (2017) argue that shifting beliefs is not an automatic or given consequence. According to Ertmer et al. (2012), a barrier threshold exists which limits pedagogical practices irrespective of beliefs as systematic barriers to technology integration may exhaust many teachers (Woodbridge, 2003). Woodbridge (2003) claims that incorporating technology is an individual choice based on the teacher's beliefs and perception towards the value of technology rather than simply because of their pedagogic stance, as teachers want both flexibility and control regarding the tools they make use of in their lessons. Due to the complex nature of these relationships Tondeur et al. (2017)

suggest an improved understanding of the interconnected factors influencing teachers' pedagogical beliefs and technology integration is needed.

2.8.2 Context is crucial

Ertmer (2005) states that the context and other associated factors influence teacher's abilities to translate their pedagogical beliefs into practice. These factors can be related to the teacher's skills and self-efficacy, the school's policies and expectations, and cultural and societal norms and expectations (Ertmer et al., 2015). Vanderlinde, van Braak, and Tondeur (2010) claim that technology integration is based on the school context as well as on the teachers' beliefs as what good education is. However, as pedagogical beliefs related to the use of technology is an individual and unique process (Woodbridge, 2003), the vision of what good education is, may not be shared by all teachers in the same school even when the environment is supportive of technology integration (Levin & Wadmany, 2005).

2.8.3 Relationship is bidirectional

When teachers view technology as an opportunity to enhance their teaching, their experiences with technology act as an enabler that has the potential to support changes in their pedagogical beliefs (Chen, 2008; Ertmer et al., 2015; Borg, 2001). Whereas, Donnelly et al. (2011) argue that when the affordances of technology support teachers' existing beliefs, it is the beliefs that act as the enabler and motivator for teachers to try-out and enhance their teaching strategies. Tondeur et al. (2017) contend that the incorporation of technology in the classroom is an iterative process involving the bidirectional relationship between beliefs, practices, and technology use. For example, working within a technology-rich environment may influence teachers' beliefs and practice, while the possibility of technology use is more likely amongst those teachers whose beliefs are aligned to the affordances of technology within education (Tondeur et al.,2017).

2.8.4 Multidimensional approach is necessary

Tondeur et al. (2017) suggest that the majority of literature supports the notion that when technology supports teachers' current pedagogical approach, the teacher tends to appreciate the value that the technology brings to the classroom (Lim & Chan 2007; Tondeur et al., 2013). According to Pedersen and Lui (2003), because teachers' pedagogical beliefs most often support their pedagogic practices, technology integration needs to support teachers' current teaching strategies and pedagogical beliefs as this

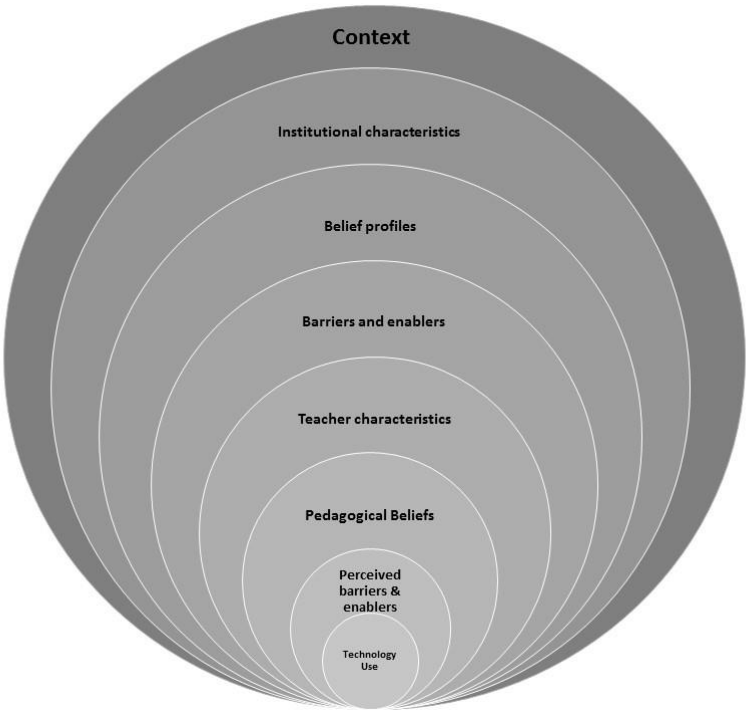
increases the likelihood teachers will utilise technology in a meaningful way (Tondeur et al., 2017). Consequently, it follows that particular pedagogical beliefs are linked with certain types of technology use. For example, Martin and Vallance (2008) claim that those more inclined to teacher-centred beliefs regularly use technology to acquire skills, whereas teachers with more student-centred beliefs utilise technology for higher-order learning outcomes (Lim & Chan 2007).

However, using the theory of planned behaviour (TPB) (Azjen, 1991) as a conceptual framework, Van Der Ross and Tsibolane (2017) studied the relationship between teachers' beliefs, practice, and technology integration at technology endowed schools in Cape Town. Findings indicate that teachers' pedagogical beliefs do not influence the extent and nature of technology integration. According to Van Der Ross and Tsibolane (2017), teachers with espoused student-centred pedagogical beliefs did not make use of the technology to support their pedagogical beliefs but rather used the technology to support traditional teaching methods and teachers with high technology self-efficacy utilised technology to support traditional teaching methods. Levin and Wadmany (2005) propose that while teachers hold multiple beliefs and approaches to technology integration, it is an individual process unique to each teacher and is also influenced by the context (Tondeur, et al., 2017). Therefore, understanding the relationship between teachers' beliefs, professional disposition and technology integration requires a multidimensional approach rather than a unidimensional view of teachers' beliefs and associated pedagogic practice as either being teacher or student-centred.

The Pedagogical Beliefs-Technology Model (PBT), shown in Figure 5, developed by Tondeur (2020) provides a graphical summary of the teachers' technology teachers' use in relation to internal and external barriers and beliefs, institutional characteristics, context[4].

[4] A description of the Pedagogical Belief-Technology (PBT) (Tondeur, 2020) can be found in section 2.3.4 which discusses social models used to study technology adoption.

Figure 5: Overview of Relationships (PBT) (Tondeur, 2020)



2.9 CONCLUSION

In this chapter to understand more about technology integration within an educational context, literature on technology use within the classroom, with a focus on the South Africa context was reviewed. Next, the unfolding COVID-19 pandemic and its impact on global and South African education were discussed. Then, the different levels of analysis at which research can be performed as well as the stages of theories used to perform research in this area were presented. Prominent technology adoption, social, structuration and educational theories were then identified and briefly reviewed explaining the overview of the theory, its application to educational technology research and any limitations identified. Based on past research, teachers' beliefs, professional disposition, and orientation towards technology were areas identified that possibly influence and shape teachers' technology integration choices. To introduce teachers' beliefs, acknowledged barriers to technology were presented, followed by a review of teachers' first-order beliefs including resources, training, support and time; and second-order beliefs including pedagogical beliefs, norms, the value of technology and knowledge beliefs were presented. Next, a review of the general meaning of disposition was presented, followed by a description of Bernstein's pedagogic discourse of instructional and regulative discourses, which provides a framework by which teachers' professional dispositions can

be explored. As the study is interested in teachers' technology integration at different schools, Bernstein's social considerations as relates to teachers' pedagogic discourses were then presented. Thereafter, orientation towards technology integration in relation to teachers' levels, manner and adoption activities was presented along with a detailed description of micro-level educational technology theories.

In the next chapter, as the study aims to explore the relationship between beliefs, professional disposition, and orientation towards technology relative to teachers' technology use, the theories of TPB and SST are presented in detail, with a rationale provided as to the selection of SST, along with initial codes.

3 THEORETICAL FRAMEWORK

A review of past literature related to the lack of technology integration amongst teachers identified beliefs, professional dispositions and orientation towards technology and the relationships between them is an area requiring more research and thus the objective for this study is to provide a deeper and more nuanced understanding of teachers' choices in relation to secondary school technology initiatives within the South African context. To answer the study's main research question: *What is the relationship between External Structures, teachers' Beliefs, Professional Disposition and Orientation towards Technology in relation to their integration of technology within South African secondary schools in different school and educational contexts?* this chapter begins with a discussion of the theories of TPB and SST, followed by a rationale as to the selection of SST. Thereafter, the theoretical framework for this study, named *Teachers Technology Use-Strong Structuration Theory (TTU-SST)*, is presented and applied to the study's research question and subquestions, with initial codes drawn from the literature and in relation to SST.

3.1 SELECTING THEORIES

Theory, derived from the Greek word *theoria* is "an explanation of a phenomenon arrived at through the examination and contemplation of relevant facts" (Oxford Dictionaries, 2019). Malone (1985) defines two major kinds of theories: explanatory or design. According to Hew, Lan, Tang, Jia and Lo (2019), explanatory or descriptive theories explain factors that influence research phenomenon, while design theories aim to create an artefact to achieve specific objectives.

Educational technology research is criticised as being undertheorised (Jones & Czerniewicz, 2011). Moore and Benbasat (1991) claim that undertheorised research is futile because it only solves the immediate research problem, whereas research that employs theory provides the structure and foundation for the research phenomenon to be explained (Mueller & Urbach, 2013). According to Bennett and Oliver (2011), educational technology research does not use existing theories to inform empirical work, as most are aimed at practical applications and creation of designs which severely limits the building of knowledge within this research field (Jones & Czerniewicz, 2011). Hew et al. (2019) suggest that to counter criticism of undertheorised educational technology research, theories that underpin a research study need to be explicit. As this study does not aim to

create an artefact, an explanatory theory is appropriate. The two explanatory theories considered for this study are: theory of planned behaviour (TPB) and strong structuration theory (SST)[5].

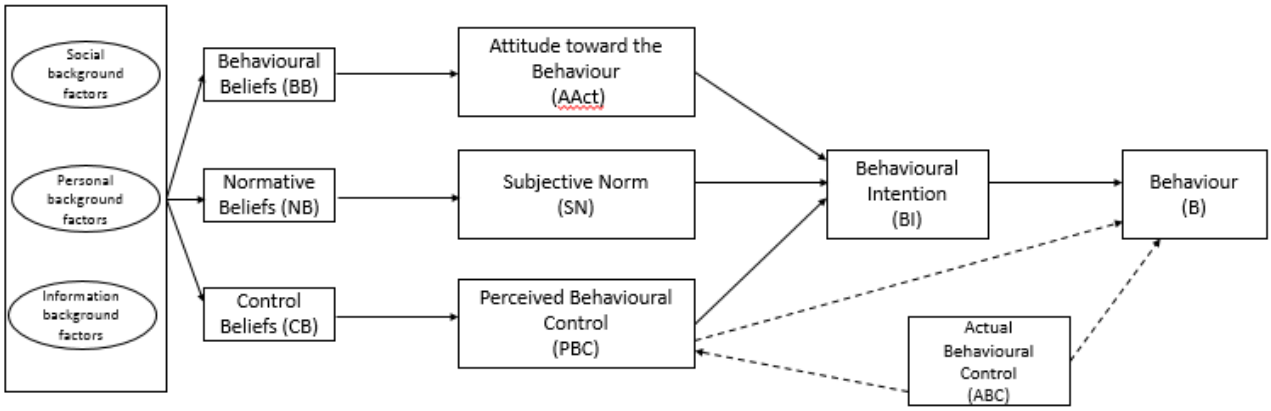
3.1.1 Theory of Planned Behaviour (TPB)

As discussed previously, Azjen (1985) created TPB in which people's behaviour could be studied as the result of conscious decisions to act in a certain way even without volitional control (Knabe, 2009).

The addition of perceived behavioural control (PBC), according to Azjen (1991) is essential as beliefs about the availability of resources, opportunities and support needed to perform a specific behaviour cannot be assumed, as there are contexts in which volitional control does not exist. Azjen (1991) claims that since people's behavioural intention (BI) is complex, distinct antecedent variables are needed. In the extended TPB, Azjen (2005, 2006) contends that each variable is preceded by associated beliefs. Another extension of TPB, the Decomposed TPB (DTPB), breaks down behavioural, normative, and control beliefs into components (Taylor & Todd, 1995), which according to Smarkola (2008) enables the identification of a wide range of external conditions and personal beliefs that teachers consider when deciding whether or not to use technology. The most frequently used representation of the extended TPB is shown in Figure 6.

[5] As SST is seen as an extension of Structuration Theory (ST), a description of ST is provided prior to the presentation of SST.

Figure 6: Azjen's Theory of Planned Behaviour (1991, 2005, 2006)



According to Azjen (1991, 2005, 2006), behavioural beliefs (BB) which produce either a favourable or unfavourable attitude (AAct) are constructed from personal beliefs about the likely consequence of a specific behaviour and the assessments of these consequences; while normative beliefs (NB) which result in perceived social pressure (SN) relate to other people's expectations of how one should behave and the motivation to adhere to these expectations; and control beliefs (CB) which produce perceived behavioural control (PBC) are beliefs about the existence of factors that may enable or hinder the performance of the specific behaviour and the perceived power of these factors (control beliefs). Azjen (2006) contends that when people are given adequate actual control over their behaviour, they are expected to carry out their intentions and thus behavioural intention (BI) is assumed to predict actual behaviour (AB). To describe the causality of TPB: the more positive AAct, SN and PBC are, the more likely it is that BI should lead to B. According to Azjen (2005), the incorporation of social, personal and informational background factors relates to the origin of beliefs, influenced by a wide range of demographics (Greyling, 2016). However, Azjen (2005) cautions that connections between beliefs and background factors may not always exist.

- **Application of TPB**

TPB, and its extensions, have been applied extensively in IS research as they do not rely on external theories, are parsimonious, and easy to understand, whilst including the complexity of human behaviour (Knabe, 2009). However, Lee, Cerreto and Lee (2010) claim that most educational technology research focuses on teachers' competence in relation to technology and tends to exclude factors such as value of technology and

teaching disposition. According to Teo and Lee (2010), while TPB has the potential to inform educational technology as it provides a theoretical lens through which teachers' beliefs relating to current technology integration in the classroom can be better understood, results using TPB are inconsistent. This is the result of many researchers not following Azjen's (1991; 2002; 2016) underlying guidelines for utilising the theory which dictates focusing on specific beliefs related to specific situations, as "teachers make local decisions about whether or not they will adopt a particular technology" (Lee et al., 2010, pg154).

TPB is a positivist theory and thus has mainly been utilised to predict teachers' intentions towards technology initiatives (Czerniak, Lumpe & Haney, 1999; Salleh & Albion, 2004; Sugar et al., 2004). While the use of TPB with an interpretivist paradigm is not common (Azjen, 2002), researchers such as Sugar et al. (2004), Tan, Hassali, Saleem, Shafie, Aljadhay & Gan (2015), Tsiantou, Shea, Martinez, Agius, Basak, Faresjo, Moschandreas, Samoutsi, Symvoulakis & Lionis (2013), and McCullough (2013) have used the TPB to understand why the variables of TPB influence intention and actual behaviour within a wide range of contexts. McCullough (2013) claims that using an interpretivist paradigm may result in rich data not in keeping with TPB variables, Azjen (1985, 1991) states that these variables can be added to extend the theory if they preserve the underlying theoretical propositions.

- **Criticisms of TPB**

Azjen (2016) argues that many criticisms of TPB are based on deficient understandings of TPB; an incomplete understanding of psychological research; and erroneous applications. Firstly, simply using the visual representation of TPB is an oversimplification which results in the theory being viewed as static due to the omission of feedback loops (Azjen, 2016). Furthermore, pertaining to TPB being incomplete, Fishbein and Azjen (2010) and Azjen (2016) state that additional measures can be added where they are well justified and in keeping with the original propositions of the theory. Secondly, Sniehotta, Presseau and Araujo-Soares (2014) claim that TPB assumes the behaviour is always rational and excludes the unconscious. According to Azjen (2016), this criticism is due to a lack of understanding of psychological theories which all acknowledge that beliefs influence intention and behaviour no matter how these beliefs are formed; and TPB which does not assume beliefs are objective and accurate but rather may be constructed from selective

information reflective of the unconscious. Lastly, Azjen (2016) argues that TPB aims to study the individual and thus the application to organisational contexts (Knabe, 2009) and intervention programmes (Sniehotta et al., 2014) is erroneous.

- **Reasons for not selecting TPB**

While TPB is a valuable theory used extensively in IS research to understand beliefs, attitudes and behaviour it has not been selected for several reasons. Firstly, TPB was constructed for a positivist paradigm which is mainly interested in understanding how identified factors can predict intended and actual behaviour (Azjen, 1985, 1991, 2002). This study does not aim to predict but rather to explore teachers' underlying beliefs, professional dispositions and competence with the technology. Secondly, Azjen (2006) states that to utilise TPB correctly, specific beliefs concerning particular technology use need to be defined. This study does not intend to understand specific technology use but rather to explore general technology integration amongst teachers, thus TPB is not suitable. Thirdly, even using TPB interpretively is not in keeping with the original philosophy of the theory and while it may advance the theory by adding new variables (Greyling, 2016), this is a complex process which if done incorrectly can result in the power of TPB being reduced (Azjen, 2016). Therefore, a more flexible theory constructed for an interpretivist philosophy would be more suited for this study.

3.1.2 Structuration Theory (ST)

ST, developed by Anthony Giddens (1984), allows one to understand the past while engaging with the present as it gives equal attention to the core social concepts of structure and agency (Whittington, 2015). Jones and Kartsen (2008) state that ST aims to understand the regular and continuous process of interaction between individuals and society across time and space rather than the fixed properties of either. According to Giddens (1984), while objectivism views human action as independent and detached from the social context, subjectivism reduces the social context to being solely a construction of human action, relationships and interpretations (Stones, 2005; Walsham & Han, 1990; Feeney & Pierce, 2016).

- **Structure**

Giddens (1984) concept of *"duality of structure"* describes humans as structured agents that are not simply puppets of society (Stones, 2005), but rather draw on social structures

through their interactions, while at the same time transforming and reproducing social structures (Walsham & Han, 1990). According to Giddens (1984), structures do not have a physical existence but are constructed from virtual rules and resources that abstractly exist over time and space within the human mind. Giddens (1984) defines rules as either overt and formal or covert and not explicit; and resources as allocative involving material resources or authoritative which relates to the control over other humans.

- **Agency**

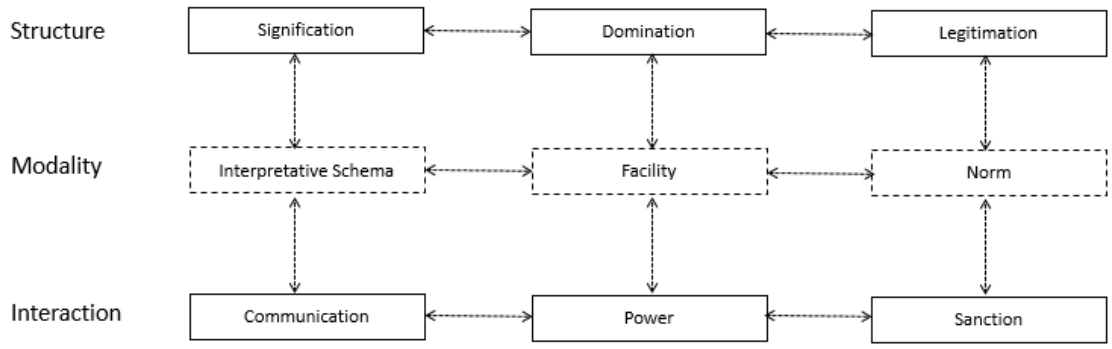
Giddens (1984) proposes that humans are purposeful agents and their activities matter as agents are aware of their actions and constantly reflect on the consequences of their routine practices, which in turn provides ontological security so that day-to-day activities can be performed with knowledge of the potential outcomes. Even though human reflexive monitoring consists of both unconscious motivations, where there is an inability to fully explain one's actions; and practical consciousness, where one can articulate the motivation for the activity explicitly (Giddens, 1984), Whittington (2015) contends that people are knowledgeable about their practices and thus ultimately only make effective choices. For Giddens (1984), agency occurs when humans abide by or discard rules within the social system as well as exert control over resources. According to Giddens (1984), the relationship between human agency and structure is contextual and does not simply describe the background that frames a society, but rather it relates to the joint evolution of structure and social interactions through time, space, local settings and other human agents (Ma, 2010). Therefore, claims Whittington (2015), it is essential that agency is understood carefully from the inside and not just objectively from the outside.

- **Framework for Analysis**

Giddens (1984) deconstructs human interactions and social structures into three dimensions: human interaction being communication, power and sanction; social structures being signification, domination and legitimation which are connected via three different modalities: interpretive schema, facility and norms (Walsham & Han, 1990). According to Walsham and Han (1990), these concepts are intimately connected and reciprocal and thus it is important to remember that the separation is not reflective of reality but simply to enable analysis. Firstly, interaction is communication in which humans use interpretative schemas, i.e., stocks of knowledge (Walsham & Han, 1990), to produce and reproduce structures of meanings through the interpretation of their actions as well as

those of others. Secondly, humans use power by drawing on facilities such as resources to produce and reproduce the structures of domination (Walsham & Han, 1990). Lastly, humans sanction their interactions based on the norms and rules of society to produce and reproduce the structure of legitimation (Walsham & Han, 1990). Structuration is the process whereby structure evolves and is reproduced, whilst at the same time human actions, i.e., agency produces and reproduces social structures that enable or constrain humans (Rose, 1998; Feeney & Pierce, 2016). According to Giddens (1984), structures are not undisputable or static but can be reproduced or challenged by humans based on the dual relationship between structure and interaction. Figure 7 shows a graphical representation of Gidden's process of structuration.

Figure 7: Giddens' Duality of Structure (1984)



- **Criticisms of ST**

According to Stones (2005), ST has been criticised for being too philosophical and abstract (Thrift, 1985), which has resulted in uneven or selective applications of ST (Whittington, 2015; Feeney & Pierce, 2016) or a reliance on other theories to contextualise a specific research phenomenon (Walsham & Han, 1990). In addition, while Archer (1995) agrees social theories need to explore the relationship between structure and agency, she argues Giddens conflation of these concepts removes the notion of dualism. However, according to Giddens (1989), ST is not intended to be a comprehensive and bounded theory but rather a sensitising device or meta-theory (Giddens, 1990) in which germane concepts are selected to empirically conduct research (Walsham and Han, 1990). Stones (2005), who developed Strong Structuration Theory (SST) using the central tenets of ST, argues that ST is still a worthwhile theory as incorporates duality of structure.

3.1.3 Strong Structuration Theory (SST)

As mentioned previously, SST advances Gidden's Structuration Theory (ST) by constructing the *quadripartite nature of structuration* with (1) external structures, (2) internal structures[6], (3) active agency, and (4) outcomes, and adding a *sliding ontological scale* for conduct and context analysis.

External Structures (1) are acknowledged or unacknowledged conditions of an action which may result in unintended consequences of an action that constrains or enables the agent (Stones, 2005). According to Stones (2005), *independent causal influences* describe external structures affecting the social conditions of the agent in focus irrespective of the agent's requirements and may affect the actions of the agent in focus, while *irresistible external influences* describe when agents have the capacity but believe they lack ability to resist external structures.

Internal Structures (2) are divided into conjuncturally-specific internal structures (a) and general disposition structures (b) (Stones, 2005). *Conjuncturally-specific internal structures* draw on the ST dimensions of signification, legitimation and domination, and relate to the specific role or position of a cluster of agents or the agent in focus (Stones, 2005). According to Stones (2005), this knowledge is gained through the modalities of interpretative schema, facilities, and norms and is related to external structures while also contributing to the overall knowledge structures. Additionally Stones (2005) defines *general dispositions* as the skills, worldviews, and habits that agents unconsciously draw upon.

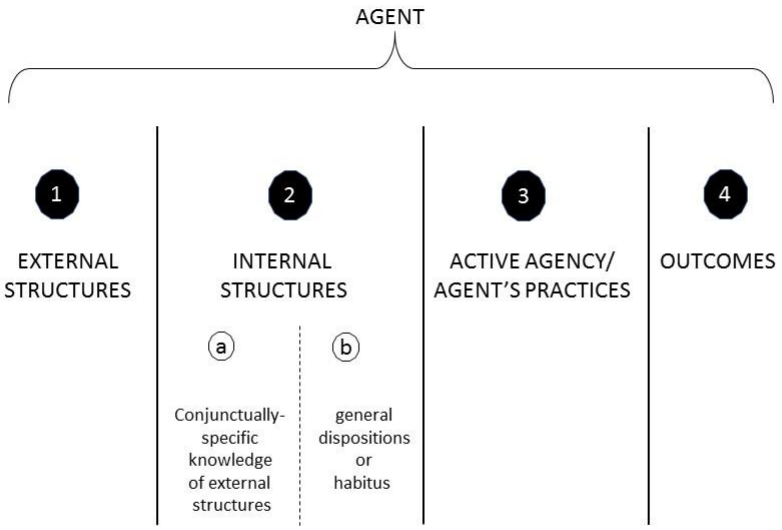
Active Agency (3) active agency is the "active, dynamic moment of structuration" (Stones, 2005, pg86) and describes the agent's visible behaviour relative to the relevant external structures, and motivated by the agent's own internal structures (Feeney & Pierce, 2016).

Outcomes (4) describe the results of active agency through which structures are reproduced or transformed, consequences intended or unintended and agents constrained or enabled (Stones, 2005; Feeney & Pierce, 2016).

[6] Stones (2005) numbers each part of the quadripartite nature of structuration in Strong Structuration Theory (SST), with external structures as (1), conjuncturally-specific internal structures as (2a), general dispositions as (2b), agent's practices as (3), and outcomes as (4).

Figure 8 shows a graphical representation of Stones (2005) quadripartite nature of structuration.

Figure 8: Stones' Quadripartite Nature of Structuration (2005)



In addition, Stones (2005) defines the concepts of conduct and context analysis within the *ontological sliding scale* to operationalise Giddens' premise of methodological bracketing, while maintaining duality of structure (Feeney & Pierce, 2016). Conduct analysis, which describes an agent's general dispositional frame together with the rules, norms, and interpretative schema of the agent's conjuncturally-specific structures used when performing a specific task or role, provides the link between external and internal structures, whereas context analysis turns the analysis outwards and explores how external structures affect the agent (Stones, 2005; Feeney & Pierce, 2016).

- **Application of ST and SST**

According to Poole and DeSanctis (2004), although ST is complex and challenging to apply, it is an influential theory for IS researchers as it facilitates the study of dynamic and interactive relationships common in technology integration. IS researchers have used ST to explore a variety of research phenomena (Jones & Kartsen, 2008) and have also applied ST in a number of different ways namely as an empirical framework, a meta-theory, and methodological-bracketing – by selecting specific concepts (Walsham & Han,

1990; Whittington, 2015). A prominent example is Orlikowski's (1992) paper which uses ST to understand technology-in-practice.

Even though researchers argue ST is a powerful theory for IS (Dobson, 2001; Poole & DeSanctis, 2004; Jones & Kartsen, 2008), SST is viewed as more suited to empirical studies (Stones, 2005) and thus has been used by a number of researchers to explore technology initiatives. Within the business context, Jack and Kholeif (2007), who utilised SST to study an accounting technology integration initiative, claim SST provides a more disciplined approach than ST for carrying out empirical research aimed at understanding how humans produce, reproduce, and transform social practices (Stones, 2005). Similarly, Feeney and Pierce (2016), used SST to explore the role of accounting information when developing a new product, as they contend SST assists in analysing complex actions involving a wide range of agents. Within health sciences, to investigate the use of technology when modernising government health programmes in the United Kingdom (UK), Greenhalgh and Stones (2010) used SST combined with Actor Network Theory (ANT) to provide a disciplined conceptual framework while simultaneously addressing empirical considerations. In a similar fashion, Greenhalgh, Swinglehurst, and Stones (2014) combined SST and ANT to develop a sociologically informed theory to understand health care staff's resistance to using mandatory technology based systems.

- **Reasons for selecting SST**

SST has been selected for several reasons. Firstly, as teachers' contexts are grounded in cultural, social and organisational structures specific to the profession (Ma, 2010), SST facilitates an in-depth study of the internal structures of individual teachers, whilst considering the relationships between agents, external structures of technology initiatives, agents' activities, and outcomes. Secondly, while most theories in technology adoption studies, such as TPB (Azjen, 1991, 2005, 2006), argue relationships between beliefs, attitudes and disposition are unidirectional i.e., beliefs inform attitude, which then informs behavioural intention and behaviour, the quadripartite nature of structuration in SST (Stones, 2005) based on the underlying premise of the duality of structure (Giddens, 1984) provides a powerful theoretical lens by which the duality and bidirectional nature of relationships can be better understood. Thirdly, SST provides a theoretical framework with structured guidelines and steps facilitating empirical research while still preserving the depth and strength of Giddens' duality of structure and human agency (Stones, 2005).

Lastly, even though to date SST has not been used extensively in IS contexts, as structuration happens in all social contexts (Jones & Kartsen, 2008), SST appears to be an appropriate theory for IS research.

3.2 DEVELOPING TEACHERS TECHNOLOGY USE-STRONG STRUCTURATION THEORY (TTU-SST) FRAMEWORK

3.2.1 Mapping of research questions

To develop the TTU-SST framework in a structured and theoretically grounded manner, each of the subquestions formulated from the literature reviewed on teachers' beliefs about external and internal structures, professional disposition, and orientation towards technology have been mapped onto SST. While each part of the TTU-SST framework intends to offer a way to analyse the micro and meso perspectives for this study, the entire TTU-SST framework aims to provide a structured way to analyse the research phenomenon from a meta-theory perspective in relation to the bidirectional relationship between the quadripartite nature of structuration, using Stones' (2005) composite research strategy.

- **Micro- and Meso-perspectives**

For **(1) external structures**, subquestions (q1) *What are the external technology structures at different schools?* and (q8) *How do the external technology structures differ between technology-rich and technologically disadvantaged schools?* are used to explore schools' external (first-order) barriers i.e., structures which include resources, training, technological support, and time (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012). According to Ertmer (1999), external barriers may present teachers with significant challenges in effectively incorporating technology, especially in developing countries like South Africa in which lack of resources, poor administrative support, technology issues, and the reliance on standardised testing are still areas of concern.

For **(2) internal structures**, in relation to **conjuncturally-specific beliefs**, subquestion (q2) *What are different teachers' beliefs around external technology structures in their school?* is used to explore teachers' beliefs as to the external structures present or absent in their school context. For **general dispositions**, subquestion (q3) *What are different teachers' internal beliefs about technology?* is used to explore teachers' internal beliefs.

According to Liu (2011) teachers' knowledge about technology is constructed from a synergy of internal beliefs related to pedagogy, norms, knowledge, the value of IT, and self-efficacy. For **professional dispositions**, subquestion (q4) *What are different teachers' professional dispositions?* is used to explore teachers' beliefs in relation to their pedagogic practices (Dottin, 2009; Hoadley & Ensor, 2009)[7].

For **(3) agent's practices** or agency, i.e., orientation toward technology subquestion (q5) *What are different teachers' orientations towards technology?* is used to explore teacher's practices in relation to technology integration by exploring their level and manner of technology adoption, and technology adoption activities (Hooper & Rieber, 1995).

For **(4) outcomes**, subquestions (q6) *How do different teachers use technology*? and (q9) *How does technology use differ between teachers at technology-rich and technologically disadvantaged schools?* are used to explore teachers' social context in relation to their current and intended future technology use in the classroom to understand the nature of school structures, consequences and agency (Stones, 2005).

For **context**, subquestion (q7) *What is the context at different schools?* using Bernstein's theory of social class, the different types of school culture (Bernstein, 1975), control (Bernstein, 1971a) and social interaction (Bernstein, 1971b) is used to explore the different school and social contexts.

- **Meta-theory perspective**

For **duality of structure** (Giddens, 1984) subquestions (q10) *How do different school contexts influence teachers' use of technology?* and (q11) *How do external structures, beliefs, professional dispositions, and orientation toward technology influence technology use in the classroom?* are used to explore the bidirectional relationship between the quadripartite nature of structuration (Stones, 2005) defined by the structures of signification, domination and legitimation (Giddens, 1984).

[7] General Dispositions (2b) in Stones' (2005) Strong Structuration Theory (SST) has been further broken down into internal beliefs as (2b-1) and professional dispositions as (2b-2).

3.2.2 Initial coding frame

A-priori or initial codes, which are codes used for deductive reasoning before collecting and examining data, are drawn from the literature reviewed in relation to the study's objectives and main research questions relative to the theoretical framework (Blair, 2015). While Elliot (2018) cautions that using *a priori* coding can limit codes emerging once the data is collected, within this study the initial codes have simply been used to guide the construction of the research protocols and initial data analysis.

A consistent naming strategy has been employed, with the first part of the code corresponding to the first letter of the SST element, and the second part of the code to the first letter of the literature reviewed. For example, for external structures which are described by teachers' external resource beliefs, the code ES-R has been used. Table 8 shows the *a priori* codes and Figure 9 shows a graphical representation of the application of the literature to SST.

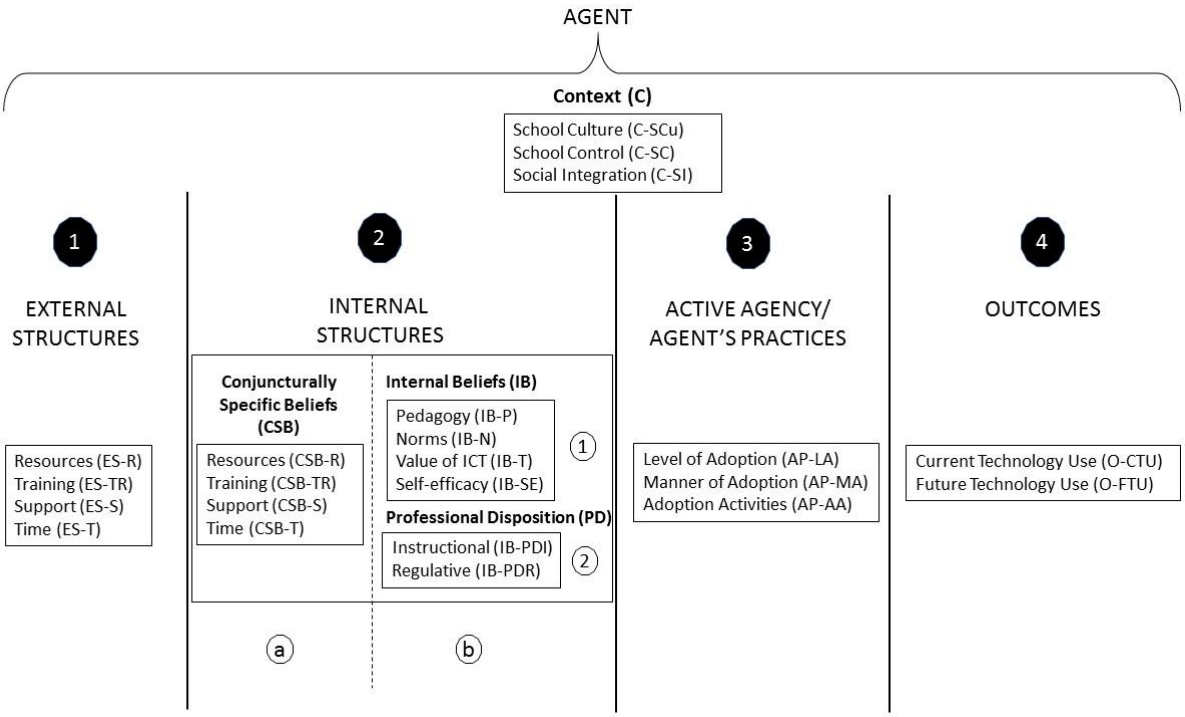
Table 8: Initial Codes from the Literature and in relation to SST

SST Concept	Initial Code	Description
External Structures: acknowledged or unacknowledged conditions of action which may result in unintended consequences of action that constrain or enable the agent (Stones 2005).	ES-R	**Resources:** (see section 2.4.1) • Accessibility (Rogers, 2000; du Plessis, 2014; Johnson et al., 2016) • Quality and suitability (Becta, 2004; Sicilia, 2005; Toprakci, 2006; du Plessis, 2014) Physical and spatial arrangements (Becta, 2004; Mercier et al., 2014; Tondeur et al., 2008)
	ES-TR	**Training:** (see section 2.4.1) • Extent (Schrum 1993, 1995; Snoeyink & Ertmer, 2001) • Quality and type (King, 2002; Tondeur et al., 2011; Ertmer et al., 2012; Johnson et al., 2016)
	ES-S	**Support:** (see section 2.4.1) • Type - Technical, Institutional (Rogers, 2000) • Nature (Ertmer, 1999; Ertmer et al., 2012; Johnson et al., 2016)
	ES-T	**Time:** (see section 2.4.1) • Familiarity (Rogers, 2000; Cuban, 2001; Ertmer et al., 2012) • Feasibility (Cuban, 2001; Karasavvidis, 2009)
Internal Structures: (a) conjuncturally-specific beliefs draw on ST concepts of legitimation and domination relative to the specific role or position of the agent in focus (Stones, 2005).	CSB-R	**Resources:** (see section 2.5.1) • Accessibility (Rogers, 2000; du Plessis, 2014; Johnson et al., 2016) • Quality and suitability (Becta, 2004; Sicilia, 2005; Toprakci, 2006; du Plessis, 2014) • Physical and spatial arrangements (Becta, 2004; Mercier et al., 2014; Tondeur et al., 2008)
	CSB-TR	**Training:** (see section 2.5.1) • Extent (Schrum 1993, 1995; Snoeyink & Ertmer, 2001) • Quality and type (King, 2002; Tondeur, et al., 2011; Ertmer et al., 2012; Johnson et al., 2016)
	CSB-S	**Support:** (see section 2.5.1) • Type - Technical, Institutional (Rogers, 2000) • Nature (Ertmer, 1999; Ertmer et al., 2012; Johnson et al., 2016)
	CSB-T	**Time:** (see section 2.5.1) • Familiarity (Rogers, 2000; Cuban, 2001; Ertmer et al., 2012) • Feasibility (Cuban, 2001; Karasavvidis, 2009)

SST Concept	Initial Code	Description
Internal Structures: (b1) general dispositions (Stones, 2005) which relate to internal beliefs.	IB-P	**Pedagogy:** (see sections 2.4.2 and 2.5.2) • Teacher or learner-centered (Denessen, 2000; Ertmer & Ottenbreit-Leftwich, 2010)
	IB-N	**Norms:** (see sections 2.4.2 and 2.5.2) • Schools in which they teach (Ertmer & Ottenbreit-Leftwich, 2010; Ertmer et al., 2012) • Peers (Abbott & Faris, 2000; Hazzan, 2003)
	IB-K	**Knowledge:** (see sections 2.4.2 and 2.5.2) • Classifications (Howard & Maton, 2011) • Knowing how to use ICT (Ertmer & Ottenbreit-Leftwich, 2010) • Types (Shulman, 1986; 1987; Angeli & Valanides, 2009)
	IB-V	**Value of ICT:** (see sections 2.4.2 and 2.5.2) • Ways to use (van Braak et al., 2004) • Affordances (Ertmer et al., 2012)
	IB-SE	**Self-efficacy:** (see sections 2.4.2 and 2.5.2) • Work-related (Farah, 2011) • Outside or personal (Farah, 2011)
Internal Structures: (b2) general dispositions (Stones, 2005) related to instructional and regulative discourse (Bernstein, 1986).	IB-PDI	**Instructional Discourse:** (see section 2.6) • Classification (Bernstein, 1971) • Boundaries of knowledge - hierarchical or horizontal knowledge (Bernstein, 1999, 2000; Hoadley & Ensor, 2009) • Nature of knowledge acquisition - horizontal or vertical discourse (Bernstein, 1971; 2000; Hoadley & Ensor, 2009)
	IB-PDR	**Regulative Discourse:** (see section 2.6) • Framing (Bernstein, 1971) • Teacher and Learner Boundaries (Bernstein, 1996; Naidoo, 2011; Hoadley & Ensor, 2009) • Classroom Control (Bernstein, 1996; Hoadley & Ensor, 2009; Naidoo, 2011)

SST Concept	Initial Code	Description
Agent's Practices: The active and dynamic moment of structuration (Stones, 2005).	AP-LA	**Level of Adoption:** (see sections 2.3.6 and 2.7.2) • HTMA (Hooper & Rieber, 1995) • ACOT (Dwyer et al., 1991; Sandholtz et al., 1997)
	AP-MA	**Manner of Adoption:** (see sections 2.3.6 and 2.7.3) • SAMR (Puentedura, 2006; 2013) • HTMA (Hooper & Rieber, 1995)
	AP-AA	**Adoption Activities:** (see section 2.3.6. and 2.7.3) • SAMR (Puentedura, 2006; 2013) • HTMA (Hooper & Rieber, 1995)
Outcomes: Results of active agency through which structures are reproduced and transformed (Stones, 2005).	O-CTU O-FTU	**Current and Future Intended Technology Use:** (see sections 2.3.6, 2.7.2, and 2.7.3) • HTMA (Hooper & Rieber, 1995) • ACOT (Dwyer et al., 1991; Sandholtz et al., 1997) • SAMR (Puentedura, 2006; 2013)
Context: Specific circumstances that form the setting (Stones, 2005).	C-SCu	**School Culture:** (see section 2.6.8) • Instrumental and expressive (Bernstein, 1975)
	C-SC	**School Control:** (see section 2.6.8) • Stratified and differentiated (Bernstein, 1971a)
	C-SI	**Social Integration:** (see section 2.6.8) • Mechanical and organic (Bernstein, 1971b)

Figure 9: Teachers' Technology Use – Strong Structuration Theory (TTU-SST) adapted from SST (Stones, 2005)



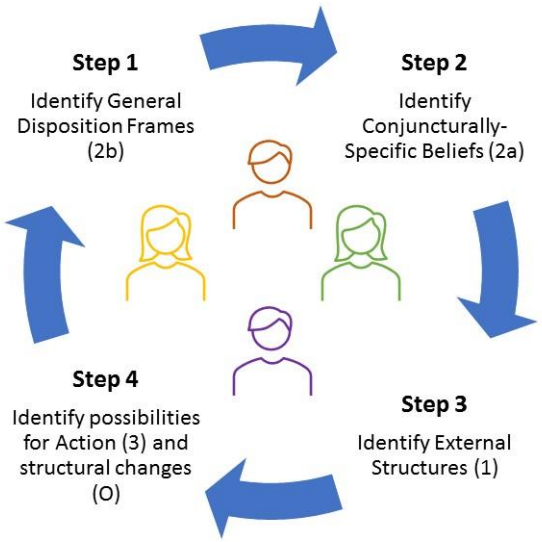
3.2.3 Stones' Composite Research Strategy

Stones' (2005) composite research strategy provides a structured way in which TTU-SST can be used as a meta-theory to analyse the "connecting tissue" between different parts of the quadripartite of structuration by making meaning of the interactions between agents' internal structures and their view of external structures (Feeney & Pierce, 2016).

The composite research strategy developed by Stones (2005) involves structured steps which when applied to a particular agent provides insights into the agent-in-focus' own processes of structuration (Feeney & Pierce, 2016). To explore the interaction between an agent's external terrain and internal knowledgeability, Stones (2005) draws on Giddens' (1984) concept of *methodological bracketing* to define conduct analysis as a means to study the internal aspects of the agent, and context analysis as a means to study the external aspects of the agent (Feeney & Pierce, 2016). Stones (2005) contends that when using the composite research strategy to explore a "particular phenomenon over a given time period" (pg126), data needs to be analysed numerous times, each time utilising a different agent-in-focus in order to develop deep insights of the relationships between agents and structures.

According to Stones (2005), Feeney and Pierce (2016), the composite research strategy consists of using the following steps, repeated for each agent-in-focus: **step 1** requires one to identify the general dispositional frames of meaning for the agent-in-focus within the bracket of conduct analysis to understand the agent's internal views and beliefs; **step 2** requires one to identify the agent-in-focus' conjuncturally-specific beliefs from within these general dispositional frames of meaning to understand the agent-in-focus' perspective of the external context; **step 3** requires one to identify the external structures at the disposal of the agent-in-focus to understand the practices that routinely constitute them and the authority relations within them; and **step 4** requires one to specify the possibilities for action and structural preservation, reproduction, or modification facilitated by the identified external structures. Figure 10 shows a graphical representation of Stones' (2005) composite research strategy.

Figure 10: Stones' (2005) Composite Research Strategy



3.3 CONCLUSION

This chapter presented a discussion of the theories of TPB and SST, followed by a rationale as to the selection of SST. Next, *Teachers Technology Use-Strong Structuration Theory (TTU-SST)* the theoretical framework for this study, was detailed and applied to the study's research question and subquestions, with initial codes drawn from the literature and in relation to SST, and Stones' composite research strategy to be used in conducting the meta-analysis, was outlined.

In the next chapter, the research methods employed to guide the research process for this study are detailed. The paradigm, research design, data collection process, data analysis used, quality and ethical considerations, and limitations are presented.

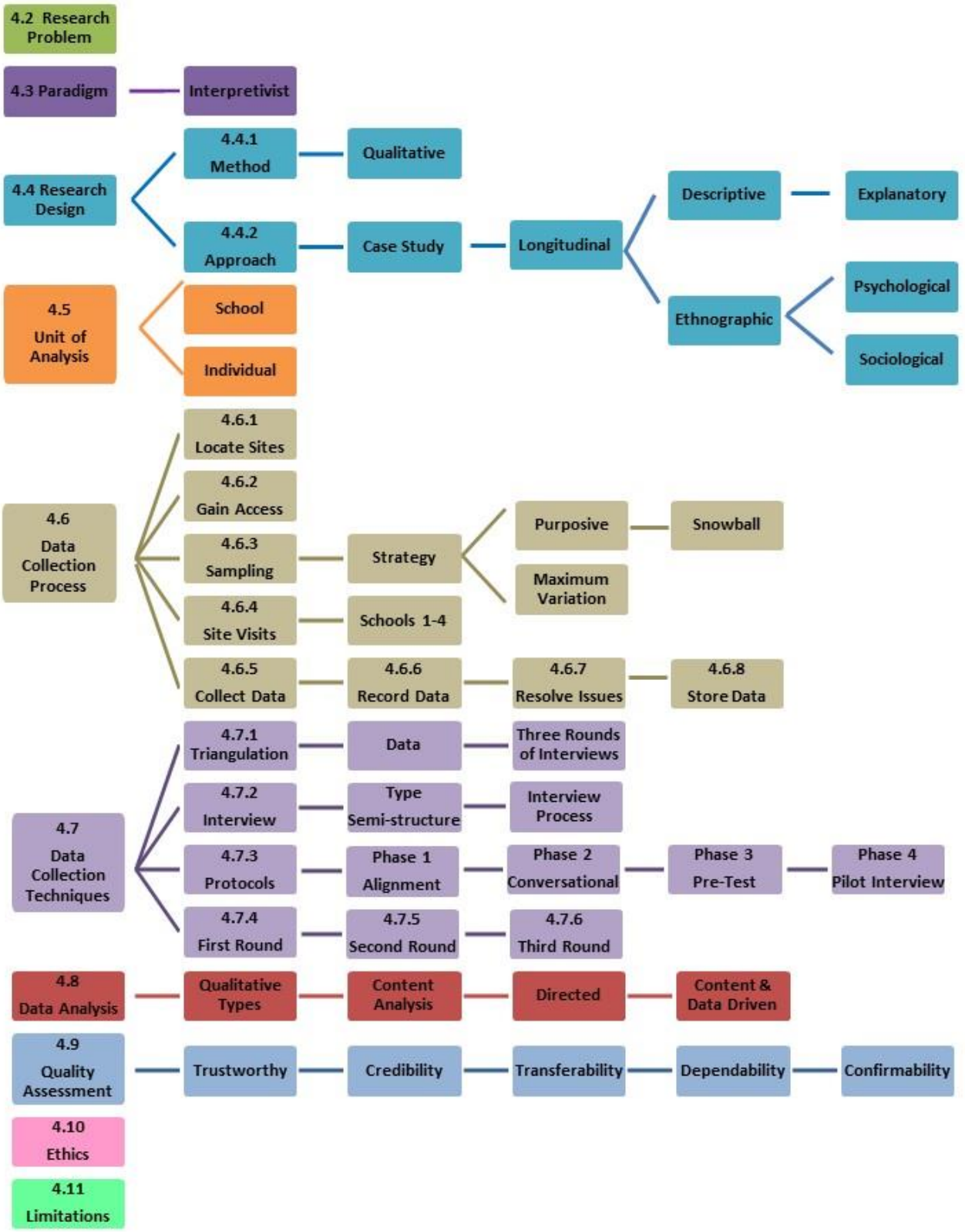
4 RESEARCH METHODS

4.1 INTRODUCTION

As research is a structured enquiry in which evidence is collected and analysed in relation to identified research problems, to understand specific research phenomenon Creswell and Creswell (2018) propose that the appropriate selection of a paradigm in relation to the research problem should be followed by the choice of the most suitable research design comprised of methodologies and detailed methods.

To contextualise the choices made in relation to research methods, this chapter begins with a review of the research problem for this study. Then an overview of different research philosophies is presented followed by a summary of research methods. Next, research approaches and the unit of analysis for the study are discussed. Creswell's (2007) data collection circle is then detailed, followed by data collection techniques. Then an overview of research protocols is presented. The Interview Refinement Protocol (IPR) phases utilised are then explained, followed by the refinement process used for each round of interviews. Next, qualitative data analysis methods are discussed. Lastly, quality assessments utilised in the study, limitations and ethical considerations, and principles employed in the data collection and analysis for the study are presented. Each section provides rationales for methodology choices made. Figure 11 provides a detailed diagrammatic view of the research methods chapter.

Figure 11: Diagrammatic View of Research Methods Chapter



4.2 SUMMARY OF RESEARCH PROBLEM

Those advocating for technology use within education claim that teachers are mainly responsible for the lack of integration due to a misalignment between beliefs and associated pedagogic practices and the inability of teachers to respond to current educational requirements (Ertmer et al., 2012). While the relationship between teachers' beliefs, professional disposition and orientation towards technology has been well researched, within both IS and educational technology literature a number of concerns exist: most studies are conducted from a technocentric stance without consideration of the teacher (Lim et al., 2013; Nkula & Krauss, 2015; Vandeyar, 2014); findings indicate teachers stated beliefs and professional dispositions do not always align with what is observed in practice (Ertmer et al., 2015); and results are frequently inconsistent due the prevalence of undertheorised educational technology studies (Mama & Hennessy, 2013).

Given the attention and funds being invested into technology initiatives within South African secondary schools (Communications Directorate, 2019) and the large differences in context between many schools within the country (Van Der Ross & Tsibolane, 2017; Mhlanga & Moloi, 2020; Le Grange, 2020) coupled with challenges brought about by the COVID-19 pandemic requiring teaching and learning to move online, or at the very least using a blended approach in an attempt to stop the spread of the virus while saving the academic project (Olivier, 2020), this study aimed to understand: *What is the relationship between teachers' Beliefs, Professional Dispositions and Orientations towards Technology in relation to their integration of technology within South African secondary schools?* using the SST-TTU theoretical framework constructed for this study from SST (Stones, 2005); Hoadley and Ensor's (2009) professional disposition; Hooper and Rieber's (1995) description of technology adoption; and Bernstein's (1975; 1971a; 1971b) view of culture, control and social interaction.

4.3 PHILOSOPHICAL PERSPECTIVE

The research paradigm is a philosophical view in relation to social phenomena and structures (Feilzer, 2010) and underpins or motivates the nature of the study (Cohen & Manion, 1994). According to Hirschheim and Klein (1989) the paradigm relates to the researcher's beliefs about the nature of knowledge and description of the world and thus

influences the way in which research is carried out and the data is studied (Mackenzie & Knipe, 2006).

4.3.1 Overview of Philosophical perspectives

Information Systems (IS) is a social science in which the nature of relationships and social phenomena is characterised by diversity and complexity, and thus Orlikowski and Baroudi (1991) claim that having a single or dominant paradigm for research limits the type and depth of knowledge that can be generated. According to Cecez-Kecmanovic, Davison, Fernandez, Finnegan, Pan and Sarker (2020), Burrell and Morgan's (1979) model which presented various paradigms alongside positivist paradigms, not only legitimized non-positivist paradigms but also served to encourage IS researchers to consider diverse philosophical positions. Therefore, in addition to positivism that has historically dominated IS research, Orlikowski and Baroudi (1991) contend that alternative paradigms such as interpretivism within IS research need to be employed. More recently, Cecez-Kecmanovic et al. (2020) argue that as technological advancements increasingly influence and shape the world's social order, IS researchers need to move away from primarily employing the dominant positivist paradigm, so that innovative and creative research methodologies can be considered to address present-day issues. To select the most appropriate paradigm for this research study, it is necessary to describe each of these paradigms.

Positivism, known as the scientific method, was originally devised to study the natural world with cause and effect, based on the assumption that the social world is value-free (Mackenzie & Knipe, 2006) and exists independent of humans (Orlikowski & Baroudi, 1991). The role of the researcher within this paradigm is to measure phenomena passively in order to discover the objective reality (Orlikowski & Baroudi, 1991). As positivists view knowledge as deductive and verifiable (Chua, 1986) casual relationships discovered facilitate the prediction of generalised behaviour across varying contexts (Putnam, 1983).

Interpretivism asserts that reality and knowledge emerge from social processes and thus social relations do not have predictable outcomes, but rather are construed from subjective meanings produced and reinforced by humans (Orlikowski & Baroudi, 1991). According to Morgan (1983), social reality can only be interpreted in relation to the context, which may shift over time as norms and circumstances change (Orlikowski & Baroudi, 1991). To provide interpretations or explanations of the way in which subjective meanings have been

constructed or sustained in a particular context (Putnam, 1983), Rosen and Underwood (2012) claim that researchers need to immerse themselves in the world of those being studied. While most interpretivist researchers aim to simply understand actions and interpret meanings through description (Weick, 1979), Orlikowski and Baroudi (1991) contend that researchers with "strong" interpretivist views aim to enact and create the social reality being studied.

Pragmatism, which is the paradigm concerned with action and its interaction with knowledge (Da Silva, Siqueira, Araújo & Dornelas, 2018), is not based on a mixture of worldviews (Hall, 2013) but rather has its own philosophical perspective. According to Goldkuhl (2012), pragmatic researchers believe humans and their subsequent actions are a means by which the world can be changed and thus knowledge is not an objective reality but rather that truth is embodied in the actions and rational thoughts of humans at any given time (Duram, 2012). Goldkuhl (2012) contends that as pragmatism is not simply trying to predict or explain, knowledge is constructive in nature and researchers need to interact with research objects and social context in order to improve problematic situations by taking appropriate actions (Duram, 2012).

4.3.2 Paradigm selected

Based on the above review of different paradigms, for this study an *interpretivist paradigm* was seen as most suitable. Reasons for this choice relate to aims of the study, worldview of the researcher, role of the researcher, links to validity, use of theory, and setting of research.

Firstly, as this study did not intend to predict, measure, intervene or change current technology initiatives but rather aimed to create a holistic understanding of the complexities of teachers' technology integration experiences, an interpretivist paradigm which aims to reveal underlying relationships of the social context being studied (Gibbons, 1987; Goldkuhl, 2012), was deemed most suited. Furthermore, as this study intended to explore a number of teachers' technology integration experiences to provide a rich and meaningful account of their journeys, an interpretivist paradigm was seen as the most appropriate (Pham, 2018).

Secondly, the researcher contends that teachers' technology integration experiences are not bounded and explicit (Hovorka & Lee, 2010) but rather are ambiguous, variable and multifaceted (Mackenzie & Knipe, 2006) due to humans' social construction of subjective and shared meanings (O'Leary, 2004). This worldview is in keeping with an interpretivist paradigm (Orlikowski & Baroudi, 1991).

Thirdly, positivist researchers are objective, value-free and remain independent of the participants, while pragmatic researchers are interested in the potential that could be realised through change (Goldkuhl, 2012). Interpretivist researchers on the other hand, claim Creswell and Creswell (2018), are not interested in changing the social context but rather are involved in understanding the context through personally gathering and interpreting the data, with the interpretation being shaped by the researchers' own knowledge and context. As a researcher I have my own values in relation to technology integration as I work within educational technology and for the past nine years have been involved in researching technology integration within South African secondary schools. During this time, I have come to appreciate that teachers play a crucial role in technology integration initiatives and simply identifying issues that hinder or assist technology integration undervalues teachers' subjective realities, which are so crucial to these initiatives.

Fourthly, positivist research data is only considered truth when it is valid, reliable and exhibits internal consistency and correlation amongst variables (Pham, 2018), while interpretivist research aims to understand the subjective social meanings constructed by humans (Hammersley, 2013). As this study aimed to understand and describe teachers' diverse and multiple subjective realities of technology integration, an interpretivist paradigm was the most suitable.

Fifthly, Goldkuhl (2012) states within interpretivism that there is not right or wrong but simply more or less exciting ways of understanding the world. As this study aimed to utilise the theoretical framework of SST (Stones, 2005) to facilitate a novel and interesting way of understanding the specific context, an interpretivist paradigm was seen as fitting.

Lastly, Orlikowski and Baroudi (1991) state that in positivist research, surveys and controlled experiments are the primary ways in which data is collected, whereas for

interpretivist research qualitative methods are mainly used in natural settings to provide rich descriptions in the words of the participants. As this study intended to gather data by speaking with teachers within their natural school context, using their words to interpret the subjective meaning (Orlikowski & Baroudi, 1991), an interpretive paradigm was utilised.

4.4 RESEARCH DESIGN

The research design, which describes the general approach to specified research, logically links the research objectives to the research questions (Ponelis, 2015) and thus informs the way in which data will be collected, analysed, interpreted and reported (Grover, 2015). The research design, which is usually shaped by the paradigm selected (Creswell, 2007), includes the research methods, approach, unit of analysis, the data collection sites and sampling, data collection techniques, and data analysis methods (Eisenhardt, 1989).

4.4.1 Research Methods

Research methods describe the way in which researchers collect and analyse data in order to answer questions related to the identified research phenomenon (Schensul, 2008).

The two main research methods used within social science research are *quantitative* and *qualitative* (Newman & Ridenour, 1998; Creswell, 2007; 2018). Firestone (1987) distinguishes qualitative and quantitative research methods based on four elements: assumptions, purpose, approach, and research role. For *assumptions*, Travers (2011) claims that quantitative and qualitative research methods are grounded on diverse understandings of knowledge and assumptions about reality and thus choosing between them defines how a researcher believes the field of social science and human beings should be studied. For *purpose*, according to Newman and Ridenour (1998), qualitative researchers are interested in studying an individual's experiences and perspective, while quantitative researchers tend to focus upon finding a common reality on which people can agree by proving or disproving hypotheses and measuring research phenomena (Firestone, 1987). For *approach*, researchers utilising quantitative methods usually employ experimental approaches to reduce error and bias (Firestone, 1987), while qualitative researchers employ more ethnographic approaches in which rich description of individuals and cultures are sought (Newman & Ridenour 1998; Creswell, 2007). Lastly, for the *researcher's role*, Firestone (1987) argues that researchers using quantitative methods are

more detached from the research context to avoid bias, while qualitative researchers are involved in the research setting.

While much interpretivist research uses qualitative research methods, Creswell and Creswell (2018) state that the choice of research methods should primarily be based on how best to answer the research question. According to Schensul (2008), while the paradigms underlying qualitative research methods may differ, the intention of researchers utilising this method should always include a focus on the behaviour and experiences of real people in their social, cultural, and physical contexts and a commitment to exploring and understanding the perspectives of others.

As this study was interested in studying teachers' experiences and perspectives in relation to technology integration, a *qualitative research method* was selected.

- **Qualitative Research Methods**

Guest, Namey, and Mitchell (2017) contend that while qualitative research is not a unified field with regular debates occurring regarding its nature, how and why it should be used, in what way data should be analysed, and how it should be presented, a consensus exists as to its ability to collect data related to the "why" and "how" surrounding human behaviour that is difficult to achieve through quantitative research methods. Qualitative researchers focus on understanding how people construct meaning and make sense of the world through their experiences (Merriam, 2009). According to Mack, Woodsong, MacQueen, Guest and Namey (2005), the value of qualitative research lies in its ability to offer rich and detailed descriptions of the human side of a research phenomenon which are often complex since they involve "contradictory behaviours, beliefs, opinions, emotions, and relationships of individuals" (pg1). Therefore, most qualitative data is collected in the participant's natural setting to establish themes or patterns in the data in which the voice of the participants dominate the findings, so that issues that are not readily visible can be described (Creswell, 2007). The defining attributes of qualitative research methods are its flexible and iterative nature which facilitate altering the sampling procedures based on incoming data, and its use of an open-ended style of questioning and observation that enables researchers to probe participants responses (Guest et al., 2017).

4.4.2 Research Approaches

Research approaches detail the plans and procedures for a research study and involve the intersection of philosophical worldviews, research designs, and methods for data collection and analysis (Creswell, 2007). Mack et al. (2005) claim that an interpretive paradigm using qualitative research approaches enables researchers to study the complex nature of human behaviours, beliefs, and relationships to society, whilst incorporating intangible factors for rich and nuanced understandings of a specific social context or research phenomenon to be achieved (Creswell & Creswell, 2018).

The most common types of qualitative research approaches are ethnographic studies, grounded theory, phenomenological research, narrative research, and case studies (Creswell, 2007; Schensul, 2008). *Ethnographic studies* involve the researcher studying a cultural group in their natural setting over a prolonged period of time by collecting mainly observational data (Creswell, 1998; 2007). *Grounded theory* involves multiple stages of data collection with constant comparisons in order to derive a theory of a process grounded in the perspectives and perceptions of the participants in a study (Corbin & Strauss, 1990; Creswell, 2007). *Phenomenological research* involves the identification of core human experiences through prolonged engagement with a few subjects in order to construct patterns and associations of meaning (Creswell, 2007; Moustakas, 1994). *Narrative research* is where individuals tell stories about their lives which are then retold by the researcher in the form of the narrative which combines the participant's life with the researcher's (Clandinin & Connelly, 2000). *Case studies* involve the researcher exploring and providing detail on an event, activity, process, individual or a number of people bounded by time for a particular activity (Stake, 1995; Creswell, 2007).

As this study employed an interpretivist philosophical perspective, aiming to explore the specific activity of technology adoption of teachers at a point in time (Ponelis, 2015), a *case study* was selected as the most suitable research approach.

- **Case Study research approach**

A case study facilitates an in-depth investigation into a research phenomenon over a period of time within a specific natural setting (Bhattacherjee, 2012). According to Hamilton and Corbett-Whittier (2014), case study methods are suited to studying complexity as they

enable the investigation of a wide range of social, individual and human factors by enhancing the understanding of contexts and individuals.

- **Types of Case Study approaches**

There are various definitions of the types of case studies that can be carried out (Hamilton & Corbett-Whittier, 2014). According to Stake (1995), case studies are either *intrinsic* when they aim to explore and detail as much of the case as possible, or *instrumental* when they aim to only explore key aspects of the case. Hamilton & Corbett-Whittier (2014) categorise case study approaches as *reflective* where the emphasis is on evaluating reflections or journals about the researcher's feelings and experiences, *longitudinal* which is carried out over a period of time in order to understand change, *cumulative* where the researcher replicates or develops existing case studies to build increasing evidence of a research phenomenon, *collective* where researchers work separately but have a similar aim, and *collaborative* where peers work together with a shared purpose and approach in order to provide substantial evidence for different contexts. Yin (2014) also provides a definition of case study types, which include *exploratory*, where research is focussed on collecting data in order to find patterns to understand what is happening, *descriptive*, which aims to capture a picture of what exists relative to possible theories and research questions, or *explanatory*, which focuses on understanding how and why things occur.

Within different types of case studies, Merriam (1985) describes several perspectives from which research can be conducted, namely *ethnographic*, which emphasises the culture of a particular institution, group of people, methods of teaching, or individual behaviours; *historical*, which is descriptive and tracks the progress of research phenomena over a period of time; *psychological*, which focuses on an individual; and *sociological*, which explores the social context and how it influences individuals. According to Swales (2004), case study approaches and perspectives are not prescriptive in nature but rather serve as an approach that guides the research design, methodology, quality of data and write-up and thus may often overlap. The selection of which approach and perspective is most suited for a particular study depends on what the research objectives are (Hamilton & Corbett-Whittier, 2014).

In keeping with the study's research objectives of exploring and detailing teachers' technology use in relation to SST; and understanding how and why individual teachers

within particular schools make certain technology choices, this study utilised a combination of Yin's (2014) *descriptive* and *explanatory* case study approaches, with a blend of Merriam's (1985) *ethnographic*, *psychological,* and *sociological* perspectives.

- **Longitudinal approach**

In addition, as data was collected at three different times over a period of eight months, Hamilton and Corbett-Whittier's (2014) *longitudinal* approach was also utilised. Longitudinal research aims to collect rich data to explore and understand changes in an individual or group over a period of time by creating ongoing relationships with participants (Flick, 2014; Derrington, 2019). In addition, Holland, Thomson, and Henderson (2006) claim longitudinal studies are valuable as they enable researchers to appreciate "lived experiences" through which outcomes are formed and mediated.

According to Saldaña (2003), to be considered longitudinal research, the study needs to take place over a period of time and include a change that can be studied or observed. Derrington (2019) and Saldaña (2003) claim that while longitudinal studies require data to be collected at no less than two different intervals, the frequency and length of time over which the data is collected varies between studies. Therefore, although longitudinal research studies usually span more than one calendar year, there appears to be no set rules or consensus as to the length of time needed (Saldaña, 2003; Derrington, 2019). So too with regard to the change, while many researchers assert the change depicts a continuous process (Sztompka, 1993; Nisbet, 1976; Fullan, 2001), a universal definition of change remains elusive (Saldaña, 2003). Sztompka (1993) states that the length of time and the nature of the change cannot be prescriptive, but rather the combination of time and change is crucial. Furthermore, Saldaña (2003) argues that time and change are contextual and therefore each researcher must define what length of time is needed to explore the change being studied (Pettigrew, 1990) as well as at what time intervals it is best time to collect data (Derrington, 2019).

As this study was interested in exploring the nature of relationships influencing teachers' technology use alongside the unprecedented unfolding context in which the necessity to integrate technology into the South African educational system became increasingly critical – in order to continue the academic project (Olivier, 2020), a longitudinal approach with three rounds of data collection spanning eight months, and exploring the initial

educational context, the change to remote teaching and learning, and then the subsequent change to a hybrid approach, was selected. Initial interviews were conducted in January of 2020, the second round of telephonic interviews was conducted between May and June 2020, and the third round between July and August 2020.

4.5 UNIT OF ANALYSIS

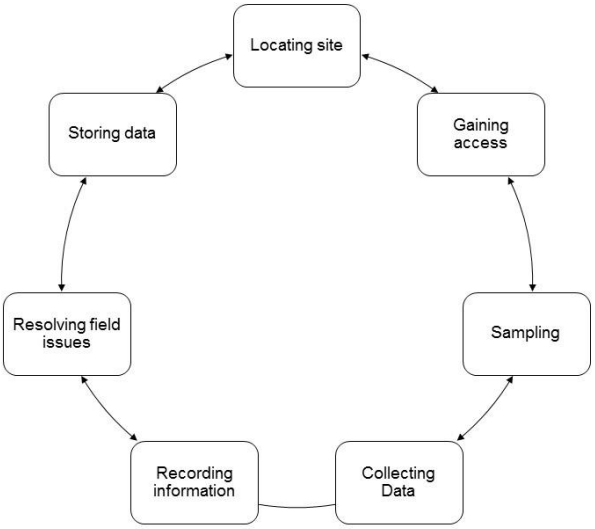
The unit of analysis is the most basic element being analysed in a research study (Long, 2011) and may consist of individuals, groups, artefacts, geographical units, and social interactions (Trochim, 2006). Sedgwick (2014) cautions that the unit of observation which describes for who and for what the data is being collected should not be confused with the unit of analysis that describes for who and for what is the data being analysed. Within social science research, units of analysis are not simply “things” or “objects” but rather are relationships that connect individuals, groups, communities, and societies and thus can be divided into different subunits (Boucke, 1923). Therefore, according to Yin (2014), case study research design can either be *holistic* – with a single unit of analysis, or *embedded* – with multiple units of analysis. Furthermore, Trochim (2006) claims that designs can be *single-case studies* or *multiple-case studies* consisting of different units of analysis within the same study.

As teachers’ individual technology integration was studied within the context of their respective schools – together with differences between technology integration at various schools – an *embedded multiple-case study* was employed with the units of analysis being both the individual teacher and the school.

4.6 DATA COLLECTION PROCESS

Data collection describes a set of interrelated activities which consists of multiple phases aimed at gathering information to answer defined and emerging research questions (Creswell, 2007). According to Creswell (2017), these activities which are circular in nature as they are constantly informing each other, include locating the site, gaining access to the site, sampling for potential participants, collecting data, recording information, resolving field issues, and storing data. A graphical representation of Creswell’s (2007) data collection circle, which was used in this study, is shown in Figure 12.

Figure 12: Creswell's (2007) Data Collection Circle



4.6.1 Locating Case Study sites

For qualitative research, Patton (2002) states that selection of the site or sites for the case study is made on consideration of which people or sites will offer an "information-rich" perspective. According to Yin (2014), selection of the case study site requires the researcher to consider the aims and objectives of the study and decide where data can best be collected to answer the research questions. In addition, the researcher needs to have prior knowledge of the phenomenon, so they are able to select the best site at which to collect data (Rapley, 2013).

- **Case Study sites selected**

The latest statistics on the number of secondary schools in South Africa indicate there 2 065 government and 563 private schools (Department of Basic Education, 2015) with the majority of these schools being located in the KwaZulu Natal and Gauteng provinces (Mail and Guardian, 2018). In order to equip potential graduates with necessary technology workplace skills, the South African government has tended to focus on technology integration initiatives within the Gauteng province (Communications Directorate, 2019), as it is the country's most populated province with over 2.3 million Basic Education learners enrolled by 2018 (Mail and Guardian, 2018).

The five-year technology integration plan for schools, originally announced by the Gauteng Minster of Education (MEC) in September 2014, aimed to ensure that all Gauteng schools are equipped with technology and related infrastructure to enable e-learning to take place. The phased technology roll-out began in 2015 when 1 800 classrooms at 377 no-fee township schools were equipped with technology infrastructure. In 2016 a further 2 300 classrooms were added, in 2017 an additional 83 secondary schools were equipped, and in 2018 an additional 3 100 classrooms were added (Mail and Guardian, 2018). Therefore, due to the size of the learner population and the continued focus of technology integration initiatives within the Gauteng province, it was decided to only select schools within the province.

Next, it was necessary for the researcher to identify potential schools within the province and thus the Gauteng Education Department (GDE) and the Gauteng branch of the Independent Schools Association of South Africa (ISASA) was asked to provide a list of secondary schools currently using technology. However, it appears that a list detailing technology use at Gauteng secondary schools does not exist and therefore the researcher was only able to acquire a list of all government and independent secondary schools in the province. Using this list, the researcher then used the details specified to contact as many schools as possible to determine if they were using technology at their school. While many school contact details were incorrect or not provided, those schools which the researcher succeeded in contacting were asked if they were utilising technology in their teaching and learning. Those answering in the affirmative were thus identified as the target population for the study.

4.6.2 Gaining access to Case Study sites

Creswell (2007) states that before gaining access to the case study sites, researchers need to explain to the decision makers at the site why that site was chosen for the study, what the participants will be required to do to take part in the study, how much time the researcher will spend at the site, how the results will be reported, and what the school and teachers will gain from taking part in the study.

- **School permission**

To obtain access to secondary schools, principals of Gauteng schools identified as using technology for teaching and learning were approached. For government schools,

permission was also sought from the GDE. Once the researcher succeeded in making contact, the aims and objectives of the study were explained to the principals, namely why the school was selected, what the teachers needed to do to take part in the study, how much time it involved, how the results would be reported, and what the school can hope to gain from participating in the study (Creswell, 2007). The principals were then asked if they would give permission for their teachers to participate in the study.

- **Teacher Permission**

Once the principals gave their permission, an information participation letter (see Appendix B-1) was emailed to the principal of each school and disseminated to teachers inviting them to take part in the study. Since participation in the study was voluntary teachers were able to choose whether or not they would like to be interviewed[8].

4.6.3 Sampling

After locating and gaining access to sites, it is important to consider the sample for the study (Creswell & Creswell, 2018). According to Creswell (2007), all sampling within qualitative research is based on *purposively* selecting individuals and sites that can best provide information to understand the research phenomenon with researchers deciding who and what will be sampled, what method of sampling will be used, and how many people or sites need to be sampled.

- **Sampling Strategy**

While a number of different sampling strategies exist for qualitative research approaches, the most common are maximum variation (Sandelowski, 1995; Creswell, 2007), critical case, convenience case, and snowball (Patton, 2002; Creswell, 2007). *Maximum variation*, which increases the possibility of diverse perspectives being present in the findings, is a sampling strategy in which sites and participants are selected due to their large differences based on some predetermined criteria (Patton, 2002; Creswell, 2007). *Critical cases* describes the selection of a specific case or site needed to answer or understand a particular problem (Patton, 2002; Creswell, 2007). *Convenience cases*, which is the least rigorous sampling strategy (Marshall, 1996), describes the selection of sites or individuals based on ease of access for the researcher (Patton, 2002; Creswell, 2007). *Snowball*

[8] A detailed description of ethical processes and procedures followed to gain access to teachers is discussed in section 4.10.

sampling describes using initial research participants to provide names of other potential participants or sites (Atkinson & Flint , 2011).

- **Sample Size**

The size of the sample, claims Creswell (2007), is just as important as the sampling strategy. As the aim of qualitative research is not generalise findings but to provide rich details and a deep understanding of the particulars of a specific case (Pinnegar & Daynes, 2006), Creswell (2007) recommends using no more than four or five case studies in a single study with extensive detail being collected on each. In practice, claims Marshall (1996) the number of required participants only becomes evident as the study progresses and new categories stop emerging from the data.

- **Sampling Strategy and Size utilised**

Due to the limited information available on prevalence of technology use within Gauteng secondary schools within South Africa, *snowball sampling* was utilised, where the initial school and subsequent schools that agreed to participate in the study were asked to provide contact details of other schools which would be suitable and potentially interested in taking part in the study. Furthermore, as this study aimed to offer different teacher's perspectives from diverse school contexts, a *purposive* sampling strategy with *maximum variation* was employed where schools with vastly different contexts were identified and contacted. In keeping with Creswell's (2007) recommendation, the combined snowball and purposive sampling strategy with maximum variation was employed until permission was obtained from four diverse schools. One independent school with numerous technology resources and advantaged learners, one independent school with some technology resources and disadvantaged learners, one government school with many technology resources and disadvantaged learners, and one government school with few technology resources and disadvantaged learners.

Once schools had agreed to take part in the study, teachers willing to participate in the study were interviewed on a first-come-first-serve basis. As teachers were only interviewed in the first round, until no additional categories emerged from the data (Schreier, 2013) i.e., data saturation was reached, a different number of teachers were interviewed at each school as data saturation between the schools differed. For the second and third round of

interviews, the same teachers who were initially interviewed, were contacted and re-interviewed. Of the original 19 teachers, 16 teachers were available and willing to take part in the additional rounds of interviews. The remaining 3 teachers did not respond and therefore, when analysing the data, findings that report on data from the second and third rounds of interviews do not include these teachers. An overview of the number of teachers interviewed per round at each school is shown in Table 9.

Table 9: Number of Teachers per Interview Round

	Month Collected	**School 1**[9]	**School 2**	**School 3**[10]	**School 4**[11]
First Round	January/February	6 teachers	4 teachers	4 teachers	5 teachers
Second Round	May/June	5 teachers	4 teachers	3 teachers	4 teachers
Third Round	July/August	5 teachers	4 teachers	3 teachers	4 teachers

Detailed tables of teachers interviewed can be found in the beginning of the chapters that present the findings for each school in this study, as this provides a more holistic understanding of the context in relation to findings being reported. Chapter 5 Table 12 provides details on teachers for School 1; Chapter 6 Table 20 provides details on teachers for School 2; Chapter 7 Table 28 provides details on teachers for School 3; and Chapter 8 Table 36 provides details on teachers for School 4.

4.6.4 Site Visits

Once the four schools had been selected, a site visit was arranged at each school to enable the researcher to establish that a diverse group of schools had in fact been selected. In order to understand the differences between the schools selected in this study, a review of the site visits, consisting of an interview with either principals, vice principals, or technology coordinators at each school and a school tour to get a sense of the school ethos as well as the classrooms, school facilities, teaching staff and technology infrastructure, is detailed below.

- **School 1**[12]

School 1 is an independent school which was established in 2015 as a family orientated and religious school. School 1 prides itself on diversity and acceptance of different viewpoints, where all learners and parents are expected to accept and abide by the ethos

[9] One teacher from school 1 did not participate in round 2 and 3.
[10] One teacher from school 3 did not participate in round 2 and 3.
[11] One teacher from school 4 did not participate in round 2 and 3.
[12] School 1's site visit was conducted with the school's vice principal and academic head.

of the school through quarterly communication and discussion amongst learners of different backgrounds within the school.

Discipline

The disciplinary code at the school not only acknowledges but also celebrates positive reinforcement, with positive learner behaviour recognised during a biannual ceremony. In addition, the school's aim to create a sense of family for the learners is further strengthened by the learners referring to the principal and teachers by their first names. Although School 1 was recently bought by a large private educational organisation which requires certain standards and level of education, the school has been able to preserve its strong ethos and culture.

Fees

School 1 is considered a middle-range fee school, with a fee structure of between R5 000 and R6 000 per month. There is also a large focus on outreach to less privileged communities, as most of the learners in School 1 are from advantaged homes.

Size of School and Classes

The school is growing rapidly and has doubled its student body in the last two years to over 400 learners currently, averaging four classes in Grades 8 and 9, three classes in Grades 10 and 11, and two classes in Grade 12. On average class sizes are around 20 learners, with the maximum of 25 learners per class. There are 30 teaching staff at the school, with the majority of the teachers being female. While some of the teachers in the lower grades teach across subjects and are grade based, many teachers in the higher grades teach the same subject across Grades 10 to 12.

Academics

School 1 claims not to be driven by results but rather aims to enhance learners' skills and focus on creative and reflective thinking, research, social awareness, and self-management. The school's pedagogical views are focused on building learners' global competencies, facilitating enquiry-based learning, utilising flipped classrooms and the integration of technology as much as possible.

The school writes the Independent Examination Board (IEB) matric examination and in addition to offering learners the most common matric subjects, the school also provides learners with a diverse set of subject choices, that include Hospitality, Business Studies, IT, Engineering and Design, and Dramatic Arts. The home language at the school is English, even though the majority of learners do not come from English-speaking homes.

Technology and Facilities

School 1 is well resourced, for both learners and teachers. Learners work on tablets that they must buy and insure themselves. These tablets are controlled at school by the Information Technology (IT) support staff who ensure that only academic related content is on the tablet. In addition to the tablets, learners need to purchase *miEbooks*[13] for all subjects except languages and accounting. Hard copy textbooks can be purchased by learners in addition to the e-textbooks. *ITSI*[14] is also used. Cellphones may not be used in the classroom, except (temporarily) when the learner's tablet is broken. Loan tablets are also available to learners if needed.

Teachers are provided with a laptop to enable them to perform teaching, assessment and administrative related work. Teachers also use a learning management system (LMS) to record marks, communicate and push content to the learners.

In some subjects, specialised technology has been purchased to assist teachers. For example, in mathematics some teachers have been given a visualiser to assist them in explaining concepts while facing the learners, and in engineering, graphics and design (EGD) laser cutters, 3D printers and small robots have been provided to teachers of this subject to enable them to demonstrate and practically apply concepts being taught.

Computer Laboratories

Currently there are two laptop labs at the school, one for the IT learners and the other for the learners doing Computer Assisted Technology (CAT). Both labs are loaded with all the

[13] Developed by ITSI, *miEbook* is an interactive e-reader, which enables learners to annotate, draw diagrams, and make highlights for summaries on their e-textbook. Teachers can use *miEbooks* to upload content and run assessments (ITSI, n.d.).
[14] *ITSI* is an educational technology company who develops and supports e-learning and teaching solutions (ITSI, n.d.). Teachers use the name *ITSI* and *miEbooks* interchangeably.

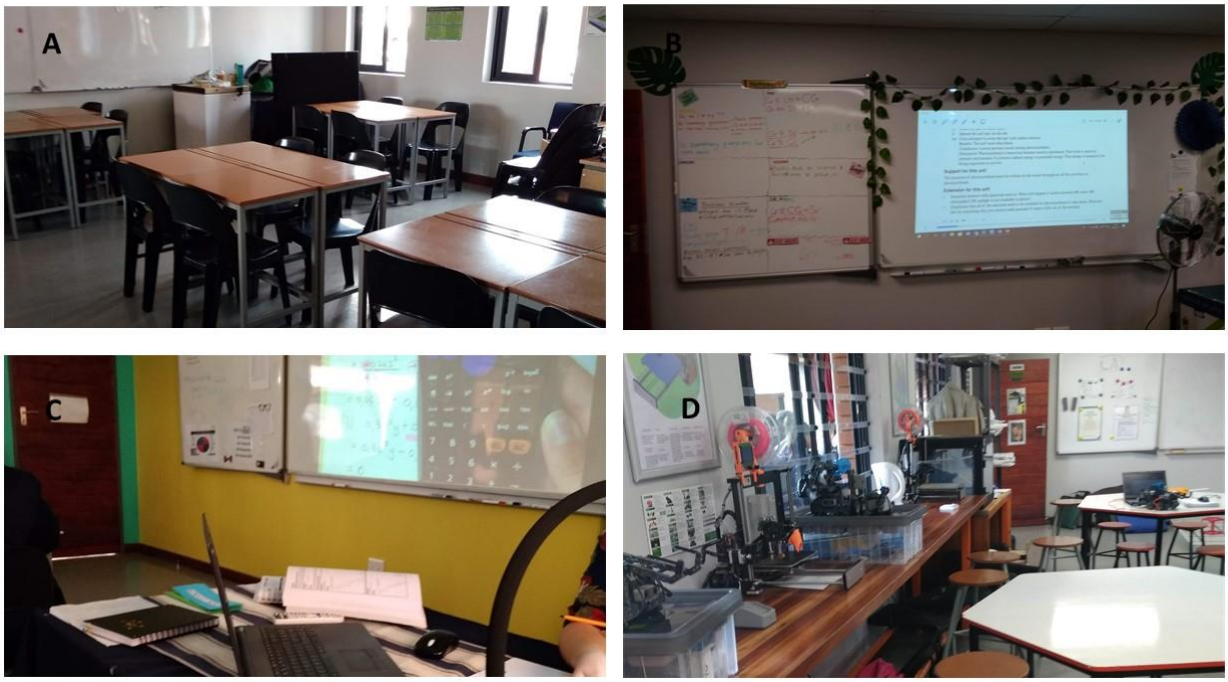
appropriate software and hardware needed for the courses. There is also a science lab and a kitchen for learners doing consumer studies.

Classrooms

Most classrooms have learner's desks organised in pods with clusters of 4 to 5 learners to enable learner discussion and teacher facilitation. In addition, all classrooms are set up with projectors, smartboards and whiteboards which also serve as a screen for teachers' laptops. Projectors are affixed to ceilings in all classrooms, and whiteboards and/or smartboard are mounted in the front of the class. Teachers' desks are all placed in the front of the classroom, opposite the door.

Figure 13 shows the classroom and technology layout in School 1. Picture A: the typical learner desk layout, Picture B: the positioning of whiteboards and/smartboards in the classrooms, Picture C: visualiser technology being used, and Picture D: EGD classroom with laser cutter, 3D printers and robots.

Figure 13: Classroom and Technology Layout - School 1



- **School 2**[15]

School 2, which was only started in 2017, is part of an independent Christian school group formed over twenty-five years ago with religion and integrity being key values and an underlying ethos for the group. The group currently has five schools in different provinces in South Africa, with School 2 being the newest school in the group. Although you do not have to be Christian to attend the school, all learners are required to be present at all religious services, which take place in the morning before school and in the afternoon before the end of the school day. Communication with parents and teachers is done via a platform called *ITSI*, which is a server-based platform that uses the Cloud as well as the app called *D6 Plus*. School 2 emphasises a holistic approach to the well-being of learners, by offering a wide range of sports, extracurricular activities and outreach opportunities.

Discipline

There is a strong disciplinary code and teacher control in place at the school, with learners addressing the principal and teachers only as Sir, Ma'am, Mr or Mrs.

Fees

School 2 is lower-range independent schools, with a fee structure of between R 2 000 and R 2 5000 per month, depending on the grade. As most of the learners at School 2 are drawn from surrounding areas that are mainly disadvantaged or low-income homes, with others being bussed in, many parents find the school fees very high but are prepared to spend the money to better the education of their children. The school has a pay-only policy and thus there are no bursary learners at the school.

Size of School and Classes

There are approximately 175 learners in School 2 from Grades 8 to 11, with the aim to grow student numbers to 250 in the next year. As the school is only 3 years old, there is not yet a matric class, 2021 will be the first matric class to graduate from the school. There are two classes per grade from 8 to 10 and one class in Grade 11. On average class sizes are around 31 learners, with a maximum of 35 learners per class. There are 16 teachers at School 2, and the majority of the teaching staff are female. While most of the teachers are

[15] School 2's site visit was conducted with the school's principal and academic head.

involved in teaching across the school, more than half of the teachers focus on teaching specialised subjects in a particular phase.

Academics

School 2 follows the Curriculum and Assessment Policy Statement (CAPS) syllabus and writes the Gauteng Education Department (GDE) National Senior Certificate exam. Learners are offered core matric subjects, with very little choice due to the small numbers of learners in the school. In addition, as School 2 is part a greater group, standardised exams are written in all grades to benchmark the performance of schools across the group. The language of teaching and learning at the school is English, even though the majority of learners and teachers do not come from English-speaking homes.

Technology and Facilities

School 2 positions itself as an Information Communications and Technology (ICT) school and thus the use of tablets by learners is compulsory. Learners are required to purchase and insure tablets at their own expense. To control the content that learners may access and view at school, no sim cards are allowed in the tablets and the school centrally limits access to the internet. In addition to purchasing tablets, learners are also required to purchase e-textbooks, with the buying of hard copy textbooks being optional. Learners utilise their tablets to takes notes in class, upload homework and assist with academic work. Cellphones are not allowed in the school and if found are confiscated, and substantial fines need to be paid each time by the learner or parent to the school, to get the cellphone returned.

Each teacher is provided with a laptop to enable them to create content, distribute resources, set and mark assessments, and teach in the classroom.

Computer Laboratories

There is one temporary desktop laboratory in the school with twenty computers, with plans for a permanent computer laboratory to be built in the near future. While the IT learners use the laboratory to create deliverables and carry out assessments, it is not used for more than teaching general technology literacy skills and maths practice by the rest of the learners, due to the small number of computers in the laboratory and the computer technology being outdated.

Classrooms

All classrooms are set up with projectors mounted on the ceiling, along with whiteboards at the front of the class to facilitate teaching and learning in the classroom. Most classrooms have learner's desks organised in traditional style, facing the teacher standing in the front. All classrooms are setup with projectors and whiteboards which also serve as a screen for teachers' laptops. Teachers desks are all placed in the front of the classroom, opposite the door.

Figure 14 shows the classroom and technology layout at School 2. Picture A: the typical learner desk layout, Picture B: temporary computer laboratory, Picture C; positioning of projectors, whiteboard, and teacher's desk in the classroom.

Figure 14: Classroom and Technology Layout - School 2

- **School 3**[16]

School 3 opened in 2016 with the aim of building pockets of excellence in the Gauteng province through establishing schools of specialisation. While School 3 focuses on science and engineering, other specialisation schools for agriculture, arts and engineering have also been established in the province. School 3 is only for learners that have an aptitude for the sciences and need to score high on a baseline assessment that covers maths,

[16] School 3's site visit was conducted with the school's technology co-ordinator and physical science teacher.

science and English skills at the end of Grade 6 in order to be accepted. Therefore, learners and their parents view their place at School 3 as a privilege and there tends to be a good work ethic amongst learners with most learners pursuing degrees at South African universities after matric. Despite attempts by the school to provide learners with a holistic education, this is hampered due to limited extra-curricular resources, playing fields and sporting facilities.

Discipline

The school has a strict discipline policy, with little tolerance for bad behaviour. However, as teachers tend to view themselves more as mentors than simply teachers, extra lessons are voluntarily given on the weekends. Many of the teachers are also from previously disadvantaged backgrounds and thus are very committed to helping learners take advantage of the opportunity given to them.

Fees

School 3 is non-fee-paying school and learners are given all e-textbooks needed as well as government issued tablets or notebooks.

Size of School and Classes

There are currently 900 learners in the school, with an average of four classes per grade. While classes can go up to 45, the majority of classes have between 37 to 42 learners. There are four classes for each grade from Grades 8 to 12. There are 30 teachers in the school, with the majority being female. The teaching staff is mainly young and newly trained teachers who have a passion for technology and the sciences.

Academics

School 3 writes NSC matric examination, using the CAPS based syllabus. While the language of instruction at the school is English, this is not the home language for most learners and teachers. Zulu and Sotho are offered as first additional languages (FAL) and classes are split based on the FAL chosen by the learner i.e., all learners doing Zulu are in class A and B, while those doing Sotho are in Class C and D.

While a full complement of subjects is offered in Grades 8 and 9, only science- and maths-related subjects are offered in Grades 10 to 12. From Grade 10 subjects include physical

science, life sciences, maths, Engineering & Design, CAT, IT, accounting, economics, and business science.

Technology and Facilities

Being a specialisation school, School 3 is well resourced as regards technology. When learners join the school in Grade 7, they are issued with tablets or (more recently) notebooks, that they are required to use throughout their schooling. The tablets are owned by the government and any lost, broken or stolen tablet must be replaced at the learner's own expense. In extenuating circumstances, learners can apply to the GDE for a replacement device, who will then decide on whether a new device will be issued. Learners utilise their devices for accessing the *Siyavula* e-textbooks, taking notes, answering assessments, and communication with their teachers. All textbooks required by the learners are downloaded to their devices, with hardcopy textbooks only used as a backup when the Wi-Fi is down or there is no electricity, and thus very few hardcopies are available.

Teachers are all provided with a laptop, no matter what subject they teach. Teachers use *Siyavula* e-textbooks for maths and science and *Google Classroom*™ for sharing of content and setting and marking assessments.

There are three science laboratories fitted with all the required equipment for the learners taking Physical Science. In addition, there are two engineering workshops for the learners that take EGD, as well as an aeroplane engine for the learners to practically apply their knowledge.

Computer Laboratories

There are two computer laboratories with appropriate software for the IT and CAT learners to use for practical components of these subjects. Each computer laboratory can accommodate approximately 50 learners at a time.

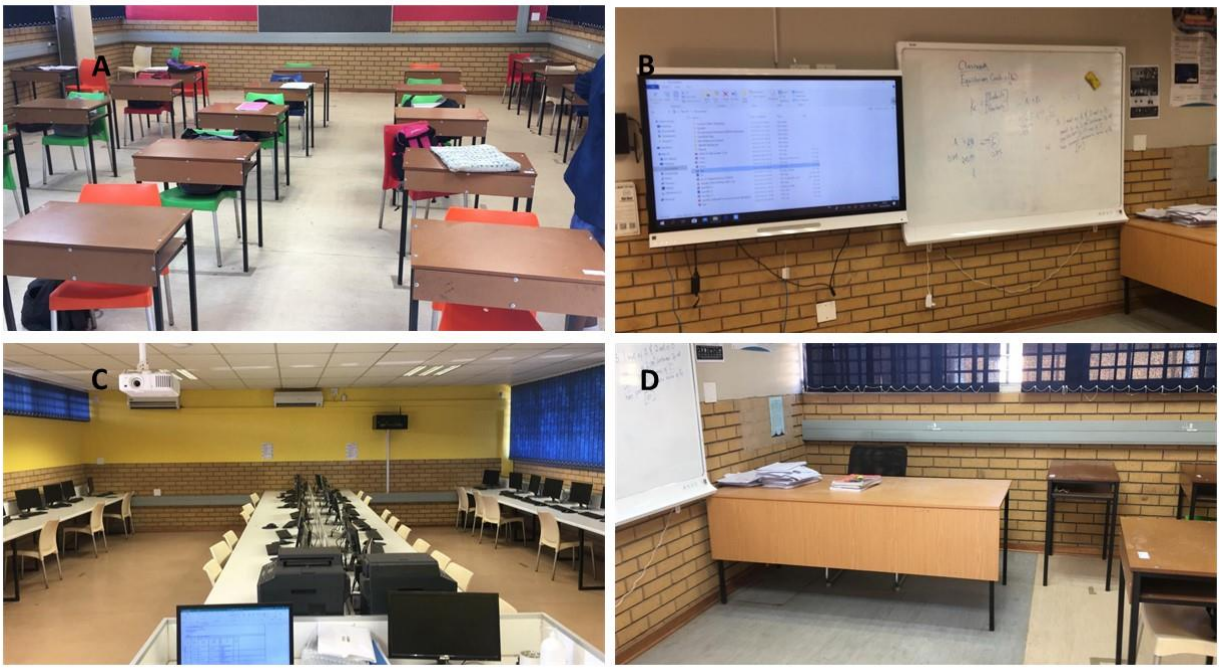
Classrooms

Learner desks are arranged in a traditional format, facing the front of the class, with the teacher's desk at the front opposite the door. All classrooms are fitted with smartboards. In

addition, each classroom has a SMART Kapp[17] board on which teachers are able to save hand-written work into a pdf document which they can then send to the learners after the lesson. The SMART Kapp is particularly helpful when there is load shedding[18] as the teacher can continue writing on the SMART Kapp, then can save the notes for distribution when the power is restored. There are no projectors in the classrooms as all teachers connect and project their laptops through the smartboard.

Figure 15 shows the classroom and technology layout at School 3 Picture A: the typical learner desk layout, Picture B: the positioning of smartboard and SMART Kapp in the classrooms, Picture C: desktop computer laboratory, and Picture D: positioning of teacher's desk in the classroom.

Figure 15: Classroom and Technology Layout - School 3



- **School 4[19]**

School 4, which was originally intended to accommodate white-only learners, was built before the end of Apartheid for but only opened in 1994. It is classified as an ex-model C[20]

[17] SMART Kapp is a digital, interactive board that allows learners to view what the teacher is writing in real-time. It also enables teachers tin capturing, saving and sharing notes as they are being written (Very PC, n.d.).
[18] Load shedding is when the electricity is deliberately switched off for certain time period to save electricity and keep the power grid stable (Oxford Dictionaries, 2019).
[19] School 4's site visit was conducted with the school's deputy principal and academic head

school, is multiracial and is seen as one of the most prestigious public schools in the Gauteng province, with a reputation of good academic results with a matric pass rate above 90%. Learners are only admitted to the school if they live in the area or if their parents or a sibling lives or works in the area. Once learners meet the location criteria, Grade 7 reports are assessed and if acceptable, places are offered to learners on a first-come basis. While School 4 is situated in a fairly affluent neighbourhood, the learners are mainly from less advantaged and often challenging homes, where parents have limited income and basic education. Therefore, School 4 tries to assist learners both academically and emotionally. To assist learners in passing, academic support and extra lessons are offered as well as study skills and the availability of external educational groups to help with tutoring maths. For emotional help support, a full-time social worker is employed at the school to support learners on an individual basis with either emotional or learning issues and to facilitate parent interventions if necessary.

Discipline

The school has a very firm discipline policy and all learners and parents are required to agree and sign the discipline declaration at the beginning of each year, with any transgression dealt with according to this policy. Teachers at the school play a pivotal role in discipline, as they ensure that correct procedures are being followed so that the district does not oppose recommendations for expulsion on a technicality. Learners and parents who refuse to sign are still bound by the rules of the school.

Academics

School 4 writes the NSC matric examination and follows the CAPS syllabus. Most subjects are offered to learners except for drama and dance and most subject combinations are offered, excluding mathematical literacy and physical science, visual art and design. The language of instruction at the school is English, even though most of the learners are not from English-speaking homes.

[20] During Apartheid, different classifications of schools were mandated by the South African government, with model C schools for white only learners. After 1994, previously advantaged white-only schools, became known as ex-Model C schools (Friederichs, 2003).

Fees

The fees at the school are just over R1 0000 per month. School 4 receives a low government subsidy, as it is located in an area that is considered more affluent, and thus it depends almost solely on parents paying school fees. Therefore, it is a major burden for the school when parents do not pay fees owed. Currently, at School 4, 20% of the parents are exempted from paying due to financial circumstances by the district, 60% pay fees and 20% of parents simply do not pay. Extra funds needed are raised by the School Governing Body (SGB).

Size of School and Classes

School 4 was originally built to accommodate 750 learners, however, there are currently 1200 learners enrolled. There are seven classes per grade, with class sizes on average around 36, with a maximum of 40 learners. There are 50 teaching staff at the school, with a mix of male and female teachers. On average each teacher is responsible for teaching five classes, with the exception of CAT, visual art and design — subjects that are only taught by a specialised teacher. To assist teachers in building experience and growing their skills, new teachers are usually allocated to teach lower grades and are encouraged to move through the grades as they become more senior staff.

Technology and Facilities

School 4 is not a designated ICT school and thus learners are not required to own devices in order to access content of complete their schoolwork. Learners are not allowed their cellphones at school, and if found, cellphones are confiscated and a large fine has to be paid to the school to have it returned. If the learner cannot pay, the cellphones are kept for 90 days at the school and then returned. This is a huge deterrent for learners. There is no access to e-books at the school and each student is issued with hardcopy textbooks.

Many teachers at the school have been given school laptops. For those who have not been issued laptops, many have purchased their own to prepare *PowerPoint* presentations to provide content and communicate with parents and learners. There are, however, a handful of teachers who have access to shared genius tablets, that have been purchased by the school and are used to project content as well as show simulations in chemistry.

Computer Laboratories

There is one computer laboratory at the school with 20 desktop computers and 40 shared tablets. The desktop computers in the laboratory are outdated and many of them are not fully functional. The computers in the laboratory are only used by the senior CAT learners and the CAT teacher uses the tablets for the Grade 8s and 9s to conduct digital literacy classes. There is a projector in the laboratory for the teacher to project images for the learners, but at the time of the site visit it had been broken for over four months.

Classrooms

Some of the classes have projectors installed on the ceiling, other projectors are carried around by the teachers between different classrooms. In addition, most classrooms have been converted from chalkboards to whiteboards which are fixed in the front of the classroom. There are very few smartboards installed in the classrooms, and those that are installed are either not being used by teachers due to lack of expertise or do not functional at present. Most of the classrooms have learners' desks organised in a traditional layout, facing the front. Teachers' desks are all placed in the front of the classroom, opposite the door.

Figure 16 shows the classroom and technology layout at School 4. Picture A: the typical learner desk layout, Picture B: the positioning of projectors and whiteboards in the classrooms, Picture C: computer laboratory.

Figure 16: Classroom and Technology Layout - School 4

Following the site visits summarised in Table 10, it is evident that the objective of selecting sites purposively and with maximum variation had been achieved. Two independent schools have been selected: *School 1* is a middle range school that has mainly advantaged learners, with extensive resources and technology; *School 2* is a lower end private school with mainly disadvantaged learners from low income homes, with some resources and technology. Two government schools, that write the NSC examinations have been selected: *School 3* which is a free fee-based township school specialising in technology, science and maths with a disadvantaged learner bases and substantial technology and resources available; *School 4* which is an ex-model C school located in an advantaged area, with learners from disadvantaged homes, with scarce technology and resources.

Table 10: Summary of School Contexts

	School 1	School 2	School 3	School 4
Type of School	• Independent/IEB	• Independent/NSC	• Government/NSC	• Government/NSC
Ethos Culture	• Family & Religion Orientated • Reinforce Positive behaviour • Refer to teachers by first names	• Christian Values • Strong discipline & teacher control • Teachers Sir, Ma'am, Mr, or Mrs	• Strong discipline • Teachers view themselves as mentors & are committed	• Strong discipline code of conduct • Teachers discipline to ensure procedures are followed
Fees	• R5 000 - R6 000	• R2 000 - R2 500	• Free – no fees	• R1 200
Size of School	• 400 learners • 30 teachers	• 175 learners • 16 teachers	• 900 learners • 30 teachers	• 1200 learners • 50 teachers
Learners per Class	• Average 20 • Maximum 25	• Average 31 • Maximum 35	• Average 37 • Maximum 42	• Average 36 • Maximum 40
Subjects offered	• Core subjects • Wide range of additional subjects	• Core subjects • Small range of additional subjects	• Core subjects • Only Science and Maths related subjects	• Core subjects • Most subjects • Combinations list
Skills Focus	• Creative & reflective thinking • Social awareness • Self-management	• Holistic view of learning • Extra curricula activities	• Excellence in Science, Technology & Maths	• Passing matric exams
Pedagogic Principles	• Flipped Classroom • Blended Learning	• ICT school • E-based learning	• School of specialisation • IT, Science, Maths	• Continuing high pass rate for matric
Technology used by Learners	• Tablets • *ITSI & miEbooks* • Hardcopy optional	• Tablets • *ITSI & miEbooks* • Hardcopy optional	• Tablets/Notebooks • Siyavula • Google Classroom	• No devices used at school • Hardcopy used
Technology used by Teachers	• LMS • *ITSI & miEbooks* • Laptops	• *ITSI & miEbooks* • Laptops	• Laptops • Siyavula • Google Classroom	• School or private laptops • Shared genius tablets
Other Technology at the School	• Projectors • Smartboard • Whiteboard • Visualisers, 3D Printers, Robots, Laser Cutters	• Projectors • Whiteboards	• Smartboards • SMART Kapp	• Whiteboards • Few smartboards - but not used • Some projectors - some broken
Computer Laboratories	• Two state of the Art laptop labs	• One temporary, outdated desktop lab	• Two computer labs for IT and CAT	• One outdated lab for CAT learners • Tablets grade 8/9
Classroom Layout	• Desks mainly in pods • Projectors on ceiling • White/smartboard front of class • Teacher's desk in the front	• Desks face front • Projectors on ceiling • Whiteboard front of class • Teacher's desk in front	• Desks face front of class • Smartboard & Smart KAPP front of class • Teacher's desk in front	• Desks face front of class • Projectors – some ceiling others not • Whiteboard front of class • Teacher's desk in front

4.6.5 Collecting Data

To collect data, one first needs to decide whether in-person or telephonic interviews will be more practical, and then which mode will provide the richest and most meaningful data that can then be used to answer the study's research questions (Creswell, 2007). According to Johnson, Scheitle and Ecklund (2019) *in-person interviews* are best suited when the context in which a person lives, or works is important to the data being collected. Furthermore, in-person interviews offer the most natural conversational situation, which facilitate building a rapport between interviewer and interviewee and aids in taking note of visual and emotional cues (Irvine, Drew & Sainsbury, 2013). However, Creswell (2007) cautions that in-person interviews are often hard to schedule and thus are often impractical. On the other hand, *telephonic interviews* provide the best source of information when the researcher cannot directly access people in a face-to-face context and are more convenient to arrange (Creswell, 2007; Tessier, 2012; King & Horrocks, 2019) and quicker as they do not require the researcher or participant to travel (Walliman, 2011). According to Johnson et al. (2019), even though telephonic interviews may be necessary and more advantageous in some situations, the researcher cannot view informal communication and the body language of the interviewee (Novick, 2008) which limits the ability to gather contextual and non-verbal data. Conversely, Sturges and Hanrahan (2004) argue that data collected from telephonic interviews is comparable to data from in-person interviews and often provides rich detail on sensitive issues and may even facilitate participants sharing sensitive information more freely (Hopper, 1992; Novick, 2008).

In addition to the mode of interview, researchers also need to ensure interviewees are willing to share their thoughts, beliefs and opinions since *shy* and *inarticulate interviewees* may not be able to provide rich and meaningful data (Creswell, 2007; King & Horrocks, 2019). In addition, it is essential to *secure a quiet and private location* so that interviewees are free from distractions and are able to provide honest answers without concern that other people are listening (King & Horrocks, 2019; Walliman, 2011) and that the interview is recorded with good sound quality (Creswell, 2007). Lastly, it is important that the researcher *keeps to the questions in the protocol,* complete the interview within the allotted time, and listen to the interviewee more than speaking (Creswell, 2007; Al-Yateem, 2012).

Firstly, as this study used a longitudinal approach three rounds of interviews were conducted, with the first round of interviews held in-person, with telephonic interviews for the second and third rounds due to the COVID-19 pandemic as opportunities for face-to-face interaction with teachers were limited as schools across the country closed their campuses and shifted to remote teaching and learning (Olivier, 2020). This the combination, while necessary due to the current context, did not appear to compromise the data collected as a rapport had already been established between the researcher and the teachers during the first round of interviews. Secondly, teachers interviewed were willing to share their ideas, beliefs and thoughts and thus rich data was collected. Thirdly, the first round of interviews was conducted in private offices or rooms and thus teachers were prepared to provide honest answers without fear of people listening, and all interview recordings were clear and audible. The second and third round of interviews were conducted telephonically whilst teachers were at home, so teachers were not concerned about privacy and calls were recorded directly through an app on the phone with no interference. Finally, within each round of interviews, the researcher kept to the time allocated and listened to what the teacher had to say, which is apparent in the length of teachers' responses in the interview transcripts. A sample transcript can be found in Appendix C.

4.6.6 Recording Information

Recording information during the qualitative data collection process can consist of writing up descriptive field notes (Sanjek, 1990), textual write-ups of interviewee responses, mind mapping of initial thoughts during the interview (Emerson, Fretz & Shaw, 1995); photographing of places, people or artefacts to illustrate points made by interviewees or to describe a particular context; voice recordings, and analysis of documents (Tessier, 2012). Creswell (2007) also recommends that to facilitate the recording of interviewee responses, the interview protocol must have *space in the header to record important insights* about the interview, and lines or space to write notes on responses given by the interviewee because people may not always respond directly to the questions being asked. Furthermore, Creswell (2007) suggests that the interviewer needs to *be very familiar with the questions being asked* and in most cases should memorize them so as to maximise eye contact with the interviewee. Lastly, researchers should utilise *sensitive recording devices* that are as unobtrusive as possible (Al-Yateem, 2012) and a backup device so

that no data is lost due to power issues or device faults (Creswell, 2007; King & Horrocks, 2019).

Within this study, the researcher utilised a number of techniques to keep records of data collected. Firstly, for site visits, descriptive field note summaries were written up and photographs of the school, classroom layout and technology resources were taken. Secondly, to record interview responses, voice recordings were taken, all protocols had a header where important insights were noted, and space was provided between questions on the protocols that allowed the researcher to take notes for those questions not answered in order. The layout of the interview protocols, with these provisions can be found in Appendix A-1; A-2; and A-3. Thirdly, the researcher rehearsed asking the questions multiple times prior to beginning each interview, in order to ensure familiarity. Lastly, the researcher recorded each interview with a cellphone application designed specifically for recording conversations and also used two recording devices to ensure that if one device failed, the interview data was not lost.

4.6.7 Resolving Field Issues

Researchers need to consider and plan for a number of issues and problems that may occur during the data collection phase, including gaining access to sites, the transparency of data collected, and the interpretation of the data (Creswell, 2007; King & Horrocks, 2019). According to Creswell (2007), *gaining access to sites and individuals* can be challenging as it requires convincing gatekeepers or people of authority in the research context to allow you access (King & Horrocks, 2019). Next, it requires the researcher to recruit individuals to participate by building confidence and credibility at the site and getting people from a site to agree to cooperate (Creswell, 2007). For example, the researcher may select a site based on convenience of access or because of someone they know which potentially may result in worthless data being collected and limited findings being reported. In addition, data collected may not be *transparent* as participants may be fearful that data may be shared with their superiors or people outside of their organisation and thus may not share their honest feelings and opinions for fear of retribution (Creswell, 2007; Walliman, 2011). In regard to the *interpretation of the data*, the researcher's own views and sentiments may hinder data analysis as not all facets of participant's responses and experiences may be appropriately interpreted or reported (Creswell, 2007; Walliman, 2011).

Regardless of the research approach used, researchers may encounter a number of ethical issues such as off-the-record data being shared or asymmetrical power dynamics between researcher and participants (Creswell, 2007). During the data collection process, researchers may be told *off-the-record information* which may be concerning and then needs to be reported to the appropriate people outside of the research, thus breaching confidentiality, to prevent further harm (Walliman, 2011) or, if shared, may potentially harm individuals (Creswell, 2007). The *imbalance of power* between researcher and participant can result in questions not being answered or deflection of questions (Creswell, 2007; King & Horrocks, 2019). Researchers therefore need to recognise the issues surrounding the power dynamics during data collection and be able to ascertain what is authentic and truthful as well as be sensitive to potential discriminatory factors such as status, race, culture, and gender (Nunkoosing, 2005).

In this study, firstly, case study sites were purposively sampled with snowballing and thus case sites were not selected based on convenience or prior relationships with the researcher. To gain access to potential schools identified, the researcher first contacted the principals of each school for their permission and then information participation emails were sent to all teachers inviting them to take part (see Appendix B-1 for information participation letter). Secondly, transcriptions and data analysis per teacher were not shared with the management at each school and thus teachers felt comfortable to share their opinions with the researcher. Thirdly, the researcher does not hold any preconceived notions as to whether teachers should or shouldn't utilise technology, but simply aimed to explore teachers' beliefs, professional dispositions, technology orientation and school culture and context and thus interpretation and analysis of the data was done with a particular agenda in mind. Fourthly, in regard to ethical issues, no off-the-record or harmful information was shared during the data collection and teachers were willing to share information and did not appear to perceive power or control issues during the process.

4.6.8 Storing Data

Qualitative research creates massive amounts of textual data due to the multiple data collection techniques that may used (Johnson, Dunlap & Benoit, 2010). Data can orginate from field notes of what has been seen or heard during site visits, interviews or observations; initial protocols constructed to elicit in-depth and rich accounts of perceptions and experiences from participants; and follow-up protocols which are typically

very similar to the initial protocol but often asks fewer questions and prompts participants for updates; and provides details needed as the study's context changes over time (Creswell, 2007; Walliman, 2011; Johnson et al., 2010). Once collected, these large volumes of words need to be stored easily and for the appropriate amount of time, protected in regard to access and the confidentiality of participants, and categorised to enable data analysis to take place (Creswell, 2007; Given, 2008; King & Horrocks, 2019).

For easy *storage of data*, Johnson et al. (2010) and King and Horrocks (2019) recommend using digital audio devices so that recordings can be effortlessly stored using cloud or computer technology. Creswell (2007) claims that using a computer to store data enables researchers to store all data in one location and speedily and effortlessly locate data files when needed. In regard to the *length of time that data can be stored*, traditionally ethical procedures required data files to be destroyed after they were no longer being used for the original research study, however King and Horrocks (2019) argue that more recently storage practices for research related data have shifted to rather archiving data files for later research or reference.

As the data collected may contain confidential information about participants and organisations, it is crucial to *protect the data* by ensuring that it is stored in a physical or digital location that is safe, is only accessible by the researcher, and is not vulnerable to unauthorised access (Walliman, 2011; King & Horrocks, 2019). If digitally stored, files should be password protected with the password being known only to the researcher (Johnson et al., 2010; King & Horrocks, 2019). To assure the protection of data confidentiality, King and Horrocks (2019) propose using pseudonyms or numbers to identify participants or case study sites and the subsequent naming of data files, so that identifying details in the data can be concealed.

Once data files have been uploaded, named, and protected, *data needs to be categorised* and entered into a data collection matrix so that the researcher to track of data (Johnson et al., 2010). In addition Given (2008) suggests that data files stored need to be accompanied by descriptions of how the data was collected, arranged for analysis i.e. transcription, and then organised.

In this study, firstly to enable easy storage of the data files, all recordings were done using the researcher's cell phone and save to the *Dropbox*™ app on the phone. The data files were then synchronised and saved on the researcher's cloud storage and computer's hard drive. Secondly, to protect access to the data, all files were password protected, with a password known only by the researcher[21]. Thirdly, to protect the confidentiality of the data, schools utilised in the study were given numbers and participants were allocated pseudonyms, so that the data was anonymised and identifying details concealed. Lastly, to assist in the categorisation of the data, a spreadsheet was created in which the teachers were grouped according to school and notes were made as to the transcription of the data, how and when the data was collected, and initial insights gained. The template utilised for data storage and categorisation in this study is shown in Figure 17.

Figure 17: Data Storage and Categorisation Template Utilised

Name	Type	Comments
School 1		
School 2		
School 3		
School 4		

School 1

Teacher Pseudonym	Face to face interview Insights	1st telephonic interview Insights	2nd telephonic Interview Insights	Uploaded	Transcribed	Analysed

School 2

Teacher Pseudonym	Face to face interview Insights	1st telephonic interview Insights	2nd telephonic Interview Insights	Uploaded	Transcribed	Analysed

School 3

Teacher Pseudonym	Face to face interview Insights	1st telephonic interview Insights	2nd telephonic Interview Insights	Uploaded	Transcribed	Analysed

School 4

Teacher Pseudonym	Face to face interview Insights	1st telephonic interview Insights	2nd telephonic Interview Insights	Uploaded	Transcribed	Analysed

The first section of the spreadsheet stores the number assigned to the school; whether the school is independent, or government funded; and has space for any comments or insights gathered that need to be remembered or actioned by the researcher. The spreadsheet is

[21] In accordance with the University of Pretoria's policy regarding storage of research data, following the completion of the study all research data will be uploaded, archived and managed by the University in an institutional Research Data Management System for a period of 10 years (University of Pretoria, 2017).

then categorised by each school, with space for recording the pseudonym for each teacher, insights from each round of interviews, and then the relevant data files have been uploaded, transcribed, and analysed.

4.7 DATA COLLECTION TECHNIQUES

The main data collection techniques used for qualitative research approaches are interviews, observations, and document analysis (Schensul, 2008). *Interviews* are the verbal accounts of what a researcher learns from speaking with the participants; *observations* relate to what the researcher can see; and *document analysis* is a structured means of reviewing or evaluating printed or electronic documents, communication or artefacts constructed without the intervention of the researcher and may include text or images or a combination of both (Creswell, 2007; Schensul; 2008; Bowen, 2009). According to Schensul (2008) the choice as to which data collection technique to utilise depends on the level or unit of analysis, the time available for both the researcher and the participants to collect data, the financial resource available to the researcher, the appropriateness of the technique for the particular context, and the ability to provide trustworthy information.

4.7.1 Triangulation

Creswell (2007) claims that qualitative researchers need to collect data from more than one source to provide trustworthy information, i.e., triangulate data. Triangulation refers to using multiple methods, data sources or theories to develop a complete understanding of research phenomena (Patton, 1999).

According to Denzin (1978) and Patton (1999) four types of triangulation exist: investigator triangulation, theory triangulation, data source triangulation, and method triangulation. *Investigator triangulation* involves two or more researchers conducting the same study to offer multiple observations, perspectives and conclusions of the data (Denzin, 1978; Carter, Bryant-Lukosius, DiCenso, Blythe & Neville, 2014). *Theory triangulation* involves utilising different theories to examine and interpret data (Carter et al, 2014). *Data triangulation* collects data from different types of people in order to offer several perspectives and confirmation of the data (Carter et al., 2014). *Method triangulation*, commonly used in qualitative research approaches, consists of using multiple data collection methods to gather confirmatory data about the same research phenomenon

(Polit & Beck, 2012). Flick (2018) and Creswell and Creswell (2018) contend method triangulation frequently includes interviews, observations, and field notes (Bhattacherjee, 2012; Carter et al., 2014).

Data source triangulation was achieved by interviewing different teachers' technology integration choices in relation to their beliefs, pedagogic practice and orientation towards technology at several schools. While the researcher initially intended to utilise observations to also achieve method triangulation, to confirm teachers' self-reports of technology use following the initial interviews, due to the closure of South African schools for most grades from the end of March till August 2020 due to the COVID-19 pandemic (Mail and Guardian, 2020), this could not be achieved.

4.7.2 Interviews

Interviews are based on participants' oral self-report of their beliefs and experiences (Schensul, 2008; Creswell & Creswell, 2018). Interviews can either take place with individuals or groups, depending on the aims and objectives of the research. Individual interviews are usually in-depth conversations about participants beliefs and lived experiences (Schensul, 2008; Creswell & Creswell, 2018) while group interviews, also called focus group interviews, focus the group dynamics to gather data. Creswell (2007) states that focus groups are hard to manage and thus should only be used when interaction between participants is needed to produce the best information on a stated research problem. As group interactions are not central to the research objectives, interviews with individual teachers were considered as suitable for this study.

- **Types of Interviews**

The types of interviews that can be conducted are structured, unstructured, and semistructured (Gill, Stewart, Treasure & Chadwick, 2008). *Structured interviews*, which are easy to administer, are in reality verbal surveys where a list of planned questions is asked with little or no ability for the researcher to vary questions or follow up with additional questions to explore responses that require more explanation (Gill et al., 2008; Creswell, 2007; Creswell & Creswell, 2018). While structured interviews are appropriate when clarification is needed on specific questions or if literacy is an issue, Gill et al. (2008) claim that this type of interview is limited in its ability to provide an in-depth understanding. *Unstructured interviews*, on the other hand, have little or no organisation to the interview

as they are not constructed using any defined theories or research questions and thus begin with a general opening question and then progress depending on the initial answer (Gill et al., 2008; King & Horrocks, 2019). As unstructured interviews are very time-consuming and difficult to conduct, Gill et al. (2008) propose that this type of interview is only used when almost nothing is known about the subject. Lastly, *semistructured interviews* consist of various questions, usually drawn from a review of relevant literature, which guide the interview with the ability to diverge if necessary, to seek clarification, explanation or pursue a response in greater detail (Gill et al., 2008; Patton, 2015; King & Horrocks, 2019). The advantage of using semi-structured interviews, claim Creswell and Creswell (2018), is that they do not only guide the researcher as to what to discuss, but they also facilitate the discovery of information that may be important to the participant but was not defined by the researcher.

- **Interview Process**

Since the interviewer controls the quality of information collected, Creswell (2007) states that the researcher must follow a series of steps to conduct an interview to ensure that the most useful information for the study is collected. *First,* the researcher must decide what type of interview is most practical and will provide the most valuable information (Creswell, 2007; Patton, 2015). *Second,* the interview protocol must be designed in relation to the literature reviewed, the main research question and subquestions of the study (Creswell, 2007), and the methods that will be utilised to analyse the data (Roulston, 2014). *Third,* the researcher must conduct a pretest and pilot test to improve and refine the interview questions to confirm that the protocol is not biased and is able to collect the data required to answer the research question (Creswell, 2007; Patton, 2015). *Fourth,* the researcher must decide on the most suitable location for conducting the interview that is also convenient for the participants (Creswell, 2007; Roulston & Choi, 2018). *Fifth,* before conducting the interview the researcher must explain the purpose of the study and obtain the participants' consent (Creswell, 2007; Roulston & Choi, 2018). *Finally,* during the interview the researcher must keep to the questions, probe where greater clarification is needed, listen to what the participant is saying, and record the interview to enable to transcription for later data analysis (Creswell, 2007; Roulston & Choi, 2018).

As this study aimed to interview teachers in order to gain an in-depth understanding of their technology integration choices, semistructured interviews were deemed as the most

appropriate technique. This type of interview structure allowed the researcher to guide the participants through the interview process by exploring the research questions while at the same time facilitating probing and clarification (Nieuwenhuis, 2010a). In addition, the interview process defined by Creswell (2007) was followed to ensure that rich, quality information was collected in relation to the research questions, that was also suitable for the subsequent data analysis.

4.7.3 Research Protocols

According to Creswell (2007) research protocols are "pre-designed *(sic)* forms used to record information collected during an observation or interview" (pg135). The research protocol for semistructured interviews guides the structure of an interview by providing a set of questions developed in relation to the theoretical framework and research questions for the study (Patton, 2015). Furthermore, it enables the researcher to take notes to be used in analysing the data (Creswell, 2007). In order to ensure that the interview protocol is able to provide valuable data, Clark and Creswell (2014) recommend taking steps during the design and development of protocol development. The structured Interview Protocol (IPR) framework (Castillo-Montoya, 2016) used to refine the protocols for this study is presented below.

4.7.4 Interview Protocol Refinement (IPR)

In order to strengthen the quality of data collected during interviews, Castillo-Montoya (2016) developed the Interview Protocol framework (IPR) to systematically guide researchers in constructing and refining interview questions to ensure protocols used are consistent with the study's objectives and are able to collect data that is meaningful, appropriate and trustworthy (Jones, Torres & Arminio, 2014). The four phases of the IPR are: (1) ensuring protocol questions align with the study's research questions, (2) creating an inquiry-based conversation, (3) pretesting the protocol, and (4) piloting the interview protocol (Castillo-Montoya, 2016; Yeong, Ismail, Ismail & Hamzah, 2018). While these phases most often follow a sequential order, input from subsequent phases can be used to refine and revise the protocol (Yeong et al., 2018).

- **Phase 1: Align interview and research questions**

As qualitative interviews require participants to discuss and reveal their multilayered and intricate experiences, protocols utilised need to enable participants in articulating their

stories one layer at a time while also achieving the aims and objectives of the study and answering the stated research questions posed (Castillo-Montoya, 2016). Therefore Castillo-Montoya (2016) proposes creating a matrix to identify any gaps in what is being asked. Interview questions can be mapped to research questions, with marked cells indicating which interview question has the potential to answer a particular research question (Neumann, 2008). Gaps identified can then be addressed and the protocol can be refined prior to data collection beginning (Yeong et al., 2018). Gaps not identified during the design stage of the protocol, may result in researchers only realising gaps exists once data collection has been completed (Castillo-Montoya, 2016).

- **Phase 2: Construct an inquiry-based conversation**

The protocol used to guide the interview should not only enable the researcher to enquire about specific information related to the objective of the research (Patton, 2015) but should also facilitate a meaningful conversation between the researcher and participants (Castillo-Montoya, 2016; Yeong et al., 2018). The phrasing of research questions is based on the researcher's understanding of the context and thus most often these questions are phrased in theoretical language whereas interview questions, which are constructed to answer research questions, aim to gather understanding and perceptions from the targeted population (Yeong et al., 2018) Therefore, interview questions should not be expressed in theoretical language but should be adjusted and expressed in more colloquial and informal language that will be easily understood by participants (Brinkmann & Kvale, 2015; Castillo-Montoya, 2016) and avoid jargon (Merriam, 2009; Patton, 2015) thereby enabling an everyday type of conversation to take place between researcher and participant (Yeong et al., 2018).

- **Phase 3: Pretest**

Once the researcher has constructed a protocol that is aligned to the study's research questions and phrased in a way in which an inquiry-based conversation can take place, it is necessary to pretest, i.e., receive feedback, on the interview protocol (Castillo-Montoya, 2016) for the researcher to know whether the participants' understanding of the interview questions is similar to the intentions of the researcher (Patton, 2015). According to De Vaus (1993) pretesting research protocols assists researchers in identifying whether the proposed instruments are inappropriate or too complicated, in which instances and at what

point the protocols may not be followed. Pretesting of a particular research protocol increases the possibility that the protocols will gather the appropriate data needed to successfully answer the study's research questions (van Teijlingen & Hundley, 2001). In addition, for interview protocols Hurst, Arulogun, Owolabi, Akinyemi, Uvere, Warth and Ovbiagele (2015) claim that pretesting can detect issues with cross-cultural language differences and whether the questions are clearly stated.

In order to conduct a pretest of the protocol, Castillo-Montoya (2016) proposes asking a colleague to perform a close reading of the protocol to review the structure, length, style of writing. Further, to assess participants' expected level of understanding of the interview questions, Maxwell (2013) suggests that the researcher ask the reviewer to place themselves in the participant's context in order to envisage their possible understanding and responses to the interview questions posed. The feedback received then provides the researcher with insights as to whether questions are clearly understood, appropriate answers are possible, and what aspects of the questions are ambiguous or unclear and need to be refined (Fowler, 1995; Hurst et al., 2015; Willis, 2004).

- **Phase 4: Pilot interview**

Next, the researcher should simulate conducting an interview in similar conditions with participants who are comparable to the sample to be interviewed for the study (Maxwell, 2013). This enables the researcher to gain insight into the logic and flow of the questions in the protocol (Merriam, 2009), to get a realistic idea as to the time needed for the interview and whether, in reality, participants are able to understand and answer questions posed (Castillo-Montoya, 2016). Once revisions have been made based on insights gained, researchers can begin using the protocol to conduct interviews for the study (Maxwell, 2013).

- **IPR utilised**

Within this study, all four phases were utilised in designing the protocol for the first round of interviews. Protocols used for the second- and third round follow-up interviews only utilised phases two to four, as interview questions in these protocols were simply adjusted to understand changes over time, and therefore phase one did not need to be repeated.

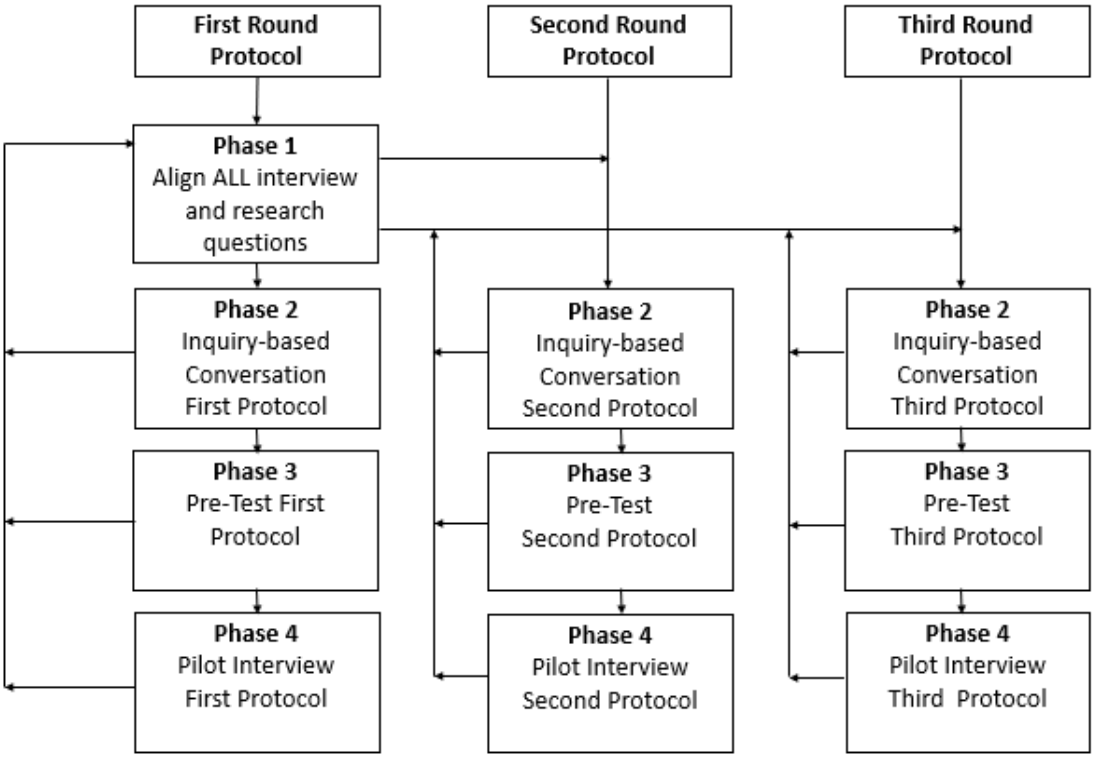
Both phases one and two were carried out by the researcher. Phase 1 involved firstly reviewing the research questions, interview protocols and theoretical framework and then developing a matrix to ensure the alignment of the research and interview questions. Phase 2 required the researcher to read through the interview protocols with the aim of refining and rephrasing the terminology used in questions to be more conversational.

Phase 3, which involved conducting a pretest, was done by a colleague of the researcher. All three protocols were pretested by the same lecturer in the Information Systems Division. The selection was made as the lecturer has extensive experience in education and the discourse used by teachers and has conducted past research in the area of technology and education. Therefore, the lecturer is appropriately qualified to provide suggestions about how to make the questions more accessible and easily understandable to the teachers.

Phase 4, which involved simulating an interview with a number of teachers that are comparable to the those in the sample for this study, was conducted for all three protocols with the same two teachers: one from a government school, and one from an independent school. These teachers were selected as they have participated in prior studies conducted by the researcher and are teaching in schools with existing technology initiatives.

A diagrammatic representation of the way in which the IPR framework was utilised in this study, including feedback between each phase, is shown in Figure 18. A detailed account of the design and development of each protocol is discussed in the sections that follow.

Figure 18: Interview Protocol Refinement Framework Utilised (based on Castillo-Montoya, 2016)



4.7.4 First Interview Protocol

The protocol for first-round interviews, conducted in-person, is the most comprehensive of all three protocols as it needed to gain initial beliefs and perceptions of teachers as well as establish a rapport with the participants. Therefore, all phases of the IPR were conducted which resulted in a number of substantial changes being made to the interview protocol. Changes for each phase is detailed below.

- **Phase 1: Align interview and research questions**

Each interview question for the first-round interview protocol was constructed in relation to the teachers' view of each of the SST-TTU Theoretical Framework. For example, questions on (1) *External Structures* (ES) relate each of the identified external beliefs of agents: *can you describe your beliefs in relation to the resources; training; assessment requirements; technological support available to assist your technology integration in the classroom?* In addition, to ensure there were no gaps in the protocol, that there were not too many or too few interview questions related to each research question and that each research question was covered in the interview protocol (Castillo-Montoya, 2016), a matrix, shown in Table 11, was constructed. From the mapping shown in the matrix, it is evident all research questions posed in this study are covered in the first-round interview

protocol and there are sufficient questions per research question[22]. See appendix A-1 for the research protocol.

Table 11: Interview Protocol Matrix

	General Info	RQ1[23]	RQ2[24]	RQ3[25]	RQ4[26]	RQ5[27]	RQ6[28]	RQ7[29]	RQ8[30]
Section 1: General									
Q1	X								
Q2	X								
Q3	X								
Section 2: Internal Structures –Conjunctual Knowledge									
Q4.1.a		X							
Q4.1.b			X						
Q4.2.a		X							
Q4.2.b			X						
Q4.3.a		X							
Q4.3.b			X						
Q5.1.a		X							
Q5.1.b			X						
Q5.2.a		X							
Q5.2.b			X						
Q6.1.a		X							
Q6.1.b			X						
Q6.2.a		X							
Q6.2.b			X						
Q6.3.a		X							
Q6.3.b			X						
Q7.1.a		X							
Q7.1.b			X						
Q7.2.a		X							
Q7.2.b			X						

[22] As the IPR is an iterative process with feedback between phases, the matrix shows the order of the final protocol used in the first-round of interviews (see Appendix A-1).
[23] RQ1: External Structure (ES) difference between technology rich & technology poor schools
[24] RQ2: Different teacher's Beliefs (IB) around External Structures of Technology (ES-CSB)
[25] RQ3: Different teacher's Internal Beliefs (IB) about technology
[26] RQ4: Teacher's Professional Dispositions (IB-PD)
[27] RQ5: Teacher's Orientation towards Technology (AP)
[28] RQ6: Differences in technology use (O)
[29] RQ7: Different school contexts (C) influence on teacher's technology use
[30] RQ8: Duality of Structure & relation between all

	General Info	RQ1	RQ2	RQ3	RQ4	RQ5	RQ6	RQ7	RQ8
Section 3: Internal Structures – General Dispositions – Conjunctual Knowledge									
Q8				X					
Q9.1				X					
Q9.2				X					
Q10.1				X					
Q10.2				X					
Q11.1				X					
Q11.2				X					
Q12.1				X					
Q12.2				X					
Q13.1					X				
Q13.2					X				
Q14.1					X				
Q14.2					X				
Section 4: Technology Activities and Current									
Q15						X			
Q16						X			
Q17						X			
Q18							X		
Section 5: School Context									
Q19								X	
Q20								X	
Q21								X	
General Questions									
Q22	X	X	X	X	X	X	X	X	X

- **Phase 2: Create an inquiry-based conversation**

As the interview questions were drawn and formulated directly from theoretical framework utilised in this study, it was evident during Phase 2 that some of the questions were phrased using technical terms that may not have been easily understood by teachers and would not encourage a conversation between the researcher and interviewees. Therefore, terminology was refined to be more natural, using everyday language known by teachers. For example, question 10.1 asking about teachers' beliefs as to the nature of knowledge was originally phrased as *please explain your beliefs in relation to the nature of knowledge*; suggested change *please explain how you believe one acquires knowledge.* Terminology was also changed to be more colloquial in questions 4.3.a; 4.3.b; 9; 11.2.b; and 13.2.

- **Phase 3: Pretest**

After a close reading of the protocol, recommendations made included: phrasing questions more clearly and explicitly detailing probes on the protocol.

Firstly, it was suggested to make the questions clearer so there was no room for ambiguity. For example, question 4.3.a asking teachers about the physical arrangement of the technology at the school was originally phrased as *please describe the physical arrangements of the technology resources at your school*; suggested change *please describe how the technology resources at your school are physically arranged*. Refining questions to allow for better understanding was also done for 4.1.a; 8; 13.1 and 15.

Secondly, where the teacher may not necessarily be clear as to what is being asked, probes were suggested. For example, question 4.3.a asking about physical arrangement of technology training was originally phrased as *please describe how the technology resources at your school are physically arranged;* probes suggested *labs, laptop per child.* Probes were also added to questions 5.1.a and 5.2.a

- **Phase 4: Pilot interview**

After conducting a pilot interview it was evident that the time allocated per interview was too short and the order and flow of some of the questions was not logical.

Firstly, it was clear that the original *timing* of 30 minutes allocated per interview was not appropriate and thus the interview time was extended to between 45 and 60 minutes in order to allow the teacher to answer each question in sufficient detail.

Secondly, the *flow of the questions* was confusing, which resulted in the researcher either jumping around a lot between different parts of the protocol or for the interviewee answering questions related to actual structures and beliefs about structures in one, without differentiating between these, which could have led to a conflation of data concepts. Thus, questions related to *external structures*, i.e., the actual resources, training, support and time and *internal structures* (i.e., beliefs about these external structures) were placed sequentially to enable the researcher to gather rich data related to both concepts. For example, for question 7 on familiarity, question 7.1.a on external structures *please*

describe how familiar you are with using technology in the classroom was followed by the related internal structure question 7.1.b *please explain whether you believe that you are familiar enough with using technology in order to effectively use it in your teaching.* This was done for all questions 1 to 7 which are related to external structures and the associated internal beliefs about these structures. See Appendix A-1 for the final protocol used in the first round of interviews.

4.7.5 Second Interview Protocol

The protocol for the second round of interviews, conducted telephonically, aimed to understand the school and teachers' technology infrastructure during the initial lockdown in South Africa (South African Government , 2020) due to the COVID-19 pandemic and also whether their beliefs around technology had been changed during this time. The context in which each school was situated was also of interest. As the background to the study had already been described to the teachers, explanations of the concepts being discussed were not include in this protocol. Furthermore, as interview questions were simply adjusted to assess the changes due to the COVID-19 pandemic, Phase 1 was not repeated.

- **Phase 2: Create an inquiry-based conversation**

After reviewing the protocol it was clear some of the words being used in the question were too broad or jargon-like and thus would not be easy for the teacher to understand what was being asked. For example, question 8 asking about self-efficacy was originally phrased as: *please describe how confident you feel about using technology for remote teaching*. The suggested change was*: please describe how you feel about your technology skills when teaching remotely.* Refining questions to allow for better understanding was also done for questions 3.1; 5; and 9.

- **Phase 3: Pretest**

After a close reading of the protocol, recommendations made involved changing the order of some of the questions to make the flow of the interview more logical. For example, question 1.3 on the *physical arrangement* of the technology was *moved to after* question 1.2 on *suitability and quality*, as it was felt that teachers would need to consider the suitability and quality of technology prior to the physical arrangement. No other changes were suggested.

- **Phase 4: Pilot interview**

After conducting a pilot interview it was evident that questions from different sections needed to be grouped together to shorten the interview; and that a question had to be added to gather information on teachers' future intentions to utilise technology.

Firstly, the rationale for grouping together questions was based on the experience that during the pilot interview teachers appeared to find answering as many questions as in the first protocol very tiresome and also that the time needed to answer the questions was too long. Therefore, questions related to external and internal structures, and agent's practices and outcomes were grouped together. For example, for external and internal structures, when asking teachers about access to resources only one question (1.1) was asked that encompassed both concepts, i.e., *please describe what access teachers at your school currently have to technology (external) and whether you believe this is adequate to perform their job remotely (internal).*This was changed for all questions that relate to external and internal structures.

Secondly, to understand whether any changes mentioned by teachers could potentially influence their future beliefs and pedagogic practice, question 11, *please explain whether you intend to continue using technology so extensively when school returns to face-to-face teaching*, was added. See Appendix A-2 for the protocol used in the second round of interviews.

4.7.6 Third Interview Protocol

The protocol for the third round of interviews, also conducted telephonically, aimed to understand whether teachers' beliefs, experiences and desire to utilise technology had shifted due to the growing reality that remote teaching and learning needed to continue when government schools were closed July in the face of the increasing rate of COVID-19 infection in South Africa (Mail and Guardian, 2020). Only questions related to the extension of COVID-19 implications and school closures were included

- **Phase 2: Creating an inquiry-based conversation**

After a review of the protocol, it was evident that question 3 needed to be refined and phrased in more everyday language so that the intended meaning was more understandable to teachers. The question changed from: *in what new and innovative ways*

are you now using technology, to *describe the different ways in which you are now using technology.*

- **Phase 3: Pretest**

After pretesting the protocol, recommendations were made only in regard to the changing of the wording for one question. For question 5, *have your beliefs around technology use for teaching changed since we last spoke*, the suggested change was: *have your beliefs around the value and use of technology for teaching changed since we last spoke.* No other changes were suggested.

- **Phase 4: Pilot interview**

After conducting the pilot interviews it was evident that some of the questions needed to be reordered to make the interview flow better. For example, the question *how do you envision the future of education in relation to technology use* was moved from being question 3 to the last question of the interview. The question, *describe the different ways in which you are now using technology* was moved from question 7 to question 3. The order of all other questions remained the same. See Appendix A-3 for the final protocol used in the third round of interviews.

4.8 DATA ANALYSIS

Data analysis within qualitative research is an ongoing and iterative process that assists researchers in discovering common insights (Nieuwenhuis, 2010b).

4.8.1 Types of Qualitative Data Analysis

Qualitative techniques used to analyse data, include thematic analysis and content analysis. A *thematic analysis* is a sense-making approach used to systematically find relationships and identify the main themes using qualitative data (Boyatzis, 1998) while *content analysis* involves systematic and detailed coding, analysis, and transformation of the data into interesting research findings (Payne & Payne, 2004). However, as the boundaries between these two types of data analysis methods are blurred, they are often used interchangeably (Sandelowski & Leeman, 2012) and researchers are frequently confused about which one to use (Braun & Clarke, 2006).

While thematic data analysis is frequently used in qualitative case study research approaches with interpretivist paradigms, Lapadat (2012) states that the process of decomposing texts breaks the consistency and contextuality of the participant's narratives. Furthermore, Holloway and Todres (2003) argue that the inherent flexibility of thematic analysis may limit the study's empirical findings due to the potential for inconsistent approaches when developing themes derived from the research data. Based on these concerns, *content analysis* was decided as most suitable for this study.

4.8.2 Content Data Analysis

Qualitative content analysis is the process of systematically describing the meaning of qualitative data (Schreier, 2013). Content analysis views the data as depictions of documents, images, and words created to be read, understood, and acted on for their meanings (Krippendorff, 2004). Payne and Payne (2004) contend that content analysis is not simply an objective analysis of patterns within the data but when used with an interpretivist paradigm, enables the researchers' own meanings and values to enhance the interpretation of the data. According to Schreier (2013), content analysis is characterised by a series of systematic steps that reduce the possibility of analysing the data only through the researcher's own assumptions and perspectives as it assists researchers in focusing specifically on the meanings of the data relative to the study's main research question.

- **Types of Content Analysis**

Hsieh and Shannon (2005) define three types of qualitative content analysis based on the extent of inductive reasoning used: conventional, directed, and summative. *Conventional*, mainly used for grounded theory, involves the coding categories being derived directly from the data (Assarroudi, Nabavi, Armat, Ebadi & Vaismoradi, 2018; Hsieh & Shannon, 2005). *Directed*, which is mainly used to confirm or extend theories, initially defines codes in relation to the theory being used and the literature reviewed. Once data has been collected, the researcher's analysis may result in codes emerging from the data (Hsieh & Shannon, 2005). Hsieh and Shannon (2005) propose using directed qualitative content analysis when a theory is being used to refine or delve deeper into the understanding of a research phenomenon. *Summative* is usually aligned with quantitative methods and involves counting words or phrases in the data to explore the usage of the words (Hsieh & Shannon, 2005; Assarroudi et al., 2018).

4.8.3 Content Analysis Process

The process of content analysis requires the researcher to perform a series of steps, namely building a coding frame, trial coding, evaluation and modification of the coding frame, main analysis, segmentation, and presentation and interpretation of findings (Schreier, 2013).

Building a coding frame has two stages: First, it requires the researcher to build an *initial coding frame* by selecting material to be analysed; then structuring, generating, and defining content-driven categories guided by the study's main research questions and theoretical framework. Second, data that has been collected and analysed is used to revise and *expand the initial coding frame* by adding categories and subcategories (Boyatzis, 1998; Schreier, 2013). Schreier (2012) proposes using a subsumption strategy for generating data-driven subcategories once the main categories have been defined. The subsumption process, which continues until no new additional concepts are found in the data, i.e., saturation, involves firstly, reading transcripts until an applicable concept is identified; secondly, checking whether the concept exists in a subcategory already created; and lastly, creating a new subcategory if needed (Schreier, 2013).

Next, *trial coding*, is the pretesting of the codes which involves conducting two rounds of coding with the identical procedures that will be utilised during the main coding to ensure that codes being used are appropriate for analysing the data (Schreier, 2013).

Next, *evaluation and modification of codes* involves assessing whether the trial codes are consistent and valid definitions of subcategories are clear and straightforward (Barbour, 2001). Consistency refers to the codes being the same in both rounds of coding due to clear and straight-forward subcategory definitions; validity outlines how adequately the subcategories define the data and concepts relative to the study's research questions (Schreier, 2012; Bengtsson, 2016). Based on the evaluation of the trial codes, modifications are then made for the coding to be used in the actual analysis (Schreier, 2013).

Next, the *main analysis* involves the coding of all the data, recording of the results, the resolution of inconsistencies, and the organisation of results into a suitable format that can be used to answer the research question (Schreier, 2013).

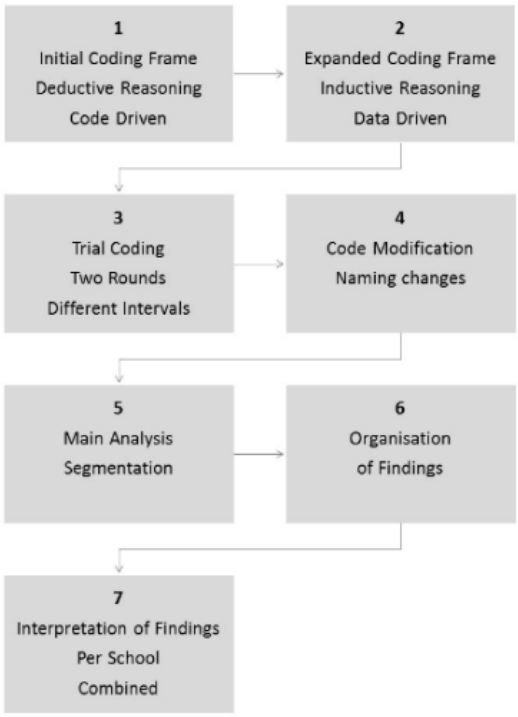
Next, *segmentation* which relates to the consistency of the coding can be achieved by executing two rounds of coding, either by two different independent coders of by the same coder at different times (Schreier, 2013). It involves dividing the data into coding units, which can vary from an entire book to a single word, to facilitate the meaningful interpretation relative the defined subcategories (Schreier, 2013; Bengtsson, 2016).

Finally, the *findings are interpreted and presented*, which can be the presentation of the coding frame with participants' quotes, a continuous piece of text, or a set of patterns that assist in understanding the relationships between selected categories (Gibbs, 2007; Miles and Huberman, 1994).

- **Content Analysis Process utilised**

As this study aimed to explore teachers' technology integration choices and use in relation to TTU-SST, a *directed content analysis* was used with *content and data driven codes*, following a structured data analysis process. The content analysis process followed in this study is shown in Figure 19.

Figure 19: Content Analysis Process Utilised (based on Schreier, 2012, 2013)



First, the initial coding frame, which can be found in Table 8, was created using the theoretical framework constructed for this study. *Second*, once interviews had been transcribed and carefully analysed, the coding frame was expanded through inductive reasoning by creating subcodes drawn from the data (see Appendix D for Expanded Subcodes). *Third,* trial coding, which was conducted at different intervals by the researcher, involved checking the initial and expanded coding frame against the theoretical framework and interview transcripts. *Fourth,* codes were modified where naming was not clear nor consistent, or where naming of codes was based on the first letter of each of the categories. For example: External Structures-Resources was coded as ES-R. Codes for Internal Beliefs-Norms-School was changed from IB-N-N to IB-N-S; Internal Beliefs-Professional Disposition-Instructional Discourse-Boundaries was changed from IB-PDI-C to IB-PDI-B; and Internal Beliefs-Professional Disposition-Instructional Discourse-Nature of Knowledge was changed from IB-PDI-N to IB-PDI-K. *Fifth,* the researcher conducted the main analysis, by reviewing each of the transcripts by teacher and then by school to ensure consistency, i.e., segmentation in the coding process. *Sixth*, the researcher organised the results into a format that was then used to answer the research questions. *Lastly,* findings were interpreted in relation to the theoretical framework and the additional codes, written up per school, and then combined in order to understand the relationships being studied, using the participants' quotes as evidence.

4.8.4 Content Analysis Reporting: Within and Across Cases

Within qualitative research, the context in which participants' recount their experiences is crucial to making sense of the data (King & Horrocks, 2019). Therefore, the data analysis needs not only to interpret each individual's experience within the case, but also needs to be applicable across all cases in the data set (Ayres, Kavanaugh & Knafl, 2003; Mills, Durepos & Wiebe, 2010). Ayres et al. (2003) claim that *within-case analyses*, which aim to provide rich person-specific information by concentrating on the individual through exploring their particular stories, are crucial to understanding the case as they facilitate the identification and analysis of key elements. However, within-case methods are not helpful in drawing comparing between all participants across different contexts (Ayres et al., 2003; Mills et al., 2010). Therefore, it is essential that *cross-case analyses* are also utilised as they enable researchers to identify commonalities and differences between cases, resulting in a synthesis of participant's experiences across different contexts (Ayres et al., 2003; Yin, 2009; Mills et al., 2010). Furthermore, Denzin and Lincoln (1998) argue that

regardless of the quality of data collected and reporting method, the quality of the case study depends on reporting that is structured, detailed, and has a "story-like" writing style (Rashid, Rashid, Warraich, Sabir & Waseem, 2019).

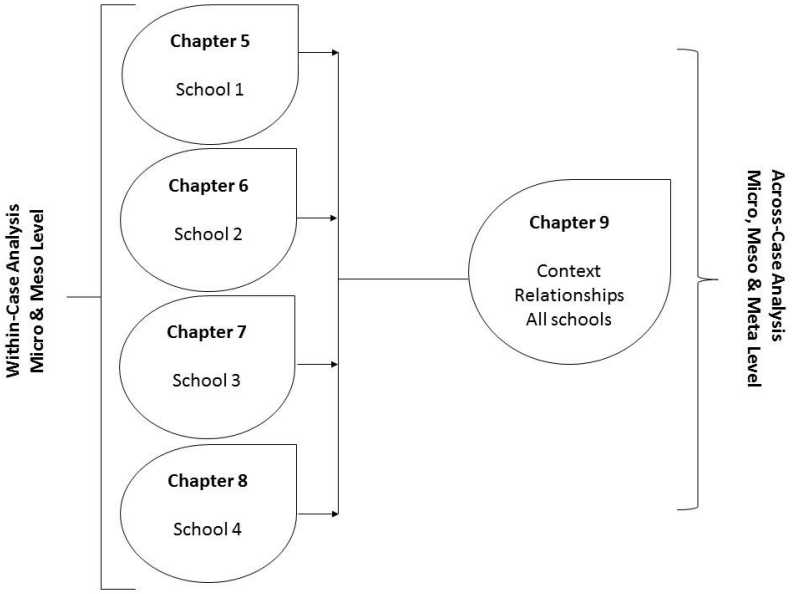
- **Content Analysis Reporting utilised**

Within this study, to address the two categories of research questions posed and the individual and school as the units of analysis, it was necessary to analyse and report findings both within- and across cases. In order to answer the research questions related to individual teachers at a particular school, subquestions (q1) *What are the external structures at different schools?* (q2) *What are different teachers' beliefs around the external technology structures in their school?* (q3) *What are different teachers' internal beliefs about technology?* (q4) *What are different teachers' professional dispositions?* (q5) *What are different teachers' orientations towards technology*? (q6) *How do different teachers use technology?* and (q7) *What is the context at different schools?* were used to perform the within-case analyses utilising the micro- and meso-level of the TTU-SST framework (see Chapters 5 to 8).

Next, the cross-case analyses of the 4 different schools utilising subquestions (q8) *How do the external technology structures differ between technology rich and technologically disadvantaged schools?* and (q9) *How does technology use differ between teachers at technology-rich and technologically disadvantaged schools?* were used to as an introduction to Chapter 9[31] to provide a micro- and meso-level perspective on teachers' experiences within different school contexts. Finally, subquestions (q10) *How do different school contexts influence teachers' use of technology?* and (q11) *How do external structures, beliefs, professional dispositions, and orientation towards technology influence technology use in the classroom?* were used in conjunction with Stones' (2005) composite research strategy[32] to understand the relationships being studied across different contexts, utilising the TTU-SST framework to provide a meta-theory perspective. A diagrammatic representation of the within-case and cross-case data analyses reporting by chapters is shown in Figure 20.

[31] Chapters 5 to 8 address each component of the adapted SST framework as depicted in Figure 9 using a within-case analysis, while chapter 9 addresses the cross-case analysis of the quadripartite nature of structuration and duality of structure in relation to modality and interaction.
[32] A detailed description of Stones' (2005) composite research strategy can be found in Section 3.2.3 and in Figure 10.

Figure 20: Content Analysis Reporting by Chapter



4.9 QUALITY ASSESSMENT

Qualitative approaches are often criticised for lacking scientific rigour (Vaismoradi, Turunen & Bondas, 2013). Lincoln and Guba (1985) propose criteria that can be used to evaluate the trustworthiness or quality of interpretive research studies: credibility, transferability, dependability, and confirmability.

4.9.1 Credibility

Credibility refers to the internal consistency so that "adequate representation of the constructions of the social world under study" (Bradley, 1993, p436) is evident. According to Zhang and Wildemuth (2009), as the knowledge and experience of the coder influences the credibility of research, it is essential to design clear data coding processes so that the appropriate conclusions are drawn from the data. Lincoln and Guba (1985) propose that regular and consistent observations, triangulation, examining interpretations against raw data, peer debriefing, and member checking are needed to ensure credibility. Lincoln and Guba (1985) also suggest using semistructured protocols to assist in achieving credibility, since they facilitate the participant being able to provide answers to concepts not asked (Harrell & Bradley, 2009). Furthermore, Byrne (2001) and Denzin (1978) suggest that utilising member checks after the end of the interview to verify that the participant's responses capture the essence of what is taking. In addition, Morrow (2005) proposes that credibility can be achieved by providing detailed descriptions of the source of the data,

along with “thick descriptions” (Geertz, 1973) of participants’ experiences and the setting in which the experiences occurred, and how data saturation was assessed.

For this study, to ensure credibility, the interview questions and initial coding frame was drawn directly from the theoretical framework and then checked and aligned with the research questions. Semistructured interviews, which were refined using the IPR framework, were used to collect data along with verbatim transcriptions of the interview and member checks after the first and second interview. In addition, thick descriptions of the participant’s experiences and setting have been detailed and presented in the findings of the study.

4.9.2 Transferability

Transferability refers to the degree to which the research can be applied to another context (Zhang & Wildemuth, 2009). Tobin and Begley (2004) claim that transferability within qualitative research does not relate to generalising findings but rather to the transfer of case-to-case. Morrow (2005), Zhang and Wildemuth (2009) state that to ensure transferability researchers need to offer a set of rich descriptions of the researcher, setting, processes used, and the relationship between the researcher and participant to enable other researchers to make decisions as to the findings’ transferability to other contexts. Furthermore, Yin (2009) states that purposive sampling of participants can assist with transferability.

To ensure the transferability of the findings in this study to other contexts, the researcher made use of purposive sampling strategy with maximum variation in order to locate diverse schools. In addition, rich detailed descriptions of the research settings and processes have also been presented.

4.9.3 Dependability

Dependability refers to the degree to which the internal research processes are reasonable, visible, and clearly documented (Tobin & Begley, 2004) and whether the characteristics of the data can be confirmed (Bradley, 1993). Denzin (1978) states that the verbatim transcription of the interviews with member checks and the subsequent data analysis can assist researchers in achieving dependability. Furthermore, Morrow (2005) proposes researchers keep an audit trail to ensure that processes are explicit and that they can be repeated by another researcher if they desire.

For this study to ensure dependability, all interviews were transcribed verbatim, and all participants have been given the opportunity to check interview recordings, transcriptions and the subsequent data analysis. In addition, an audit trail clearly documenting the processes and characteristics of the data was kept by the researcher throughout the research process.

4.9.4 Confirmability

Confirmability focuses on establishing whether the interpretations and findings from the research have been explicitly derived from the data and requires the researcher to reveal as to how conclusions and interpretations were derived (Tobin & Begley, 2004). Morrow (2005) argues that as research is never completely objective, it is essential that the integrity of findings lies in the data and not in the beliefs and perspectives of the researcher. Guba and Lincoln (1985) state that confirmability can only be achieved when credibility, transferability, and dependability are present.

To ensure confirmability in this study, member checks of interviews recordings and transcriptions were used to ensure that conclusions and interpretations are drawn from the data and explicitly stated.

4.10 ETHICS

Regardless of the research approach, all researchers need to obtain informed consent from the research's study site, government organisations and participants and ensure ethical considerations have been addressed in conducting the study (Creswell, 2007). Several ethical forms are needed before beginning with data collection starting: permission letters giving the researcher access to the sites being used to collect data, ethical clearance from the university at which the research is being supervised, participation information letters, and signed consent forms.

As this study involved teachers at both private and government schools, to gain access to the schools, permission letters were sought from all schools (see Appendix B-3) as well permission was obtained from the Gauteng Department of Education (GDE) (see Appendix B-4) for the government schools.

To comply with the University of Pretoria's (UP) Ethics committee, clearance with the relevant documentation, was applied for so that research could be conducted ethically and in relation to the study's research aims and objectives. The study was approved unconditionally by the Faculty of Engineering, Built Environment and Information Technology (EBIT) ethics committee (Clearance number EBIT/215/2019). The ethical clearance certificate from the UP committee can be found in Appendix B-5.

Once ethics was granted, schools for the study were identified and teachers were invited to take part in the interviews. An information participation letter (see Appendix B-1) detailing the aims and objectives of the study, the timing of the interview and explaining that their participation is voluntary and that their confidentiality is assured was sent to the schools and disseminated to teachers within the schools. Teachers that agreed to take part in the study, were asked to sign the consent form (see Appendix B-2), prior to beginning the first interview. In addition, teachers were also given the option of not having the interview recorded and were able to withdraw from the interview at any time.

To ensure confidentiality of the selected schools and participating teachers, no real names have been used in reporting the findings. Numbers have been assigned to each school and pseudonyms, which resemble the demographic of the teacher interviewed, along with the subject taught by the teacher have been used to report teacher's comments and findings.

4.11 LIMITATIONS

Several limitations of qualitative research are cited by Anderson (2010): the inability to generalise statistically, ambiguity of human language, heavy dependence on the researcher's abilities, large volumes of data to analyse, the researcher's presence during data collection; and the lack of confidentiality and anonymity of participants in the findings. These limitations and approaches that were used to address them, are presented below.

Firstly, qualitative research, specifically case study research which is about specific individuals or groups of individual's experiences at a point in time, is viewed with scepticism by the many in the scientific research community (Anderson, 2010) due to its inability to generalise statistical findings (Atieno, 2009). In keeping with Yin's (2012) guidance as to how to counter this concern within a case study approach, analytical

generalisations have been used to illustrate how the findings support or contest the theory being used and the literature reviewed.

Secondly, Atieno (2009) states that a major limitation of qualitative research is the intrinsic ambiguities present in human language which may influence the data analysis and findings. While three rounds of interviews, conducted at different times, were used within this study to limit uncertainties that may be present in the some of the interviews, not all may have been addressed.

Thirdly, qualitative research is criticised for being deeply influenced by the skills and personal biases of the researcher (Anderson, 2010). Yin (2012) suggests that qualitative research that is trustworthy does not suffer from this limitation. This study adhered to criteria as specified by Lincoln and Guba (1985) for achieving quality research with regards to data collection, analysis and presentation of findings.

Fourthly, as qualitative research is powerful and enables deep investigations, the high volume of qualitative data makes its analysis and interpretation time consuming (Anderson, 2010). To address this concern, this study used content analysis to reduce the volume of data to be analysed (Schreier, 2013).

Finally, while the presence of the researcher during data gathering is seen as a limitation of qualitative research as it can influence the participant's responses, it can also be viewed as an advantage as it enables the participant to expand on answers and experiences (Anderson, 2010). Moreover, while qualitative research cannot assure participants of anonymity, this does not limit the ability to ensure confidentiality (Creswell, 2007; King & Horrocks, 2019). To address this limitation, no names were used in the storage of data files or in the presentation of findings, with numbers used to identify each school and pseudonyms for teachers.

4.12 CONCLUSION

This chapter presented an overview of the research methodology followed for this study. First, a review of the research problem was provided. Next an overview of research philosophies was presented with a rationale for the selection of an interpretivist paradigm. Next a summary of research methods, with a rationale for the selection of qualitative

research methods was provided. Research approaches were then presented, with a rationale for the selection of the case study approach. The units for analysis of the teacher and the school were then discussed. The data collection process involving the selection and access to the case study sites; purposive and multiple variation sampling strategies; sample size; recording and storing of data were then discussed. Thereafter, the data collection technique of the interviews was presented with a discussion on data triangulation and the construction and revision of the interview research protocols. Data analysis was then presented with a rationale for the selection of directed-content code and data driven analysis as the most appropriate way to examine the data. Quality criteria of the confirmability, transferability, and dependability of the research were then presented. Finally, limitations of the research methods employed and approaches used to address these concerns, along with ethical considerations were discussed.

Chapters 5 to 8 present the within-case analyses of the schools in this study in relation to each part of TTU-SST.

5 FINDINGS AND DISCUSSION – SCHOOL 1

To understand teachers' lived experiences within School 1, the case study site and participants must be contextualised. Therefore, this chapter begins with a summary of the site visit at the school, followed by a summary of teachers' personal technology use, teaching experience, a brief description of each teacher interviewed and an overview of the school's response to the COVID-19 pandemic (Olivier, 2020). Next, to provide a holistic understanding of School 1 and its teachers' beliefs, findings and discussions are presented using within-case analyses for each of the relevant research questions, using codes drawn from the study's theoretical framework for the micro- and meso-level theories (see Table 8 for initial codes). In addition, as data was collected at three different intervals, teachers' accounts are presented in chronological order.

5.1 SUMMARY OF SITE VISIT

School 1 is an independent IEB school focused on reinforcing positive learner behaviour in order to foster a family-like and caring atmosphere, with learners encouraged to refer to teaching staff by their first names.

School 1 is considered a middle-range fee school with most of the learners coming from advantaged homes. In the last few years, the school has grown and currently has over 400 learners, with a maximum class size of 25. There are 30 teaching staff, the majority being female. The school offers a diverse set of subject choices with English being the language of instruction even though the majority of learners do not come from English-speaking homes. Furthermore, School 1 aims to enhance learners' creativity, reflective thinking, social awareness and self-management by focusing on inquiry-based learning with a flipped classroom pedagogic approach.

School 1 is well resourced in regard to technology. All learners are required to have their own tablets loaded with *miEbooks* controlled by the school's IT support staff. While the school has a no cellphone policy, cellphones can be used temporarily when learners' tablets are broken. Teachers are provided with school laptops and use an LMS and *ITSI* to record marks, communicate and push content to learners. In addition, specialised technology devices for certain subjects are available to teachers. There are also two laptop labs loaded with all the latest software. All classrooms have projectors affixed to the

ceiling, smartboards and whiteboards, with learners' desks mainly arranged in pods to encourage learner discussion and teacher facilitation.

5.2 TEACHERS

Five teachers with different subject specialisations were interviewed at School 1. Two teachers are relatively newly qualified with School 1 being their first teaching post, two have taught at other schools for a short while before joining School 1, and one teacher has been teaching for over 35 years. In relation to personal use of technology, while some teachers report using technology for every facet of their personal lives including social media, news, ordering food, transport, cloud storage, banking, shopping, scheduling their time and streaming, others report limited personal use outside of messaging and communication through *WhatsApp* or email. Table 12 provides a summary of teachers' experience and personal technology use.

Table 12: Teacher's Experience and Personal Technology Use - School 1

Pseudonym	Teaching Experience	Years at School 1	Subject Taught	Personal Use of Technology
Carol	15 years	10 years	Social Science	I have everything on my phone, all my emails, my *OneDrive*…I stream a lot of shows…it is 99 per cent for entertainment purposes.
Lennie	4 years	2 years	Engineering, Graphics & Design (EGD)	For almost everything, I can't think of anything where don't use technology…for transport, entertainment, *WhatsApp* for communication, phoning, transport…even food.
Maxine	3 years	3 years	Accounting	I'm completely computer literate…I'm quite savvy with *Microsoft Office* and all their programmes. I'm still on computer emails and obviously the smartphone, I'm not a big Instagram user or stuff like *Facebook*. I am part of the older generation…use *WhatsApp* a lot for communication…I don't stream videos…not for entertainment…I like to listen to podcast sermons and talks like that… and use electronic banking.
Magda	38 years	14 years	Maths	I use technology everywhere…I use it to read newspapers…banking…I don't get emails on my phone…not many apps…no *Facebook*.
Shirley	6 years	2 years	Maths	In my personal life, I use technology a lot, I plan everything…I make grocery shopping lists on the app, we plan our whole lives on *Google Calendar*…watch a lot of videos about whatever topics arise…obviously *WhatsApp* to send messages…then all the internet banking, Netflix, the normal stuff.

5.2.1 Carol

Carol is a dynamic teacher with an outgoing and bubbly personality. While she enjoys using technology in her teaching, she believes a blended approach is more appropriate as learners still need to write and develop parts of their brains through exposure to a variety of pedagogic modes. She views herself as technologically skilled and is happy to make use of technology in the classroom where it makes sense, enhances the learning experience and makes her life easier. Carol is seen as one of the unofficial technology champions in the school and is constantly helping her peers with queries and issues. While Carol likes to facilitate learning in the classroom by moving around amongst the learners and discussing content rather than lecturing, she has firm boundaries between herself and learners.

5.2.2 Lennie

Lennie is a young and tech-savvy teacher who makes extensive use of technology in both his personal and work life. He enjoys working with specialised technology, much of which he has taught himself, and uses it to empower learners through practical hands-on and virtual experiences. Due to his passion, he informally assists, trains, and exposes teachers and learners to the latest technology tools. Lennie also enjoys collaborating with and learning from other schools to solve technology and curriculum-related issues. Lennie chose teaching as a profession because he feels it is the most effective way to impact the world by shaping and guiding the next generation of leaders by giving them crucial skills needed to be successful in an ever-changing world. Lennie likes to control the classroom and has strong professional boundaries between himself and the learners. He views mutual respect between teachers and learners as essential to a conducive learning environment.

5.2.3 Maxine

Maxine is a newly qualified teacher who worked in a professional capacity in the subject she now teaches. While she sees the benefit of technology use in the classroom and finds using technology essential for presenting and displaying content, she believes that her subject does not really lend itself to being completely technology-driven. In her personal life, she limits her technology use to communication and occasional listening to podcasts. While Maxine considers herself a lifelong learner and would like to use new and innovative technology tools, she feels she lacks the time to search for the information or learn it on her own and thus would appreciate hands-on training sessions. For Maxine, active learner engagement and hard work are essential for meaningful learning to take place but she is frustrated by the lack of work ethic and respect in the millennial generation. While Maxine prefers to control the learning context in the classroom, asking questions is encouraged.

5.2.4 Magda

Magda is a devoted and experienced teacher who has been with the management of School 1 since its inception. Magda's use of technology in her personal life is focused on reading the news and for communication with boundaries between her work and personal technology use. While Magda feels that she can always ask if she needs further guidance or assistance on technology, she appreciates training sessions on new technologies and novel ways of integrating technology even though some of the training is not relevant to

her as she will be retiring within the next few years. Although the technology was initially challenging for Magda, she now feels reliant on technology for the projection of content and is lost when the technology is not working. While Magda sees herself as a holistic educator building the next generation, she also considers herself strict and controls the classroom through mutual respect between herself and the learners.

5.2.5 Shirley

Shirley is a dedicated and passionate teacher who feels that technology is indispensable and uses it for almost every facet of her personal life. Shirley loves using technology in her teaching as she feels it enables learners to review concepts not understood and can make the learning context more exciting and thus is constantly teaching herself new ways to incorporate it into the classroom. Nevertheless, she believes that technology should not be used to replace teachers. Shirley feels that there is a lack of formal technology training at the school which is needed for teachers that are not comfortable using technology or feeling overwhelmed and she is happy to ask her peers who are always willing to assist. Shirley feels that teachers need to be lifelong learners as one needs to master concepts and skills before passing on knowledge. In addition, Shirley believes learners need to be actively involved in the learning process and teachers need to be caring and supportive whilst still maintaining professional boundaries with shared control.

5.3 SCHOOL'S RESPONSE TO CHANGES IN EDUCATIONAL CONTEXT[33]

5.3.1 Start of COVID-19 pandemic[34]

At the start of the COVID-19 pandemic, the South African government closed all school campuses from the 18th of March until the 1st of June 2020 (Mail and Guardian, 2020; South African Government, 2020). In order to **continue teaching remotely**, teachers report using **school-issued laptops:** *"we already have our laptops and all that stuff, so now we just have them at home"* (Carol); *"I already have a work computer that I could take home"* (Lennie); *"we had our laptops that we were already given"* (Shirley), as well as **additional software in the form of *MS Teams*** was purchased *"they actually bought* MS Teams*"* (Lennie); *"we are now relying on* MS Teams*"* (Carol); *"they've set us and the kids up with* MS Teams*"* (Maxine); *"we've got the system with* MS Teams *and everything"*

[33] Prior to COVID-19, all teachers and learners were on campus.
[34] At the start of the COVID-19 pandemic, all teachers and learners at school 1 were working remotely.

(Magda) and in **some cases, where needed, teachers were provided with data** *"*Rain *unlimited sim cards, so that we can still teach*" (Carol).

Furthermore, to ensure teachers were able to make use of technology, the school provided **extensive training and support** through the use of **"how to" videos** *"our IT teacher sent a lot of videos, instructions and documents to explain exactly how to do things"* (Lennie); *"our IT teacher made a lot of little videos for the teachers" (Maxine)* and created **small teacher-led technical teams** *"we have small team groups…before we closed we sat with our small team and did training*" (Carol), while head office provided **technical training** *"we have had a lot from head office…showed us some system tricks…posted exactly what to do"* (Lennie); *"they trained us on* MS Teams *and on more functions of* miEbooks*"* (Maxine) and **training on pedagogic changes needed for remote teaching** *"on quality over quantity"* (Carol), *"on how to engage kids more online"* (Maxine), *"to keep the students engaged or breathe more life into online classes"* (Shirley).

5.3.2 During COVID-19 pandemic[35]

During COVID-19, since School 1 is a smaller and independently run school, the closure of all South African government schools from the end of July till August 2020 did not stop teaching from continuing at the school, with **all teachers and most learners returning to campus** while catering for **leaners who preferred to continue remotely**. To accommodate both groups of learners, teachers report that the school adopted a **hybrid type approach** to teaching and learning[36] which requires all teachers to **record on-campus lessons** *"now all my lessons…the* MS Teams *meeting is running through the webcam"* (Carol); *"I am still recording all live lessons"* (Shirley); *"it's not actually a video of the lesson, it's more recording of the lesson"* (Magda) and to ensure that **remote learners are still able to participate** in classes through the ***MS Teams*** platform *"I'm teaching live in my class and the ones at home just dial in"* (Maxine). Table 13 provides a summary of School 1's response to the change in the educational context.

[35] During the COVID-19 pandemic, School 1 utilised a remote and hybrid model, with all teachers and most learners on campus, with some learners remaining at home.
[36] The hybrid model provides live teaching in the classroom while at the same to learners working remotely and usually includes both synchronous and asynchronous methods of instruction (Callahan, 2020).

Table 13: Summary of Response to Educational Context Change - School 1

Change in Educational Context	School's Response
Remote Teaching	• Teachers continued to use school-issued laptops • Head office bought a license for *MS Teams* • School provided some teachers with data • Technical and pedagogical training given by the school and head office • Support through small teacher-led technical teams
Hybrid Teaching	• Learners in-class and remote, all teachers on campus • All live lessons recorded

5.4 SCHOOL CONTEXT

The context in which teachers live and work provides important insights into understanding beliefs and subsequent technology integration practices (Ertmer, 2005). According to Ertmer et al. (2015), not only is it necessary to explore schools' policies and expectations but also cultural and societal norms at particular points in time. Therefore, in this study, to understand the school context and to answer the research question (1) *What is the context at different schools,* it is necessary to explore the **Context (C)** using Bernstein's theory of social class which includes **School Culture** C-SCu defined as **instrumental** or **expressive** (Bernstein, 1975), **Control** C-SC defined as **stratified** or **differentiated** (Bernstein, 1971a) and **Social Interaction** C-SI defined as **mechanical** or **organic** (Bernstein, 1971b)[37]. Findings are first presented, followed by a discussion on school context, with Table 14 providing a summary of School 1's context.

5.4.1 Culture

Teachers seem to be unified in their description of the culture at School 1 being a **family-based school with religious values** *"very family based"* (Carol), *"family orientated school"* (Shirley), *"it is a religious and family-based school"* (Lennie) with a **close group of teachers** *"the staff are very close…we share heartaches and we share joys"* (Carol); *"we're a tight knit group of teachers"* (Lennie) who aim to **provide discipline in a caring and positive manner** *"there is discipline but also a lot of praise"* (Maxine); *"helps us discipline in a very loving manner"* (Shirley); *"we believe in building relationships with the kids…not to only judge them on behaviour"* (Carol); *"we try and instill positive values in the children…we are mentors not just registered teachers"* (Magda).

[37] Question 20 on Culture; question 21 on Control; and question 22 on Social Integration can be found in Interview Protocol 1, Appendix A-1.

Teachers report that even though the school aims to produce good academic results, the school also focuses on providing **learners with life skills needed to contribute to society** *"we are focusing on the world out there, 'cause they are going out there when you're done with school"* (Lennie); *"we care that they are ready and able to adapt to the problems that life will bring"* (Shirley) through **emotionally supporting learners** *"there's a lot of emotional support…what we offer in terms of support, I think it's very special…we really put in a lot of effort"* (Maxine); *"it's not just academics…it's a very holistic perspective…we support them in everything"* (Shirley).

5.4.2 Control

Teachers all report that learners are grouped in class in **relation to their age** and not academic ability *"they fit into classes based on their age"* (Carol); *"they are just graded by age"* (Maxine); *"all grade 8s are together"* (Shirley); *"I teach grade 8s, they are all the same age"* (Magda).

5.4.3 Social Integration

Teachers report that although a lot of the teachers appear to be **favourable in relation to using technology,** *"I think most people are very excited about technology…a lot of people share my viewpoint"* (Shirley), *"others are open"* (Maxine), *"there's people that use technology a lot more than me"* (Carol), **some are still fearful** *"a handful are very intimidated"* (Shirley). While Magda believes **technology use is an individual decision** "*I think needs are different…for example when they say I must share this on* Instagram*, I don't want* Instagram*…other people may want that…that's fine, but I don't"*, Maxine feels the decision to use technology is often **based on the nature of subject taught** *"I think it differs from subject to subject…it is more difficult to use in analytical subjects like maths, science and accounting…kids just have to work stuff out…you cannot do it in any other way"*. Carol concurs that even though teacher's technology use **can be influenced by subject taught** *"it depends on your subject"*, **more importantly, it is an individual choice** "*if you're willing you can bring it in anywhere…for example the Afrikaans teachers uses the VR goggles…she makes them go to a random place and then write a descriptive essay"*.

5.4.4 Summary of School 1's Context

Findings indicate School 1 has a more **expressive culture** as teachers believe the school not only focuses on providing learners with school knowledge and rankings (Bernstein,

1975; South African Institute for Distance Education, 2010) but rather aims to develop learners' life skills in a caring and supportive manner (Bernstein, 1975; South African Institute for Distance Education, 2010) with **stratified control** as learners are grouped according to the fixed attribute of age (Bernstein, 1971a; South African Institute for Distance Education, 2010). With regard to integration, findings suggest that School 1 possesses a combination of **mechanical integration** because social cohesion is apparent (Bernstein, 1971b; South African Institute for Distance Education, 2010) as teachers seem to hold similar beliefs regarding the importance of family and religious values at the school and report that most educators subscribe to the school's pro-technology views (Shirley, Maxine, Carol) and **organic integration** since some teachers believe decisions to use technology are personalised and subject-based (Magda, Maxine, Carol) as teachers are seen as unique (Bernstein, 1971a; South African Institute for Distance Education, 2010).

Table 14: Summary of School Context - School 1

Culture – Expressive (C-SCu-E)
• Family and religious orientated school • Close group of teachers • Disciplined but caring, focus on positive behaviour and emotional support • Aims for good academic results along with skills needed to contribute to society
Control – Stratified (C-SC-S)
• Learners are grouped according to age
Social Integration – Combination (C-SI-M; CS-I-O)
• Lots of teachers are favourable about using technology • Individual decision to use technology and can differ between teachers • Subject being taught needs to be considered but willingness to use the technology most important

5.5 BELIEFS OF EXTERNAL TECHNOLOGY STRUCTURES - BY CONTEXT[38]

External technology Structures (ES) and teachers' associated beliefs (CSB) about these structures, which have been conceptualised in this study as **Resources (R)**; **Training (TR)**; **Support (S)**; and **Time (T)**, are shown in Table 8 and Figure 9.

In order to answer the research question (2) *what are the external structures at different schools,* a summary and discussion of the within-case analyses of teachers' general accounts of external technology resources at school 1 and their associated beliefs over time for each part of the theoretical framework is presented. Table 15 provides a summary

[38] While accounts of training and support are reported separately, the summary of findings and discussion have been combined to avoid repetition as much of the literature is related to both constructs.

of findings for teachers' beliefs of External Structures (ES) at school 1 by context, along with expanded subcodes drawn from the data (see Appendix D for expanded subcodes).

5.5.1 On-Campus Teaching

- **Resources**[39]

Johnson et al. (2016) and Rogers (2000) claim technology integration in the classroom does not simply rely on providing teachers with access to required resources but also necessitates teachers having extensive time and regular access to the resources because if teachers believe otherwise the prospect of incorporating technology into their pedagogic practice is reduced (Ertmer & Ottenbreit-Leftwich, 2010). In keeping with the literature, findings indicate even though the school owns a **small number of specialised devices** teachers report they are able to **integrate technology** as they believe **School 1** is a **technology-rich school** where both teachers and learners have **regular access** to a **wide range of resources** for extended **periods of time**, which include school-issued laptops for each teacher, learner-owned tablets, computer laboratories, every classroom fitted with a wireless projector and whiteboard, Wi-Fi throughout the school, and *miEbooks* software loaded on both teachers' and learners' devices.

Furthermore, according to Topracki (2006) and Sicilia (2005) unsuitable, unreliable, and poor resource quality often results in teachers not integrating technology into their pedagogic practices (Kopcha, 2012). However, Chigona et al. (2014), Sicilia (2005), and Vongkulluksn et al. (2018) claim that teachers place less emphasis on barriers and are more willing to put in the extra effort required when they believe technology enables their teaching while those who maintain technology does not benefit their classroom practice tend to amplify resource barriers and seek alternatives (Norris et al., 2003). Findings indicate that teachers **utilise** the **Wi-Fi even though** it is **slow** and **unreliable** at times, as teachers believe **without the internet** they are **unable to continue teaching**. However, teachers report they are **not using some specialised hardware** and ***ITSI* for maths assessments** due to **quality** and **unsuitability** concerns which suggests teachers feel these **technologies may not be assisting** them in **achieving** their **pedagogic goals**.

[39] Resource questions 4.1 to 4.3 asked prior to COVID-19, when teachers and learners were on campus, can be found in can be found in Interview Protocol 1, Appendix A-1.

For the physical arrangement of resources, Tondeur et al. (2008) and Mercier et al. (2014) argue that the placement of technology can either promote or limit technology integration, with traditional computer laboratories being seen as incongruent with current educational goals (Zandvliet, 2006). Findings agree as teachers believe the **physical arrangement** of **technology** in **classrooms** at School 1 with wireless ceiling-mounted projectors, whiteboards and laptop **laboratories** enables them to **utilise the technology effectively**.

- **Training and Support**[40]

Teachers report technology **training** at School 1 is **less frequent** than it was when the school first began integrating technology, with **limited induction training** for new teachers. Furthermore, while **some teachers** report they **do not need technology training** and are **happy to ask others** for assistance, teachers who are **fearful of asking their peers** or believe they **do not have the time** to **teach themselves** report they are **integrating technology less** as they **do not know how** and **where to use technology** in their teaching. Findings agree with Ertmer et al. (2012) who argue that insufficient training for new teachers as well as experienced teachers is the most commonly reported reason for the lack of technology integration since teachers need to constantly update their technical skills in order to effectively utilise technology in their teaching (Johnson et al., 2016).

In addition to the frequency of training, Schrum (1999) contends training that mainly consists of theoretical workshops with limited opportunities for practice is ineffective because teachers need time to learn and master basic "how to" skills before they can explore the value of technology in their teaching (Snoeyink & Ertmer, 2001). According to Johnson et al. (2016), while there is no standard way in which to train teachers, a progression of approaches is preferable (Joyce & Showers, 1983). Findings indicate that teachers believe **traditional professional development training**, which is **mostly technical** in nature and covers new system updates and demonstrations, is **insufficient** and instead, it is **the pervasive peer mentoring culture** at the school that is **crucial** in assisting teachers to **incorporate technology**.

[40] Training and Support questions 5.1 to 5.2 and 6.1 to 6.3 asked prior to COVID-19, when teachers and learners were on campus, can be found in can be found in Interview Protocol 1, Appendix A-1.

For support, Rogers (2000) claims both institutional support, which relates to the encouragement and funding for technology from the school administration, and technical support, which is contingent on financial support from the school and refers to a specialist who assists in maintaining technology, are essential for teachers to integrate technology (Ertmer et al., 2012). Findings concur as teachers indicate the **extensive support** at the school, which includes a **permanent on-site technical support person** who fixes all technology-related issues at the school timeously; a pervasive **culture of peer support** where teachers feel comfortable to ask for assistance; a **principal** who is very **pro-technology** and **supports technology initiatives** and the **head office support** team who deals with issues related to use of the administration system greatly **assists** them in **integrating technology** into their pedagogic practices.

In addition to types of support, as teachers' technology integration matures, the nature of support shifts from technical to more pedagogical (Ertmer, 1999) and the types of support personnel require should change from technology professional to more peer discussions and professional learning communities (Johnson et al., 2016). Findings concur as some teachers believe **more pedagogical support should be offered** for meaningful technology integration to occur as School 1 is a technology-mature school and many **teachers already possess technical "how to" knowledge**.

- **Time**[41]

Karasavvidis (2009) claims that time as relates to teachers' technology integration can be defined by familiarity which refers to time needed to learn new skills, explore affordances of technology, experiment with technology, and reflect on technology use for the future (Condie et al., 2007; Smeets et al., 1999; Conlon, 2004); and feasibility which describes teachers' concerns of technology being time-consuming and in some cases, not possible due to time constraints in current educational structures such as lesson times and the curriculum (Cuban, 2001). Findings are in keeping with the literature as teachers indicate even though they **can utilise technology effectively**, they believe **significant amounts of time** needs to be invested to **become familiar** with technology due to its **continuous evolution** and the **endless possibilities** it offers to education. So too for **feasibility**, findings suggest teachers believe **short lesson times**, demands of **covering the**

[41] Time questions 7.1 to 7.2 asked when teachers and learners were on campus, can be found in Interview Protocol 1, Appendix A-1.

curriculum, additional **preparation time** and **extra administration** often **limit the feasibility** of **using technology** in the classroom.

5.5.2 Remote Teaching

- **Resources**[42]

Findings indicate that teachers believe access to **additional hardware** and **software** which includes laptops, extra recording devices and *MS Teams* for pre-recording and giving live lessons, is **enabling** them to **continue** with the **academic** project. This finding concurs with Bergdahl and Nouri (2020), Hadijah and Shalawati (2017) who state teachers are only able to continue teaching remotely if they are provided with the necessary ***digital tools***. However, findings also indicate **access to data** is an **issue** for **some teachers** that has necessitates them **buying their own** as teachers believe they are **unable to continue** teaching remotely **without this access**. This finding concurs with Vongkulluksn et al. (2018) who claim that teachers seek alternatives or place less emphasis on barriers when they believe the technology is valuable to their teaching. In addition, findings suggest the **quality of internet connection differs** with **poor quality lines** affecting teachers' ability to conduct and record live lessons. This finding is in keeping with Bergdahl and Nouri (2020), Mailizar et al. (2020), Rasheed et al. (2020), and Giovannella et al. (2020) who contend that both teachers and learners need access to suitable digital tools to effectively teach remotely.

Furthermore, for physical arrangement, findings indicate teachers believe **stands provided** by the school are **assisting** them in **physically arranging** their technology to **easily record videos**. This is in keeping with Tondeur et al. (2008) and Mercier et al. (2014) who argue that the placement of technology can either promote or hinder technology integration.

- **Training and Support** [43]

Findings indicate teachers **no longer** feel **training** at the school is **insufficient**. A possible reason for teachers' change in beliefs may be that **extensive peer mentoring** and **head**

[42] Resource questions 1a to 1c asked at the start of COVID, when learners and teachers were remote, can be found in Interview Protocol 2, Appendix A-2.
[43] Training and Support questions 1 and 2 asked when learners and teachers were remote, can be found in Interview Protocol 2, Appendix A-2.

office training taking place is improving teachers' beliefs about their ability to successfully plan and integrate technology into their pedagogic practices (Kopcha, 2012). Another possible reason may be that **the focus of training** at the school has shifted towards more **pedagogic** type training which is seen by teachers as **more beneficial**. This concurs with Wells (2007) who claims that to be effective, training needs to connect to classroom practice and provide teachers with the necessary knowledge on how to effectively utilise technology in a specific context.

So too for support, findings suggest teachers believe **institutional support** which includes **standardising**, **purchasing**, and **training on *MS Teams***, along with the **technical support** for software issues and **peer support** through **"how to" videos** and **small teacher-led teams**, are **helping** them use the new technology tools for online teaching. This is in accordance with literature which states that the provision of appropriate resources (Bergdahl & Nouri, 2020), holistic and unified institutional support, and the necessary technical support is essential in encouraging and motivating teachers to integrate technology (Vandeyar, 2014; Ertmer et al., 2012).

Concerning the type of support, Johnson et al. (2016) state that professionals and technical-type support is needed in the beginning phases of technology integration whereas when technology integration matures, more peer and pedagogic type support is required. However, while findings indicate teachers believe **pedagogic support** and **peer involvement** is now **essential**, many also feel **technical support** is **needed** from **technology professionals**. A possible reason could be the **dramatic shift** in educational **context** — even teachers in **mature technology environments** require **technical assistance**.

- **Time**[44]

Findings indicate even though teachers still believe **lots of time is needed** to **prepare lessons** and **distribute content**, they maintain **time** spent on attending **training** from their **peers** and **head office**, coupled with the understanding they are **unable to continue** teaching **without the technology**, is really **assisting** them to become **more familiar** with technology tools needed for online teaching. This finding concurs with literature which

[44] Time questions 4a and 4b asked when learners and teachers were remote, can be found in Interview Protocol 2, Appendix A-2.

claims teachers are less focused on external barriers if they believe technology assists them in achieving their pedagogic goals (Vongkulluksn et al., 2018; Ertmer & Ottenbreit-Leftwich, 2010). However, findings also indicate some teachers believe current **extra time commitments** are **unsustainable**, as they are feeling **exhausted** and **overwhelmed**. This finding is in keeping with See, Wardle and Collie (2020) who claim that teachers' wellbeing is being adversely affected due to the additional time needed for remote teaching.

5.5.3 Hybrid Teaching

- **Resources**[45]

Findings indicate while **access**, **quality**, and **suitability** of **resources** for those on campus appear to be as they were **initially**, teachers believe **additional resources** are now **needed** to accommodate **learners still working remotely** and the **physical arrangement of technology** in the classroom has **changed** to facilitate the **recording of all lessons**. Although Kopcha (2012) claims that when teachers believe setting up technology is too complicated they may choose not to integrate technology into their pedagogic practices, findings suggest that even though the **physical arrangement is cumbersome** teachers are still **utilising the technology** for recording live lessons and accommodating learners still at home but **not** for recording **additional videos at home**. A possible reason may be teachers **do not believe setting up technology** to **pre-record videos is worth the effort** as they can continue teaching by recording live lessons. While this perspective concurs with Mhlanga and Moloi (2020); Vongkulluksn et al. (2018); and Ertmer and Ottenbreit-Leftwich (2010) who claim teachers are willing to put in the extra time and effort required when they believe using technology is the only way they can continue with the academic project, it seems as if technology integration is not linear since barriers do not automatically result in non-integration but rather that teachers' technology choices appear more multifaceted and bidirectional (Tondeur et al., 2017).

- **Training and Support** [46]

Findings show although **extensive training** seems to have been **scaled down**, with **fewer "how to" videos** and **small teams** being **less active** and **intentional**, teachers appear to

[45] Resource question 1 asked during COVID-19, when all teachers and most learners returned to campus, can be found in Interview Protocol 3, Appendix A-3.
[46] Training and Support question 1 asked when all teachers and most learners returned to campus, can be found in Interview Protocol 3, Appendix A-3.

believe **training** is still **adequate.** A possible reason may be the significant amount of **time teachers spent** learning **new technology skills** when **remote**. This finding is in keeping with Snoeyink and Ertmer (2001) who claim teachers believe training is only effective once they have had time to learn and master basic "how to" skills and practice extensively. In addition, it is possible that observing technically-skilled educators utilising technology during "how to" videos and in their small teams, coupled with teachers' need to use technology extensively for remote teaching, has improved teachers' beliefs about their technology skills (Farah, 2011) and thus less training is needed.

- **Time**[47]

Findings indicate teachers believe the **extra time** needed to **set up classrooms** for recording lessons is **feasible**, however, **time** needed to make **additional videos** for learners **is not**. A possible reason may be teachers **no longer** feel making **pre-recorded videos** is **essential** as **live lessons** are being **recorded**. This finding agrees with Vongkulluksn et al. (2018); Ertmer and Ottenbreit-Leftwich (2010) who argue that when teachers believe using technology is essential for their teaching they focus less on external barriers, such as time.

[47] Time question 2 asked when all teachers and most learners returned to campus, can be found in Interview Protocol 3, Appendix A-3.

Table 15: Summary of Teachers' Beliefs of External Technology Structures - School 1

On Campus	Remote	Hybrid
Resources (ES-R and CSB-R)		
Access (ES-R-A, CSB-R-A)		
Hardware (R-AH); Software (R-AS)		
• Wide range of access to hardware • No Apple TV limits mobility • Limited specialised devices • Access to *ITSI* and *miEbooks* • No accounting software	• Additional hardware given • Access to *ITSI* and *MS Teams*	• Similar to before remote teaching • Need to access different resources to cater to learners at home
Wi-Fi/Data (R-AW)		
• Wi-Fi throughout school	• Different data access for teachers	
Quality and Suitability (ES-R-Q, CSB-R-Q)		
Hardware (R-QH); Software (R-QS)		
• Mainly of high quality • 3D printers an issue • *ITSI* hard to use for maths	• Desk cameras not suitable as skips words and recording blurred • *MS Teams* suitable but crashes	
Wi-Fi/Data (R-QW)		
• Wi-Fi slow and unreliable • Hinders effective technology use	• Quality of different data lines an issue, affects remote teaching	
Physical Arrangement (ES-R-P and CSB-R-P)		
Classroom Setup (R-PC); Remote Setup (R-PR)		
• Projector ceiling mounted and wireless, facing whiteboard in front • Control devices from Android phone • Can face learners with visualiser • Desks in pods or front-facing	• Stands made to physically hold device when recording • Quiet space needed to record	• Classes physically arranged to cater for learners at school and at home • Takes time to arrange devices to record lessons • No videos as set-up time too much
Training (ES-TR, CSB-TR)		
Extent (ES-TR-E, CSB-TR-E)		
Frequency (TR-EF)		
• Infrequent training, not sufficient for newer teachers	• Widespread and frequent from peers, small teams and head office	• Scaled down, optional if needed • Small teams not as active
Training Provided (TR-EP)		
• Can ask peers for help or teach themselves	• Lots of peer training with small team • Extensive training from head office	• Small teams not as active as can now ask in person
Quality (ES-TR-Q, CSB-TR-Q)		
Professional Development (TR-QPD); Courses (TR-QC)		
• Focus on software updates or new apps from school and head office • Principal supportive of courses	• On how to use the new software and pedagogic changes	
Peer Mentoring (TR-QPM); Communities of Practice (TR-QCP)		
• Skilled peers assist, ask for help • Share best practices with technology	• Organised with videos, small teams • Helped other schools with remote	• More informal and less deliberate
Type of Training (TR-QT)		
• Mainly theoretical or show and tell	• Practical and pedagogic training	• Informal peer mentoring, training

On Campus	Remote	Hybrid
Support (ES-S and CSB-S)		
Technical (ES-S-T, CSB-S-T); Institutional (ES-S-I, CSB-S-I)		
Location (S-TL, S-IL)		
• Person on site, can call or message • Team at head office, phone or email	• Support available remotely	• Permanent support person on site
Function (S-TF, S-IF)		
• Fixes technology issues at school • For admin system and updates	• Fixes all software issues • *MS Teams* and pedagogic support	
Response Time (S-TRT, S-IRT)		
• Very prompt and responsive • Delayed response	• More responsive, hard remotely	
Peer Support (S-TP); Communities of Practice (S-TC)		
• Skilled peers assist, can ask others • With teachers at different schools	• Made videos and with small groups • Helped other schools with remote	• Fewer videos, teams less active
Nature of Support (ES-S-N, CSB-S-N)		
Technical Support (S-NT)		
• On "how to" to use technology • Updates by peers and head office	• Videos, small teams by peers • Using software by head office	
Pedagogical Support (S-NP)		
• Pedagogical support should be provided on using technology effectively for teaching	• Given by head office on remote • Some find it not useful but required to attend	
Time (ES-T and CSB-T)		
Familiarity (ES-T-F, CSB-T-F)		
Use (T-FU)		
• Able to use for what they need, mainly for support and admin tasks	• Able to use tools for remote teaching and learning	• Extended and learnt new technology skills for hybrid approach
Time and Effort (T-FTE)		
• Lots of time needed to be familiar, do not always have the time • Need to time to learn continuously	• Lots of time needed to be familiar	• Lots of time and effort, more familiar
Support (T-FS)		
• Can learn from peers or learners	• Technical and "how to" support from small teams and peers • Technical and pedagogic support from head office	
Feasibility (ES-T-FE, CSB-T-FE)		
Time to Learn (T-FEL)		
• Takes lots of time to learn new skills and find out about technology	• Support and training assisted but still need lots of time to be familiar	• Less time as now familiar • Time needed to self-teach, explore
Time to Use (T-FEU)		
• Classes too short for practical use	• Takes time even though familiar	
Time to Prepare (T-FEP)		
• Large amount of time needed to prepare but can save time later	• Huge amounts of time needed to prepare and distribute content	• Time is still needed to prepare classroom setup
Time to Administer (T-FEA)		
	• Extra admin required takes time	• Extra admin is exhausting

5.6 BELIEFS OF EXTERNAL TECHNOLOGY STRUCTURES – BY TEACHER

According to Ertmer (1999), it is not only important to understand what External technology Structures (ES) exist within a particular context but one also needs to explore individual teachers' beliefs about these structures as this can influence teachers' willingness to integrate technology in the classroom (Van Der Ross & Tsibolane, 2017). Therefore, to answer the research question (3) *What are different teachers' beliefs around external structures,* first a summary and discussion of the within-case analyses of different teacher's accounts of each ES at School 1 and their associated beliefs in relation to TTU-SST are presented. Then an overall discussion of different teachers' beliefs about ES at the school is provided. Table 16 presents a summary of the findings for ES, and Appendix E-1 provides the detailed analyses for each teacher's account of ES.

5.6.1 Resources

Findings indicate **Maxine** and **Magda** appear to hold similar beliefs that although technology plays an important role in **supporting** their **teaching**, at times they feel it **hampers their efforts**. Reasons include lack of **access to software** *"I wish I could expose, especially my seniors...but funding is a problem"* (Maxine) and **data** *"I really feel it is inadequate"* (Maxine) *"I've got a big problem...I've really run out data...I'm not the only one"* (Magda); **poor quality** and **suitability** of **hardware** *"these desk cameras...takes away words while I'm recording for no reason"* (Magda) and **software** *"*MS Teams*...just collapses now and then...freezes up...you have to leave the meeting and reconnect"* (Maxine) *"can't type the different formulas...it is too difficult...it is not suitable"* (Magda) and **physical constraints** of technology for **on campus** *"without an Apple TV...have to sit at my desk and scroll"* (Maxine), *"miss the Apple TVs...I could use my iPad...to highlight on"* (Magda) as well as for **remote** and **hybrid** teaching *"it takes time...to set up the meeting on* MS Teams*"* (Magda).

On the other hand **Carol**, **Lennie**, and **Shirley** appear to believe technology **enhances** and **advances** their **pedagogic practices** *"it advances learning in my subject"* (Carol), *"makes whatever we do in class easier"* (Lennie), *"it really help us do our job"* (Shirley) and report even though access to specialised devices requires **alternatives** to be **explored** *"looking for technology...so we can teach all learners...even those at home"* (Lennie) and **data quality** is a **barrier** *"you lose touch with some of them...when you can't see them"* (Carol), *"for learners...can be quite frustrating...I would not be able to follow anything...their*

line is so slow" (Shirley). When teaching on campus and remotely, **primary concerns** seem to be centred around how these issues **limit** their ability to **teach** and **connect with learners**.

These findings agree with Woodbridge (2003) and Vongkulluksn et al. (2018) who claim that incorporating technology is an individual choice based on teachers' beliefs and perceptions towards the value of technology. Teachers who believe technology enhances their classroom practice more commonly perceiving barriers as minor and actively working around the constraints to integrate technology whereas teachers who believe benefits of technology are not as significant tend to amplify barriers present (Ertmer & Ottenbreit-Leftwich, 2010).

5.6.2 Training and Support[48]

While Ertmer et al. (2012) claim that inadequate professional training is teachers' most commonly reported reason for lack of technology integration, findings indicate that even though most teachers believe **formal on-campus training** is **inadequate** *"when we started there was a lot"* (Carol); *"it is not sufficient"* (Lennie); *"would like to have more training"* (Maxine); *"I haven't had any technology training since I joined"* (Shirley) as it **wastes time** *"I get it in the first two or three minutes...then you need to sit through the rest"* (Carol); *"we don't need any more training"* (Magda) and should be **more pedagogic** *"show and share with us how the technology works"* (Maxine); *"there's a lot of teachers...who are afraid of technology"* (Shirley), **all teachers** report they **incorporate technology** as they are able to **teach themselves** when needed *"you can ask others...get the information yourself"* (Carol); *"we show each other each"* (Lennie); *"we can do it ourselves"* (Magda); *"I teach myself"* (Shirley). Therefore, despite training concerns, whilst it is possible the **pro-technology culture** at the school is **motivating teachers** to incorporate technology into their teaching (Zhao & Frank, 2003; Hennessy et al., 2010), it seems as if teachers' **unified beliefs** as to **permanent on-site** and **head office support** for **technical issues** while **on campus** *"there is help"* (Carol); *"have a physical contact person"* (Lennie); *"he is good at getting you up and running...at head office there's a whole support centre"* (Maxine); *"there's sufficient support"* (Magda); *"support is more than sufficient"* (Shirley), formal **head office training** on ***MS Teams*** and **technical software support** when

[48] The summary of the findings and discussion have been combined to avoid repetition as much of the literature is related to both constructs.

teaching **remotely** *"all stuff like that is happening"* (Carol); *"our IT support person...small teams...a lot from head office"* (Lennie); *"there's a technical teacher...it's really worked...trained us on MS Teams...it is helpful"* (Maxine); *the guidance...is invaluable"* (Magda); *"there's a lot of support"* (Shirley) and **peer mentoring and support in all contexts** *"you can ask other teachers"* (Carol); *"people here are willing to help"* (Lennie); *"if a school doesn't have a person like her, then I don't know how they would cope"* (Maxine); *"we can always go and ask"* (Magda); *"everyone here helps each other"* (Shirley), are **crucial** in assisting teachers utilise technology effectively in their teaching. This is in keeping with Rogers (2000) who claims sufficiency in quality and quantity of technical or institutional support is essential to promoting technology integration.

Furthermore, according to Bernstein (1971b), mechanical integration occurs when teachers hold a common set of beliefs while organic integration takes place when there is an appreciation that people are unique. Findings suggest a **combination of integration approaches** is present at the school since, although teachers' beliefs about training and support are **unified in most instances**, **differences exist** due to **individual teacher's opinions** and **changing teaching contexts**. This is in agreement with Levin and Wadmany (2005) who claim teachers can hold multiple opinions, as forming beliefs is an individual process, unique to each teacher and influenced by the context in which the teacher finds themself (Tondeur et al., 2017).

5.6.3 Time

Findings indicate most teachers' beliefs as to time needed to become **familiar** with technology and the **feasibility** of using technology in the classroom are similar and include it takes **time to learn how to use technology** effectively *"so the first time you do something new it's obviously going to take you time"* (Carol); *"spend time learning and teaching myself"* (Lennie); *"I don't have the time to go and dig for it"* (Maxine); *"it is a lot of preparation...every minute is hectic"* (Magda); *"it takes a long time"* (Shirley), being **happy to ask their peers** *"we can always ask other teachers to help"* (Carol); *"people here are willing to help"* (Lennie); *"teachers help me"* (Maxine); *"if I don't know I will find out"* (Magda); *"there are colleagues here I can run to and they help"* (Shirley) and in some instances **learners** *"if we struggle we can ask the kids"* (Carol); *"learned a lot from the kids themselves"* (Lennie) when needed, **continuously learning** about new ways to utilise technology *"we are lifelong learners"* (Carol); *"every single day there is something new I*

can try" (Lennie); *"I know there are many more things"* (Shirley), and **wanting to know more** *"there is a lot more that could be done"* (Maxine). In addition, while some teachers believe it takes **time to use technology** in class *"time constraints are a big problem...using technology can only happen...after school"* (Lennie); *"I don't have the luxury of putting a whole period aside"* (Maxine), others believe the **extra time** needed to **prepare content** is **worthwhile** as it **saves time** later on *"once you have got it...the next year you can do other sections"* (Carol) and **benefits teaching** *"without technology I think it would be a struggle and may even take longer"* (Shirley). These findings agree with Hadijah and Shalawati (2107); Mailizar, et al., (2020) who claim that even though many teachers believe technology can benefit education, teachers who are already stretched for time in their daily activities are concerned about the extra time needed to prepare content; learn, explore and practice using technology devices; handle technical problems and receive sufficient training.

When **remote**, all teachers report although they are **more familiar** with the technology due to peer and head office training and support, their extensive use, and the ability to teach themselves, they believe **lots of extra time** is needed to **prepare** and **distribute content** to the learners *"I don't think we can continue...it is just not feasible"* (Carol); *"it's hours more work to teach like this...it is a nightmare"* (Maxine); *"I don't think they realise how tiring this is"* (Magda); *"the uploading also takes time...you have to share the link...post guidance documents...all that takes time"* (Shirley) with only **Lennie** reporting rethinking his pedagogic practice has resulted in **less time demands** *"if I just teach differently...you can lessen the time you spend"*. When **back on campus**, while all teachers feel they are **more familiar** with technology and some are using it **more extensively** *"being challenged to use it consistently"* (Carol); *"I feel more easy with technology now"* (Maxine), they believe **using technology** to cater to **learners at home** and at **school is not feasible** in the long term, reasons differ as to where time is needed: to **prepare videos** *"that is burnout for a teacher"* (Shirley); to **set up the classroom** for recording *"it is a lot of preparation"* (Magda); do **extra administration** *"the admin is very exhausting"* (Magda); *"the extra admin...it is killing me"* (Maxine) and **learn new skills** *"the first time in my life I have looked at programming languages"* (Lennie). While findings concur with Hadijah and Shalawati (2017) who contend that even though teachers believe finding extra time to prepare lessons using technology is a challenge, sufficient professional development training and technical support can greatly assist teachers in gaining confidence in their

technology skills and it is essential for the impact on teachers' wellbeing due to additional time needed for hybrid teaching to be considered (See et al., 2020).

5.6.4 Different Teachers' Beliefs of External Structures

Overall findings suggest teachers hold **many similar beliefs** as to the ES at School 1, however, **Magda**, a teacher who is almost at retirement age, and **Maxine,** a newly qualified teacher, believe the technology simply **supports** their **teaching** activities and appear to be more **focused on ES barriers** while **Carol, Lennie** and **Shirley** who believe technology can greatly **enhance the educational experience** seem to **find ways** to explore and **address** them. According to Woodbridge (2003) and Vongkulluksn et al. (2018), teachers who believe technology enhances education focus on seeking alternatives to counter issues whereas teachers who believe technology simply play a supporting role in their teaching can magnify them (Ertmer & Ottenbreit-Leftwich, 2010). However, Tondeur et al. (2017) contend that while teachers who believe technology provides value are also more likely to incorporate technology and work around barriers, teachers' technology integration is an iterative process involving bidirectional relationships between beliefs, practice and technology use mediated by the teachers' school context. These perspectives may account for the **coexistence** of **cohesive** and **disparate teachers' beliefs** in **relation to ES** even though **School 1** has a **technology-rich** environment.

Table 16: Summary of Different Teacher's Beliefs of External Structures - School 1

Carol	Lennie	Maxine	Magda	Shirley
Resources (ES-R and CSB-R)				
On Campus				
Access (ES-R-A, CSB-R-A); Quality and Suitability (ES-R-Q, CSB-R-Q)				
Hardware (R-AH, R-QH)				
•Wide range access •No Apple TV so mobility limited	•Wide range access •Special devices few •Some poor quality	•Wide range access •No Apple TV so mobility limited	•Access to laptop, projector •No Apple TV	•Wide range access •Has a visualiser
Wi-Fi/Data (R-AW, R-QW)				
•Wi-Fi whole school but slow	•Wi-Fi whole school but slow	•Wi-Fi whole school, slow, unreliable	•Wi-Fi whole school	•Wi-Fi whole school but slow
Software (R-AS, R-QS)				
•Use *ITSI*, *miEbooks*	•Use *ITSI*, *miEbooks*	•Use *ITSI*, *miEbooks*, no account package	•Use *ITSI*, *miEbooks*, not suited for maths	•Use *ITSI*, *miEbooks*
Physical Arrangement (ESR-R, CSB-R-P)				
Classroom Setup (R-PC)				
•Most well placed •Mobility limited due to device control •Desks in pods	•Arranges learners in groups around a table	• Most well placed • Mobility limited if no Wi-Fi for laptop • Desks front-facing	•Most well placed •Mobility limited due to device control •Desks front-facing	•Most well placed •Visualiser face class •Desks in pods
Remote				
Access (ES-R-A, CSB-R-A); Quality and Suitability (ES-R-Q, CSB-R-Q)				
Hardware (R-AH, R-QH)				
•Access to school laptop	•Access to school laptop •No special devices, alternative needed	•Access to school laptop	•Access to school laptop • Have desk camera but use phone rather	•Access is adequate •Have visualiser
Wi-Fi/Data (R-AW, R-QW)				
•School gave data, but poor •Quality of internet limits connection	•Data does not seem to be an issue	•No data provided by school, is an issue	•No data provided by school, is an issue	•Uncapped fibre at home •Poor internet quality an issue
Software (R-AS, R-QS)				
•Got *MS Teams* •Use *ITSI*, *YouTube*, *PowerPoint*	•Got *MS Teams* •Use *ITSI*, video software, *WhatsApp*	•Got *MS Teams*, but crashes, waste time •Use *ITSI*	•Got *MS Teams* •Use *ITSI*	•Got *MS Teams* •Use *ITSI*, *YouTube*, other free software
Physical Arrangement (ES-R-P, CSB-R-P)				
Remote Setup (R-PR)				
•Stands made to hold devices	•Stand to hold device •Setup takes time	•Setup takes time	•Hard to arrange camera, made a box	•Need quiet space •Setup takes time
Hybrid				
Classroom Setup (R-PC)				
•Arranged to record lessons	•Arranged to record lessons	•Arranged to record lessons	•Arranged to record lessons, takes time	•Arranged to record lessons, takes time

Carol	Lennie	Maxine	Magda	Shirley
Training (ES-TR and CSB-TR)				
On Campus				
Extent (ES-TR-E, CSB-TR-E)				
Frequency (TR-EF)				
• Erratic, infrequent	• Insufficient to keep up with technology	• Insufficient, no time to learn on her own	• Training is sufficient	• Insufficient for new teachers and do not like to ask
Provided by (TR-EP)				
• Mainly peers • Some head office, school • Self-taught	• Mainly peers • Some head office • Self-taught • Few outside course	• Mainly peers	• Mainly peers • Self-taught	• Mainly peers • Self-taught • Outside courses
Quality (ES-TR-Q, CSB-TR-Q)				
Professional Development (TR-QPD); Courses (TR-QC); Peer Mentoring (TR-QPM) Communities of Practice (TR-QCP)				
• Formal training waste of time • School supports courses • Self-teach, others • Asks peers	• Like formal training, head office, courses • Self-teaches, others • Asks peers • Part of community of practice	• Would prefer more formal training, no time to teach herself • Asks peers	• Can self-teach • Ask peers • Can attend courses	• Attends courses • Self-teach, others • Asks peers
Type (TR-QT)				
• Mainly technical	• Mainly technical • Specialised training	• Mainly theory • Prac, need teaching	• Mainly technical	• Mainly technical • Pedagogic needed
Remote				
Extent (ES-TR-E, CSB-TR-E)				
Frequency (TR-EF)				
• Lots of training	• Peer training videos and small teams	• Peer training videos and small teams	• Peer training videos and small teams	• Peer training videos and small teams
Provided by (TR-EP)				
• Peers, head office how to use tools • Pedagogic from head office	• Peers, head office on how to use tools • Pedagogic from head office	• Peers, head office how to use tools • Pedagogic from head office	• Peers, head office on how to use tools	• Peers, head office on how to use tools • Pedagogic from head office
Quality (ES-TR-Q, CSB-TR-Q)				
Professional Development (TR-QPD); Courses (TR-QC); Peer Mentoring (TR-QPM) Communities of Practice (TR-QCP)				
• Peer mentoring • Head office train	• Peer mentoring • Head office train	• Peer mentoring • Head Office train	• Peer mentoring • Head office train	• Peer mentoring • Head office train
Type (TR-QT)				
• Technical • Pedagogic	• Technical • Pedagogic	• Technical • Pedagogic	• Technical	• Technical • Pedagogic
Hybrid				
Extent (ES-TR-E and CSB-TR-E), Quality (ES-TR-Q and CSB-TR-Q)				
Frequency (TR-EF)				
• Less often, ad-hoc	• Less often optional	• No training offered		
Professional Development (TR-QPD); Courses (TR-QC); Peer Mentoring (TR-QPM) Communities of Practice (TR-QCP)				
• Mainly peers	• Mainly peers	• Mainly peers	• Mainly peers	• Mainly peers
Type (TR-QT)				
• Technical	• Technical			• Technical

Carol	Lennie	Maxine	Magda	Shirley
Support (ES-S, CSB-S)				
On-Campus				
Technical (ES-S-T, CSB-S-T); Institutional Support (ES-S-I, CSB-S-I)				
Location (S-TL, S-IL)				
• On-site tech support • Head office remote	• On-site tech support • Head office remote	• On-site tech support • Head office remote	• On-site tech support	• On-site tech support • Head office remote
Function (S-TF, S-IF)				
• On-site tech issues • Head office admin	• On-site tech issues • Head office admin	• On-site tech issues • Head office admin	• On-site tech issues	• On-site tech issues • Head office admin
Response Time (S-TRT, S-IRT)				
• On-site fast • Head office delayed	• On-site fast • Head office okay	• On-site fast • Head office delayed	• On-site fast	• On-site fast
Peer Support (S-TP); Communities of Practice (S-TCP)				
	• Peer support culture		• Peer support culture	• Peer support culture
Nature of Support (ES-S-N, CSB-S-N)				
Technical (S-NT); Pedagogical Support (S-NP)				
• Mainly technical	• Mainly technical	• Mainly technical • More pedagogical needed	• Mainly technical	• Mainly technical • More pedagogical needed
Remote				
Technical (ES-S-T, CSB-S-T); Institutional Support (ES-S-I, CSB-S-I)				
Location (S-TL, S-IL)				
• IT support person, head office remote	• IT support person, head office remote			• IT support person, head office remote
Function (S-TF, S-IF)				
• IT support person for software issues • Head office for technical, pedagogic	• IT support person for software issues • Head office for technical, pedagogic	• IT support person for software issues • Head office for technical, pedagogic		• IT support person for software issues • Head office for technical, pedagogic
Response Time (S-TRT, S-IRT)				
• IT support person still responsive	• IT support person still responsive			• IT support person still responsive
Peer Support (S-TP), Communities of Practice (S-TCP)				
• Videos, documents from IT teacher • Small groups led by tech-savvy teachers	• Videos, documents from IT teacher • Small groups led by tech-savvy teachers	• Videos, documents from IT teacher • Small groups led by tech-savvy teachers	• Videos, documents from IT teacher • Small groups led by tech-savvy teachers	• Videos, documents from IT teacher • Small groups led by tech-savvy teachers
Nature of Support (ES-S-N, CSB-S-N)				
Technical (S-NT); Pedagogical Support (S-NP)				
• Technical support provided by peers • Technical, pedagogic by head office	• Technical support provided by peers • Technical, pedagogic by head office	• Technical support provided by peers • Technical, pedagogic by head office	• Technical support provided by peers	• Technical support provided by peers • Technical, pedagogic by head office

Carol	Lennie	Maxine	Magda	Shirley
Time (ES-T and CSB-T)				
On Campus				
Familiarity (ES-T-F, CSB-T-F)				
Use (T-FU); Time and Effort (T-FTE)				
•Familiar with technology •Always learning	•Familiar with technology •Always learning	•Familiar with technology •Need to know more	•Familiar to do what is needed •Part of pedagogy	•Familiar with technology •Always learning
Support (T-FS)				
• Ask peers, learners	• Ask peers, learners	• Ask peers, learners	• Ask peers	• Ask peers
Feasibility (ES-T-FE, CSB-T-FE)				
Time to Learn (T-FEL); Time to Use (T-FEU); Time to Prepare (T-FEP); Time to Administer (T-FEA)				
• Takes time to learn • Saves time, only prepare once	• Takes time to learn and explore • Takes time to use, so do after school	• No time to learn on her own, would prefer training • Time to use a lot	• Takes time to learn and explore	• Time to learn, explore, not effective • Prepare takes time, but benefits teaching
Remote				
Familiarity (ES-T-F, CSB-T-F)				
Use (T-FU); Time and Effort (T-FTE)				
•More familiar as tech used a lot	•Dedicated time to learn new skills	•More familiar due to training and support	•More familiar due to training and support	•More familiar due tech used a lot
Support (T-FS)				
• Peers, head office • Self-taught	• Peers, head office • Self-taught	• Peers, head office • Self-taught	• Peers, head office • Experiments herself	• Peers, head office • Self-taught
Feasibility (ES-T-FE, CSB-T-FE)				
Time to Learn (T-FEL); Time to Use (T-FEU); Time to Prepare (T-FEP); Time to Administer (T-FEA)				
• Extend skills • Prepare takes time	• Prepare takes time • Need to rethink pedagogic	• Prepare takes time • Upload, admin takes time	• Prepare takes time • Upload, admin takes time	• Extend skills • Prepare, upload takes time
Hybrid				
Familiarity (ES-T-F, CSB-T-F)				
Use (T-FU); Time and Effort (T-FTE)				
•More familiar as used extensively	•More familiar as used extensively	•More comfortable as used extensively	•More familiar but finds it exhausting	•More familiar and taking less time
Feasibility (ES-T-FE, CSB-T-FE)				
Time to Learn (T-FEL); Time to Use (T-FEU); Time to Prepare (T-FEP); Time to Administer (T-FEA)				
•Doing both not sustainable •Use more consistently	•Doing both is not sustainable •Learning new skills takes time	•Extra time for admin, preparation, feedback	•Lots of time to setup class and admin	•Doing both not sustainable •Preparation time a lot

5.7 INTERNAL BELIEFS OF TECHNOLOGY - BY TEACHER AND CONTEXT

Internal Beliefs (IB) have been conceptualised in this study as **Pedagogy (P)**; **Norms (N)**; **Knowledge (K)**; **Value of ICT (V)**; and **Self-efficacy (SE)**, are shown in Table 8 and Figure 9.

In order to answer the research question (4) *What are different teachers' internal beliefs about technology* a summary and discussion of the within-case analyses of different

teacher's accounts of Internal Beliefs (IB) at School 1 as relates the changing educational context and TTU-SST, are first presented. Thereafter, since belief systems are constructed from a combination of beliefs (Liu, 2011) an overall discussion of different teachers' IBs at the school is provided. Table 17 presents a summary of the findings for IB, and Appendix E-2 provides the detailed analyses for each teacher's account of IB.

5.7.1 Pedagogical Beliefs[49]

Findings indicate teachers hold varied **pedagogical beliefs** as to the **aims of teaching**, which include **passing on knowledge** *"know if their child can do the subject"* (Magda) and **providing skills** and instilling the notion of **lifelong learning** *"they can never stop learning"* (Shirley); *"focus on what skills they have"* (Lennie). Similarly, in regard to the **role of the teacher**, beliefs seem to **exist on a continuum** with some teachers reporting that being a **facilitator of learning** is most important *"I'm a facilitator of learning"* (Carol); *"we are just facilitators"* (Shirley) while others believe the teacher needs to **actively engage learners** *"we talk...we do stuff"* (Carol); *"give them a challenge, then they try it"* (Lennie); *"the kids have to be involved"* (Maxine) through **collaboration** *"to collaborate on"* (Carol), *"sit and pull their tables together"* (Maxine), *"can put them in groups"* (Magda). While much educational technology literature defines pedagogical beliefs as teacher- or learner-centred, findings concur with Ertmer and Ottenbreit-Leftwich (2010) who claim pedagogical beliefs are not one-dimensional as teachers can hold multiple pedagogical beliefs even within the same context. For example, **Magda**, who holds **more teacher-centred views** as to the **aims of teaching**, **concurrently** believes **learner-centred techniques** such as collaboration are **appropriate**.

When **remote**, all teachers feel their **pedagogical beliefs have shifted**, with some teachers reporting pedagogy needs to be **more adaptable** to the ever-changing context *"we need to be prepared for anything"* (Lennie); *"we've learned a lot about adaptability"* (Carol); *"we need to do more to develop skills"* (Shirley) and also the need for **greater learner support** *"have to physically reach out and check on them"* (Carol); *"greater need to support learners"* (Lennie). Findings about learner support concur with Anderson (2011); Rapanta, Botturi, Goodyear, Guàrdia, and Koole (2020) who state that for online education to be successful not only are appropriate technology and infrastructure essential but that

[49] Pedagogy question 8 asked when teachers and learners were on campus, can be found in can be found in Interview Protocol 1, Appendix A-1; question 4 and 7 asked when all teachers and most learners returned to campus which can be found in Interview Protocol 3, Appendix A-3.

supporting learners, i.e., a faciliatory presence that enables teachers to play an active mentoring and supportive role during the remote teaching and learning process, is equally important. However, while Rapanta et al. (2020) claim that a social presence potentially enhances learner-teacher interaction and makes remote teaching as effective as face-to-face situations, **findings disagree** as teachers believe even though they now have a **greater appreciation** for **technology in education** most teachers maintain **face-to-face** is still **preferable** because humans need physical interaction *"it is the human connection...with remote teaching you just can't"* (Carol); *"you can forget about the individual in the class"* (Lennie); *"face-to-face contact is important"* (Maxine) as **online learning can be isolating** *"it is too hard for the children...they will become lonely"* (Magda).

Furthermore, some teachers believe **not all learners** are **suited to online** learning due to a **lack of self-discipline** *"you have to be self-motivated"* (Shirley); *'it's got to do with internal motivation"* (Maxine). While Rapanta et al. (2020) argue that it is not that learners are not suited to online learning contexts, but rather that teachers need to have the cognitive presence to consider learner preparedness for online learning and assist where necessary. Findings agree with Artino and Stephens (2009); Childers and Jones (2017) who contend that for remote education to be successful, irrespective of the teacher, learners have to be self-motivated and responsible.

5.7.2 Normative Beliefs[50]

Findings indicate teachers believe the **school** and **principal** are very **pro-technology** and expect teachers to **utilise technology** in their teaching *"we have to use technology"* (Carol); *"we expect everyone to use it"* (Shirley); *"be able to use computers"* (Lennie); *"we're using e-textbooks"* (Maxine) and consequently when needing to teach remotely, **School 1** was asked to **advise other schools** *"we had multiple schools coming to us"* (Carol). Similarly, teachers report although **most** of their **peers are favourable** towards using technology in their teaching *"some are extremely positive"* (Shirley); *"we're all very pro-technology"* (Maxine); *"we embrace it"* (Carol), some are **not supportive** of technology **as they are fearful** *"some are scared of using technology"* (Shirley); *"teachers are scared"* (Lennie) or believe **learners** are already **using too much technology** in their personal

[50] Norm questions 9.1 and 9.2 asked when teachers and learners were on campus, can be found in can be found in Interview Protocol 1, Appendix A-1; question 5 asked when learners and teachers were remote, can be found in Interview Protocol 2, Appendix A-2.

lives *"kids already spend too much time on the device"* (Carol). According to Sadaf et al. (2012); Hennessy et al. (2005), each school has a set of norms directing which tools and resources are utilised and thus in a school where technology integration is favoured, it is unlikely teachers will choose not to integrate technology into their pedagogic practices. Findings **partly concur** as even though **most teachers** seem to be **integrating technology**, some **appear not to be**. A possible reason for this may be that beliefs are complex in nature (Liu, 2011) and are often influenced by multiple factors at the same time (Van Der Ross & Tsibolane, 2017) and thus simply understanding school and peer norms in isolation from other teachers' beliefs is insufficient to explain teachers' technology integration behaviours.

When **remote**, teachers report some of their **peers** are **managing** *"peers who are absolutely rocking"* (Carol); *"they are managing"* (Magda); "*we are all on the same track"* (Shirley) while others are **struggling** *"some are feeling completely overwhelmed"* (Carol); *"some are overwhelmed"* (Lennie) with the new technology demands due to **pedagogic changes** and **data challenges** *"making videos is very uncomfortable...struggling with not having enough data"* (Maxine). Even though it is unclear from the findings whether those teachers not managing are the same teachers who were initially unfavourable towards technology; multilevel and bidirectional relationships might exist (Ertmer, 1999) between teachers' beliefs about first-order barriers such as resource access, and second-order beliefs such as pedagogy — which is influencing teachers' willingness to integrate technology irrespective of changes in context.

5.7.3 Knowledge Beliefs[51]

Kim et al. (2013) contend that teachers' beliefs about the type and classification of knowledge can influence and shape teachers' technology choices. Howard and Maton (2011) define knowledge through Legitimation Code Theory (LCT), which differentiates between epistemic and social relations with codes characterised by specialised knowledge and knower codes acquired either naturally or socially and result in a code match when teachers' beliefs agree with policies and goals being pursued, or a code clash when they are not aligned. Findings suggest **all teachers** possess **knower codes** as they believe

[51] Knowledge questions 10.1 and 0.2 asked when teachers and learners were on campus, can be found in can be found in Interview Protocol 1, Appendix A-1; question 6 asked when learners and teachers were remote, can be found in Interview Protocol 2, Appendix A-2. Teachers' beliefs in regard to Knowledge for Utilisation and Types of Knowledge have been presented together as the interview question encompassed both of these considerations.

knowledge is acquired through **interacting with the world** *"experiencing the world"* (Lennie), *"information all around us"* (Carol), *"seeing and reflecting on everyday things"* (Magda) and being **actively involved** in the process *"have to be actively involved"* (Maxine), *"can only learn by doing"* (Shirley), *"making mistakes...thinking critically"* (Lennie). Furthermore, as School 1 has strong **pro-technology** beliefs coupled with a combination of **mechanical** and **organic integration**, it seems a **code clash** exists for some teachers who are **less favourable towards technology** (Magda, Maxine) and a **code match** for those teachers that are **wanting to integrate technology** into their pedagogic practices (Carol, Shirley, Lennie).

Teachers report **"how to" work** the technology in the classroom *"if I know more I'm going to use it more"* (Maxine); *"I must know...how it works"* (Magda); *"the more knowledge you have...the more daring you will be"* (Carol) and knowledge of **technology affordances** *"if I don't even know about it, you are not going to use it at all"* (Maxine); *"if you don't know about the full capacity...you are only going to use one part of it"* (Shirley) are **both needed** to make teachers **less fearful** of technology *"if you don't have the knowledge, you will fear it"* (Carol); *they are too scared"* (Shirley); *"you need to be willing to be scared"* (Lennie). This finding concurs with Angeli and Valanides (2009) who argue that technology integration not only requires teachers to know how to use technology but that they also need to know about the possible benefits technology can provide.

Furthermore, while utilisation knowledge is the first step to technology integration, Ertmer and Ottenbreit-Leftwich (2010) argue it is not sufficient as teachers also need knowledge as to how technology assists and benefits their teaching (Taimalu & Luik, 2019). Findings concur as when **remote** most teachers report they not only **gained "how to" knowledge** of the new technology tools provided (all teachers) but also **learnt more** about **affordances** *"we are using it more effectively now"* (Carol); *"I have more experience and so I use it more"* (Lennie); *"now I am able to just jump right into it"* (Magda); *"we are more comfortable"* (Shirley). Within this context, it is possible teachers are **motivated** to acquire **both types of knowledge** as **online teaching cannot take place without technology**.

5.7.4 Beliefs about the Value of ICT[52]

According to van Braak et al. (2004), lack of technology competence, the unpredictability of technology (Zhao et al., 2002), the value teachers believe technology provides to their teaching (Taimalu & Luik, 2019) and their pedagogical beliefs (Kim et al., 2013) can influence teachers' decisions about how to utilise technology in the classroom. **On-campus** findings suggest while **ways to use technology vary**, all teachers believe technology **adds value** to their **teaching** as it can be used to **support existing pedagogic practices** *"to make whatever we do in class easier"* (Lennie), *"as an aid to help you"* (Shirley), **enhance teaching** and **learning** (all teachers), and improve **productivity** *"can use their tablets to take pictures"* (Maxine) and **administration** *"parents can see how many resources their kids have opened"* (Carol). During **remote** and **hybrid** teaching, all teachers feel they have an even **greater appreciation of technology** *"our perception and dependence has increased"* (Carol); *"without technology, we wouldn't have got this far"* (Lennie); *"it aids teaching a lot"* (Maxine); *"it is more valuable"* (Magda); *"now it is an integral part"* (Shirley) and thus report they are aware of even **more ways** to utilise technology. This finding concurs with Ertmer et al. (2012) who contend that teachers who believe the affordances of technology can assist and enhance their professional practice are more likely to integrate technology in the classroom in a variety of ways.

Within an online context, teachers may not have a good idea of what learners have actually gained from classes or content posted and when problems are encountered (Chen, Wang & Chen, 2014). Furthermore, teachers may find it challenging to motivate learners as spontaneous interactions present in face-to-face classes can be lost (Graham, 2006) and explaining some content to learners can also be more problematic (Mailizar et al., 2020). Although teachers report they now **value technology more**, findings concur as using technology is **not without difficulties** as it is hard to **stimulate** and **motivate learners** *"we had to apply different techniques to keep learners interested"* (Lennie); *"the challenge is how do you get them to come along"* (Maxine), **track learner progress** and **get feedback** during online lessons *"it's so difficult to get feedback...also difficult to track how they are coping"* (Shirley), **explain certain concepts** *"some aspects...it's just easier to teach...when they're physically in class"* (Lennie), and **rely on learners putting in**

[52] Value of ICT questions 11.1 and 11.2 asked when teachers and learners were on campus, can be found in can be found in Interview Protocol 1, Appendix A-1; question 7 asked when learners and teachers were remote, can be found in Interview Protocol 2, Appendix A-2; question 5 asked when all teachers and most learners returned to campus which can be found in Interview Protocol 3, Appendix A-3.

effort *only the motivated learners really benefit"* (Carol); *"some just don't have the self-discipline"* (Maxine).

In addition, all teachers believe **technology** should **not replace the human side of education**. This concurs with Chui, Manyika and Miremadi (2016) who claim that even though technology is becoming indispensable in education, it cannot replace the human teacher-learner connection as the role of the teacher is not simply to deliver content to learners but requires expertise and complex interactions to guide and develop learners in a holistic way (Collinson, 2001).

5.7.5 Self-Efficacy Beliefs[53]

Self-efficacy, which can be related to work or personal activities (Farah, 2011) determines whether one thinks positively or negatively about technology (Bandura, 2000). In a work context, self-efficacy includes the perception of local support, the amount of time technology is used at work, and opportunities to gain technology skills. In a personal context, these are the extent of home access, beliefs about the value of technology, the perception of ease of use, and the convenience afforded by the technology (Farah, 2011).

Findings indicate all teachers are **comfortable** using **technology at work** which may be due to the school's requirement of **technology integration** coupled with teachers' beliefs that the **technical support** provided by the school **enables utilising technology**. In addition, all teachers appear to **value technology** and thus are willing to spend time **teaching themselves** *"I enjoy using technology"* (Carol); *"I really enjoy using technology"* (Lennie); *"I love computers"* (Shirley), **attending training** and **getting support** *"if I get the opportunity...I will incorporate it"* (Maxine) and **experimenting** prior to using technology in the classroom *"it must be something that I know"* (Magda). This is in agreement with Bandura (2000) who claims teachers who perceive technology provides benefits to their teaching are prepared to expend time and effort incorporating technology into their pedagogic practice.

Similarly, findings about **personal self-efficacy** are also in keeping with the literature as teachers report they **make use of technology** in their personal lives as they all have

[53] Self-efficacy questions 12.1 and 12.2 asked when teachers and learners were on campus, can be found in can be found in Interview Protocol 1, Appendix A-1; question 8 asked when learners and teachers were remote, can be found in Interview Protocol 2, Appendix A-2.

access to school-issued devices at home and believe technology **benefits** their teaching *"it makes my life easier"* (Carol); *"I can't think of anywhere where I don't use technology"* (Lennie); *"open to using technology"* (Maxine); *"I use technology a lot"* (Shirley).

5.7.6 Summary of Different Teachers' Internal Beliefs

Findings indicate, as with ES, IBs are aligned between **Maxine** and **Magda**, and **Carol**, **Lennie** and **Shirley**. While the similarity in teachers' IBs can be attributed to the prevailing pro-technology school context (Tondeur et al., 2017), Ertmer (1999) claims teachers' beliefs and explanations of their frustration of first-order barriers is often closely related to their IB, which may explain the **alignment in certain teachers' accounts of ES** and their **IB**. Furthermore, findings indicate **IBs cannot be understood in isolation**, for example, a teacher's beliefs about utilisation knowledge appear to influence their self-efficacy beliefs. So too with the shift to remote and hybrid teaching and learning. Even teachers who previously held pro-technology pedagogical beliefs now feel technology cannot replace face-to-face teaching. This concurs with Liu (2011) who claims teachers' IBs are constructed from a synergy of overlapping IBs which collectively influence teachers' technology integration (Rogers, 2000).

Table 17: Summary of Different Teacher's Internal Beliefs - School 1

Carol	Lennie	Maxine	Magda	Shirley
Pedagogy (IB-P)				
On Campus				
Aims of Teaching (P-TA, P-LA)				
	•Skill, lifelong learning		•Passing on content	•Skill, lifelong learning
Role of Teacher (P-TRT, P-LRT)				
•Facilitator role				•Facilitator role
Role of Collaboration (P-TRC, P-LRC)				
•Promotes learning		•Maturity of learners	•Size of learner group	
Role of Learner (P-TRL, P-LRL)				
•Engagement crucial	•Engagement crucial	•Engagement crucial		
Hybrid				
Aims of Teaching (P-TA, P-LA)				
•Holistic support	•Holistic support			•Human connection
Role of Teacher (P-TRT, P-LRT)				
•More adaptable	•More adaptable		•Changed a lot	•More adaptable
Role of Learner (P-TRL, P-LRL)				
•More responsible	•More responsible	•Self-motivated		•More responsible
Sustainability of Change (P-S)				
•In-class also needed	•In-class also needed	•In-class also needed •Unsuited all learners		

Carol	Lennie	Maxine	Magda	Shirley
Norms (IB-N)				
On Campus				
School Norms (N-S)				
•Expected to use tech •Principal supportive	•Expected to use tech •Principal supportive	•Expected to use tech •Principal supportive	•Expected to use tech •Principal supportive	•Expected to use tech •Principal supportive
Peer Norms (N-P)				
•Most positive •Already use a lot	•Older teachers scared to use tech	•Most positive		•Most positive, some scared to use tech
Remote				
School Norms (N-S)				
•Helped other schools				
Peer Norms (N-P)				
•Some managing •Some struggling	•Some struggling as not comfortable	•Some struggle, data, pedagogy change	•Some managing	•Some managing
Knowledge (IB-K)				
On Campus				
Classification of Knowledge (IB-K-N)				
Acquisition of Knowledge (K-NA)				
•Interacting with world	•With time and effort	•Be actively involved	•Interacting with world	•Do things, involved
Learner Role (K-NLR)				
	•Reflect on process	•Effort needed		
Knowledge Utilisation and Affordances (IB-K-U)				
•How to use, benefits	•How to use, benefits	•How to use, benefits	•How to use is key	•How to use, benefits
Remote				
Knowledge Utilisation and Affordances (IB-K-U)				
•More knowledge as lots of use, use more	•More knowledge as lots of use	•More knowledge as lots of use, benefits	•More knowledge as support and training	•More knowledge as lots of use, benefits
Value of ICT (IB-V)				
On Campus				
Ways to Use Technology (IB-V-U) and Affordances (IB-V-A)				
Place for Technology in Education (V-UP)				
•Variety of ways •Depends on subject and personality	•To enhance teaching •Not to replace good pedagogic practices			•Variety of ways •Not to replace human connection
Supports Teaching (V-UST, V-AST)				
	•Improve and support			•Improve and support
Enhances Teaching (V-UET, V-AET)				
•Exciting and relevant •Virtual field trips •Augment reality •Learning styles			•Outside in the class	•Exciting and relevant •Outside in the class
Productivity (V-UP); Administration (V-AA)				
•Provides information		•Picture of class work		
Enhances Learning (V-UEL, V-AEL)				
•Outside in the class	•Possibilities of technology •Practice concepts	•Outside in the class •Reinforces concepts	•Outside in the class	•Outside in the class •Differentiation •Better concentration

Carol	Lennie	Maxine	Magda	Shirley
Value of ICT (IB-V)				
Remote				
Ways to use Technology (IB-V-U) and Affordances (IB-V-A)				
Enhances Learning (V-UEL, V-AEL)				
•Work at own pace •More self-motivated	•Work at own pace	•Review content •Reinforces concepts •Helps understanding	•Review content •Reinforces concepts •Helps understanding	•Work at own pace •Review content •Reinforces concepts •Helps understanding
Productivity (V-UP); Administration (V-AA)				
•For absent learners •Flexible schedule	•For absent learners •Submit online, so not lost or forgotten •Bank of resources		•Can be isolating •Bank of resources	•For absent learners •Mark online so less to carry around
Challenges (V-AC)				
	•Stimulate interest and motivation hard	•Stimulate interest and motivation hard		• Track progress and get feedback hard
Hybrid				
Affordances of Technology (IB-V-A)				
Enhances Teaching (V-AET)				
•Value tech more	•Value tech more	•Value tech more	•Value tech more	•Value tech more
Challenges (V-AC)				
•Valuable only if learners put in effort	•Some things easier to explain in class	•Valuable only if learners put in effort		
Carol	**Lennie**	**Maxine**	**Magda**	**Shirley**
Self-Efficacy (IB-SE)				
On Campus				
Work-Related Activities (IB-SE-W)				
•Feels confident	•Feels comfortable	•Feels comfortable	•Feels comfortable	•Feels comfortable
Ways to gain Self-Efficacy (IB-SE-WA)				
•Teach oneself	•Teach oneself	•Training, support	•Know well before	•Teach oneself
Personal-Related Activities (IB-SE-P)				
•Feels comfortable •Uses extensively	•Feels comfortable •Uses extensively	•Feels comfortable •Uses extensively	•Feels comfortable •Use limited	•Feels comfortable •Uses extensively
Remote				
Work-Related Activities (IB-SE-W)				
•Feels confident with new technology	•More confident than peers, more skills	•Confident, due to school support, learning quickly	•Feels confident for what is needed, can always learn more	•Feels more confident and using more efficiently

5.8 PROFESSIONAL DISPOSITION – BY TEACHER AND CONTEXT

Professional Disposition (PD) which has been conceptualised in this study as **Instructional discourse (PD-I)** and **Regulative discourse (PD-R)**[54], is shown in Table 8 and Figure 9.

[54] Instructional Discourse questions 13.1 and 13.2 and Regulative Discourse questions 14.1 and 14.2 asked when teachers and learners were on campus can be found in Interview Protocol 1, Appendix A-1; Regulative Discourse question 6 asked when all teachers and some learners were on campus can be found in Interview Protocol 3, Appendix A-3.

To answer the research question (5) *what are different teachers' professional dispositions* since Professional Dispositions (PD) are analytically distinct (Bernstein, 1986), first a summary and discussion of the within-case analyses of different teachers' accounts of their instructional and regulative discourses over time, in relation to TTU-SST, are presented. Then, as these discourses are in reality interrelated (Bernstein, 1986), a summary and discussion of the teachers' professional dispositions at School 1, are presented. Table 18 presents a summary of the findings for teachers' PD at School 1, and Appendix E-3 provides the detailed analyses for each teacher's account of PD.

5.8.1 Instructional Discourse

All teachers report **school** and **everyday knowledge** is **integrated** as school knowledge on its **own is meaningless** *"if you never make it practical...going to stay words on a page"* (Carol); *"you can't just give them information"* (Lennie); *"it can't just be loose standing pieces of knowledge"* (Maxine) as it **needs to be applied** to the outside world *"try and link it"* (Magda), *"link the outside and the inside"* (Shirley). In addition, although opinions about the **involvement** needed to acquire knowledge are similar and include **active engagement** *"they are building models"* (Carol); *"sit down and do the problems"* (Maxine); *"learn by doing"* (Shirley), **reflection** and **experimentation** *"figure it out for themselves"* (Lennie) and **continual practise** *"practise, practise, practise"* (Maxine), differences are apparent as to whether one **first** needs to acquire **school knowledge** in a **structured** and **organised manner** and only then **apply** it to **everyday knowledge** *"school is the best place to learn...then you can apply"* (Lennie); *"you have to build foundations"* (Maxine) or if knowledge is **acquired in either direction** by interacting with the world *"information all around...so many sources"* (Carol); *"don't only have to use my method"* (Magda); *"need access to the outside and not just textbook driven"* (Shirley).

According to Bernstein (1999; 2000), the instructional discourse describes teachers' views on knowledge structures and acquisition and can be defined as horizontal or everyday knowledge, which is weakly classified, context-specific, and usually given over orally; or vertical specialised school knowledge which is strongly classified and typically given over in a formal school context in written form. While findings indicate **boundaries** between types of **knowledge are present** as teachers acknowledge **differences** in the **nature** and **transmission** of **horizontal** and **vertical discourses**, all teachers believe **school** and **everyday knowledge** is **integrated** "they are absolutely intermeshed" (Carol); *"school is*

basically a mini world" (Lennie); *"it's all integrated"* (Maxine); *"it is all interlinked"* (Magda); *"they should integrate"* (Shirley). Therefore, it appears as if classification of the different types of knowledge exists on a **continuum for teachers** at School 1, with a **stronger classification** of knowledge boundaries for **Lennie** and **Maxine** who believe specialised knowledge first needs to be acquired in a structured and vertical manner and then integrated at lower levels with weakly classified everyday common sense knowledge, and **weaker classification** for **Carol**, **Magda** and **Shirley** as they feel the transmission and acquisition of either discourse can occur in either direction.

5.8.2 Regulative Discourse

According to Bernstein (1996), performance pedagogic modalities are strongly framed with clear boundaries between teachers and learners, coupled with teacher control of the classroom context whereas competence pedagogic modalities are weakly framed with less explicit boundaries between teachers and learners and greater learner control of content sequencing, timing and the classroom.

All teachers report **strong teacher–learner boundaries** exist at School 1, with most believing their professional relationship with the learners is built on **mutual respect** and **trust** *"it is built on trust"* (Carol); *"there is a form of respect both ways"* (Lennie); *"they respect me and I respect them"* (Magda); *"to build them up"* (Shirley) and the **classroom context** is primarily **controlled by the teacher** *"I'm their teacher not their friend"* (Carol); *"it is my class...they are guests"* (Lennie); *"more controlled by me"* (Maxine); *"I control...it is my palace"* (Magda). In addition, some teachers appear to believe **changes** in the **educational context** have **blurred teacher–learner boundaries** *"have become more comfortable"* (Lennie); *"boundaries have really blurred"* (Maxine); *"I think I am closer to them"* (Magda) and Shirley feels boundaries are the same but learners now **expect teachers** to be **available all the time** *"they contact you at any time"*. Findings suggest even though most teachers possess a **more performance-based** pedagogic modality, **aspects of a competence** pedagogic modality are also present. This concurs with Morais (2002); Bourne (2004; 2006) who claim that while different pedagogic modalities are conceptually distinct, in reality, a combination of modalities can exist concurrently for a teacher and may shift according to changes in the surrounding context.

5.8.3 Summary of Different Teachers' Professional Dispositions

While Bernstein (2000) defines codes to describe teachers' instructional and regulative discourses, with collection codes exhibiting strong classification and framing and enabling the development of specialised knowledge with strong teacher–learner boundaries in place and integrated codes with weak classification and framing with little separation between different types of knowledge and blurred boundaries (Morais, 2002). However, findings indicate the **distinction** between codes **may not be as clear** as even though teachers like **Lennie**, **Maxine** and **Magda** possess more **collection codes**, aspects of **integrated codes** are also present in their PDs. Similarly, **Carol** and **Shirley** seem to possess more **integrated codes**, also have aspects of **collection codes** present in their PDs. A possible reason for this may be PDs are not constructed in a vacuum but rather are shaped by a combination of personal attributes, interactions with people and the social context in which teachers live and work (Hoadley & Ensor, 2009; Dottin, 2009). Thus, while **codes** are extremely **helpful** in conceptually **analysing** and **describing teachers' instructional** and **regulative discourses**, they are **unable** to neatly **define** and **categorise teachers' multifaceted** and **complex PDs**.

Table 18: Summary of Different Teacher's Professional Dispositions - School 1

Carol	Lennie	Maxine	Magda	Shirley
On Campus				
Instructional Discourse (IB-PDI)				
Boundaries of Knowledge (IB-PDI-B)				
•Everyday and school integrated •School on its own is meaningless	•Everyday and school integrated •School on its own is meaningless	•Everyday and school integrated •School on its own is meaningless	•Everyday and school integrated •School needs to be applied outside world	•Everyday and school integrated •School needs to be applied outside world
Knowledge Acquisition (IB-PDI-K)				
Direction of Knowledge Acquisition (PDI-KD)				
•Either direction	•School to everyday	•School to everyday	•Either direction	•Either direction
Ways to Acquire Knowledge (PDI-KW)				
•Interact with world •Maturity	•Organised and structured by teacher	•Vertical manner with foundations	•Interact with world	
Involvement Needed (PDI-KI)				
•Active Engagement	•Experiment and reflect	•Continual practice •Active engagement	•Engagement needed	•Continual practice •Explore opportunities
Regulative Discourse (IB-PDR)				
Teacher-Learner Boundaries (IB-PDR-B)				
•Strong professional boundaries •Mutual respect	•Strong professional boundaries •Mutual respect	•Strong professional boundaries •Learners lack respect	•Strong professional boundaries •Mutual respect	•Strong professional boundaries •Mutual respect
Classroom Control (IB-PDR-C)				
•Teacher control	•Teacher control	•Teacher control	•Teacher control	•Shared control
Hybrid				
Regulative Discourse (IB-PDR)				
Teacher-Learner Boundaries (IB-PDR-B)				
•Not changed	•Less strict •Comfortable online, anytime comms	•Less strict •Apathy to rules and discipline	•Less strict •Sharing more with learners	•Not changed •Learners contact anytime

5.9 ORIENTATIONS TOWARDS TECHNOLOGY – BY TEACHER AND CONTEXT

Orientation towards Technology (OTT) i.e., Agent's Practices (AP) and Outcomes (O), which have been conceptualised in this study as **Level of Adoption (AP-LA)**; **Manner of Adoption (AP-MA)**; **Adoption Activities (AP-AA)**; **Current (O-CTU)**; and **Future (O-FTU) technology use**, are shown in Table 8 and Figure 9[55].

In order to answer the research questions (6) *What are different teachers' orientations towards technology* and (7) *How do different teachers use technology*, summaries and

[55] Question 15 on LA, question 16 on MA and questions 17 to 19 on AA and O asked when teachers and learners were on campus, can be found in Interview Protocol 1, Appendix A-1; question 10 on MA, question 9 and 11 on O, asked when teachers and learners were remote, can be found in Interview Protocol 2, Appendix A-2; questions 3 and 8 on AA and O, asked when all teachers were on campus and some learners were remote, can be found in Interview Protocol 3, Appendix A-3.

discussions of the within-case analyses of different teachers' accounts of Orientation towards Technology (OTT): Level and Manner of Adoption (LA; MA); Current Adoption Activities and Outcomes (AP-AA; O-CTU) and Future Adoption Activities and Outcomes (AP-AA; O-FTU) over time and in relation to TTU-SST are presented. Thereafter, as belief systems are constructed from a combination of beliefs (Liu, 2011) an overall discussion of different teachers' OTT over time at School 1 is provided. Table 19 presents a summary of the findings for teachers' OTT at School 1 and Appendix E-4 provides the detailed analyses for each teacher's account of OTT.

5.9.1 Level and Manner of Adoption[56]

The HTMA (Hooper & Rieber, 1995; Rogers, 2000) and ACOT models (Sandholtz et al., 1997) define different levels of technology adoption (AP-LA) which include familiarisation, where teachers learn basics; utilisation, where technology supports existing practices and minor issues can cause teachers to discontinue use; integration, where teachers view technology as essential for traditional practices; reorientation, where teachers begin to rethink educational goals utilising technology and evolution, where teachers discover new uses for technology and seamlessly integrate these into the classroom (Hooper & Rieber, 1995; Rogers, 2000; Sandholtz et al., 1997). Findings suggest **all teachers' LA** includes **familiarisation**, **utilisation**, and **integration** when **on campus** while for **some teachers** levels of **reorientation** and **evolution** are being achieved *"it has transformed by*(sic) *pedagogic practice"* (Carol); *"it is really transforming how I was teaching"* (Lennie); *"I'm seeing different things happening"* (Shirley).

For **Manner of Adoption**, Hooper and Rieber (1995) define product technologies as contemporary technology use and idea technologies as enhancing and enriching learning experiences. Furthermore, Puentedura (2006) describes teachers' use of technology as substitution, where no functional change occurs due to technology; augmentation, which improves pedagogic practice; modification is the redesign of existing tasks and redefinition, where technology is used for tasks that were previously not possible (Hamilton et al. 2016; Hilton, 2016). Findings indicate when **on campus** and **remote all teachers** at School 1 report that they use technology in a **product manner** to **support** and **improve existing pedagogic practices** through **substitution** and **augmentation** while **some**

[56] As mentioned previously, within this study LA and MA are not seen as progressive but rather are used to describe teachers accounts of their technology integration.

teachers also utilise technology in an **idea manner** to **modify** and **redefine existing tasks** and **pedagogic practices** *"can use the VR googles to take them on a virtual tour...augment a river...conduct a virtual open day"* (Carol); *"can virtually programme...use the laser cutter....robots"* (Lennie); *"create digital tests...a Kahoot...create videos"* (Shirley). Interestingly, teachers who view technology as mainly **supporting traditional pedagogic practices** sometimes believe **technology** makes their **job harder** *"the hardcopy is much easier"* (Maxine); *"for maths teachers, it is too difficult"* (Magda), whereas teachers who report technology also **re-orientates** and **evolves their pedagogy** believe **technology** makes their **job easier** *"to make our lives easier"* (Carol); *"to make what we do in class easier"* (Lennie); *"to make everything better"* (Shirley). This finding concurs with Dwyer et al. (1991) who claim that teachers using technology in a product manner often find it challenging to utilise technology to transform their pedagogic practices as historical beliefs and entrenched professional dispositions (Hooper & Rieber, 1995) not only limit their ability to consider alternative ways in which technology can be used but also makes them feel technology makes their jobs harder at times.

5.9.2 Current Adoption Activities and Outcomes

While all teachers report when **on campus** they use technology to **support existing teaching activities** some indicate they also utilise technology to **transform educational experiences** (Carol; Lennie; Shirley) and for **administration** (Carol; Magda). When **remote**, all teachers report **greater use of technology** for **administration** while continuing to make use of technology to **support teaching activities** which now include **the creation of videos** (all teachers), **conducting live lessons** (all teachers) and **assisting learners online** (all teachers). Some also use technology to **set** and **conduct** online **assessments** (Lennie, Maxine), **submit** and **mark online** (Carol, Lennie, Maxine, Shirley), and **build up resources for future use** (Lennie, Magda). Similarly, in a **hybrid** setting, all teachers report technology is still being used to **support existing pedagogic practices** but also now includes **recording lessons** and **catering** to **learners at home**.

Findings indicate even though all teachers' **current activities** are more aligned to **supportive** and **administrative** tasks, even within a **remote** and **hybrid** context, **Lennie, Carol**, and **Shirley** still appear to **use technology more** for **transformative activities** than **Maxine** and **Magda.** A possible reason may be technology integration on its own is not a goal, but rather it is how teachers believe technology assists them in achieving their

educational objectives that influence choices regarding what activities they decide to use technology for (Hamilton et al., 2016).

5.9.3 Intended Future Adoption Activities and Outcomes

When **remote,** although all teachers report they intend to **record live lessons**, only some intend to **carry on creating videos** (Carol, Lennie, Shirley). However, when **returning to campus** findings indicate **only live lessons** are being **recorded** as teachers report **too much effort** and **time** is needed to also **record videos**. This concurs with See et al. (2020) and Mailizar et al. (2020) who claim that the extra time needed by teachers to develop online content is often significant, which can lead to initial intentions being abandoned despite the potential benefits.

Regarding the **future of education**, findings indicate while **all teachers** believe a **blended approach** is **preferable**, rationales differ and include **loss of in-class benefits** *"given the choice they choose to be in school"* (Carol); *"we need to do practical work in class"* (Lennie); *"they will become lonely"* (Magda), **lack of infrastructure** *"most learners in this country don't have the infrastructure"* (Maxine); *"you can't do this if you don't have data"* (Carol), **need for self-regulated learners** *"only the motivated students go back and listen"* (Carol); *"there are kids that cannot cope"* (Maxine); *"you have to be self-motivated...to engage with online learning"* (Shirley) and the **unsuitability of online for some parents** *"online learning sounded good on paper...when parents had to do it without the teacher"* (Carol). Findings concur with Stein and Graham (2020) who argue although online learning enables more flexibility and potentially offers greater learner participation and reflection as constraints of time and space are removed, concerns as to the loss of human connection, the spontaneous generation of ideas and some unexpected and important discoveries made during traditional face-to-face classes can be addressed by using blended learning that combines both approaches. Furthermore, findings are in keeping with Rasheed et al. (2020) who claim that the main challenges of online education include the reliance on learners being self-regulated and adequate provision of resources.

5.9.4 Summary of Different Teachers' Orientation toward Technology

Findings indicate that although **teachers' OTT** at School 1 are **similar** with **all teachers** using technology to **support existing activities** and for **administration**, with **greater use** for supportive tasks in **remote** and **hybrid** contexts, it appears **Lennie**, **Carol**, and **Shirley**

also utilise technology to **transform** their **existing pedagogic practices**. These findings concur with Vannatta and Fordham (2004) who claim although teachers' Professional Dispositions (PDs) and Internal Beliefs (IBs) coupled with External Structures (ES) may promote or hinder technology integration, teachers who aim to utilise technology to enhance learning experiences and inspire a shift to lifelong learning are not only more likely to integrate technology more extensively but also in more transformative ways (Becta, 2004).

Table 19: Summary of Different Teacher's Orientation toward Technology - School 1

Carol	Lennie	Maxine	Magda	Shirley
Level and Manner of Adoption (AP-LA; AP-MA)				
On Campus				
Supporting and Enhancing Pedagogic Practice (LA-SEP, MA-SEP)				
•Supports pedagogy •Makes job easier	•Supports pedagogy •Makes job easier	•Supports pedagogy •Can make job harder	•Supports pedagogy •Can make job harder	•Supports pedagogy •Makes job easier
Transforming Pedagogic Practice (LA-TP, MA-TP)				
•Enhances pedagogy	•Rethinking pedagogy			•Rethinking pedagogy
Remote				
Supporting and Enhancing Pedagogic Practice (LA-SEP, MA-SEP)				
•Supporting pedagogy •Making structured	•Supporting pedagogy	•Supporting pedagogy	•Supporting pedagogy	•Supporting pedagogy
Transforming Pedagogic Practice (LA-TP, MA-TP)				
•Enhancing pedagogy	•Transform pedagogy •More learner control	•Experimenting with technology		•Transform pedagogy •Making it better
Adoption Activities (AP-AA) and Outcomes (O)				
On Campus				
Current Teaching Activities (AP-AA; O-CTU)				
Supporting Teaching Activities (AP-AAS, O-CTUS)				
•Prepare, present, push, upload content •Search information •Access videos •Conduct assessment	•Prepare, present, push, upload content •Search information •Expose learners to technology	•Prepare, present, push, upload content •Access textbook videos	•Prepare, present, push, upload content •Search information	•Prepare, present, push, upload content •Search information •Access videos •Conduct assessment
Transforming Teaching Activities (AP-AAT, O-CTUT)				
•Virtual field trips •Augmented reality	•Virtual and physical experiences			•Create own videos
Administration Activities (AP-AAA, O-CTUA)				
•Info to parents			•Enter, upload marks	

Carol	Lennie	Maxine	Magda	Shirley
Adoption Activities (AP-AA) and Outcomes (O)				
Remote				
Current Teaching Activities (AP-AA; O-CTU)				
Supporting Teaching Activities (AP-AAS, O-CTUS)				
•Record videos •Post guides, content •Conduct live lessons •Assist learner online •Submit work online	•Record videos •Bank of resources •Post guides, content •Conduct live lessons •Set, run assessment •Assist, submit online	•Record videos •Post guides, content •Conduct live lessons •Assist learner online •Set, run assessment •Submit, mark online	•Record videos •Bank of resources •Post guides, content •Conduct live lessons •Assist learner online	•Record videos •Post guides, content •Conduct live lessons •Assist learners online •Submit, mark online
Administration Activities (AP-AAA, O-CTUA)				
•Comms with learners •Teacher support •Meetings and training •Virtual open day •Catch up learners	•Comms with learners •Teacher support •Meetings and training •Catch up learners	•Comms with parents •Teacher support •Meetings and training	•Teacher support •Meetings and training	•Comms with learners •Teacher support •Meetings and training
Intended Future Technology Use (O-FTU)				
Supporting Role (O-FTUS)				
•Record live lessons •Record more videos	•Record live lessons •Record more videos	•Record live lessons	•Record live lessons •Camera as visualiser	•Record live lessons •Record more videos •Submit, mark online
Hybrid				
Current Teaching Activities (AP-AA; O-CTU)				
Supporting Teaching Activities (AP-AAS, O-CTUS)				
•Record live lessons •Learners at home	•Record live lessons •Learners at home •Online assessments	•Record live lessons •Learners at home	•Record live lessons •Learners at home	•Record live lessons •Learners at home •Submit, mark online
Administration Activities (AP-AAA, O-CTUA)				
•Comms with learners •Catch up learners	•Comms with learners •Catch up learners		•Track attendance	•Catch up learners
Future of Technology in Education (O-CTUF)				
•Must be blended	•Must be blended	•Must be blended	•Must be blended	•Must be blended
Challenges of Only Online (O-CTUC)				
•Lose class dynamic •No home schooling •Infrastructure barrier	•Some things better in physical class	•Not suitable for all learners •Infrastructure barrier	•Lose class dynamic	•Not suited for all learners

5.10 CONCLUSION - SCHOOL 1

This chapter presented the findings and discussion for School 1. First, an overview of the case study site, the school's response to the COVID-19 pandemic and a summary of the teachers interviewed were provided. Next, summaries of findings and discussions in relation to the micro- and meso-level theories[57] for each of the theoretical framework components i.e., ES and CSB; IB; PD; AP and O were presented pertaining to prior literature reviewed or where necessary, new literature to substantiate or counter findings. Initial codes that were deductively formulated from the theoretical framework and

[57] Figure 9 depicts the micro- and meso-level theories utilised for this chapter.

subcodes that emerged inductively from the data were then detailed in the summary tables.

6 FINDINGS AND DISCUSSION - SCHOOL 2

In order to understand teachers' lived experiences within School 2, it is necessary to first contextualise the case study site and participants. Therefore, the chapter begins with a summary of the site visit to the school, followed by a summary of teachers' personal technology use, teaching experience and a brief description of each teacher interviewed and an overview of the school's response to the COVID-19 pandemic (Olivier, 2020). Next, to provide a holistic understanding of School 2 and its teachers' beliefs, findings and discussions are presented using within-case analyses for each of the relevant research questions, using codes drawn from the study's theoretical framework for the micro- and meso-level theories (see Table 8 for initial codes). In addition, since data was collected at three different intervals, teachers' accounts are presented in chronological order.

6.1 SUMMARY OF SITE VISIT

School 2, which is the newest school in an independently owned group, aims to provide a holistic approach to education with core values of religion, integrity, a strong discipline code firmly entrenched.

School 2 offers a lower range of fees for independent schools, however, as most of the learners come from low-income homes and the school has a pay-only policy with no bursaries, parents find the school fees high. As the school is relatively new, there are only 175 learners with growth plans to accommodate up to 250 learners in the coming year. There are two classes per grade, with a maximum of 35 learners per class and 16 teaching staff, with the majority being female. School 2 writes the GDE National Senior Certificate exam and offers core matric subjects, with English being the language of instruction although the majority of learners are not from English-speaking homes.

School 2 positions itself as an ICT school and thus *miEbooks* is being used, and each learner is required to purchase their own tablet according to school specifications but learners have no access to the internet during school. In addition, there is a no cellphone policy at the school, with substantial fines being imposed for the return of confiscated phones. All teachers are provided with laptops and there is also a computer laboratory with 20 desktop devices, which are mainly used by IT learners and for general technology

literacy skills. Classrooms have ceiling-mounted projectors, along with whiteboards at the front of the class and learner's desks are organised in traditional format facing frontwards.

6.2 TEACHERS

Four teachers, with different subject specialisations, were interviewed at School 2. All the teachers joined the school when it started in 2017 and are relatively newly qualified with ten years or less teaching experience. Concerning personal use of technology, teachers report using technology mainly for social media, communication, banking, transport, getting information and taking pictures. Table 20 provides a summary of teachers' experience and personal technology use.

Table 20: Teacher's Experience and Personal Technology Use - School 2

Pseudonym	Teaching Experience	Years at School 2	Subject Taught	Personal Use of Technology
Chantal	6 years	2 years	Maths Lit Life Science	I do gaming…use it as a communication tool…social media…online banking…Uber.
Phillip	10 years	3 years	Maths	I use it a lot...I have moved into digital world...banking....for almost everything...I could apply for a bank account online...for communication…*WhatsApp*…*Twitter*...even *Google*...just everywhere.
Mattie	8 years	2 years	Business Accounting	Communication...I use internet for getting info…downloading…banking.
Mpho	6 years	3 years	English	Honestly speaking I'm not a technical person...I am old school...even the phone that I use, I mainly use it for *WhatsApp*, and for emails and taking pictures...I'm not updated on the latest...mainly for receiving calls, sending messages, *WhatsApp*...that's about it.

6.2.1 Chantal

Chantal is a young tech-savvy teacher who enjoys using technology in her teaching, nevertheless, she believes technology should only be used where it makes sense because face-to-face contact time with learners is still important. She views herself as computer literate and although she is happy to assist her peers with technology-related issues as she is seen as the unofficial technology champion in the school, Chantal believes more technology training is needed to assist teachers in working with the technology and using it for teaching and administrative tasks. Furthermore, Chantal feels it is feasible for her to utilise technology in the classroom as it saves her time and enhances the learning experience. Chantal maintains that to acquire knowledge, one needs to interact, research

and engage and while she encourages learner discussions during lessons and is approachable, she has firm boundaries between herself and the learners and controls the classroom context.

6.2.2 Phillip

Phillip is a young but experienced teacher who uses technology in his personal life and believes technology can greatly assist teachers and learners by providing instant feedback and speeding up the pace of the work covered in lessons. However, he feels while he is familiar with technology, limitations with certain subjects exist which makes incorporating technology challenging at times. Furthermore, Phillip believes training on how to utilise technology in the class would be beneficial. To acquire knowledge in maths, Phillip believes learners need to be active as well as practice skills and techniques within a strong, disciplined learning context and thus very strong boundaries exist between himself and the learners, with Phillip controlling the content and pace of learning in the class.

6.2.3 Mattie

Mattie believes being a teacher requires one to provide content to learners and also make a difference by impacting learners' lives. While Mattie appreciates the value technology can bring to the classroom for teaching and administrative tasks, she believes simply using technology for technology sake does not enhance her teaching. Although Mattie does not consider herself tech-savvy and would appreciate more focused and subject-specific training she believes she is familiar enough with the technology to make use of it effectively. Mattie believes learners need a good foundation alongside consistent repetition to acquire knowledge. For Mattie, her relationship with the learners is one of mutual respect and even though she engages with learners on a more friendly basis outside of the formal learning context she feels it is essential for the teacher to control the classroom and have firm boundaries in place.

6.2.4 Mpho

Mpho does not consider herself technically inclined and reports not making extensive use of technology in her personal life. While Mpho prefers to make use of traditional teaching methods, she acknowledges technology has a role to play in education and feels it expands the range of available resources for teachers and learners. Mpho reports most of the technology training at the school is conducted informally by her peers and believes that to be valuable, the formal training needs to be less frequent and more subject-specific. In

terms of familiarity, Mpho believes she is able to utilise the technology effectively but finds time is wasted by learners when switching between subjects on the tablets. Mpho feels teaching is about lifelong learning and assisting the younger generation to develop by engaging with the subject matter on a practical level to acquire knowledge. Although Mpho encourages learner discussion in the classroom she believes it is essential for learners to know teachers are in control of the learning context and that well-defined boundaries need to exist between teacher and learners.

6.3 SCHOOL'S RESPONSE TO CHANGES IN EDUCATIONAL CONTEXT [58]

6.3.1 Start of COVID-19 Pandemic[59]

At the start of the COVID-19 pandemic, teachers at School 2 report they are using their **school-issued laptops to teach remotely** *"no extra hardware was needed"* (Chantal); *"whatever we had we are using"* (Phillip); *"I've got my laptop"* (Mpho), as well as **additional software purchased by the school i.e., *Google Classroom*** *"they created a* G-Suite *account…we are now all active on* Google Classroom*"* (Chantal); *"we've got* Google Classroom*…and access to* Google Drive*"* (Phillip); *"we are trying out new methods like* Google Classroom*"* (Mattie); *"they've introduced* Google Classroom…Google Drive*"* (Mpho), and in **where needed, provided teachers with limited amounts of data** *"they purchased us 2GB of data"* (Mpho); *"we used our transport allowance to purchase data"* (Mattie); *"they compensated us for data"* (Phillip).

In addition, the organisation that owns School 2 set up a **task team** with representation from each of its schools to **advise the group on the best way forward** regarding **technology tools for remote teaching** "*there are teachers that have been appointed from the different schools"* (Mattie); *"we have this one person she's been talking to head office, we collaborate also with the other schools so at least we do something uniform…if they think it is something we need to try and move towards…she will suggest it"* (Phillip) and to **train teachers on how to use the new technology** *"the training is on the six of us…one of use will make a tutorial video on how to…we created a classroom itself and a* Google Drive *to share with all the educators"* (Chantal); *"the only training I've received is from a colleague of mine…our IT guru…she trained us"* (Mpho); *"they will give training to*

[58] Prior to COVID-19, all teachers and learners were on campus.
[59] At the start of COVID-19 pandemic, all teachers and learners at School 2 were working remotely.

you" (Mattie); *"she will show us what are the things that we need to do and she will get us there"* (Phillip).

6.3.2 During COVID-19 Pandemic[60]

During COVID-19, since School 2 is an independently run school teaching did not stop when the South African government closed schools from the end of July until August 2020. While **all teachers returned** to school during this time, to ensure social distancing amongst learners, the school implemented a **staggered attendance model** *"even number coming on one day and the odd numbers coming on other days"* (Chantal); *"so in a space of two weeks each grade would have been five times"* (Phillip). In addition, for **learners who chose to remain at home**, the school provided **online resources** to enable them to continue exclusively in a remote fashion *"there's some of them who prefer to stay at home"* (Chantal); *"even if we do have learners come in, it's usually half of the actual class"* (Mpho); *"some learners prefer online…they just come in for assessments"* (Mattie); *"there are learners that are sitting at home"* (Phillip). Therefore, a **mix of hybrid and remote models** were adopted by the school as teachers are required to offer **additional in-class lessons** *"there are three groups so you have to teach everything more"* (Chantal); *"you do a lesson twice"* (Phillip) as well as **continue using *Google Classroom* and other technology tools** to teach learners that are either **never on campus** or are only **on campus on alternate days** *"much of work is still continuing online…they are relying on getting taught online"* (Phillip); *"continued conducting of online lessons"* (Mattie). Table 21 provides a summary of School 2's response to the change in the educational context.

Table 21: Summary of Response to Educational Context Change - School 2

Change in Educational Context	School's Response
Remote Teaching	• Teachers continued to use school-issued laptops • *Google Classroom* was purchased by the group • School provided teachers with limited data bundles • Task team established to advise on tools to be used for remote teaching • Training conducted by teacher task team through videos
Remote and Hybrid Teaching	• All teachers on campus • Learners attend on alternate days, with some remaining exclusively remote • Physical classes taught multiple times to accommodate smaller classes • Teachers continuing to use technology tools for remote and hybrid teaching

[60] During the COVID-19 pandemic, School 2 adopted a hybrid and remote model with all teachers returning to campus and learners attending on alternate days, with some learners continuing to work only remotely.

6.4 SCHOOL CONTEXT

Within this study, to understand School 2's context and answer Research Question (1) *What is the context at different schools,* findings in relation to **School Culture** C-SCu defined as **instrumental** or **expressive** (Bernstein, 1975); **Control** C-SC defined as **stratified** or **differentiated** (Bernstein, 1971a); and **Social Interaction** C-SI defined as **mechanical** or **organic** (Bernstein, 1971b) are detailed. Next, a discussion of the findings in relation to the literature is presented. A summary of findings for the context at School 2 is shown in Table 22.

6.4.1 Culture

Teachers believe the culture at School 2 is founded on **religious values** *""we are a religious school"* (Phillip); *"Christian-based school"* (Mpho); *"based on true religious values"* (Mattie), coupled with a **code of discipline** *"there is also discipline"* (Phillip); *"discipline is a core value"* (Chantal) in a **warm and welcoming setting** *"we have a family type atmosphere…it's a relaxed school"* (Mpho); *"everyone is open and approachable"* (Mattie). While the school aims to produce **good academic results** *"we urge our kids to thrive in academics"* (Mpho), the school also focuses on **developing learners** to become **entrepreneurs** by *"emphasising entrepreneurship…to think out of the box"* (Chantal); *"entrepreneurial skills…not only focus on content of the work…be mindful that they can own a business…that is cool"* (Mpho), be **curious** "encourage our kids to be curious with searching" (Mpho); *"curiousity"* (Chantal) and become **future leaders** *"they are the future"* (Mpho); *"they will create a better future"* (Chantal). In addition, **technology is a core value** at the school *"technology is almost everywhere…we are a technology-driven school"* (Phillip); *"value e-learning"* (Mpho); *"they like technology and the use of tablets"* (Chantal); *"their main aim is to use technology"* (Mattie).

6.4.2 Control

Teachers report learners are **grouped according to their age** group *"it's all based on age"* (Mattie); *"it's based on age"* (Phillip), *"they're grouped based on ages"* (Chantal).

6.4.3 Social Integration

While Mpho feels her **peers all value technology** *"they do value…they embrace it…they appreciate it…they are in full support",* most teachers report beliefs at the school **differ amongst their peers in relation to technology use for education** *"the beliefs of my peers are not similar to mine…only 60% with the belief that technology can aid education"*

(Chantal) due to: **past experiences** *"we come from different backgrounds…some feel like it is slowing them down…others feel it assists them"* (Phillip); **personal preference** *"it's a personal preference…if I could stay away from a technological device I would"* (Mattie); and **subject constraints** *"it is not sufficient for every subject"* (Mattie); *"I think for some subjects…things are quite easy"* (Phillip). Importantly, all teachers feel the **school's requirement to utilise technology is often not in the best interest of education** *"you find a teacher just pushing resources for the sake of pushing resources…because the school wants us to"* (Mpho); *"we share the same frustrations…the level of expectation…that we are supposed to push technology…just push resources"* (Phillip); *"it's more of lip service, like I mean we are meant to be a technology school…but we are just using e-textbooks really"* (Chantal); *"they want us to use it all the time…but my main aim is not to use technology, it's actually to teach the learners"* (Mattie).

6.4.4 Summary of School 2's Context

Findings indicate School 2 has a more **expressive culture** as teachers believe the focus of the school is not only on providing learners with formal school knowledge and ranking success and failure (Bernstein, 1975; South African Institute for Distance Education, 2010) but instead to develop entrepreneurial skills, curiosity and future leaders. In addition, the school displays **stratified control** as learners are grouped according to the fixed attribute of age and teachers' roles are clearly defined (Bernstein, 1971a; South African Institute for Distance Education, 2010). With regard to integration, findings indicate School 2 possesses a **combination of mechanical** and **organic integration** as social cohesion amongst teachers appears to be based on a common set of beliefs (Bernstein, 1971b; South African Institute for Distance Education, 2010) since teachers believe the school's requirements to utilise technology is simply for the sake of technology and most teachers believe their decisions to use technology are based on experience, personalised and subject taught (Phillip, Mattie) as teachers are seen to be unique (Bernstein, 1971b; South African Institute for Distance Education, 2010).

Table 22: Summary of School Context - School 2

Culture – Expressive (C-SCu-E)
• Religious values • Strong discipline with a warm and welcoming atmosphere • Aims to produce good academic along with enabling learners to develop entrepreneurship skills, be curious and become future leaders
Control – Stratified (C-SC-S)
• Learners are grouped according to age
Social Integration – Combination (C-SI-M; CS-I-O)

• Teachers report different beliefs about technology use based on:
  ◦ Past teachers' experience
  ◦ Personal preferences
  ◦ Inherent subject constraints
• Teachers hold similar beliefs about the school's demands to utilise technology without considering the educational benefits

6.5 BELIEFS OF EXTERNAL TECHNOLOGY STRUCTURES - BY CONTEXT

External technology Structures (ES) and teachers' associated beliefs (CSB) about these structures that have been conceptualised in this study as **Resources (R)**; **Training (TR)**; **Support (S)**; and **Time (T)**, are shown in Table 8 and Figure 9.

In order to answer the research question (2) *what are the external structures at different schools,* a summary and discussion of the within-case analyses of teachers' general accounts of external technology resources at School 2 and their associated beliefs over time for each part of the theoretical framework is presented. Table 23 provides a summary of findings for teachers' beliefs of External Structures (ES) at School 2 by context, along with expanded subcodes drawn from the data (See Appendix D for expanded subcodes).

6.5.1 On-Campus Teaching

- **Resources**

According to Johnson et al. (2016), Ertmer and Ottenbreit-Leftwich (2010), and du Plessis (2014), it is extremely challenging for teachers to incorporate technology when they believe access is inconsistent and limited. While findings indicate teachers believe they have sufficient access to technology with school-issued laptops, Wi-Fi for teachers, *ITSI*, *MathU*, tablets for each learner and projectors and whiteboards in each class, they believe **limited access** to the **computer lab**, **no internet access** on **learners' tablets**, **few educational apps** on learners' tablets, **lack of accounting package** and the **tablet's hardware limitations** is **limiting** their ability to **integrate technology** in the classroom. Furthermore, Chigona et al. (2014), Norris et al. (2003), and Vongkulluksn et al. (2018)

contend that for teachers to continue using technology in the classroom, they need to believe technology enables facilitating classroom activities and teaching goals. Findings concur as some teachers indicate they are **not using *ITSI* for maths** or **tablets for accounting** as they feel these technologies are **not suitable** and **do not assist t**hem in **achieving** their **pedagogic goals**.

For the physical arrangement of resources, Tondeur et al. (2008) and Mercier et al. (2014) state that suitable placement of technology **promotes technology integration**. When teaching **on campus**, findings concur since most teachers believe the **physical arrangement** of **technology in classrooms** with ceiling projectors centrally mounted, facing the whiteboard and learners' desks facing forward, is **appropriate** as it enables them to effectively **utilise the technology** and if needed, **deal with any technical issues**.

- **Training and Support**

According to Ertmer et al. (2012), insufficient training is the most commonly reported reason teachers cite for lack of technology integration. While Johnson et al. (2016) argue that there is no "single best way", teachers' beliefs as to the sufficiency of training mainly includes perceptions of frequency (Ertmer et al., 2012; Johnson et al., 2016; (Tondeur, et al., 2011); structure (Schrum, 1993, 1999; Tondeur, et al., 2011; Joyce & Showers, 1983); and content (Ertmer & Ottenbreit-Leftwich, 2010; Wells, 2007). Findings indicate teachers believe **technology training** is **insufficient** at the school for several reasons. Firstly, most teachers feel technology training, which occurs once a term or when there are updates, is **too infrequent**. The findings concur with Johnson et al. (2016) and Ertmer et al. (2012), who claim that teachers need ongoing training to update their technical skills in order to effectively utilise technology for teaching and for administrative tasks. Secondly, findings indicate teachers who **do not find theoretical** and **demonstration-based training** at School 2 **helpful**, believe there is **too much training** and **attendance should be voluntary**. This is in keeping with Schrum (1993, 1999) and Tondeur et al. (2011) who contend that teachers need to be given sufficient opportunities to practise skills and observe model educators utilising technology since there is little indication that theoretical workshops by experts are useful. Thirdly, findings indicate teachers believe the **sole focus on *ITSI* training** at the school is **inadequate** and would **prefer training** to assist with **technology integration** for **specific subjects** and **classroom practices**.

This concurs with Ertmer and Ottenbreit-Leftwich (2010) who state that training programmes focusing only on technical skills are insufficient as teachers also need knowledge on how to make effective use of technology in the classroom (Wells, 2007).

For **technology support**, teachers believe **assistance** at the school, which mainly deals with **technical issues**, is **adequate** with access to **general on-site support**, **remote *ITSI* support** and **limited peer support**. While teachers always need access to technical assistance to support technology integration (Ertmer et al., 2012; Hadijah & Shalawati, 2017), Ertmer (1999) and Johnson et al. (2016) state that initially, more technological support is needed from technology support staff and professionals but as teachers become more capable, pedagogical support is needed from peers and professional communities. Findings suggest **School 2** is still in the **initial phases** of technology integration as teachers feel **technical support** from **technology support staff** and **professionals** is **sufficient**. For **institutional support**, while some teachers believe the school **financing additional apps is sufficient**, others feel **school support is lacking** as the prime focus is on **monitoring teachers' technology use** and **resources pushed**. A possible reason for the difference in opinions may be related to **teachers' perceptions** of the **school's technology policy** as either **encouraging technology use** where appropriate or **just for the sake of using technology**. This finding concurs with literature which states schools can either support technology integration by providing the required funds, having a holistic and unified vision and encouraging teachers' use of technology (Rogers, 2000; Hew & Brush, 2007), or constrain integration efforts by simply pushing technology without having an understanding of how it benefits specific pedagogic activities (Vandeyar, 2014; Ertmer et al., 2012).

- **Time**

Findings suggest although teachers are **familiar with using technology** for what they need more **time is needed** to **learn** and **explore** how to **use technology effectively** in teaching their specific subjects. Findings are in keeping with literature which states even when teachers are familiar with technology significant time is still needed to explore, plan and experiment with potential technology benefits (Condie et al., 2007; Smeets et al., 1999; Conlon, 2004; Karasavvidis, 2009). Furthermore, teachers maintain the **extra time** needed to **use technology in class** and **prepare content** can **make technology integration unfeasible**. These findings concur with literature which claims time needed to

use technology in relatively short school lesson times (Cuban, 2001; Karasavvidis, 2009) and extra time needed to create new course content (Rogers, 2000) can make using technology unfeasible.

6.5.2 Remote Teaching

- **Resources**

Although findings indicate teachers believe **access** to their **school-issued laptops** enables them to **continue teaching remotely**, it seems as if **concerns** about **high data usage** and **quality issues with *ITSI*** has resulted in the school rather selecting ***Google Classroom*** and ***WhatsApp*** as the platforms of choice. This finding is in keeping with Kopcha (2012) and Rogers (2000) who argue concerns about quality and availability of resources may result in teachers choosing not to integrate certain technologies into their pedagogic practice. However, Vongkulluksn et al. (2018), Ertmer et al. (2012), and Kopcha (2012) claim that when teachers believe technology is invaluable, they seek alternatives by actively trying to work around constraints. Findings concur as **teachers without uncapped Wi-Fi** at home report that even though **data** was **initially not provided**, they **purchased** their own **data** as they believe they are **unable to continue teaching** without access to data.

While findings indicate teachers purchase their own data when needed, teachers maintain **learners' lack of data access** and **outdated technology** is **hindering remote teaching efforts** because learners **cannot access the content**. This finding is in keeping with the literature which states that when learners are unable to access sufficient data (Mailizar et al., 2020; Rasheed, et al., 2020; Giovannella, et al., 2020) and are using outdated and broken technology (Sicilia, 2005; Toprakci, 2006) teachers' ability to utilise the technology effectively is limited. According to Bergdahl and Nouri (2020); Hadijah and Shalawati (2017), teachers are only able to teach remotely if they are provided with the appropriate digital tools. Findings concur since teachers report that when recording videos for learners not only are the **blurry camera** and **outdated software** on their **laptops** a challenge but they also believe **additional hardware** such as **headsets** and an **external camera** for recording videos would **really assist them**.

- **Training and Support**

Findings indicate teachers believe **"how to" videos** provided by a **team of teachers** from schools in the group, alongside **communities of practice** are **assisting** them in effectively **using the technology** tools to teach online. Teachers' change in beliefs about the sufficiency of training concurs with the literature which claims increased frequency of training (Johnson et al., 2016) with content connected to classroom practice (Wells, 2007; Ertmer & Ottenbreit-Leftwich, 2010) are both necessary for teachers to be able to effectively use technology. In addition, it seems as if teachers find the shift to **practically-based peer mentoring** and **communities of practice** more **beneficial**. This is in keeping with Kopcha (2012) who states that active peer mentoring and communities of practice promote positive beliefs among teachers as to their ability to successfully integrate technology into their pedagogic practices. Lastly, while most teachers believe **training** has been **sufficient**, it appears as if some of the **older teachers** need **more training**. A possible reason may be that older teachers who have many years' experience in traditional face-to-face teaching are often less competent in using technology for teaching and therefore need greater assistance as using technology so extensively within their daily practice is challenging and disrupting their existing proficiencies (Rasheed, et al., 2020).

For **support**, findings indicate teachers believe **remote technical assistance** from the **IT support person** and ***ITSI* staff** coupled with a **task team of teachers** established by the school to support teachers, alongside **communities of practice**, are **helping teachers make use of the technology** for remote teaching. Furthermore, some teachers report **head office** and the **principal** are providing them with **useful tactical support** and **limited financial assistance** to **purchase data**. These findings concur with Vandeyar (2014), Ertmer et al. (2012), and Hadijah and Shalawati (2017) who claim that access to technical support combined with institutional support is essential in encouraging and motivating teachers to integrate technology since a lack of either contributes to teachers' negative perceptions and unwillingness to utilise technology (Rasheed et al., 2020). In addition, Mailizar et al. (2020) argue that as most teachers currently have to use technology in order to continue teaching, access to technical and school-level support is even more critical, as without these remote teaching is not possible.

- **Time**

Van Der Ross and Tsibolane (2017) contend that teachers with high technology self-efficacy are more likely to incorporate technology into their pedagogic practices, however, Karasavvidis (2009) argues teachers often feel they do not have the time needed to become proficient with technology. Findings concur as some teachers report **extensive use** and **time spent** watching "**how to" training videos** has resulted in them being **more familiar** with the **technology**, but others believe **more time** and **training** is **needed**.

Findings indicate that even though most teachers understand **extra time** is **needed** because they **teach multiple subjects** and are required to **prepare**, **repurpose** and **distribute content** to learners and perform **administrative** tasks – they find using **technology exhausting**. While Mailizar et al. (2020) and See et al. (2020) claim that teachers need to spend extra time on becoming familiar with the new tools, Mhlanga and Moloi (2020) contend teachers are willing to spend the time utilising technology as it is the only way to continue the academic project. This finding concurs with See et al. (2020) who claim that teachers' wellbeing is affected due to the extra time needed for administration and preparation of content.

6.5.3 Hybrid and Remote Teaching

- **Resources**

Mhlanga and Moloi (2020) and du Plessis (2014) state that the significant access barriers present in developing countries can result in learners from disadvantaged backgrounds not being able to continue with their schooling (Mailizar et al., 2020; Le Grange, 2020). Findings indicate **access**, **quality** and **suitability of resources** for those on campus appear to be as they were **initially** although teachers believe that for **learners at home,** the **lack of access to data** and the ***MathU* app** are **hindering** the **academic project**.

- **Training and Support**

Findings suggest teachers believe **ongoing peer mentoring** on *Google Classroom* is **sufficient** to assist them in **utilising the new technology tools**. Teachers' change in beliefs about sufficiency of training at the school are in keeping with literature which states frequent training (Johnson et al., 2016) focused on providing teachers with technical proficiency as well as knowledge on how to make effective use of technology in the classroom (Ertmer & Ottenbreit-Leftwich, 2010; Wells, 2007) is essential in improving

teachers' beliefs about their ability to effectively integrate technology into their pedagogic practices (Kopcha, 2012; Farah, 2011).

In addition, while **technical support** at the school seems to be the **same** as it was before moving off-campus, the **teacher** appointed to the task team appears to be **more active** in **assisting her peers.** A possible reason may be that technology integration at the school has matured and thus more peer mentoring is needed (Ertmer, 1999; Johnson et al., 2016).

- **Time**

Teachers report being **remote** has **forced** them to **improve** and **extend their technology skills** and now they are not only making **more extensive use** of technology but they have also begun to **explore** and **appreciate** the **affordances technology** offers. This finding concurs with Condie et al. (2007) and Van Der Ross and Tsibolane (2017) who state that teachers are more likely to consistently integrate technology into the classroom when they are familiar with the tools due to time spent utilising and exploring the technology. Furthermore, while some teachers believe **utilising technology** at this **level** is **sustainable** as it enables them to dedicate **more time to the learners**, **others disagree** and believe the current approach is not feasible in the longer term due to the **excessive amounts of time required**. A possible reason for this may be that when **teachers believe technology offers immeasurable value** to their pedagogic practices, their **focus on external barriers** such as the **extra time** needed may be **reduced**. This concurs with Vongkulluksn et al. (2018) and Ertmer and Ottenbreit-Leftwich (2010) who state that teachers are less focused on barriers when they believe technology assists them in achieving their pedagogic goals. In addition, this finding indicates that even though barriers are discussed as separate issues it is the combination that influences teachers as there is a complex and overlapping relationship between beliefs (Rogers, 2000).

Table 23: Summary of Teachers' Beliefs of External Technology Structures - School 2

On Campus	Remote	Hybrid & Remote
Resources (ES-R and CSB-R)		
Access (ES-R-A, CSB-R-A)		
Hardware (R-AH); Software (R-AS)		
• Have laptop, projector, whiteboard • No hologram device • Have *ITSI*, *miEbooks*, *D6*, *MathU*, *WhatsApp* • No accounting software or extra education apps on learners' tablets	• Access to *ITSI*, *Google Suite* including *Google Classroom* • No access to *MathU* app	
Wi-Fi/Data (R-AW)		
• Wi-Fi for teachers, not for learners	• Different data access for teachers	• Learners at home, data is an issue
Quality and Suitability (ES-R-Q, CSB-R-Q)		
Hardware (R-QH); Software (R-QS)		
• Mainly of adequate quality • *ITSI* not suited for all subjects • Tablets one page at a time	• Laptop camera blurry • Some software outdated • *ITSI* not able to handle extra load	
Wi-Fi/Data (R-QW)		
• Wi-Fi sluggish at times		
Physical Arrangement (ES-R-P, CSB-R-P)		
Classroom Setup (R-PC); Remote Setup (R-PR)		
• Wireless projector ceiling-mounted • Whiteboard in front • Desks front-facing	• Headsets and camera would be helpful to record videos	
Training (ES-TR and CSB-TR)		
Extent (ES-TR-E, CSB-TR-E)		
Frequency (TR-EF)		
• Once a term or whenever needed • Some believe too much, others too little	• Frequent videos from teacher task team	• Appears more peer training on *Google Classroom*
Training Provided (TR-EP)		
• Formal *ITSI* training	• Peer training from task team • Teaching themselves	• Appears sufficient training on *Google*
Quality (ES-TR-Q, CSB-TR-Q)		
Professional Development (TR-QPD) and Courses (TR-QC)		
• For using and updates of *ITSI*	• On "how to" use *Google Classroom*	• On "how to"use *Google Classroom*
Peer Mentoring (TR-QPM); Communities of Practice (TR-QCP)		
• Informally ask peers for help	• Team of teachers from school group	• Work together to provide training
Type of Training (TR-QT)		
• Theoretical and demonstration • Practical and hands-on • Need to ask what is needed as some teachers not computer literate	• Practical "how to" videos made by task team of teachers	• Formal training on *Google Classroom*

On Campus	Remote	Hybrid
Support (ES-S and CSB-S)		
Technical (ES-S-T, CSB-S-T); Institutional (ES-S-I, CSB-S-I)		
Location (S-TL, S-IL)		
• Person on-site, can call or message • Principal at the school • *ITSI* mainly remote	• Support available remotely	• IT person on-site every few days
Function (S-TF, S-IF)		
• Fixes technology issues at school • Give financial support, monitors use	• Fixes software and hardware issues • Tactical support, limited financial	
Response Time (S-TRT, S-IRT)		
• Mainly responsive	• Responds immediately	
Peer Support (S-TP); Communities of Practice (S-TC)		
• Can ask peer who knows tech	• Videos from task team and peer	• Peer still assisting
Nature of Support (ES-S-N, CSB-S-N)		
Technical Support (S-NT)		
• Mainly to sort out *ITSI* • General technical issues	• "How to" videos on new software by peers and communities of practice	
Institutional Support (S-NI)		
• Financing apps for maths	• Tactical by principal, head office • Financial support lacking	
Time (ES-T and CSB-T)		
Familiarity (ES-T-F, CSB-T-F)		
Use (T-FU)		
• Able to use for what they need, mainly to push resources • Limited options to use technology in some subjects	• Able to use new software for remote teaching	•Extended and learnt new skills •Using technology more •More positive about using technology
Time and Effort (T-FTE)		
• Lots of time is needed to be familiar, time is limited • Lots more to learn	• Lots of time needed to be familiar • More time for older teachers • More training, time and use needed	• Lots of time and effort, more familiar • Exploring affordances
Support (T-FS)		
	• "How to" support from peer and task team	• "How to" support from peer
Feasibility (ES-T-FE, CSB-T-FE)		
Time to Learn (T-FEL)		
	• As more familiar taking less time	
Time to Use (T-FEU)		
• Class periods are short • Too much time to use *miEbooks*	• Takes time even though familiar	
Time to Prepare (T-FEP)		
• Lots of time to assess on *ITSI* • Time to digitize existing content • Tech-savvy can save prepare time	• Huge amounts of time needed to prepare and repurpose content • Small school size, number of subjects makes time unfeasible	•Time needed to prepare for learners at home and school
Time to Administer (T-FEA)		
• Marking time is saved • Pictures of notes less time • Work can be completed at home	• Admin takes longer with technology	• Need to send work to learners at home

6.6 BELIEFS OF EXTERNAL TECHNOLOGY STRUCTURES - BY TEACHER

According to Ertmer (1999), it is not only important to understand what External technology Structures (ES) exist within a particular context but one also needs to explore individual teachers' beliefs about these structures as this can influence teachers' willingness to integrate technology in the classroom (Van Der Ross & Tsibolane, 2017). Therefore, to answer research question (3) *What are different teachers' beliefs around external structures,* first a summary and discussion of the within-case analyses of different teacher's accounts of each ES at School 2 and their associated beliefs in relation to TTU-SST is presented. Then, an overall discussion of different teachers' beliefs about ES at the school is provided. Table 24 presents a summary of the findings for ES, and Appendix F-1 provides the detailed analyses for each teacher's account of ES.

6.6.1 Resources

Findings indicate when **on campus** all teachers believe they have **sufficient access** to **quality** and **appropriately placed** technology **resources** but **limited access to the computer lab**, with differences of opinions evident in several areas. Firstly, **Chantal** and **Phillip**, who teach maths and Life Sciences, believe ***ITSI*** is **unsuitable for their subjects** *"have to click on each question...takes a lot of time"* (Chantal); *'for certain subjects...it is very limited"* (Phillip) while **Mattie**, who teaches EMS and accounting maintains the **hardware limitations** of **one page at a time** makes **tablets unsuitable** for her subject *"kids cannot work on the tablet...it's completely not working"*. Next, **Chantal** and **Phillip**, who appear to believe **technology** plays an important role in **supporting**, **enhancing** and **transforming** their pedagogic practices, report even though **on campus lack of access** to additional hardware *"would like a device to project holographic images"* (Chantal); **few educational apps** on learners' devices *"could do so much more with the tablets"* (Chantal); and **no access to the Wi-Fi for learners** *"kids are not able to get onto the internet"* (Phillip), and when **remote,** lack of **data access** *"when it came to data we had to struggle the first month"* (Phillip) and ***ITSI*** issues *"the system was not able to function properly"* (Phillip); *"on* ITS*...learners had to download every resource"* (Chantal) are **frustrating**, their **primary concerns** seem to be centred around how these **issues limit** their **ability to teach** and **connect with learners** *"when I ask why they are not joining us, they say we don't have data"* (Phillip); *"*Google Classroom *is accessible for everyone...data is less"* (Chantal).

On the other hand, although **Mattie** initially appears to believe **technology** plays an important role in **supporting** and **enhancing** her **teaching**, she feels a **lack of access** to accounting **software limits** her ability to **integrate technology** *"the book system we are using is outdated"* but when **remote,** Mattie maintains **technology** is now **essential** and mentions **no access constraints** *we have our laptops...uncapped Wi-Fi at home...*Google Classroom*...*WhatsApp*"*. Conversely, **Mpho** who reports using technology very little in her personal life and at school for simply **pushing resources** initially maintains there are **no access** or **quality problems** *"the technology we have...is remarkable...the quality is great"*, however, when needing to **utilise** the **technology more extensively** due to being **remote**, Mpho believes data for teachers, outdated software on tablets, broken tablets and learners' lack of data are **major concerns** *"I had to cough up a lot of money to continue teaching...the kids had old software...their tablets are broken and damaged"*.

A number of possible explanations for these findings exist. Firstly, it seems that incorporating technology is an **individual choice** based on teachers' beliefs and perceptions around the value of technology (Woodbridge, 2003; Vongkulluksn et al., 2018). Secondly, it appears when teachers like **Chantal** and **Phillip** believe **technology enhances** their classroom practice they are more **willing to work around constraints** and **amplify** the **access** they have while teachers who believe technology is not crucial for their teaching, like Mattie and Mpho, tend to amplify barriers present (Ertmer & Ottenbreit-Leftwich, 2010; Vongkulluksn et al., 2018). Thirdly, findings indicate the **educational context** change may have **shifted** some **teachers' value beliefs** and thus when remote, **Mattie amplifies constraints less** as she feels **technology** is now **essential** and **Mpho amplifies constraints more** as even though she needs to utilise the technology more, she still appears to believe **technology is not essential** for her teaching. This explanation is in keeping with Tondeur et al. (2017) who state that a complex relationship exists between teachers' beliefs about technology and contextual aspects such as the societal characteristics of the educational context and therefore one needs to analyse all the interconnected factors influencing technology integration. Fourthly, it is plausible that **Mpho** is **only now aware** of **access constraints** as she is **unable** to continue **teaching without technology**. This concurs with Hadijah and Shalawati (2017); Bergdahl and Nouri (2020) who maintain that teachers are only able to continue teaching remotely if they have appropriate access to digital tools.

6.6.2 Training and Support[61]

According to Wells (2007), Tondeur et al. (2011), teachers believe training is a barrier when it is too theoretical and lacks connection to classroom practice. Findings concur as teachers agree that **on-campus** professional development **training** is **too theoretical** and **demonstration-based** *"telling us how to create and push an assessment"* (Chantal); *"say these are the things we have introduced...this is how each one works"* (Phillip); *"covers how to send resources...the textbook"* (Mpho) and should **not focus only on *ITSI*** but must rather be directed towards **pedagogic approaches** of **integrating technology** into **specific subjects** *"no training on how to incorporate technology into life sciences"* (Chantal); *"this is how you use it...if you're an English teacher"* (Phillip); *"specific training about accounting and technology"* (Mattie); *"how to incorporate technology...into your subject"* (Mpho) providing teachers with **technical skills** and **exposing** them to **technology affordances** *"there are a lot of gaps"* (Chantal). Consequently, when **remote**, the change in training to a **task team of teachers** creating numerous **"how to" instructions** and **videos** on *Google Classroom* (all teachers) and more **active involvement** in **communities of practice** *"we collaborate with other schools"* (Phillip), seem to have resulted in all teachers believing **training** at the school has **improved**. In addition, while Ertmer et al. (2012) contend that to be effective training needs to be ongoing Tondeur et al. (2017) claim that the incorporation of technology is an iterative process involving bidirectional relationships and thus it is not possible to attribute teachers' beliefs to any single factor. This perspective may explain why when **on campus, Mattie** and **Mpho** who seem to **value** and **utilise technology less** report there is **too much training** *"training should be voluntary"* (Mattie); *"it is more than enough"* (Mpho) while the other teachers believe training is **too infrequent** *"there could be more training"* (Phillip); *"training is not sufficient...it should be once a week"* (Chantal).

Interestingly, with **support**, even though all teachers report the school provides **responsive on-site technical assistance** and **remote *ITSI* support** some teachers maintain the school provides **little support to assist teachers** *"they want to be an e-school but their support is lacking"* (Chantal) and simply **monitors use** *"they monitor us...so we can step up our use of technology"* (Mattie) while others maintain the school **encourages technology integration** *"they school really encourages us...assists us"*

[61]The summary of the findings and discussion have been combined to avoid repetition as much of the literature is related to both constructs.

(Mpho); provides **funding for additional apps** where needed *"they try and bring in a whole lot of technology"* (Phillip) and offers some **peer support** *"can help me with the tablets and computers"* (Mpho). However, with the **educational context change**, findings indicate support **beliefs** of some teachers have **shifted** as even though **Mpho** feels **more school support** is **needed** to **fund data "***I had to cough up a lot of money from my own pocket to continue teaching"* the **principal** is now providing teachers with **tactical support** *"the principal is regularly checking...are there any challenges, do you need assistance"* (Mpho); *"the principal is suggesting things...helping us"* (Phillip) and **peer mentoring** is still **continuing** (all teachers). According to Bernstein (1971b), organic integration is apparent when there is an appreciation that people are unique whereas mechanical integration occurs when teachers hold a common set of beliefs. Furthermore, Levin and Wadmany (2005) contend that not only do teachers hold multiple opinions at one time they are also influenced by the context in which they find themselves (Tondeur et al., 2017). Findings suggest that although there is a **combination of integration approaches** present at School 2, the school's **response** to the **changing educational context** which resulted in the **provision** of **more** frequent and **different** types of **training** and **support** may account for teachers' more **unified beliefs** and a **shift** to greater **mechanical integration** in this regard.

6.6.3 Time

Findings indicate that when **on campus,** teachers believe they are **familiar** with technology with only **Chantal** reporting she can always **learn more** *"are still aspects I can develop"*. Regarding **feasibility**, even though some teachers believe it **takes time** to **use technology in** and **between class** *"it actually slows you down"* (Phillip); *"it is very time consuming"* (Mattie); *"when they change classes...10 minutes is wasted...having to wait for the textbook to load"* (Mpho); **explore affordances** *"to know how to use it more in Maths"* (Phillip); *"I need time to be engaged with the technology...not just push resources"* (Mpho) and **assess with *ITSI*** *"takes more time to development an assessment on* ITSI*"* (Chantal), some believe the **extra time** needed is **worthwhile** as it **saves marking time** *"you don't have to mark...it saves you a weekend of marking"* (Chantal) and **enables learners to work at home** *"a video not watched in class, they can watch it at home"* (Mpho). Findings agree with the literature which states that even though teachers are concerned about the extra time needed as they are already stretched (Hadijah & Shalawati, 2107; Mailizar et al., 2020), when teachers believe technology benefits their pedagogic goals less focus is

placed on barriers such as time (Vongkulluksn et al., 2018; Ertmer & Ottenbreit-Leftwich, 2010).

When **remote**, while most teachers report they are **more familiar** with the **technology** *"learning more as I go"* (Chantal); *" I'm okay"* (Phillip); *"I can follow their instructions"* (Mattie) some feel **more time** is needed *"I'm really not comfortable and confident using these tools"* (Mpho); *"I'm not sure I'm using the technology effectively"* (Phillip) and **older teachers** are **not managing** *"greater problem with older teachers"* (Mattie). Even though **Mattie** believes **technology** is **benefitting her teaching** *"I am utilising my time to the benefit of education"*, teachers believe **extra administration** *"it takes more time to do it electronically"* (Mpho) and the **small size of the school** which requires **teaching multiple subjects** and **classes** makes **extra time** needed for **preparation** (all teachers) and **teaching** *"have to convert everything to an electronic format"* (Mattie); *"you already had a lesson plan...now you have to send it to the learners"* (Mpho) **unfeasible**. Now **back on campus**, some teachers feel they are **more familiar** with technology *"forced us to familiarise ourselves"* (Phillip); *"had to come on board and really train myself"* (Mpho) and consequently have a **greater appreciation of affordances** *"had to change my attitude drastically"* (Mpho) and report **using** and **exploring technology more** *"take it to another level"* (Phillip). Furthermore, while **Mattie** feels using **technology is sustainable** as it enables **greater engagement** with learners *"individually give the attention to each and every student"*, **Phillip** believes the **current approaches** are **not viable** in the longer-term due to **additional time** needed to service both **in-class** and **remote learners** *"it has really been quite stressful...you do a lesson twice...have contact with learners here...learners at home are waiting for you"*. While findings concur with Condie et al. (2007), Van Der Ross and Tsibolane (2017) who state that teachers are more likely to consistently integrate technology into the classroom when they are familiar with the tools, due to time spent utilising and exploring the technology, it seems as if teachers' wellbeing needs to be addressed since the additional time needed for hybrid and remote teaching can be exhausting and challenging (Hadijah & Shalawati, 2017; Mailizar et al., 2020; See et al., 2020).

6.6.4 Summary of Different Teachers' Beliefs of External Structures

Overall findings suggest when **on campus,** although teachers hold **many similar beliefs** as to the ES at School 2, **Mpho** who prefers not to utilise technology and **Mattie** who feels

technology is not suited to her specific discipline appear to be more **focused on ES barriers** whereas **Chantal** and **Phillip** who believe technology can greatly **enhance** the **educational experience** seem to **find ways** to **explore** and **address** most **challenges**. Interestingly, when **remote** and using a **hybrid** approach as **Mattie** and **Mpho** report **spending more time** on **exploring** and **utilising** technology, alongside a growing **appreciation of technology**, their **focus** on **external barriers** seems to **lessen**. Furthermore, the school's **provision** of **additional resources**, **training** and **support** when using a **remote** and **hybrid** approach seems to have resulted in **Mattie** and **Mpho's** general **beliefs of ES** at the school being **more positive** and shifted **Chantal** and **Phillip's** beliefs around **training** and **support**. These findings concur with Tondeur et al. (2017) who claim that teachers' technology integration is an iterative process involving bidirectional relationships between beliefs, practice and technology use mediated by the teachers' school context.

Table 24: Summary of Different Teacher's Beliefs of External Technology Structures - School 2

Chantal	Phillip	Mattie	Mpho
Resources (ES-R and CSB-R)			
On Campus			
Access (ES-R-A, CSB-R-A); Quality and Suitability (ES-R-Q, CSB-R-Q)			
Hardware (R-AH, R-QH)			
•Access sufficient, mainly suitable, good quality •No hologram device, little lab access, entry laptops	•Access sufficient, good quality, suitable	•Access sufficient, good quality, tablet not suitable for accounting •Lab access limited	•Access, quality excellent •Lab access limited
Wi-Fi/Data (R-AW, R-QW)			
• Wi-Fi for teachers	• Wi-Fi for teachers • Learners need access	• Wi-Fi for teachers	• Wi-Fi for teachers
Software (R-AS, R-QS)			
• Have *ITSI*, hard to assess • Want more apps on tablet	• Use *ITSI*, unfit for maths • Recently got *MathU* app	• Use *ITSI* • No accounting package	• Use *ITSI* to push resources
Physical Arrangement (ESR-R-P, CSB-R-P)			
Classroom Setup (R-PC)			
• Devices well placed • Desks face forward for structure, want open spaces	• Devices well placed • Desks face forward • Extra speaker for videos	• Most devices well placed • Desks face forward, at the back cannot see at times	• Devices well placed • Desks face forward, helps discipline, deal with tech
Remote			
Access (ES-R-A, CSB-R-A); Quality and Suitability (ES-R-Q, CSB-R-Q)			
Hardware (R-AH, R-QH)			
• Access sufficient • Has school laptop but camera blurred	• Access sufficient • Has school laptop	• Access sufficient • Has school laptop	• Teacher access sufficient • Has school laptop • Learners hardware old
Wi-Fi/Data (R-AW, R-QW)			
•Uncapped Wi-Fi at home •Should give modems to teachers without	•Initial data access issues •School now funds teachers •Issue for learners	•Uncapped Wi-Fi at home	•Lack enough data •School should purchase more
Software (R-AS, R-QS)			
• Had *ITSI* issues, also uses lots of data • Using *Google* platform	• Had *ITSI* issues • Using *Google* platform, *WhatsApp*	• Using *Google* platform, *WhatsApp*	• Using *Google* platform, *WhatsApp* • Learner software outdated
Physical Arrangement (ES-R-P, CSB-R-P)			
Remote Setup (R-PR)			
• Need headset for sound			• Need camera for recording
Hybrid & Remote			
Access (ES-R-A, CSB-R-A); Quality and Suitability (ES-R-Q, CSB-R-Q)			
Software (R-AS, R-QS)			
• Using *Google Classroom*			

Chantal	Phillip	Mattie	Mpho
Training (ES-TR and CSB-TR)			
On Campus			
Extent (ES-TR-E, CSB-TR-E)			
Frequency (TR-EF)			
•Too infrequent	•Too infrequent	•Too much, be voluntary	•Ask what is needed
Provided by (TR-EP)			
•Focus is *ITSI* •Need more subject specific, technical	•Focus is *ITSI* •Need more subject specific, technical	•Focus is *ITSI* •Need more subject specific, technical	•Focus is *ITSI* •Need more subject specific, technical
Quality (ES-TR-Q, CSB-TR-Q)			
Professional Development (TR-QPD); Courses (TR-QC); Peer Mentoring (TR-QPM) Communities of Practice (TR-QCP)			
•*ITSI* prof development	• *ITSI* prof development	•*ITSI* prof development	•*ITSI* prof development
Type (TR-QT)			
•Theoretical, demo-based	•Theoretical, demo-based	•Theoretical, Practical	•Theoretical, demo-based
Remote			
Extent (ES-TR-E, CSB-TR-E)			
Frequency (TR-EF)			
•Numerous "how to" videos		•"How to" videos	•"How to" videos
Provided by (TR-EP)			
•Peers	•Communities of practice	•Peers •Communities of practice	•Peers
Quality (ES-TR-Q, CSB-TR-Q)			
Professional Development (TR-QPD); Courses (TR-QC); Peer Mentoring (TR-QPM) Communities of Practice (TR-QCP)			
•Peer mentoring •test	•Communities of practice	•Peer mentoring •Communities of practice	Peer mentoring
Type (TR-QT)			
•Technical "how to" videos to use *Google* platform	•Technical "how to" videos use *Google*	•Technical "how to" videos use *Google*, screen record	•Technical "how to" videos use *Google*
Hybrid & Remote			
Extent (ES-TR-E, CSB-TR-E); Quality (ES-TR-Q and CSB-TR-Q)			
Frequency (TR-EF)			
•Still active in training		•Additional *Google* training	•Additional *Google* training
Professional Development (TR-QPD), Courses (TR-QC), Peer Mentoring (TR-QPM) Communities of Practice (TR-QCP)			
•Peer mentoring	•Peer mentoring	•Peer mentoring	•Peer mentoring
Type (TR-QT)			
•Technical "how to" use *Google*	•Technical "how to" use *Google*	•Technical "how to" use *Google*	•Technical "how to" use *Google*

Chantal	Phillip	Mattie	Mpho
Support (ES-S, CSB-S)			
On Campus			
Technical (ES-S-T, CSB-S-T); Institutional Support (ES-S-I, CSB-S-I)			
Location (S-TL, S-IL)			
•On-site technical support •*ITSI* mainly remote	•On-site technical support •*ITSI* mainly remote	•On-site technical support •*ITSI* mainly remote	•On-site technical support •*ITSI* mainly remote
Function (S-TF, S-IF)			
•General technical issues and *ITSI* •Little school support	•General technical issues and *ITSI* •School provides extra subject specific apps	•General technical issues and *ITSI* •School monitors use	•General technical issues and *ITSI* •School encourages use
Response Time (S-TRT, S-IRT)			
•Both technical responsive	•Both technical responsive	•Responsive	•Responsive
Peer Support (S-TP); Communities of Practice (S-TCP)			
			•Limited peer support
Nature of Support (ES-S-N, CSB-S-N)			
Technical (S-NT)			
•Technical, fine as little use	•Mainly technical	•Technical, less needed	•Technical
Remote			
Technical (ES-S-T, CSB-S-T); Institutional Support (ES-S-I, CSB-S-I)			
Location (S-TL, S-IL)			
•All support is remote	•All support is remote	•All support is remote	•All support is remote
Function (S-TF, S-IF)			
•IT technical support for resource issues •Main "how to" on *Google* from task team	•Main "how to" on *Google* from task team •Tactical support from principal, ops manager	•Main "how to" on *Google* and other tools from task team	•Main "how to" on *Google* from task team •Some from principal •More finances needed
Response Time (S-TRT, S-IRT)			
• IT support still responsive			
Peer Support (S-TP); Communities of Practice (S-TCP)			
•"How to" videos and info from peer task team	•"How to" videos and info from peer task team	•"How to" videos and info from peer task team	•"How to" videos and info from peer task team
Nature of Support (ES-S-N, CSB-S-N)			
Technical (S-NT)			
•Tech issues IT person •"How to" from peers	•"How to" from peers •Tactical from school	•"How to" from peers	•"How to" from peers •Some from principal

Chantal	Phillip	Mattie	Mpho
Time (ES-T and CSB-T)			
On Campus			
Familiarity (ES-T-F, CSB-T-F)			
Use (T-FU); Time and Effort (T-FTE)			
•Familiar with technology, can learn more	•Quite familiar with technology	•Familiar with technology	• Familiar for what she needs
Feasibility (ES-T-FE, CSB-T-FE)			
Time to Learn (T-FEL); Time to Use (T-FEU); Time to Prepare (T-FEP); Time to Administer (T-FEA)			
•Time to assess on *ITSI* •If tech-savvy save prep, marking time	•Lack options in specific subjects •Need time to explore •Slows him down	•Need time to digitise content •Classes short, tablet waste time	•Takes time to use, explore •Switching tablet takes time •Save time for notes, out of class work
Remote			
Familiarity (ES-T-F, CSB-T-F)			
Use (T-FU); Time and Effort (T-FTE)			
•Familiar, learn all the time	•Familiar with new tools	•Familiar, managing •Older teachers challenged	•Need more training, time to be familiar •Use *WhatsApp* alternative
Feasibility (ES-T-FE, CSB-T-FE)			
Time to Learn (T-FEL); Time to Use (T-FEU); Time to Prepare (T-FEP); Time to Administer (T-FEA)			
•Small school, lots of subjects, lot of prep time	•Lot of prep time as many classes •Not sure using effectively	•Lot of time to alter content •Lot of classes, subject •Benefitting teaching	•Lot of time to alter content •Lot of classes •Admin an issue
Hybrid & Remote			
Familiarity (ES-T-F, CSB-T-F)			
Use (T-FU);Time and Effort (T-FTE)			
	•More familiar, extend, improve skills •Use, explore tech more		•Forced to extend skills •Appreciate tech more
Feasibility (ES-T-FE, CSB-T-FE)			
Time to Learn (T-FEL); Time to Use (T-FEU); Time to Prepare (T-FEP); Time to Administer (T-FEA)			
	•Time needed not sustainable for both	•Have more time to engage with learners	

6.7 INTERNAL BELIEFS OF TECHNOLOGY – BY TEACHER AND CONTEXT

Internal Beliefs (IB) have been conceptualised in this study as **Pedagogy (P)**; **Norms (N)**; **Knowledge (K)**; **Value of ICT (V)**; and **Self-efficacy (SE)**, are shown in Table 8 and Figure 9.

In order to answer the research question (4) *What are different teachers' internal beliefs about technology,* first a summary and discussion of the within-case analyses of different teacher's accounts of Internal Beliefs (IB) at School 2 in relation to the changing educational context and TTU-SST is presented. Thereafter, as belief systems are constructed from a combination of beliefs (Liu, 2011) an overall discussion of different

teachers' IBs at the school is provided. Table 25 presents a summary of the findings for IB, and Appendix F-2 provides the detailed analyses for each teacher's account of IB.

6.7.1 Pedagogical Beliefs

Findings indicate teachers have varied beliefs as to the aims of teaching which include provide **learners with knowledge** *"delivering knowledge"* (Chantal), **skills** *"they need skills from me"* (Phillip) and **content** *"teach the learners content"* (Mattie) and **enabling learners' growth** *"see them grow"* (Mpho). Teachers also appear to hold **varied opinions** about their **role**, which include **ensuring learners do their work** *"have to make sure learners do their work"* (Phillip); **sharing** and **engaging with learners** *"share knowledge, to engage"* (Mpho); **positively influencing learners' lives** *"to touch someone's heart"* (Mattie) and **utilising technology to make education relevant** *"create relevance and engagement"* (Chantal). Even though much educational technology literature classifies pedagogical beliefs as either teacher- or learner-centred, Ertmer and Ottenbreit-Leftwich (2010) claim teachers' pedagogical beliefs are not one-dimensional as teachers can hold multiple pedagogical beliefs even within the same context. Findings appear to concur with **both perspectives** as **Chantal**, **Phillip** and **Mpho** seem to hold **one-dimensional pedagogical beliefs** while **Mattie** seems to believe the **aims of teaching** are more **teacher-centred** and her **role** more l**earner-centred**.

When using **hybrid** and **remote** approaches, some teachers feel even though they need to **repeat content more often** *"you have to repeat the work that they do on their own"* (Chantal); *"have to reteach concepts"* (Phillip), they believe their **role** is now **more facilitative** *"more of a facilitator"* (Phillip), **collaborative** *"focus more on teamwork and collaboration"* (Chantal) and provides **learners with more individual attention** *"send to them individually"* (Mattie). Tondeur et al. (2008), Teo et al. (2008) claim that pedagogical beliefs exist on a continuum with teachers moving between these two extremes depending on the context in which they find themselves (Sadeck & Cronjé, 2017). This perspective may explain why **Phillip** and **Chantal** who **initially appear to hold more teacher-centred beliefs** report having a more **facilitative** and **collaborative role** when the **educational context changed**.

While most teachers feel **pedagogical changes** are **sustainable** *"it has changed forever"* (Phillip); *"it has changed...moving towards a technology revolution"* (Mattie); *"everything is*

going to be technologically based" (Mpho) and will include **more virtual teaching** *"can now always have learners remain at home"* (Phillip); *"this homeschooling thing...it is going to happen"* (Mattie) in the future, **Chantal** maintains although **more technology** will be used, **changes** will be **temporary** *"just going to revert back all the way"* as **face-to-face teaching** is still **preferable** for **certain learners** *"kids struggling are those choosing to do remote learning"* (Mpho) as **only self-motivated learners** can **benefit** from **remote education** *"have the self-discipline to perform at home"* (Chantal). These findings are in keeping with Artino and Stephens (2009); Childers and Jones (2017) who state remote education can only be successful if learners are self-motivated.

6.7.2 Normative Beliefs

While beliefs are complex in nature (Liu, 2011) and are often influenced by multiple factors at the same time (Van Der Ross & Tsibolane, 2017), Sadaf et al. (2012) and Hennessy et al. (2005) claim that each school has a set of norms directing which tools and resources are utilised and teachers are unlikely to deviate from these norms (Somekh, 2008) given the strong cultural pressure that exists in schools (Brodie, 2004; Ponticell, 2003). Therefore, in schools where beliefs around technology integration are favourable teachers are more likely to be motivated to integrate technology into their pedagogic practices (Zhao & Frank, 2003; Hennessy, et al., 2010). However, Vandeyar (2014) and Ertmer et al. (2012) contend that schools constrain integration efforts by simply pushing technology without having an understanding of how it benefits specific pedagogic activities and should rather encourage teachers' use of technology integration by having a holistic and unified vision of how technology benefits education (Rogers, 2000; Hew & Brush, 2007). Findings concur as even though all teachers report **technology** is a **core value** at the school and some believe being a **technology-driven school differentiates them** from other schools *"makes us different from the rest of the schools"* (Phillip), others feel **school support** is **lacking** as the **use of technology** is **too restrictive** *"using it too restrictively"* (Chantal); is simply being **used for technology sake** *"main aim is to use technology"* (Mattie) and rather than encouraging teachers the school **monitors use** *"if you don't use it, it's a big issue...may even be called to the principal"* (Mpho).

In addition, while some teachers report **many** of their **peers** are **favourable towards technology** *"60% believe it can aid education"* (Chantal); *"they do value technology"* (Mpho), others believe teachers should be able to **decide for themselves** *"we can decide*

for ourselves" (Mattie); **more training** is **needed** to bring other **teachers on board** *"need to get more teachers keen on technology...they need more support and training"* (Phillip); and even though **constraints exist** when using technology for **some subjects**, some teachers **simply do not want to utilise the tools** *"they don't want to use it...even for accounting...you can do it"* (Chantal). According to Hazzan (2003) and Abbott and Faris (2000), teachers who hold negative beliefs about technology may discourage their peers, while teachers may be more motivated and feel pressured to make use of technology if their peers value technology are already using it and encourage them to do the same. In addition, Ertmer and Ottenbreit-Leftwich (2010) claim that the perceived benefits of incorporating technology must be significant for teachers to choose to utilise technology as teachers often feel exposed due to their lack of technology competence (Zhao et al., 2002). In keeping with the literature, it is possible **teachers** who feel **unfavourable towards technology** due to the **school's requirement** to **use technology wherever possible**, coupled with some teachers' **limited technology skills** owing to **insufficient training**, is **negatively influencing** other teachers' **technology use** at the school.

When **remote**, Bergdahl and Nouri (2020) claim that a technology strategy prevents disorganised and disjointed technology use and limits the amount of time teachers need to spend exploring different technology options on their own. Findings suggest that even though all teachers report the school developed a **framework** to **guide teachers**, as it is **mainly non-prescriptive** *"it doesn't say you have to"* (Chantal); *"there are no restrictions"* (Phillip); *"pretty open to use whatever suits you"* (Mattie) and only dictates **where teachers need to post content** and what **level of teacher involvement is needed for content creation** *"work needs to be posted on all platforms"* (Mattie), it is **unclear** whether the **strategy** has resulted in **teachers spending less time exploring technology options** and **technology** is being used in a **more organised** and **unified manner**.

Furthermore, while Rasheed et al. (2020) claim that older teachers who have many years' experience in traditional face-to-face teaching are often less competent in using technology for teaching and therefore need greater assistance (since using technology so extensively within their daily practice is challenging and disrupting their existing proficiencies) findings indicate that even though some teachers believe **older teachers** find utilising the **new technology hard** *"older teachers are finding the technology more challenging"* (Chantal); *"teachers are struggling...ones that are a little bit old"* (Phillip), they

are **excited** about the **affordances** *"more enthusiastic"* (Chantal) and believe technology is making their **jobs easier** *"in her 60s...she's loving it...makes her life easier"* (Mpho) and **younger teachers** are **not enthusiastic** or **familiar** with the new remote tools *"younger teachers are not very excited...reluctant to ask for help...would rather struggle"* (Chantal).

6.7.3 Knowledge Beliefs

According to Kim et al. (2013), teachers' beliefs about classification of knowledge can influence and shape teachers' technology choices. To understand teachers' knowledge beliefs, Howard and Maton (2011) used LCT to construct knowledge and knower codes to separate the epistemic and social relations of knowledge. Findings indicate **teachers** at school 2 appear to possess **knower codes** as they believe knowledge is acquired either naturally or socially (Howard & Maton, 2011) by **interacting** and **drawing on past experiences** *"what you see, read...been taught"* (Chantal); being **inquisitive**, **making** and **learning from mistakes** *"asking, being curious...making mistakes...corrections"* (Mpho); **practical use** and **experiences** *"put their hands on something...use the device"* (Phillip); and **repetition** and **making content relevant** *"relevance...repetition...keeping it interesting"* (Mattie). Furthermore, Howard and Maton (2011) contend teachers' technology integration is closely related to whether codes are aligned with policies and goals being pursued at their school i.e., code match, or are in conflict i.e., code clash. Findings suggest that even though School 2 espouses **pro-technology beliefs** it seems as if even Chantal and Phillip, who are **favourable towards technology,** have a **code clash** with the school's **technology policies** and **goals** being pursued.

Furthermore, Angeli and Valanides (2009) claim that technology integration not only requires teachers to know how to use technology but also requires teachers to be aware of the possible benefits technology can provide. Ertmer and Ottenbreit-Leftwich (2010) concur as even though utilisation knowledge is the first step to technology integration, it is insufficient since teachers also need knowledge about how technology assists and benefits their teaching (Taimalu & Luik, 2019). According to Johnson et al. (2016), differences in technology use is shaped by teachers' beliefs as to how the transmission of knowledge takes place. While Chantal and Phillip believe **both types of knowledge** are **needed** to effectively incorporate technology in their teaching *"the more they know...the more they will use"* (Chantal); *"a correlation between knowing and using"* (Phillip), this perspective may explain why **Mpho**, who feels technology wastes time and often disrupts

her lessons, believes only **"how to" knowledge** is essential *"if I knew more, I would use it more"* and **Mattie** who maintains technology is not valuable for her subject feels **affordance knowledge** is **crucial** *"if I knew more about what I could do...could use technology"*.

When **remote**, findings concur with Angeli and Valanides (2009) who claim that technology integration necessitates knowing how to use technology and being aware of possible affordances as **Chantal** believes she is **incorporating technology** more than others teachers *"I'm using it a lot more than others...because I'm more comfortable"* who feel they **lack utilisation knowledge** *"if I knew how to...would use it more"* (Mattie) and thus are **using alternatives** *"use* WhatsApp *as this is the tool I know"* (Mpho).

6.7.4 Value of ICT Beliefs

While Maton and Howard (2018) claim that teachers need to prepare current learners for the technology-enabled future, Vandeyar (2014) states that integration is constrained when teachers believe they are forced to incorporate the technology without an understanding of how it benefits specific pedagogic activities (Ertmer et al., 2012). According to Cheok et al. (2016), Taimalu and Luik (2019), teachers need to believe technology will assist their teaching and enable them to achieve their learning objectives, otherwise they may choose not to incorporate it into their pedagogic practices (Zhao et al., 2002; Ertmer & Ottenbreit-Leftwich, 2010). Findings agree since even though when **on campus,** teachers believe **technology is valuable** *"brings the outside world into the classroom...is a big advantage"* (Chantal); *"creates a pathway for learners"* (Phillip); *"thank goodness for technology"* (Mattie) all teachers feel one should only **utilise technology where it makes sense** to **support** and **enhance existing pedagogic** practices, **improve administration** and **productivity tasks** and **enhance learning** because one needs to be **mindful about technology use** *"need to be mindful...is the technology helping the kids"* (Mpho) since the **aim** is to **teach** and **benefit learners** *"where it will benefit the kids"* (Phillip) by using technology for **suitable learning activities** *"technology is not suited to every subject...main aim to teach content to learners"* (Mattie); **providing engaging lessons** *"sitting and talking, you lose them...their interest is with technology"* (Chantal); and **preparing learners** for the **technological future** *"an advantage to know how to use technology"* (Chantal). Furthermore, when using a **remote** and **hybrid** approach, teachers report they **appreciate technology more** *"technology is the way to go"* (Phillip); *"value*

technology more" (Mattie); *"you can actually see...what technology can give them"* (Mpho) and maintain they are finding even **more ways to utilise technology** to **support** and **enhance teaching** and **learning**. This concurs with Ertmer et al. (2012) who claim that teachers are more likely to integrate technology in different ways when they believe the affordances it provides their teaching are significant.

According to Rasheed et al. (2020), to effectively utilise technology for remote learning learners need to possess competent technological skills. However, Mailizar et al., (2020) claim even though current learners are presumed to experience fewer challenges in using technology, many lack the knowledge and skills to use technology for academic work. Furthermore, while Rapanta et al. (2020) argue that remote teaching can be as effective as face-to-face situations if teachers have a social presence, Giovannella et al. (2020) state that online education lacks the same human connection and thus it is harder to motivate learners without face-to-face classes (Graham, 2006). Findings concur as when **remote**, Phillip feels **learners lack technology skills** for **academic purposes** *"the kids are battling...they don't know what to do"* and all teachers believe it is **difficult** to **engage** and **motivate learners** when **not physically in class** *"challenging to engage them"* (Chantal), *"they join...hardly interact"* (Phillip), *"you don't know if they are with you"* (Mattie), *"technology makes them lazy"* (Mpho). In addition, all teachers feel **remote** teaching is being **constrained** as **many learners at the school** come from **less advantaged homes** and thus are **unable to purchase sufficient data** *"kids don't have data"* (Mpho); *"at the end of the month...a lot of kids are not opening any resources"* (Chantal) needed to **participate in lessons** *"half the school isn't online"* (Phillip) and **access content** *"not everyone has data to look at stuff"* (Mattie). This is in keeping with Mhlanga and Moloi (2020), du Plessis (2014), Mailizar et al. (2020), and Le Grange, (2020) who claim that in a remote setting many learners from disadvantaged backgrounds are not able to continue with their schooling since they lack access to adequate technology resources.

Rasheed et al. (2020), Artino and Stephens (2009), Childers and Jones (2017), and Mailizar et al. (2020) claim that for online teaching and learning to be successful, learners must be self-regulated because learners without self-motivation tend to be distracted and need parental assistance and monitoring to ensure they continue with their academic work (Giovannella et al., 2020). Findings concur when using a **hybrid** approach, teachers

believe the **technology** is making **learners lazy** *"it gives them everything"* (Mpho), benefits **self-motivated learners** *"can benefit some learners more than others"* (Chantal); *"requires a whole lot of responsibility from them"* (Phillip); *"hard for them to be motivated"* (Mpho) and **requires parents to be actively involved** *"parents also need to come on board"* (Phillip).

6.7.5 Self-Efficacy Beliefs

Technology self-efficacy which describes a person's beliefs in their own abilities to achieve pedagogic goals using technology, influences whether an individual thinks positively or negatively about technology, the amount of effort they are willing to invest and their level of perseverance in overcoming technology challenges (Bandura; 2000; Ertmer & Ottenbreit-Leftwich, 2010). In addition, Farah (2011) states that factors such as teachers' perceptions of technology support, their beliefs about their subject and the amount of time they use technology at work shape work-related self-efficacy whereas teachers' home access personality traits, beliefs about the value of technology in education and personal fears of using technology in their pedagogic practice influences their self-efficacy. According to Van Der Ross and Tsibolane (2017), teachers with higher technology self-efficacy beliefs are more likely to integrate technology into their teaching. Findings concur as teachers who feel **technology plays a valuable role** in their lives report feeling **confident using technology** in their **teaching** and **personal lives** *"I am confident about using technology"* (Chantal); *"I am fine with technology"* (Phillip); *"I am confident using technology"* (Mattie) whereas **Mpho** who believes **technology integration opportunities** are **limited** and **prefers not using technology** in her **personal** and **work life**, reports feeling **not confident** with her **technological skills** *"I really struggle"*.

Furthermore, according to Bandura (2000), teachers who perceive technology as providing benefits to their teaching are prepared to expend time and effort to integrate technology into their pedagogic practice. When **remote**, findings suggest **teachers** who are willing to **learn from peer training** and **follow instruction** *"it is easy to follow the instructions"* (Mattie); *"I am learning as I go"* (Phillip) and are **part of the peer mentoring team** *"training is on the six of us"* (Chantal) report **feeling confident** using **the new tools** while **Mpho** reports being **reluctant to use the new tools** as she believes **more time** is needed to **use** and become **confident** *"I have struggled...I'm still reluctant...if I was granted more time...would be more comfortable"*.

6.7.6 Summary of Different Teachers' Internal Beliefs

Findings suggest the **school's technology policy** which most teachers perceive as requiring them to utilise technology wherever possible (Chantal Mattie Mpho) appears to be **negatively influencing** some teachers' **IBs** regarding the **value of ICT**, **knowledge** and **self-efficacy**. In keeping with the literature, it seems as if teachers' **IBs cannot be understood in isolation** from each other as they are **complex in nature** and are constructed from a synergy of beliefs that collectively influence teachers' technology integration choices (Liu & Johnson, 2000; Liu, 2011; Rogers; 2000; Ertmer. 1999). For example, even though Ertmer et al. (2015) and Kim et al. (2013) claim that teachers with more constructivist beliefs use technology more actively and in varied ways, Hughes (2005), Snoeyink and Ertmer (2001) argue that even teachers with learner-centric views will only incorporate technology if they believe it benefits their teaching. However findings indicate **Chantal** and **Phillip,** who hold more **teacher-centred,** views seem to **value technology** more, feel they possess **knowledge** of **utilisation** and **affordances** and maintain they have **high technology self-efficacy** whereas **Mpho,** who appears to hold more **learner-centred** pedagogical beliefs feels technology has **little value** and believes her **utilisation knowledge** and technology **self-efficacy** is **limited** and **Mattie** seems to possess a more **multidimensional** set of IBs.

In addition, according to Ertmer (1999) and Ertmer et al. (2015), technology use is influenced by a combination of first- and second-order barriers with teachers' explanations of their first-order barriers often being closely related to their IBs mediated by context. Findings suggest **teachers' accounts** of **ES** and their **IBs** are **aligned** and have **shifted** in relation to the **changing context**. For example, **Mpho** who **initially** reports **ES** at the school are **insufficient** also seems to hold **mainly negative IBs** about **technology integration**, however, when **remote**, provision of **better ES** seems to have **positively influenced Mpho's IBs**. Furthermore, findings indicate when **remote** and using a **hybrid** approach all teachers believe **teaching efforts** are being **constrained** as **barriers exist** in regard to **ES** for both teachers and learners. This finding suggests ES barriers may exhaust teachers and result in limited technology integration irrespective of teachers' IBs (Ertmer et al., 2012; Woodbridge, 2003).

Table 25: Summary of Different Teacher's Internal Beliefs - School 2

Chantal	Phillip	Mattie	Mpho
Pedagogy (IB-P)			
On Campus			
Aims of Teaching (P-TA, P-LA)			
•Give over knowledge	•Enable skills	•Provide content	•Enable learner growth
Role of Teacher (P-TRT, P-LRT)			
•Use tech more relevant	•Ensure work is done	•Influence leaners' lives	•Share, engage learners
Hybrid & Remote			
Role of Teacher (P-TRT, P-LRT)			
•Repeat work, collaborate	•Repeat work, facilitate	•More individual focus	
Sustainability of Change (PS)			
•Temporary, use tech more •Need self-motivation	•Changed forever, use tech •Virtual teaching, learning	•Changed forever, use tech •Virtual teaching, learning	•Changed forever, use tech •Not suited to all learners
Norms (IB-N)			
On Campus			
School Norms (IB-N-S)			
•Tech school, but restrictive use, limited school support	•Tech school, differentiates from other schools	•Use tech for tech's sake	•Technology core value •Monitor use
Peer Norms (IB-N-P)			
•Lot of teachers favourable •Say constraints but do not want to use it	•More teachers need to come on board	•Should decide, teachers' personal preference	•Lot of teachers favourable
Remote			
School Norms (IB-N-S)			
•Require tech, check on use •Framework not strict, except for content creation	•Framework not strict	•Framework not strict, except for posting content	•Framework not strict, except for posting content
Peer Norms (IB-N-P)			
•For older teachers hard but excited by tech possibilities •Younger teachers less excited, not ask, struggle	•For older teachers hard the new tools		•For older teachers make life easier
Knowledge (IB-K)			
On Campus			
Classification of Knowledge (IB-K-N)			
Acquisition of Knowledge (K-NA)			
•Interact, past experiences, knowledge base	•Practically using, engaging	•Repetition, making content relevant	•Inquire, make mistake, learn from them
Knowledge Utilisation and Affordances (IB-K-U)			
•How to use key •Affordances also important	•How to use key •Affordances also important	•Affordances important	•How to use is key
Remote			
Knowledge Utilisation and Affordances (IB-K-U)			
•Know more affordances, so use more features		•Would use more if knew more	•Using alternative as lack knowledge of new tools

Chantal	Phillip	Mattie	Mpho
Value of ICT (IB-V)			
On Campus			
Ways to Use Technology (IB-V-U) and Affordances (IB-V-A)			
Place for Technology in Education (V-UP)			
•Prepare learners for future •Need human connection •Makes sense, engaging	•Where it makes sense •Benefit learners •To enhance teaching	•Not just for tech's sake •Suited to activity	•Not just for tech's sake •Mindful of why using tech
Supports Teaching (V-UST, V-EST)			
•Create, distribute content •Save marking time	•Create, distribute content •Supports teaching •Save marking time	•Create, distribute content •Other teaching approaches	•Create, distribute content •Supports teaching
Enhances Teaching (V-UET, V-AET)			
•Exciting and relevant •Virtual experiences •Prepare learners for future	•Exciting and relevant	•Prepare learners for future	•Exciting and relevant •Learning styles
Productivity (V-UP); Administration (V-AA)			
•Easier communication •Save time for admin, class	•Save time in class	•Communication •Save time in class	•Take picture for notes •Cover work at home
Enhances Learning (V-UEL, V-AEL)			
•Outside in the class •Advance learning	•Practice skills •Reinforce content	•Outside in the class	•Outside in the class •Advance learning
Remote			
Ways to use Technology (IB-V-U) and Affordances (IB-V-A)			
Supports Teaching (V-UST, V-AST)			
•Resource management •Carry on academic project •Teacher creativity •Access resources, future	•Resource management •Track learner progress	•Resource management •Resources for future	•Resource management
Productivity (V-UP); Administration (V-AA)			
•For absent learners •Comms with learners	•Comms with leaners	•Comms with learners	•Comms with learners
Enhances Learning (V-UEL, V-AEL)			
•Review content few times	•Review content few times, for learner understanding	•Review content few times •Cover work at home	•Review content few times •Learners more self-reliant
Challenges (V-AC)			
•Engage, motivate hard •Data access, costs high	•Engage, motivate hard •Data access, costs high •Learners unskilled with tools	•Engage, motivate hard •Data access, costs high	•Engage, motivate hard •Data access, costs high
Hybrid & Remote			
Affordances of Technology (IB-V-A)			
Enhances Teaching (V-AET)			
•Value tech more	•Value tech more	•Value tech more	•Value tech more •More relevant content
Enhances Learning (V-AEL)			
•Encourages collaboration	•Learners more self-reliant	•Review content, better	•Learners more self-reliant
Challenges (V-AC)			
•Tech can be distracting •Learners need to be self-motivated	•Learners need to be self-motivated •Parents need to help	•Valuable only if learners put in effort	•Learners can be lazy •Learners need to be self-motivated

Chantal	Phillip	Mattie	Mpho
Self-Efficacy (IB-SE)			
On Campus			
Work-Related Activities (IB-SE-W)			
•Feel confident	•Feels comfortable	•Feels comfortable	•Not confident, also subject related
Ways to gain Self-Efficacy (IB-SE-WA)			
•Learn more by using		•Following instructions	•Learn by using, with time
Personal-Related Activities (IB-SE-P)			
•Feels comfortable, uses it where it makes sense	•Feels comfortable, uses it extensively	•Feels comfortable, uses for most things	•Feels comfortable, would prefer not to use
Remote			
Work-Related Activities (IB-SE-W)			
•More confident, new skills	•Confident with new tools	•Able to utilise with training	•Not confident, reluctant
Ways to gain Self-Efficacy (IB-SE-WA)			
•Gain new skills		•Follow instructions, training	•More use and time

6.8 PROFESSIONAL DISPOSITION - BY TEACHER AND CONTEXT

Professional Disposition (PD) which has been conceptualised in this study as **Instructional discourse (PD-I)** and **Regulative discourse (PD-R)**, is shown in Table 8 and Figure 9.

In order to answer the research question (5) *what are different teachers' professional dispositions* since Professional Dispositions (PD) are analytically distinct (Bernstein, 1986), first a summary and discussion of the within-case analyses of different teachers' accounts of their instructional and regulative discourses over time, in relation to TTU-SST, are presented. Then, as these discourses are in reality interrelated (Bernstein, 1986), a summary and discussion of the teachers' professional dispositions at School 2 are presented. Table 26 presents a summary of the findings for teachers' PD at School 2 and Appendix F-3 provides the detailed analyses for each teacher's account of PD.

6.8.1 Instructional Discourse

The instructional discourse refers to "what is being transmitted" (Morais, 2002, pg560) and describes teachers' view of knowledge structures and acquisition procedures (Bernstein, 1999; 2000). Bernstein (1999; 2000) defines everyday knowledge as horizontal since it is weakly classified, context-specific and usually given over orally whereas specialised school knowledge is defined as vertical as it is strongly classified and typically given over in a formal school context and in written form. Findings indicate **all teachers** believe they are **interlinked** even though **boundaries exist** between **school** and **everyday**

knowledge *"they are related"* (Chantal); *"one influences the other"* (Phillip), *"they interact, they relate"* (Mattie), *"incorporate everything into one"* (Mpho), however, teachers seem to possess different beliefs in relation to the **importance**, **nature** and **direction of transmission**. **Phillip** and **Mattie** believe **school knowledge** is **more essential** *"you need school knowledge to guide you"* (Phillip); *"school knowledge comes first"* (Mattie) and needs to be **acquired first** in a **vertical manner** through **continuous practise** and **repetition** *"need to teach from a good base...practising a whole bunch of times"* (Mattie); *"need a base...need to practise"* (Phillip) whereas **Chantal** believes **everyday knowledge** needs to be **acquired first** to enable the **creation**, **acquisition** and **structuring** of **school knowledge** *"everyday knowledge creates new knowledge...if everyday knowledge is lacking you don't have the discipline to acquire school knowledge"* and **Mpho** who feels **knowledge** can be **acquired in either direction** *"at home you can teach and learn...come back and share...learn it at the same time"*. Therefore, it appears as if the **classification of knowledge** exists on a **continuum** for teachers at School 2, with **stronger classification** of knowledge boundaries for **Phillip** and **Mattie** and **weaker classification** for **Chantal** and **Mpho**.

6.8.2 Regulative Discourse

According to Bernstein (1996), the regulative discourse describes teacher–learner boundaries and control of the classroom in terms of content sequencing, timing and pace. While findings suggest **Phillip** who reports being **strict** and **firm** with learners and **controls** the **classroom** *"have strong boundaries...100% in control of what happens in my classroom"* has a **dominant performance-based pedagogic modality**, other teachers seem to possess a **combination of both modalities** as they maintain even though they have **strong boundaries** and **control the classroom** *"I am the educator and they are the students...I am in charge of my classroom"* (Chantal); *"I am their teacher...don't usually share control"* (Mattie); *"there are boundaries...I control the classroom"* (Mpho) they believe they are **approachable** *"got an open door policy"* (Chantal) and have **mutual respect** between themselves and the learners *"there's a level of respect"* (Mattie); *"first thing is respect"* (Mpho) and **share limited control** depending on the **time of year** and **class makeup** *"can share a little...depends on time of year...what class"* (Mattie). This is in keeping with Morais (2002), and Bourne (2004; 2006) who contend that even though pedagogic modalities are conceptually distinct with a performance-based pedagogy being strongly framed with clear teacher–learner boundaries, strong teacher control of the

classroom context and a competence-based pedagogy possessing weak framing with less explicit boundaries and shared control of the classroom (Bernstein, 1996) that a combination of modalities can concurrently exist for a teacher, depending on the context and circumstances.

Additionally, Bourne (2006) claims shifts in circumstances and contexts can influence teachers' pedagogic modalities. According to Bouhnik and Deshe (2014), the use of technology can potentially lessen teacher–learner boundaries as learners are able to contact teachers more frequently, even after school hours. When **remote**, while findings concur as **Phillip** believes **boundaries** have become **less strict** *"am learning with the learners now"* and **Chantal** indicates **extra boundaries** are needed since learners have **unrealistic expectations** *"I've maintained my boundaries...tell them after 8pm...there will be no response"* **Mattie** and **Mpho** report **boundaries have not changed** *"have not changed really"* (Mattie), *"nothing has really changed"* (Mpho). A possible reason for reports of **boundaries not changing** may be that **aspects** of a **competence-based** pedagogic modality were **already present** for **both teachers** when **on campus**.

6.8.3 Summary of Different Teachers' Professional Dispositions

Bernstein (2000) defines "collection" and "integrated codes" as two distinct concepts based on their strengths of boundaries of knowledge and power. However, it appears as if the separation is not so clear since classification and framing function independently from each other, thus it is possible that one may be strong and the other weak (South African Institute for Distance Education, 2010). Findings concur as even though **Mattie** appears to mainly possess **collection codes** due to **strong classification** in her instructional discourse, **integrated codes** are present as **aspects** of her **regulative discourse** are **weakly framed**, whereas **Chantal** and **Mpho** who seem to possess **integrated codes** as they view **knowledge** as **weakly classified**, have some **collection codes** in their PDs as part of their **regulative discourse** is **strongly framed**. Interestingly, although **Phillip** seems to possess **only collection codes**, when **remote,** it seems as if **integrated codes** are now also present as he reports **boundaries have lessened** and he is playing a **more facilitative role**. A possible reason for the change in Phillip's regulative beliefs may be because PDs are not constructed in a vacuum (Fonseca-Chacana, 2019) as the way people behave is based on their social context (Bourdieu, 1974) and teaching environment (Dottin, 2009) which can change over time due to experiences (Burant et al., 2007).

Therefore, while codes assist in conceptually analysing and describing teachers' instructional and regulative discourses, as teachers' worldview and resulting pedagogic practices are constructed from a combination of personal attributes and the surrounding social context (Hoadley & Ensor, 2009), in reality, one is unable to neatly categorise teachers' multifaceted and complex PDs.

Table 26: Summary of Different Teacher's Professional Dispositions - School 2

Chantal	Phillip	Mattie	Mpho
On Campus			
Instructional Discourse (IB-PDI)			
Boundaries of Knowledge (IB-PDI-B)			
•Everyday and school integrated •School structured •Everyday needed to acquire, new knowledge	•Everyday and school integrated •School needed to provide skills	•Everyday and school integrated •School needs knowledge base	•Everyday and school integrated
Knowledge Acquisition (IB-PDI-K)			
Direction of Knowledge Acquisition (PDI-KD)			
•Everyday first	•School to everyday	•School to everyday	•Either direction
Ways to Acquire Knowledge (PDI-KW)			
•Interact with world	•Vertical with base	•Vertical with base	Interact with world
Involvement Needed (PDI-KI)			
	•Teacher guidance •Continual practice	•Continual practice •Repetition	
Regulative Discourse (IB-PDR)			
Teacher- Learner Boundaries (IB-PDR-B)			
•Strong professional boundaries •Approachable	•Strong professional boundaries •Strict, firm	•Strong professional boundaries •Mutual respect, open	•Strong professional boundaries •Mutual respect
Classroom Control (IB-PDR-C)			
•Teacher control	•Teacher control	•Teacher control •Share time of year, class	•Teacher control
Hybrid & Remote			
Regulative Discourse (IB-PDR)			
Teacher- Learner Boundaries (IB-PDR-B)			
•Not changed •Boundary for times	•Less strict •More facilitative	•No change	•No change

6.9 ORIENTATION TOWARDS TECHNOLOGY - BY TEACHER AND CONTEXT

Orientation towards Technology (OTT) i.e., Agent's Practices (AP) and Outcomes (O) which have been conceptualised in this study as **Level of Adoption (AP-LA)**, **Manner of Adoption (AP-MA)**, **Adoption Activities (AP-AA)**, **Current (O-CTU)** and **Future (O-FTU) technology use** are shown in Table 8 and Figure 9.

In order to answer the research questions (6) *What are different teachers' orientations towards technology* and (7) *How do different teachers use technology*, summaries and discussions of the within-case analyses of different teachers' accounts of Orientation towards Technology (OTT), Level and Manner of Adoption (LA, MA), Current Adoption Activities and Outcomes (AP-AA, O-CTU) and Future Adoption Activities and Outcomes (AP-AA; O-FTU) over time and in relation to TTU-SST are presented. Thereafter, as belief systems are constructed from a combination of beliefs (Liu, 2011) an overall discussion of different teachers' OTT over time at School 2 is provided. Table 27 presents a summary of the findings for teachers' OTT at School 2 and Appendix F-4 provides the detailed analyses for each teacher's account of OTT.

6.9.1 Level and Manner of Adoption

While **all teachers** believe technology **supports** and **enhances existing** practices, some feel technology can be **transformative** as it **empowers leamers** *"it is completely different"* (Chantal) and **changes the role** and **approach** of **teachers** *"changes everything...my approach in class"* (Phillip) and others believe technology it **not suited to all subjects** *"not suitable for every subject"* (Mattie) and should only be used **where it makes sense** *"just to use it for the sake of using it...what is the value of that"* (Mpho). Findings suggest when **on campus**, **LA** for **all teachers** is at the **familiarisation** and **utilisation** level as teachers know the basics and use technology to support existing practice (Hooper & Rieber, 1995; Rogers, 2000), whereas for **Chantal** and **Phillip** it seems as if **integration**, **reorientation** and **evolution** levels are also being achieved as they report that technology is essential to their teaching, have begun to rethink educational goals utilising technology and are discovering new uses for technology (Hooper & Rieber, 1995; Rogers, 2000).

For **MA**, when technology is used as a substitute for other mediums or to augment existing pedagogic practices (Puentedura, 2006), Hooper and Rieber (1995) claim that this is called a product technology whereas an idea technology is present when teachers utilise technology to modify and redefine existing tasks and practices. Findings indicate that when **on campus,** although **all teachers** at School 2 use technology in a **product manner** to **support** and **enhance existing practices** through **substitution** and **augmentation** *"enrichment of what I do...just supports really"* (Mpho); *"my teaching hasn't changed...it just help us reach more kids"* (Mattie) only **Chantal** and **Phillip** appear to be utilising technology in an **idea manner** to **modify** and **transform** tasks and pedagogic

roles *"I don't have all the knowledge...if we are curious about something, we can satisfy it...focus more on teamwork and collaboration"* (Chantal); *"kids are not relying on me for the information, they can go elsewhere...can track how far the kids are...creates a pathway"* (Phillip). When **remote**, **Phillip** and **Chantal** maintain the **move from face-to-face classes** has resulted in them **modifying** and **redefining** their teaching. It seems as if **Mattie** and **Mpho** are also utilising technology to **modify** and **redefine** their practices and teaching roles. Because teachers' technology integration choices and how technology is used can be influenced by their beliefs as to the value of technology (Woodbridge, 2003), these findings suggest **Mattie** and **Mpho** may be **expanding** their **MAs** as they **appreciate technology more** since they are aware **teaching remotely** cannot occur **without technology** (Hadijah & Shalawati, 2017; Bergdahl & Nouri, 2020). Furthermore, in keeping with the literature it seems that even for the same teacher integration may differ depending on the surrounding context, as technology integration is complex and multifaceted (Hamilton et al., 2016).

6.9.2 Current Adoption Activities and Outcomes

All teachers report that when **on campus,** they mainly use technology to **support existing practices.** Activities include **content management** and **projection** (all teachers), **assessment** (Chantal), **show videos** (all teachers), **searching the internet** (Chantal, Mpho), **marking** (Chantal, Phillip), **recording marks** (Chantal), **checking learners' resource activities** (Phillip) and **communication** (all teachers). Furthermore, some teachers indicate they are using technology to **transform practices** by providing **other teaching approaches** (Phillip, Mattie), making **abstract concepts more real** (Chantal) and offering **personalised learning experiences** (Phillip). When **remote**, teachers report a **greater need** to **use technology** for **communicating with learners** (all teachers), **getting support** (all teachers), **attending meetings** (Phillip, Mpho), **catching up learners** (Chantal, Mattie, Mpho) and to **support existing practices.** The latter now includes **posting guidelines** and **content** (all teachers), **pre-recording lessons** (all teachers), finding **additional content** (all teachers), building a **bank of future resources** (Chantal, Mattie), **online learner assistance** (Chantal, Phillip, Mattie) and online **submission of work** and **feedback** (all teachers). Similarly, in a **hybrid** setting, teachers report technology is still being used to **support existing practices** but now also includes **recording** and **conducting live lessons** (all teachers), **storing resources online** (Chantal) and **catering to learners at home** (all teachers).

Findings suggest when **on campus,** although all **teachers' current activities** are mainly for **supportive** and **administrative** tasks, **Chantal** and **Phillip** appear to utilise technology for more **transformative tasks**. However, with the move to **remote** and **hybrid** teaching, **Mattie** and **Mpho** also seem to be **utilising technology** to **enhance** and **transform certain parts** of their **pedagogic practices**. While Vannatta and Fordham (2004), Deng et al. (2014), and Ertmer et al. (2015) claim that teachers' dispositions and beliefs may promote or inhibit technology activities and Woodbridge (2003) argues that the way teachers' use of technology can be influenced by their beliefs about the value of technology, it seems as if the **shift** in **Mattie** and **Mpho's current technology activities** is mainly **due** to **educational context changes**. This perspective is in keeping with literature which states that context influences teachers' abilities to translate beliefs into practice (Ertmer, 2005) and thus technology integration can differ, even for the same teacher (Hamilton et al., 2016).

6.9.3 Intended Future Adoption Activities and Outcomes

When **remote**, most teachers report they **intend to use technology** more **extensively** (Chantal, Mattie) to **record live lessons** (Chantal, Phillip, Mattie), **pre-record lessons** (Mattie), **teach more than one class at a time** (Phillip) and **post additional resources** (Mpho). However, when **returning to campus** findings indicate teachers are only using technology to **record live lessons** (Chantal, Mattie, Mpho), **conduct remote lessons** (Mattie, Mpho), **cater to learners at home** (all teachers) and **store resources online** (Chantal). A possible reason some intended activities are not taking place may be that teachers find the extra time needed to teach in a face-to-face as well as a remote context is too onerous and thus, despite the benefits, initial intentions may not be realised (See et al., 2020; Mailizar et al., 2020).

Regarding the **future of education**, although all **teachers** believe the incorporation of **technology** has the potential to **expand the homeschooling market** they maintain that a **blended technology approach** must **be used** *"will be a blended approach"* (Mattie) *"will come in for contact time only...the rest online"* (Chantal); *"being blended"* (Phillip). Findings concur with literature which states using a blended approach enables teachers and learners to still reap the benefits of face-to-face engagements alongside greater flexibility offered by online education as constraints of time and space are removed (Stein & Graham, 2020). Notwithstanding the benefits of using a blended approach, the success of

remote learning depends on learners being self-regulated, having appropriate skills (Rasheed et al., 2020), adequate provision of resources (Bergdahl & Nouri, 2020; Mailizar et al., 2020; Hadijah & Shalawati, 2017) and greater parental support (Giovannella et al., 2020). Findings concur as teachers report being **concerned** about utilising an **exclusively remote approach** because they feel **online approaches** are **unsuitable** for **some learners** *"some students really need to be at school"* (Chantal); *"their side is really lacking"* (Phillip); *"kids studying at home we can see a huge dip in their marks"* (Mattie); *"they are not responsible"* (Mpho), **learners lack technology skills** *"you find some don't even know how to use a laptop"* (Mpho), **technology infrastructure in South Africa is poor** and thus **cannot support remote education** *"the kids that are at a disadvantage are the kids not on technology...the kids in public schools"* (Phillip); *"kids need data to do this"* (Mattie) and **parents** are **disinterested in assisting their children** *"parents...should be sitting and helping their kids do their work"* (Phillip).

6.9.4 Different Teachers' Orientation toward Technology

While Deng et al. (2014), Vannatta and Fordham (2004), and Ertmer et al. (2015) contend that technology choices are primarily influenced by teachers' dispositions with teachers with learner-centred beliefs having more active and varied use of technology in the classroom, Hamilton et al. (2016) argue that technology integration can differ even for the same teacher within different contexts as societal norms and expectations (Ertmer et al., 2015) and the school context (Vanderlinde et al., 2010) play an important role in influencing teachers' abilities to translate beliefs into practice (Ertmer, 2005). Findings are in keeping with the literature because when **on campus,** even though all teachers' **OTT** is **similar** in regard to **supporting** and **enhancing existing practices**, **Chantal** and **Phillip** appear to be **utilising technology more consistently** in a **greater variety of ways**, yet it seems the **educational context change** is also **shifting Mpho's** and **Mattie's technology use** and resulting OTT. However, even though context is crucial, according to Tondeur et al. (2017), it is impossible to attribute teachers' incorporation of technology or lack thereof to any single factor since complex and bidirectional relationships seem to exist between teachers' OTT and their beliefs of External Structures (ES), Internal Beliefs (IB) and Professional Dispositions (PD).

Table 27: Summary of Different Teacher's Orientation toward Technology - School 2

Chantal	Phillip	Mattie	Mpho
Level and Manner of Adoption (AP-LA; AP-MA)			
On Campus			
Supporting and Enhancing Pedagogic Practice (LA-SEP, MA-SEP)			
•Support and enhance	•Support existing pedagogy •Benefit learners	•Support and enhance •Not suited to all subjects	•Support and enhance •Not suited to all subjects
Transforming Pedagogic Practice (LA-TP, MA-TP)			
•Learners get own info	•Changes role, approach		
Remote			
Supporting and Enhancing Pedagogic Practice (LA-SEP, MA-SEP)			
•Support and enhance •Save time, easier comms	•Support pedagogy •Save time, easier comms •Track learner activity •Understand better	•Support pedagogy •Save time, easier comms •Understand better	•Support pedagogy •Save time, easier comms •Understand better
Transforming Pedagogic Practice (LA-TP, MA-TP)			
•More collaborative	•Transform pedagogy •More facilitative	•Transform pedagogy •Individual focus	•Transform learner skills, more self-reliant
Adoption Activities (AP-AA) and Outcomes (O)			
On Campus			
Current Teaching Activities (AP-AA; O-CTU)			
Supporting Teaching Activities (AP-AAS, O-CTUS)			
•Prepare, present, push, upload content •Show videos •Assessments, marking •Search information	•Prepare, present, push, upload content •Show videos •Marking	•Prepare, present, push, upload content •Show videos	•Prepare, present, push, upload content •Show videos •Search extra resources
Transforming Teaching Activities (AP-AAT, O-CTUT)			
•Make abstract concept real	•Other teaching approaches •Own learning experience	•Other teaching approaches	
Administration Activities (AP-AAA, O-CTUA)			
•Record marks •Communication	•Communication •Learner resource activity	•Communication	•Communication
Remote			
Current Teaching Activities (AP-AA; O-CTU)			
Supporting Teaching Activities (AP-AAS, O-CTUS)			
•Pre-record lessons •Find resources, build bank •Post guides, content •Assist learner online •Submit, feedback online	•Pre-record lessons •Find resources •Post guides, content •Assist learner online •Submit, feedback online	•Pre-record lessons •Find resources, build bank •Post guides, content •Assist learner online •Submit, feedback online	•Pre-record lessons •Find resources •Post guides, content •Submit, feedback online
Administration Activities (AP-AAA, O-CTUA)			
•Comms with learners •Teacher support •Catch up absent learners	•Comms with learners •Teacher support •Attend Meetings •Check resource activity	•Comms with learners •Teacher support •Catch up absent learners	•Comms with learners •Teacher support •Meetings •Catch up absent learners
Intended Future Technology Use (O-FTU)			
Supporting Role (O-FTUS)			
•Use tech more •Record live lessons	•Use tech more •Record live lessons •Teach two classes at once	•Record live lessons •Make pre-recordings	•Post extra resources

Chantal	Phillip	Mattie	Mpho
Adoption Activities (AP-AA) and Outcomes (O)			
Hybrid & Remote			
Current Teaching Activities (AP-AA; O-CTU)			
Supporting Teaching Activities (AP-AAS, O-CTUS)			
•Record live lessons •Learners at home •Store resources online	•Learners at home	•Record live lessons •Conduct remote lessons •Learners at home	•Record live lessons •Conduct remote lessons •Learners at home
Administration Activities (AP-AAA, O-CTUA)			
•Comms with learners	•Comms with learners	•Comms with learners	•Comms with learners
Future of Technology in Education (O-CTUF)			
•Must be blended •Not sustainable, transform •Expand home schooling	•Must be blended •Change forever, transform •Expand home schooling	•Must be blended, be willing •Change forever, transform •Expand home schooling	•Mainly online •Change forever, transform •Expend home schooling
Challenges of Only Online (O-CTUC)			
•Not suited to all learners	•Not suited to all learners •Parents disinterested •Infrastructure barrier	•Not suited to all learners •Infrastructure barrier	•Not suited to all learners •Learners lack tech skills

6.10 CONCLUSION – SCHOOL 2

This chapter presented the findings and discussion for School 2. First, an overview of the case study site, the school's response to the COVID-19 pandemic and a summary of the teachers' interviews were provided. Next, summaries of findings and discussions as relates the micro- and meso-level theories[62] for each of the theoretical framework components, i.e., ES and CSB, IB, PD, AP and O were presented in reference to prior literature reviewed or, where necessary, new literature to substantiate or counter findings. Initial codes that were deductively formulated from the theoretical framework and subcodes that emerged inductively from the data were then detailed in the summary tables.

[62] Figure 9 depicts the micro- and meso-level theories utilised for this chapter.

7 FINDINGS AND DISCUSSION – SCHOOL 3

In order to understand teachers' lived experiences within School 3, the case study site and participants must be contextualised first. Therefore, the chapter begins with a summary of the site visit to the school, followed by a summary of teachers' personal technology use, teaching experience, a brief description of each teacher interviewed and an overview of the school's response to the COVID-19 pandemic (Olivier, 2020). Next, to provide a holistic understanding of School 3 and its teachers' beliefs, findings and discussions are presented using within-case analyses for each of the relevant research questions, using codes drawn from the study's theoretical framework for the micro- and meso-level theories (see Table 8 for initial codes). Further, because data was collected at three different intervals, teachers' accounts are presented in chronological order.

7.1 SUMMARY OF SITE VISIT

School 3 is a relatively newly established, non-fee-paying, government school of specialisation focusing on disadvantaged learners that have an aptitude for the sciences. The school currently has 900 learners, 30 teachers and the average class size is between 37 and 42 learners. The school writes the NSC matric and offers mainly technology-based subjects, with English being used as the language of instruction even though this is not the home language for most learners and teachers. While the school has a strict discipline policy, many of the teachers who are also from previously disadvantaged backgrounds appear to be extremely dedicated to the learners and view themselves more as mentors. The academic staff is mainly young and newly trained teachers who have a passion for technology and the sciences.

Being a school of specialisation, School 3 is well resourced in relation to technology. All learners who attend the school are provided with e-textbooks and government-issued tablets or notebooks and teachers are given laptops. There are two science and computer laboratories and all classrooms are fitted with SMART Boards and SMART Kapps. Teachers utilise *Siyavula* for maths and science, and *Google Classroom*™ for the sharing of content and assessments. For academic work and communication with their teachers, learners mainly use technology and hardcopy textbooks are only used when the Wi-Fi is down or there is no electricity.

7.2 TEACHERS

Three teachers, with different subject specialisations were interviewed at School 3. All the teachers are relatively newly qualified with four years or less teaching experience. In relation to personal use of technology one teacher reports she uses technology extensively but others indicate they utilise their phones for basic functions and out of necessity preferring the computer, even for phone calls. Table 28 provides a summary of teachers' experience and personal technology use.

Table 28: Teacher's Experience and Personal Technology Use - School 3

Pseudonym	Teaching Experience	Years at School 3	Subject Taught	Personal Use of Technology
Ben	2 years	2 years	Maths	I don't like a phone...like a computer more...at some point I was using my computer to also make calls…my phone I use it out of necessity because I need to communicate
Nombuso	2 years	2 years	Natural Science Maths	Outside of work I use my smartphone…just use the basic functions, the normal person will use
Kgomotso	4 years	4 years	Civil Technology	With the cellphones we are able to do all banking…transactions…I don't go to the bank anymore…communication, photos, everything...I use Uber if I don't feel like walking

7.2.1 Ben

Ben is a newly qualified teacher who is passionate about making a difference in learners' lives and assisting them in reaching their potential. Ben considers himself tech-savvy and is part of the ICT committee at the school but he feels he would use technology more effectively if training on utilisation in the classroom was provided. While Ben believes technology can benefit education, he feels teachers should not be forced to use technology but instead should be allowed to decide for themselves where it best supports and enhances their teaching. Ben maintains that utilising technology in the classroom not only saves him time but also engages the learners. Ben believes that to acquire knowledge, one learns from relevant experiences around us and then applies this to real-life situations. While Ben has firm boundaries in place between himself and the learners and likes to control the learning context he believes he is approachable and can be flexible when needed.

7.2.2 Nombuso

Nombuso is a newly qualified teacher who believes education is about providing a space where learners can share views, learn from others and grow their skills. As Nombuso was not familiar with technology before joining the school, she believes continuous training is essential to equip teachers with the appropriate skills so they can utilise technology effectively in their teaching where it makes sense, to save time in class and also to enhance teaching. To acquire knowledge, Nombuso believes one needs to read, study and interact with the world. In addition, Nombuso maintains there are boundaries in place between herself and the learners and she controls the classroom to ensure engagement and discussions between herself and the learners and amongst the learners themselves are respectful.

7.2.3 Kgomotso

Kgomotso is a newly qualified teacher who is passionate about impacting, guiding and changing learners' lives for the better. While Kgomotso feels technology saves time in class, makes teaching easier and enhances learners' educational experience, she believes technology should only be used where it makes sense. Kgomotso is comfortable with using all the technology tools in her classroom but when needed she indicates she is happy to ask learners for assistance and appreciates training in areas she feels she lacks skills. Although Kgomotso believes all people acquire knowledge by interacting and making mistakes she feels the process of acquisition differs according to the subject matter and a person's particular learning style. In the classroom, Kgomotso maintains that she not only has firm boundaries in place between herself and the learners but that she also controls the content and pace of learning.

7.3 SCHOOL'S RESPONSE TO CHANGES IN EDUCATIONAL CONTEXT [63]

7.3.1 Start of COVID-19 Pandemic[64]

Although teachers at School 3 reported at the start of the COVID-19 pandemic that they are using **school-issued laptops** *"we have our laptops"* (Ben); *"we all have laptops"* (Kgomotso); *"can use our laptops"* (Nombuso), ***Siyavula*** and **Vodacom e-school** for maths and science *"we have* Siyavula *and Vodacom e-school"* (Ben) and **learners are**

[63] Prior to COVID-19, all teachers and learners were on campus and were utilising technology.
[64] At the start of COVID-19 pandemic, all teachers and learners at school 3 were working remotely.

using tablets *"they have tablets"* (Ben); *"the learners do have tablets"* (Kgomotso), they maintain they are **unable to utilise *Google Classroom*** and other **remote software teaching tools** as most learners **cannot afford data** *"I don't upload or use apps…all take too much data"* (Ben); *"the learners can't afford data"* (Nombuso); *"can't use the other platforms because they are expensive for the learners…they can't afford the data"* (Kgomotso). Therefore, teachers report **mainly using *WhatsApp*** as they believe it **requires less data** *"we resort to* WhatsApp*…they cannot afford the data"* (Ben); *"most of the educators are using* WhatsApp*…videos don't work because of the amount of data that is required"* (Nombuso); *"it will be too much for learners for me to record myself…they do not have enough data…use* WhatsApp *groups"* (Kgomotso).

During this time, teachers felt that the **school** had not been **prescriptive about what technology teachers needed to use** *"we share different ideas…helps us succeed in teaching during this time…guidelines on how we can work better"* (Ben); *"they did not talk much about how we are going to do it but they said we must do it…use whatever you can"* (Kgomotso), but rather **encouraged remote teaching efforts** where possible *"she supports us with information…updates"* (Nombuso). In addition, while the school did **not offer extra technology training** *"there's never been anyone who came to train us"* (Ben); *"they did not give such training"* (Kgomotso), teachers believe such training was **not necessary** as they were **already familiar with utilising technology tools in their teaching** *"it's not something I needed training for…because it is in our practice already"* (Kgomotso); *"I wouldn't see fault…we did receive training before…they've been training us in preparation for this time"* (Ben).

7.3.2 During COVID-19 Pandemic[65]

During COVID-19, as School 3 is government-run, in-person teaching stopped when the South African government closed schools from the end of July until August 2020. After this time, **all teachers** and only **certain grades returned to school** *"only grade 7s and 12s initially came back to school"* (Ben) while other **grades** as well as **learners who chose to remain at home** *"some kids did not come back…they were given permission to do so"* (Kgomotso) continued to **work remotely**. Therefore, a **mix of hybrid and remote models** were adopted by the school which included **additional lessons needing to be taught** *"I*

[65] During the COVID-19 pandemic, School 3 adopted a hybrid and remote model with all teachers returning to campus and only a few grades being present. In addition, even in grades which returned to school, some learners continued to work only remotely.

have moved from five classes to seven classes…so that I can record for those doing lockdown learning…then in the classroom it's a repeat if what I've done" (Ben); **continued use of *WhatsApp*** *"first option is to send over* WhatsApp*"* (Kgomotso) and the **provision of soft or hardcopy resources** for **remote learners with data or device issues** *"if learners don't have data…may come and collect…with their memory stick"* (Nombuso); *"it depends on the situation of the child but they said we must have both hardcopy and softcopy…physical copy for those learners having challenges"* (Kgomotso). Table 29 provides a summary of School 3's response to the change in educational context.

Table 29: Summary of Response to Educational Context Change - School 3

Change in Educational Context	School's Response
Remote Teaching	• Teachers continued to use school-issued laptops • Learners continued to use tablets but access to data was an issue • *WhatsApp* mainly used as remote technology tools require too much data • School supportive of remote teaching efforts but not prescriptive • Training not provided as teachers were already familiar with tools
Remote and Hybrid Teaching	• All teachers on campus • Only certain grades returned to school, but not all learners in these grades • Extra classes to accommodate learners on campus and those at home • *WhatsApp* still used for grades that are remote • Hard- and softcopy provided for remote learners with device or data issues

7.4 SCHOOL CONTEXT

Within this study, in order to understand School 3's context and answer the research question (1) *What is the context at different schools,* the findings in relation to **School Culture** C-SCu are defined as **instrumental** or **expressive** (Bernstein, 1975), **Control** C-SC defined as **stratified** or **differentiated** (Bernstein, 1971a) and **Social Interaction** C-SI defined as **mechanical** or **organic** (Bernstein, 1971b) are detailed. Next, a discussion of the findings with respect to the literature is presented. A summary of findings for the context at School 3 is shown in Table 30.

7.4.1 Culture

Teachers believe School 3's culture centres around providing **disadvantaged learners** with **better opportunities** through **discovering talent** *"we are trying to discover talent…create opportunities for learners that they wouldn't get at a normal school"* (Ben); *"our learners have opportunities that other learners in township schools don't have…we remind the learners that they all are gifted in a way"* (Nombuso); *"want to discover talents in the kids"* (Kgomotso); **hard work** *"the school is centered around hard work"* (Ben); **respect** *"we are a school that embraces UBUNTU, living with other people and respecting*

them" (Kgomotso); **striving for excellence** *"the culture is always to do our best…promote academic growth, excellence"* (Nombuso); **celebrating others' success** *"if you just obtained a qualification the whole staff will be celebrating your success"* (Kgomotso); **exposure to technology** *"the heart of the school is technology…our mindset is a bit different…technology excites us"* (Nombuso); *"give our learners a better experience of this fourth industrial revolution"* (Ben) and **discipline** *"if there is a learner that goes against the code of conduct of the school, there are consequences"* (Nombuso); *"we try and impose discipline most of the time, more than anything"* (Ben).

7.4.2 Control

Teachers report learners are **grouped according to their age** *"all learners of the same age are in the same class"* (Kgomotso); *"it's always the same grade together"* (Nombuso) as grouping learners of different ages has the potential to **embarrass older learners** *"I don't mix them…it embarrasses them to say they are learning with people in lower grades*" (Ben).

7.4.3 Social Integration

While Nombuso feels her **peers all value technology** *"they are very pro technology"*, other teachers report even though **teachers at the school utilise technology** *"we all use it"* (Kgomotso) **beliefs differ** as to the **extent and type of use** *"they do not feel the same"* (Ben); *"we are not the same"* (Kgomotso). Possible reasons include **lack of familiarity with technology** *"those who are not used to using technology…are not comfortable with using the technology"* (Ben); **established** and **entrenched practices of older teachers** *"some people believe in doing things the traditional way…the way they were taught…maybe when we started teaching we found it like this…using technology"* (Kgomotso); *"the older teacher use technology but not to the extent that we use it…it's more two dimensional"* (Ben) and **demands of specific subjects** *"there are these subjects…like my subject…topics where you are teaching…using the technology is not easy"* (Kgomotso).

Teachers report the **school encourages technology use** *"management always tries to make everything be electronic"* (Ben) by **praising** and **showcasing teachers who utilise technology effectively in the classroom** *"they encourage us to use technology…in our briefings…if the principal picks up something that is outstanding…will show the staff this is*

what this teacher is doing and we can all do that" (Kgomotso); *"the principal always praises people who use technology in the classroom…speaks about it…to encourage others"* (Ben).

7.4.4 Summary of School 3's Context

Findings suggest even though School 3 strives for excellence it has a more **expressive culture** as teachers believe the school's main aim is not simply to provide learners with academic content to rank success and failure (Bernstein, 1975; South African Institute for Distance Education, 2010), but rather to offer disadvantaged learners better opportunities by discovering talents, celebrating others' success and exposing learners to the possibilities of technology. In addition, the school displays **stratified control** since learners are grouped according to the fixed attribute of age and teachers' roles are clearly defined (Bernstein, 1971a; South African Institute for Distance Education, 2010). Concerning integration, findings indicate that School 3 possesses a combination of **mechanical integration** as social cohesion amongst teachers appears to be based on a common set of beliefs (Bernstein, 1971b; South African Institute for Distance Education, 2010) with the school encouraging technology use in the classroom and **organic integration** as most teachers believe decisions to use technology are based on technology skills, entrenched and established pedagogic practices and subject taught as teachers are seen as unique (Bernstein, 1971b; South African Institute for Distance Education, 2010).

Table 30: Summary of School Context - School 3

Culture – Expressive (C-SCu-E)

• Provides disadvantaged learners with better opportunities by:
  ◦ Discovering talent
  ◦ Hard work and striving for excellence
  ◦ Respect and discipline
  ◦ Exposure to technology
• Celebrating other people's success

Control – Stratified (C-SC-S)
• Learners are grouped according to age • Can embarrass learners if grouped according to ability
Social Integration – Combination (C-SI-M; CS-I-O)

• Teachers report different beliefs about technology use based on:
  ◦ Lack of familiarity with the technology
  ◦ Entrenched and established pedagogic practices of older teachers
  ◦ Demands for specific subjects
• Teachers believe the school encourages technology use by praising and showcasing teachers' use in the classroom

7.5 BELIEFS OF EXTERNAL TECHNOLOGY STRUCTURES - BY CONTEXT

External technology Structures (ES) and teachers' associated beliefs (CSB) about these structures which have been conceptualised in this study as **Resources (R)**, **Training (TR)**, **Support (S)** and **Time (T)** are shown in Table 8 and Figure 9.

In order to answer the research question (2) *what are the external structures at different schools,* a summary and discussion of the within-case analyses of teachers' general accounts of external technology resources at School 3 and their associated beliefs over time for each part of the theoretical framework is presented. Table 31 provides a summary of findings for teachers' beliefs of External Structures (ES) at School 3 by context along with expanded subcodes drawn from the data (See Appendix D for expanded subcodes).

7.5.1 On-Campus Teaching

- **Resources**

According to Johnson et al. (2016) and Rogers (2000), technology integration requires regular access to resources for extended periods of time as inconsistent access makes it challenging for teachers to incorporate technology (Ertmer & Ottenbreit-Leftwich, 2010; du Plessis, 2014). Findings concur as teachers report they are able to **integrate technology** into their pedagogic practices as both teachers and learners have **regular access** to **quality resources** for **sufficient periods of time** including school-issued laptops for each teacher, learner-owned tablets, computer laboratories, every classroom fitted with a SMART Board and SMART Kapp and e-textbooks loaded on both teachers' and learners' devices. In addition to access, Sicilia (2005) and Toprakci (2006) maintain that poor resource quality limits teachers' ability to use technology effectively and may result in negative teachers' perceptions of available resources (Kopcha, 2012). In keeping with the literature, findings suggest teachers believe the **slow** and **limited Wi-Fi** at the school **inhibits utilising certain functionalities** offered by the technology such as online assessment.

As regards the physical arrangement of resources, Tondeur et al. (2008) and Mercier et al. (2014) claim that suitable classroom layouts and appropriate placement of technology motivate teachers to integrate technology. While findings indicate some teachers believe it is difficult for learners at the back of the classroom to see, **most teachers** maintain that the current **classroom layout** with learners' desks facing forward and the SMART Board

and SMART Kapp technology placed in the front of the class **enables them to utilise technology** in their lessons.

- **Training and Support**

Johnson et al. (2016) claim that while there is no "single best way" to train teachers since technology evolves continuously and even experienced teachers require technology training to keep their skills current and effectively integrate technology into their teaching. Furthermore, for technology training to be effective, Schrum (1993; 1999) and Johnson et al. (2016) contend that the content and structure must fit the particular needs of the teachers and the school. According to Tondeur et al. (2011), training programmes should include the observing of model educators utilising technology as there is little indication that traditional professional development, involving theoretical workshops with limited practise opportunities, are effective (Schrum, 1999). Findings concur since teachers believe **technology training** at School 3, which mainly consists of **professional development** provided by **external facilitators** aimed at educating teachers on **"how to" use** technology, is only **suitable for novice users**. Consequently, teachers feel more **peer-mentoring** and **demonstration-based** types of training for **tech-savvy teachers** on **"how to" effectively use technology in the classroom** is **needed**. In addition, some teachers believe for training to be considered relevant, the school should **ask teachers what training is needed**. This finding is in keeping with Wells (2007) who claims that teachers believe training is a barrier when the content lacks connection to classroom practice.

According to Rogers (2000), both institutional support, which relates to the encouragement and funding for technology from the school administration, and technical support, which is contingent on financial support from the school and refers to a specialist who assists in maintaining technology, are needed to enable teachers to integrate technology. Findings concur as teachers believe the **school** offers **support** by **encouraging** and **showcasing teachers' technology use** within the school and providing **technical** support with **on-site technical staff** addressing **minor issues**, an **ICT committee** to ensure that technology issues are dealt with, **weekly service providers** to address **major technical issues** and perform **updates** and limited **DoE support** in the form of **workshops**.

- **Time**

According to Farah (2011), self-efficacy at work is influenced by teachers' perceptions of technology support, the amount of time they use technology at work and the opportunities to gain technology skills provided to them. In addition, Van Der Ross and Tsibolane (2017) contend that it is more likely teachers with high self-efficacy beliefs will incorporate technology into their pedagogic practice. Findings concur as teachers believe they are **familiar** with **most** of the **technology tools** in the classroom and report they are **utilising** them effectively in their **teaching** and thus **do not** appear to view **time** needed as a **barrier**. A possible reason for teachers' **high self-efficacy** may be teachers' **positive perceptions** about **access to resources** and **support** at the school.

According to Cuban (2001), when teachers believe using technology is time-consuming, they tend to feel integrating technology is unfeasible, however, teachers are less likely to focus on barriers (Vongkulluksn et al., 2018; Ertmer & Ottenbreit-Leftwich, 2010) if they believe technology benefits their teaching and enables them to achieve their pedagogic goals (Cheok et al., 2016; Taimalu & Luik, 2019). Findings concur since teachers report they believe using technology is **feasible** because it **saves** them **preparation time** as well as **time in class** as fewer **notes** are **being written** and instead, **time** is being **dedicated** to **explaining**, **discussing**, and **enabling better learner understanding**.

7.5.2 Remote Teaching

- **Resources**

Findings indicate even though teachers and learners have **access to laptops** and **tablets**, teachers believe **lack of data access for learners** is not only **obstructing teaching** efforts, as **most learners** at School 3 come from **disadvantaged backgrounds** and are thus **unable to purchase data** needed to access and submit work, but it is also **limiting which technology tools** can **be used**. This finding is in keeping with literature which states learners need sufficient access to technology such as devices and internet connections (Mailizar et al., 2020; Rasheed et al., 2020) to fully participate in remote teaching and learning activities (Giovannella et al., 2020). Furthermore, in developing countries where access barriers to technology resources are significant (du Plessis, 2014; Mhlanga & Moloi, 2020), Le Grange (2020) and Mailizar et al. (2020) claim that disadvantaged learners often share devices and have little data access which not only limits which technology tools can be utilised but in many cases learners are also unable to

continue with their schooling. While findings also indicate **access to data** is an **issue** for **some teachers** as teachers believe they are **unable to continue teaching remotely without this access**, many report that they **fund their own**. This finding concurs with Vongkulluksn et al. (2018) who claim that teachers seek alternatives or place less emphasis on barriers to access when they believe the technology is invaluable to their teaching.

- **Training and Support**

According to Schrum (1993; 1999) teachers need access to technology so they can practice extensively in order to become confident in using technology because without this time, teachers may be concerned about their lack of technological expertise which can serve as a barrier to technology integration (Rasheed et al., 2020). Consequently, Farah (2011) contends that teachers who spend significant amounts of time using technology at work are more likely to have higher technology self-efficacy beliefs. This may explain why teachers believe they **do not need training** on **remote tools** as **technology** is already being **used extensively at the school** and **teachers** feel **confident** about their technology skills. In addition, findings indicate that since the **move to remote** teaching was **almost immediate**, it was **not possible** to **plan** and **train teachers** and therefore they are simply **utilising** whatever **tools they have access to** and are **most comfortable** with. This finding concurs with Bergdahl and Nouri (2020) who claim that the rapid move to remote teaching and learning resulted in many schools not being able to plan properly and thus teachers needed to creatively develop pragmatic solutions by using available digital tools so the academic project could continue. Furthermore, according to Johnson et al. (2016), as technology integration matures the types of support personnel required will change from technology professional to more peer discussions and professional learning communities. Findings concur as even though teachers report **no formal technical** and **tactical support** is being provided by the school, they believe **support** is **adequate** since **peers** are **assisting each other** with technology where required.

- **Time**

Findings suggest teachers' **limited use** of **technology tools** is **not due to a lack of familiarity** but rather due to **learners' lack of access to data**. While most teachers report that **extra time** is **needed** to utilise tools in the short term due to **initial preparation** and

lack of strategy, they **do not** believe this is **significant**. This concurs with literature which states even though teachers are aware of increased demands on their time (See et al., 2020), since they believe the technology assists them in achieving their pedagogic goals, they are less focused on barriers (Vongkulluksn et al., 2018; Ertmer & Ottenbreit-Leftwich, 2010).

7.5.3 Hybrid and Remote Teaching

- **Resources**

While findings indicate **access to resources** appears to be as it was **initially**, teachers report they are still mainly utilising ***WhatsApp* to communicate** with learners as many **learners at home** are **unable to access school content** due to a **lack of data**. This is in keeping with literature which states access to technology resources in developing countries is often limited (du Plessis, 2014; Mhlanga & Moloi, 2020) as disadvantaged learners have little access to data which restricts which technology tools can be utilised and in many cases, prevents learners from continuing with their schooling (Le Grange, 2020; Mailizar et al., 2020; Rasheed et al., 2020; Giovannella et al., 2020).

- **Training and Support**[66]

According to Johnson et al. (2016), schools must identify the content and structure of training that is best suited to the specific needs of the school and the teachers. As **teachers** at School 3 consider themselves **skilled at technology** it is possible that the use of a **collaborative approach** amongst the teaching staff to **decide which technology tools** and **approaches** are **most appropriate** for hybrid and remote teaching is **more suitable** for the school than **formal training**.

- **Time**

Teachers believe the recent **educational context changes** are **forcing them** to **spend time** on **expanding** their **technology skills** and **knowledge of technology affordances**. This is in keeping with See et al., (2020) and Mailizar et al., (2020) who claim that even though teachers need to spend extra time on learning about new technology tools, they are willing to do so because this is the only way they can continue teaching (Mhlanga & Moloi, 2020).

[66] Teachers did not comment on support when using a hybrid and remote approach.

Table 31: Summary of Changes in Teachers' Beliefs of External Technology Structures - School 3

On Campus	Remote	Hybrid & Remote
Resources (ES-R and CSB-R)		
Access (ES-R-A, CSB-R-A); Quality and Suitability (ES-R-Q, CSB-R-Q)		
Hardware (R-AH, R-QH); Software (R-AS, R-QS)		
• Have laptop, SMART Board, SMART Kapp, computer labs • Mainly adequate quality, would prefer better laptops and tablets for teaching • Learners have tablets • Have *Siyavula*, Online GDE content, Via Africa e-textbooks	• Access to laptops, *Siyavula* and other e-textbooks • Learners have tablets • Using *WhatsApp*	• Access to all devices while on campus, *Siyavula* and other e-textbooks
Wi-Fi/Data (R-AW, R-QW)		
• Wi-Fi in school but slow and limited capacity	• Teacher using their own • Learners lack data and so limited as to which tools can be used	• Learners at home, data is an issue
Physical Arrangement (ES-R-P, CSB-R-P)		
Classroom Setup (R-PC); Remote Setup (R-PR)		
• SMART Board, Kapp front of class • Desks front-facing, hard for learners at the back to see		
Training (ES-TR and CSB-TR)		
Extent (ES-TR-E, CSB-TR-E)		
Frequency (TR-EF)		
• Once a term or depends on schedule	• No formal training provided as not needed, no time	• No formal training provided
Training Provided (TR-EP)		
• Technical "how to" training by providers good for novice users	• Teaching or researching themselves	
Quality and Type (ES-TR-Q, CSB-TR-Q)		
Professional Development (TR-QPD); Courses (TR-QC)		
• For using technology tools	• Informal communities of practice	
Peer Mentoring (TR-QP); Communities of Practice (TR-QCP)		
• Past had peer mentoring, now need on using tech in the classroom		• Work together to decide on which tools and approaches
Type of Training (TR-QT)		
• Technical and demonstration • Need to ask what is needed	• No formal training provided	

On Campus	Remote	Hybrid & Remote
Support (ES-S and CSB-S)		
Technical (ES-S-T, CSB-S-T); Institutional (ES-S-I, CSB-S-I)		
Location (S-TL, S-IL)		
• On-site tech staff, ICT committee • Service providers mainly remote • Principal on site, DoE remote	• No technical support provided	
Function (S-TF, S-IF)		
• Fixes minor and major issues • Ensure technology works at school • Encourages and showcases technology use, offers training	• Principal provides information and addresses social issues	
Response Time (S-TRT, S-IRT)		
• Responsive on-site • Service providers weekly		
Peer Support (S-TP); Communities of Practice (S-TC)		
• Can ask ICT committee	• Ask peers from same grade or ICT committee for "how to" support	
Nature of Support (ES-S-N, CSB-S-N)		
Technical Support (S-NT)		
• Mainly to general technical issues	• Ask peers "how to" do something	
Institutional Support (S-NI)		
• Infrequent workshops • Encourages, showcases tech use	• Principal says what to tell learners and social issues like food parcels	
Time (ES-T and CSB-T)		
Familiarity (ES-T-F, CSB-T-F)		
Use (T-FU)		
• Mainly familiar, using effectively and confident but not using all tools	• Mainly familiar with new tools but unable to use due to lack of data	•Extended and learnt new skills •Not gaining new skills
Time and Effort (T-FT)		
• Initial time to learn tools, but now saves time	• Can self-teach if not familiar with some tools	• Aware of more affordances
Feasibility (ES-T-FE, CSB-T-FE)		
Time to Learn (T-FEL)		
• Initially needed time to learn tools		
Time to Prepare (T-FEP)		
• Can save prep time and class time for rewriting notes with more time for discussion, explanation	• Takes the same time as in class • Initially takes more time, in future will lessen	

7.6 BELIEFS OF EXTERNAL TECHNOLOGY STRUCTURES – BY TEACHER

According to Ertmer (1999), it is not only important to understand what External technology Structures (ES) exist within a particular context but one also needs to explore individual teachers' beliefs about these structures because this can influence teachers' willingness to integrate technology in the classroom (Van Der Ross & Tsibolane, 2017). Therefore, to answer research question (3) *What are different teachers' beliefs around external structures,* a summary and discussion of the within-case analyses of different teacher's

accounts of each ES at School 3 and their associated beliefs in relation to TTU-SST is first presented. Then, an overall discussion of different teachers' beliefs about ES at the school is provided. Table 32 presents a summary of the findings for ES and Appendix G-1 provides the detailed analyses for each teacher's account of ES.

7.6.1 Resources

Findings indicate when **on campus**, despite **slow** and **limited Wi-Fi**, all teachers believe they have **sufficient access** to **suitable** and **quality resources** *"for me it is 100% sufficient...can do everything that we need"* (Ben); *"it is good"* (Nombuso); *"they are suitable and good quality"* (Kgomotso) which include school-issued laptops for each teacher SMART Boards and SMART Kapps in each class and tablets for each learner. While all teachers report desks face forward some believe the **placement of technology** in the class makes it **difficult for learners** at the **back to see** *"sometimes you have to bring the learners up close"* (Ben); *"for learners at the back is a challenge"* (Nombuso). When **remote** and using a **hybrid** approach, even though **all teachers** believe **learners' lack of access to data** is a **major concern** and is **hindering teaching efforts** *"learners are unable to view the work as they can't afford data"* (Kgomotso); *"it is not adequate"* (Nombuso); *"an issue with regards to access, as learners cannot access the work"* (Ben) some report **purchasing data for themselves** to **continue with the academic project** *"it's my own internet that I pay for"* (Ben); *"I use my own data"* (Kgomotso). This finding concurs with Woodbridge (2003) and Vongkulluksn et al. (2018) who state that technology integration choices are primarily based on teachers' beliefs and perceptions of the value of technology, with teachers who believe technology enhances their pedagogic practices tending to amplify the access they have while at the same time actively working towards finding alternatives (Ertmer & Ottenbreit-Leftwich, 2010).

Furthermore, while a complex relationship exists between teachers' technology beliefs and social context (Tondeur et al., 2017), since even when a school supports technology integration the vision may not be shared by all teachers (Levin & Wadmany, 2005), Bernstein (1971b) claims that teachers in schools with mechanical integration share a common set of beliefs. Findings indicate that all teachers hold **similar beliefs** about the **valuable role of technology** in **supporting** and **enhancing** their pedagogic practices *"links to what I am doing"* (Ben); *"makes things easier"* (Nombuso); *"things are a little bit easier"* (Kgomotso) with primary **concerns** around how **access issues limit** their **ability**

to **teach** and **communicate with learners** and thus it appears that School 3 has **mechanical integration**.

7.6.2 Training and Support[67]

Findings indicate that although all teachers feel **supported by** the school **on campus**, which is **mainly technical**, is **adequate** with **responsive on-site technical staff**, an **ICT committee** and **weekly remote support** from service providers; some believe **professional development training** should be **more frequent** *"what we have isn't sufficient"* (Ben), *"current training is not sufficient"* (Nombuso) with **less technical** and **more pedagogic type training** *"they know how to play a video but don't know how to use it in class"* (Nombuso), *"better taking a teacher who has experience using technology in the classroom"* (Ben) and the school should **ask teachers what gaps exist** and only provide **training for these skills** *"ask things like how confident are you"* (Kgomotso). However when **remote**, although all teachers report **no technical support** is being offered by the school and **Kgomotso** maintains since there was no **time for training** she is **using technology she knows** *"there was no time...so just use whatever you can"* others believe **no additional training** and **support** is **needed** as they can simply **teach themselves** *"I know how to figure my way around"* (Ben), engage with peers *"contact other teachers"* (Ben); *the teacher that I teach with, if there's anything I can't do, I phone them...post on* WhatsApp*"* (Kgomotso) to **gain skills** *"you need to upskill, reskill"* (Kgomotso). While Ertmer, et al., (2012) argue ongoing training is required for teachers to integrate technology it seems as if **despite training concerns**, the **pro-technology culture** at the school, **adequate technical** and **school support**, teachers' **high technology self-efficacy** and **value beliefs in ICT** are shaping teachers' beliefs. This is in keeping with Tondeur et al. (2017) who contend that technology integration is an iterative process involving bidirectional relationships.

Moreover, according to Bernstein (1971b), organic integration occurs when people are viewed as unique whereas when teachers hold a common set of beliefs, integration is mechanical. Findings suggest there is **greater mechanical integration** present at the school as teachers' **beliefs** in relation to **training** and **support** are **unified in most instances**, with some **organic integration** due to **individual teacher's opinions**.

[67] The summary of the findings and discussion have been combined to avoid repetition as much of the literature is related to both constructs.

Furthermore, Levin and Wadmany (2005) claim that teachers can hold multiple opinions at any given time, as forming beliefs is an individual process. This perspective **may account** for Kgomotso's **incongruent views on training** when **remote**.

7.6.3 Time

On-campus findings indicate that although initially it takes **time to learn** how to **use technology** *"the more I use it, the more I gain confidence"* (Kgomotso), *"I haven't given myself the time"* (Ben) – all teachers report that they are now **familiar** with technology and believe using technology **saves preparation time** and gives them **more time in class** for **explaining** and **discussion** *"for me it actually closes time...instead of using 45 minutes to write notes...now for explanation"* (Nombuso); *"you can write notes once"* (Ben); *"makes it easier to finish the syllabus on time"* (Kgomotso). According to Tondeur et al. (2017), the incorporation of technology is an iterative process involving bidirectional relationships between different facets of teachers' belief systems. Furthermore, Vongkulluksn et al. (2018), Ertmer and Ottenbreit-Leftwich (2010) claim that when teachers believe technology benefits their pedagogic goals, they focus less on barriers, such as time. So too, Van Der Ross and Tsibolane (2017) state that teachers with high technology self-efficacy are more likely to incorporate technology as they are confident about their skills and thus are less concerned about the time needed to become familiar with technology. Thus, it seems as if **teachers** at School 3 may **not feel time is a barrier** because they believe **technology can benefit their pedagogic practices** and they **do not need to spend time** as they **already** possess **high technology self-efficacy** *"I'm very familiar"* (Nombuso); *"I feel comfortable with everything"* (Kgomotso); *"I am very familiar"* (Ben).

When **remote**, while **Ben** maintains he is **unfamiliar** with **some new technology tools** he is **able to teach himself** *"some of the tools I was not familiar with...know how to figure my way around"* and **Kgomotso** believes she is **familiar** with **most tools** *"know other tools...familiar with other platforms"*, they report being **unable to utilise most tools** as **learners do not have access to data** *"if there was data, I would use them"* (Ben); *"can't use them because they are expensive for learners"* (Kgomotso). This finding concurs with the literature which states that when learners are unable to access sufficient data (Mailizar et al., 2020; Rasheed et al., 2020; Giovannella et al., 2020) teachers' abilities to utilise many of the available technology tools is limited, irrespective of teachers' technology skills.

Additionally, according to Hadijah and Shalawati (2017) and Mailizar et al. (2020), while many teachers are finding the extra time needed for remote teaching tasks challenging, others are not focused on the additional time needed as they believe their role in the pandemic is meaningful (See et al., 2020) and understand that despite the extra time needed, using technology is the only way teaching and learning can continue (Mhlanga & Moloi, 2020). As regards **feasibility**, these perspectives may provide an understanding of teachers' **different opinions about time needed** which include **no extra time needed** *"using the same skills that I have known"* (Nombuso), **more time initially** but **less in the future** *"right now it is a lot of work for us, a lot of time...in the future...it will be less"* (Kgomotso) and **more time** needed to **prepare** and **plan** lessons *"it can take a lot of time to prepare and deliver lessons"* (Ben).

Now **back on campus**, even though **Nombuso** maintains her **technology skills** are the **same** *"I'm not using anything new"*, other teachers believe **being remote** has made them **more familiar** with **technology affordances** *"I have discovered a lot of things I didn't know"* (Ben) and **forced** them to **upskill** and **reskill** *"forcing us to be more technologically inclined"* (Kgomotso). This finding concurs with Condie et al. (2007) and Van Der Ross and Tsibolane (2017) who claim that spending time utilising and exploring technology affordances often results in teachers being more familiar and confident in utilising the technology and aware of the associated benefits.

7.6.4 Different Teachers' Beliefs of External Structures

Overall findings suggest that relatively **newly qualified** teachers at School 3 consider themselves **technologically competent** and **value** the role **technology** plays in education, mainly hold **unified** and **positive beliefs** about the **ES** at the school with **little focus on** existing **barriers**.

While providing sufficient ES is necessary for technology integration to occur (Ertmer, 1999), Tondeur et al. (2017) argue that one should rather consider teachers' beliefs as it is not the barriers themselves that influence technology integration, but rather the importance given to them by teachers (Ertmer et al., 1999). Furthermore, Rogers (2000), Sherman and Howard (2012), and Van Der Ross and Tsibolane (2017) state that even though beliefs about external barriers are often mentioned and discussed as separate issues, they do not exist in isolation as there is a complex and overlapping relationship between beliefs

that collectively influence teachers within a specific context due to the iterative nature of the process and the bidirectional relationships between beliefs, practice and technology use mediated by the teachers' social context (Tondeur et al., 2017). Ertmer et al. (2012) contend that a relationship exists between first- and second-order barriers as teachers who believe technology provides value (Woodbridge, 2003; Vongkulluksn et al., 2018) and have higher technology self-efficacy (Van Der Ross & Tsibolane, 2017) are more likely to incorporate technology and work around external barriers. These perspectives suggest it is **not possible** to **attribute** teachers' **mainly positive** and **cohesive ES beliefs** at School 3 to any **single external factor** as teachers report having **sufficient ES** when **on campus** and **limited ES** when **remote** and using a **hybrid** approach. Therefore, it is clear that a more multdimensional approach is needed (Tondeur et al., 2017) to understand how the presence or absence of ES and the beliefs about these ES within a specific social context contribute to teachers' technology integration.

Table 32: Summary of Different Teacher's Beliefs of External Technology Structures - School 3

Ben	Nombuso	Kgomotso
Resources (ES-R and CSB-R)		
On Campus		
Access (ES-R-A, CSB-R-A); Quality and Suitability (ES-R-Q, CSB-R-Q)		
Hardware (R-AH, R-QH)		
•Sufficient access, quality, suitable •Want better devices, tablets	•Sufficient access, quality, suitable	•Sufficient access, quality, suitable
Wi-Fi/Data (R-AW, R-QW)		
• Wi-Fi in school, but slow	• Wi-Fi in school, but limited capacity	• Wi-Fi in school, but slow
Software (R-AS, RQS)		
• Use *Siyavula*	• Use *Siyavula*, Online GDE content • Have Via Africa, comes with tablets	• Have Via Africa, comes with tablets
Physical Arrangement (ESR-R-P and CSB-R-P)		
Classroom Setup (R-PC)		
• SMART Board and Kapp next to each in the front of class • Desks forward, at back can't see	• SMART Board and Kapp next to each in the front of class • Desks forward, at back can't see	• SMART Board and Kapp next to each in the front of class • Desks forward
Remote		
Access (ES-R-A, CSB-R-A); Quality and Suitability (ES-R-Q, CSB-R-Q)		
Hardware (R-AH, R-QH)		
• Access same, school laptop, tablets	• Has school laptop	• Has school laptop
Wi-Fi/Data (R-AW, R-QW)		
•Using own data •Learners lack data	•Learners lack data, hampers teaching and tools that can be used	•Using own data •Learners lack data, hampers teaching
Software (R-AS, R-QS)		
• Using *WhatsApp*, existing software	• Using *WhatsApp*	• Using *WhatsApp*
Hybrid & Remote		
Access (ES-R-A, CSB-R-A); Quality and Suitability (ES-R-Q, CSB-R-Q)		
Wi-Fi/Data (R-AW, R-QW)		
•DoE giving data to teachers if needed •Learners still lack data	•Learners still lack data •Learners can collect work if needed	•How it was prior to remote teaching
Software (R-AS, R-QS)		
• Not posting online	• Using *WhatsApp*	

Ben	Nombuso	Kgomotso
Training (ES-TR and CSB-TR)		
On Campus		
Extent (ES-TR-E, CSB-TR-E)		
Frequency (TR-EF)		
•Depends on schedule	•Past was regular, twice a week •Recent training erratic	•Regular, usually once a term
Provided by (TR-EP)		
•Technology suppliers provide "how to" training	•Past training by ICT coordinator and peer mentoring •Recent by technology suppliers	•External facilitators
Quality (ES-TR-Q, CSB-TR-Q)		
Professional Development (TR-QPD); Courses (TR-QC); Peer Mentoring (TR-QPM); Communities of Practice (TR-QCP)		
•Prof development "how to" and technical, good for novice users •Need peer-mentoring on using technology more effectively in teaching	• Past "how to" and peer mentoring • Recent general, technical training • Current more focused training plan • Need on using technology more effectively in teaching	• Prof development, ask what is needed, offer on skills lacking
Type (TR-QT)		
•Theoretical, demo-based	•Demo-based, "how to" technical	• "How to" technical
Remote		
Extent (ES-TR-E, CSB-TR-E)		
Frequency (TR-EF)		
•None provided but not needed as prepared already	•None provided but not needed as prepared already	•None provided as no time, use what had access to and comfortable with
Provided by (TR-EP)		
•Self-teach	•Self-teach	
Quality (ES-TR-Q, CSB-TR-Q)		
Professional Development (TR-QPD); Courses (TR-QC); Peer Mentoring (TR-QPM); Communities of Practice (TR-QCP)		
•Informal Communities of Practice		
Type (TR-QT)		
•Research other people's use		
Hybrid & Remote		
Extent (ES-TR-E and CSB-TR-E); Quality (ES-TR-Q and CSB-TR-Q)		
Frequency (TR-EF)		
•None		
Professional Development (TR-QPD); Courses (TR-QC); Peer Mentoring (TR-QPM) Communities of Practice (TR-QCP)		
•Collaborate, Community of Practice		
Type (TR-QT)		
•Used what all think works best		

Ben	Nombuso	Kgomotso
Support (ES-S and CSB-S)		
On Campus		
Technical (ES-S-T, CSB-S-T); Institutional Support (ES-S-I, CSB-S-I)		
Location (S-TL, S-IL)		
•On-site tech, ICT committee •Weekly service providers	•On-site tech •DoE remote	•On-site tech, ICT committee, interns •Remote service providers
Function (S-TF, S-IF)		
•Minor and major technical issues •Limited DoE support, workshops	•General technical issues •DoE fixes laptops and tablets	•General technical issues •School encourages use
Response Time (S-TRT, S-IRT)		
•Onsite responsive, providers weekly	•Technical responsive •DoE can be quicker	•Adequate
Peer Support (S-TP); Communities of Practice (S-TCP)		
•ICT committee ensures things work		•ICT committee ensures things work
Nature of Support (ES-S-N, CSB-S-N)		
Technical (S-NT)		
•Technical	•Mainly technical	•Mainly technical
Remote		
Technical (ES-S-T, CSB-S-T); Institutional Support (ES-S-I, CSB-S-I)		
Location (S-TL, S-IL)		
•No formal technical support provided	•No formal technical support provided	•No formal technical, tactical support provided
Function (S-TF, S-IF)		
	•Social support from principal	
Peer Support (S-TP); Communities of Practice (S-TCP)		
•Peers from same grades providing support more frequently		•"How to" support from peers, *WhatsApp* group
Nature of Support (ES-S-N, CSB-S-N)		
Technical (S-NT); Social (S-NS)		
	•Social support for food, information	•"How to" from peers

Ben	Nombuso	Kgomotso
Time (ES-T and CSB-T)		
On Campus		
Familiarity (ES-T-F, CSB-T-F)		
Use (T-FU); Time and Effort (T-FTE)		
•Familiar, use it sufficiently	•Familiar, use it effectively	•Familiar, confident with more use
Feasibility (ES-T-FE, CSB-T-FE)		
Time to Learn (T-FEL); Time to Use (T-FEU); Time to Prepare (T-FEP); Time to Administer (T-FEA)		
•Time needed to learn SMART Kapp • Saves prep and class time	•Saves writing notes time, more time to discuss and explain in class	•Initially needed time to learn •Saves prep, different ways to explain
Remote		
Familiarity (ES-T-F, CSB-T-F)		
Use (T-FU); Time and Effort (T-FTE)		
•Unfamiliar, but can teach himself •Only *WhatsApp* due to data issues		•Familiar with other tools, but not using due to data issues
Feasibility (ES-T-FE, CSB-T-FE)		
Time to Learn (T-FEL); Time to Use (T-FEU); Time to Prepare (T-FEP); Time to Administer (T-FEA), Time to Plan (T-FEPL)		
•More time needed for prep •No time give to plan, no strategy	•No more time as already familiar, same as in class	•Lot of time initially, but in future will be less
Hybrid & Remote		
Familiarity (ES-T-F, CSB-T-F)		
Use (T-FU); Time and Effort (T-FTE)		
•More familiar, learnt better ways to use technology	•Same skills as already using tech technology tools •Familiar with additional apps	•Forced to upskill, reskill

7.7 INTERNAL BELIEFS OF TECHNOLOGY – BY TEACHER AND CONTEXT

Internal Beliefs (IB) have been conceptualised in this study as **Pedagogy (P)**; **Norms (N)**; **Knowledge (K)**; **Value of ICT (V)**; and **Self-efficacy (SE)** are shown in Table 8 and Figure 9.

In order to answer the research question (4) *What are different teachers' internal beliefs about technology,* first a summary and discussion of the within-case analyses of different teacher's accounts of Internal Beliefs (IB) at School 3 in relation to the changing educational context and TTU-SST is presented. Thereafter, as belief systems are constructed from a combination of beliefs (Liu, 2011) an overall discussion of different teachers' IBs at the school is provided. Table 33 presents a summary of the findings for IB and Appendix G-2 provides the detailed analyses for each teacher's account of IB.

7.7.1 Pedagogical Beliefs

Findings indicate that teachers **aim** to **positively impact learners' lives** *"an impact I make on them"* (Ben); *"impact their lives positively"* (Kgomotso); **build their confidence**

"create a space for learners to be confident" (Nombuso) and **create connections** through providing **support** *"give support"* (Ben), **guidance** and **direction** *"provide direction...give them guidance"* (Kgomotso) and a **safe classroom context** *"where we share views...without being scared"* (Nombuso). According to Ertmer (2005) and Ertmer et al. (2012), pedagogical beliefs are hard to change as they are commonly core beliefs with multiple connections that have been developed over an extended period of time in relation to teachers' understanding and experience about teaching and learning that they hold to be correct (Denessen, 2000). While much educational technology literature argues pedagogical beliefs are one-dimensional as they are either teacher- or learner-centered, Ertmer and Ottenbreit-Leftwich (2010) claim that teachers can hold a variety of pedagogical beliefs at the same time. **Findings** seem to **disagree** as teachers at School 3 appear to hold **one-dimensional pedagogical beliefs** deeply **rooted** in **assisting** and **guiding learners**.

Rapanta et al. (2020) claim that if teachers have a faciliatory and social presence and offer learners active mentoring, support and enhanced learner-teacher interaction, then remote teaching can be as effective as face-to-face situations. However, **findings disagree** as even though all teachers believe they now need to **embrace** and **rely more** on **technology** *"relying more on technology now"* (Ben); *"use all these things of technology"* (Kgomotso); *"the training is moving...look at how we use technology"* (Nombuso), **continually learn new skills** *"know more stuff"* (Ben) and **prepare for future changes** in the educational context *"preparing for the next time like this"* (Ben); *"have to be prepared"* (Nombuso), teachers feel **technology** should **not replace teachers** as it is **harder to assist learners** *"what has become harder is now when they ask questions"* (Ben) as **learners** still **require a holistic educational experience** *"need to holistically develop a child"* (Nombuso) with **teachers' guidance** *"the educator...to guide them"* (Kgomotso). In addition, for remote teaching to be successful Rapanta et al. (2020) state that appropriate technology and infrastructure is essential as otherwise disadvantaged learners in developing countries may be unable to continue with their schooling (du Plessis, 2014; Mhlanga & Moloi, 2020; Le Grange, 2020; Mailizar et al., 2020. This is in keeping with **Kgomotso** who believes **using technology** only **exacerbates inequalities** between **advantaged** and **disadvantaged learners** *"technology in South Africa is dividing learners...those from disadvantaged backgrounds...remain behind"*.

7.7.2 Normative Beliefs

All teachers report the school is **pro-technology** and provides **numerous technology tools** and **sufficient IT technical support** *"management always tries to make everything electronic"* (Ben); *"heart of the school is technology...have lots of technology"* (Nombuso); *have all these gadgets in the classroom"* (Kgomotso) and offers **constant encouragement** and **showcasing** of teachers' **technology use** *"praises people who use technology...encourages others to do so"* (Ben); *"encourage us in the use of technology"* (Kgomotso). Findings concur with literature which states teachers are more likely to be motivated to integrate technology into their pedagogic practices in schools where technology integration is encouraged education (Rogers, 2000; Hew & Brush, 2007) and beliefs around technology integration are favourable (Zhao & Frank, 2003; Hennessy et al., 2010) as teachers are unlikely to deviate from school norms (Somekh, 2008), given the strong cultural pressure that exists in schools (Brodie, 2004; Ponticell, 2003).

Furthermore, according to Rasheed et al. (2020), older teachers often resist integrating technology into their pedagogic practices as they are less skilled in using technology for teaching and find it challenges and disrupts their existing proficiencies. This concurs with findings which suggest that even though all teachers report **most** of their **peers** are **favourable** about **technology** *"technology excites us"* (Nombuso); *"are pro-technology"* (Ben) some believe **older teachers** are **less comfortable** as they are **not used to teaching with technology** *"older teachers believe in the traditional way of doing things"* (Kgomotso) and **prefer** more **traditional** teaching **approaches** *"older teachers are not comfortable...don't use it to same extent"* (Ben).

When **remote**, while all teachers believe the **school** would like them to **utilise technology** they report **barriers** exist: **no formal technical support** and **guidance is being provided** *"there's no technical support...it's about social support for the learners"* (Nombuso) and **learners' lack of data limits** their ability to **participate in remote classes** *"main concern is learners don't show up...because of lack of data"* (Kgomotso); *'not everyone is following"* (Nombuso). This finding is in keeping with literature which states in developing countries where access barriers to technology resources are significant (du Plessis, 2014; Mhlanga & Moloi, 2020), even when schools support and encourage technology use it is impossible to continue with the academic project if there is insufficient access to technology (Mailizar

et al., 2020; Rasheed, et al., 2020) and adequate training and support (Hadijah & Shalawati , 2017).

Lastly, **Nombuso** believes her **peers feel using technology is ineffective** as they will **need to repeat work** when learners return *"we can do all of this but at the end of the day we must repeat work"*, however, **Ben** feels with **little assistance most** of his **peers** are **managing** *"at the beginning we did have a few questions...people needed a little help, now they are managing"*. While a possible reason for **Nombuso's** beliefs may be that a bidirectional relationship exists (Ertmer, 1999; Tondeur et al., 2017) between first-order barriers, i.e., **lack of access to resources** which limits learners' ability to get school content and teachers' **second-order normative beliefs**, according to **Ben,** it seems as if teachers are willing to **work around barriers** when they **value** the role **technology** plays in their teaching (Vongkulluksn et al., 2018; Ertmer & Ottenbreit-Leftwich, 2010) and are faced with few alternatives (Mhlanga & Moloi, 2020).

7.7.3 Knowledge Beliefs

Howard and Maton (2011), using LCT, constructed codes to separate the epistemic and social relations and subsequent acquisition of knowledge from knowledge codes characterised by specialised knowledge and knower codes acquired either naturally or socially. Furthermore, according to Howard and Maton (2011), when teachers' beliefs agree with policies and goals being pursued there is a code match, or a code clash when they are not aligned. Findings suggest teachers at School 3 possess **knower codes**, with a **code match** in regard to the school's **pro-technology views** since they believe **knowledge is acquired** by: **being interested** and **past experience** *"through experience and through interest"* (Ben); **interacting with others** *"interaction with other people"* (Nombuso); using **one's senses** *"read and study"* (Nombuso); *"by seeing, by hearing, by doing"* (Kgomotso) and **making mistakes** and **learning** from them *"if they don't go right...try another way"* (Kgomotso).

While Ertmer and Ottenbreit-Leftwich (2010) claim utilisation knowledge is the first step to technology integration, Taimalu and Luik (2019), Angeli and Valanides (2009) contend that teachers also need to appreciate the affordances so they can use technology to motivate learners and enhance learning experiences (Becta, 2004) and not simply to support existing teaching practices (Waite, 2004). However, according to Ertmer and Ottenbreit-

Leftwich (2010), confidence, not competence shapes a teacher's beliefs about how they feel in managing and utilising technology. While findings concur that all teachers believe **utilisation knowledge** is **important**, it appears a **relationship** exists between the **types of knowledge** as some teachers maintain one **needs to be confident** with **utilisation knowledge** to **appreciate affordances** *"the more you know...does influence the way you use it"* (Nombuso); *"if you know how to use it then you are able to incorporate it"* (Kgomotso) and **Ben** believes teachers who are **disinterested** in **technology affordances** are **unlikely** to possess **utilisation knowledge** *"don't even want to know...don't like it...depends on how interested you are"*. So too when **remote**, all teachers maintain prior **knowledge** on **utilisation** and **affordances** is **essential** as it enables them to **effectively use the tools** and when needed, to **self-teach** and **explore new knowledge** needed for **remote tools** *"work my way around...find out for yourself"* (Ben); *"just figure it out for myself"* (Nombuso). This is in keeping with Tondeur et al. (2017) who state that incorporation of technology is an iterative process involving bidirectional relationships between beliefs, practices and technology use.

7.7.4 Value of ICT Beliefs

Findings indicate teachers believe **technology benefits education** (all teachers) and is needed to **prepare learners for the future** *"need to give our learners the experience"* (Ben) and can be used to: **support** and enhance **teaching**, improve l**earning**, make **teachers more productive** and **assist with administration** when **on campus** and **remote**. Findings are in keeping with literature which states as teachers make value judgements about technology in order to decide to incorporate technology into their practices, teachers need to believe it can assist them in achieving their pedagogic goals and specific learning objectives (Ertmer & Ottenbreit-Leftwich, 2010; Cheok et al., 2016; Taimalu & Luik, 2019). Furthermore, Ertmer et al. (2012) claim that teachers may resist integration when they are required to use technology without considering how it benefits pedagogic activities. Findings concur as **Kgomotso** maintains technology should only be **used where it makes sense** and is **suited to the learning activity** *"where it makes sense...in a practical lesson there's no way you can have technology there"*.

According to Graham (2006) and Giovannella et al. (2020), it is more difficult to motivate learners within an online or remote context as the human teacher-learner connection is absent. Findings concur, since when **remote**, teachers feel it is **harder to motivate**

learners when using technology *"when we go back to school all those kids that are not engaging will be far behind"* (Kgomotso). In addition, **Ben** maintains the **absence** of a digital **strategy** and **plan** makes **remote teaching more challenging** *"if we had a strategy...wouldn't be as difficult as it is now"*. This is in keeping with Bergdahl and Nouri (2020) who claim that without a technology strategy, not only do teachers need to spend significant time exploring different options on their own but the resulting technology use may also be difficult due to being disorganised and disjointed.

Farah (2011) contends that teachers' beliefs about the value of technology in the current educational, context coupled with the amount of time spent using technology for work related tasks positively shapes teachers' technology self-efficacy. Furthermore, according to Bandura (2000), teachers with higher technology self-efficacy are more likely to be optimistic about technology use and the related benefits. Now **back on campus**, findings concur since teachers believe they are **more technologically inclined** as they have had to **spend time upskilling** and **reskilling** *"everyone has to do it now"* (Kgomotso) and are more **reliant on technology for content** *"it's easy to get the content"* (Ben). In addition, teachers also feel that in the **current educational context,** using **technology offers significant benefits** which include **virtual schooling** *"they can be at home and access wherever they are"* (Nombuso); **better learner access to teachers** *"easier for leaners to access teachers"* (Nombuso) and **greater interaction with shy learners** *"learners who are shy to ask in class, now open to asking...are learning better"* (Ben). Findings concur with the literature which states that benefits include offering lessons in a virtual setting (Hadijah & Shalawati, 2017), greater opportunities for teacher feedback (Giovannella et al., 2020) and reaching learners who would not otherwise take part in face-to-face classes (Saltan, 2016; Bergdahl & Nouri, 2020).

Despite these benefits, teachers believe **inequalities** across **learners** and **schools within South Africa** *"learners have resources, others don't"* (Nombuso), *"not able to post online, they don't have data"* (Ben), *"now if you have money you study, if you don't then you don't"* (Kgomotso) are **major barriers**. This concurs with du Plessis (2014), Mhlanga and Moloi (2020), and Le Grange (2020) who contend that because access to technology resources in developing countries is often limited, vast inequalities exist which may prevent disadvantaged learners prevents from continuing with their schooling (Mailizar et al., 2020; Rasheed et al., 2020; Giovannella et al., 2020; Bergdahl & Nouri, 2020).

7.7.5 Self-Efficacy Beliefs

According to Bandura (2000), Ertmer and Ottenbreit-Leftwich (2010), technology self-efficacy describes a person's beliefs in their own abilities to achieve pedagogic goals using technology. All teachers report feeling **confident using technology** at **work** due to their **interest** and **appreciation of technology affordances** *"depends on how interested you are"* (Ben) and **continued use** in the classroom *"at work I exhaust it"* (Nombuso), *"the more confidence I gain, the more comfortable I feel"* (Kgomotso) and in **personal-related** activities. These findings concur with Farah (2011) who claims that technology self-efficacy is influenced positively when extensive time is spent using technology at work there are opportunities to gain technology skills and teachers believe technology plays a valuable role in their pedagogic practice.

However, when **remote**, even though all teachers believe they are **confident using the new tools** for **remote teaching** *"I am confident"* (Nombuso), *"still very confident"* (Ben), *"I am confident about using this technology"* (Kgomotso), Kgomotso reports being **unable to utilise the technology** due to **learners' lack of data access** *"can't use it...because it is expensive for learners"*. This finding concurs with Mailizar et al. (2020), Rasheed et al. (2020), Giovannella et al. (2020), and Bergdahl and Nouri (2020) who claim that in a remote context, when learners are unable to access sufficient data teachers are restricted in terms of which technology tools they can use, irrespective of technological capabilities.

7.7.6 Different Teachers' Internal Beliefs

Findings indicate that as with ES, teachers hold many **similar IBs** in relation to technology. While **on campus**, it is possible teachers' IBs are being **positively influenced** due to the school's **pro-technology policy** coupled with extensive **technical support** and **access to quality resources** and **teachers' deep commitment to mentoring** and **guiding learners**, alongside **high technology self-efficacy beliefs** and an **appreciation of the role ICT can play** in their teaching. This is in keeping with literature which states teachers' IB cannot be understood in isolation as they are constructed from a synergy of beliefs which collectively influences teachers' technology integration (Rogers, 2000). Additionally, findings suggest technology use is being influenced by a combination of first- and second-order barriers mediated by contextual factors which are crucial in shaping teachers' abiilities to translate beliefs into practice (Ertmer, 2005; Ertmer et al., 2015). For example, in schools where beliefs around technology integration are favourable it is more

likely teachers' will be motivated to incorporate technology into their pedagogic practices (Zhao & Frank, 2003; Hennessy et al., 2010).

Furthermore, according to Ertmer et al. (2012) and Woodbridge (2003), a barrier threshold exists which may exhaust teachers and limit integration practices irrespective of teachers' beliefs. Findings indicate that when **remote** and using a **hybrid** approach, it seems as if **despite** teachers' **positive IBs** about technology and **willingness to work around barriers** teachers believe **learners' lack of access to technology** and **data** is **severely constraining teaching efforts**.

Table 33: Summary of Different Teacher's Internal Beliefs - School 3

Ben	Nombuso	Kgomotso
Pedagogy (IB-P)		
On Campus		
Aims of Teaching (PA)		
•Make an impact on learner	•Enable learners to build confidence, form opinions, express beliefs	•Make a positive impact on learners' lives, for the better
Role of Teacher (PRT)		
•Create connection, support learners	•Provide a safe classroom context	•Give guidance and direction
Hybrid & Remote		
Role of Teacher (PRT)		
•Rely on technology in teaching •Open to learning new things •Prepare for future changes	•Holistically develop the learner •Embrace technology •Prepare for future changes	•Give guidance to learners •Be familiar with technology, know benefits
Sustainability of Change (PS)		
•Sustainable, but harder to assist learners	•Changed forever, use tech •Not replacing teachers, need both	•Changed forever, use tech •Not replacing teachers, need both •Technology amplifies inequalities

Ben	Nombuso	Kgomotso
Norms (IB-N)		
On Campus		
School Norms (IB-N-S)		
•Pro-tech school, access to resources •Encourage wherever possible	•Pro-tech school, access to resources	•Pro-tech school, access to resources •Encourage and support tech use
Peer Norms (IB-N-P)		
•Most teachers favourable •Older teachers less comfortable, use less and more traditionally	•Most teachers excited by technology	•Young teachers favour tech, as have always taught with it •Older teachers prefer traditional
Remote		
School Norms (IB-N-S)		
•Encourages tech use but no formal support or guidance given	•Encourages tech use but no formal support given •Focusing on social support, as learners disadvantaged	•Encourages tech use but no formal tech support given, only emotional •Feel tech ineffective as learners make excuses for non-attendance
Peer Norms (IB-N-P)		
•Most teachers managing, needed a little assistance initially •Using peers inside and outside school for support	•Feel ineffective as will need to repeat work as learners not getting content	
Knowledge (IB-K)		
On Campus		
Classification of Knowledge (IB-K-N)		
Acquisition of Knowledge (K-NA)		
•Experience, being interested	•Interact with others, reading, studying	•Seeing, hearing, reading, doing, making and learning from errors
Knowledge Utilisation and Affordances (IB-K-U)		
•Disinterest in tech affordances leads to lack of ability to use	•Utilisation knowledge influence way tech used, awareness of affordances	•Utilisation knowledge is essential for integration, no matter which subject
Remote		
Knowledge Utilisation and Affordances (IB-K-U)		
•Current knowledge from prior experience, exploring, self-teaching	•No extra knowledge needed as possess it already, can self-teach	•Prior knowledge needed to make effective use of current technology

Ben	Nombuso	Kgomotso
Value of ICT (IB-V)		
On Campus		
Ways to Use Technology (IB-V-U) and Affordances (IB-V-A)		
Place for Technology in Education (V-UP)		
•Prepare learners for future •Enhance learning •Support and improves teaching	•Benefit learners •Support and improve teaching	•Where it makes sense •Suited to activity
Supports Teaching (V-UST, V-AST)		
•Create and distribute content	•Distribute content online	•Create, distribute content •Utilise digital textbooks
Enhances Teaching (V-UET, V-AET)		
•Learners engaged with tech medium •Exciting and fun •Bring outside world into classroom	•Lessons more exciting and relevant •Make abstract concepts real •Cater to different learning styles	•Bring outside world into classroom •Exciting and relevant
Productivity (V-UP); Administration (V-AA)		
•Save preparation and marking times •Easier communication •Content distribution outside of school	•Save time in class •Learners' work cannot get lost	•Saves time in class for notes •Content distribution outside of school
Enhances Learning (V-UEL, V-AEL)		
•Multiple reviews of recorded lessons	•Practise skills, immediate feedback •Improve understanding •Different mediums for explanation	•Practise skills, immediate feedback •Different mediums for explanation
Remote		
Ways to use Technology (IB-V-U) and Affordances (IB-V-A)		
Supports Teaching (V-UST, V-AST)		
•Partially carry on academic project •Distribute content •Assist learners	•Partially carry on academic project •Create, distribute content •Assist learners	•Create, distribute content •Prepare future lessons
Productivity (V-UP) and Administration (V-AA)		
•Comms with learners	•Comms with learners	•Comms with learners •Support from peers
Enhances Learning (V-UEL, V-AEL)		
•Review content few times	•Review content few times •Assist learners	•Assist individual learners
Challenges (V-AC)		
•Lack of plan or strategy •Data access issues	•Data access issues •Lack of technology at home	•Hard to motivate hard using tech •Data access issues
Hybrid & Remote		
Affordances of Technology (IB-V-A)		
Enhances Teaching (V-AET)		
•Relying more on tech now •Create, distribute recordings once	•Can benefit education •Offer virtual schooling option	•More tech inclined, have to upskill, reskill
Enhances Learning (V-AEL)		
•Shy learners interacting more	•Better access to teachers	
Challenges (V-AC)		
•Data access, high costs	•Inequalities across schools •Data access issues	•Inequalities across learners •Data access, hardware issues

Ben	Nombuso	Kgomotso
Self-Efficacy (IB-SE)		
On Campus		
Work-Related Activities (IB-SE-W)		
•Feels confident, selective of tools	•Feels confident, use a lot at school	•Feels confident
Ways to gain Self-Efficacy (IB-SE-WA)		
•Need an interest, appreciate benefit	• Learn by continual, extensive use	•Learn by continual use
Personal-Related Activities (IB-SE-P)		
•Feels comfortable, prefers not to use phone a lot	•Feels comfortable, uses normally	•Feels comfortable, uses extensively
Remote		
Work-Related Activities (IB-SE-W)		
•Still very confident	•Still confident as had skills	•Feels confident, knows other tools but can't use as learners lack data

7.8 PROFESSIONAL DISPOSITION - BY TEACHER AND CONTEXT

Professional Disposition (PD) which has been conceptualised in this study as **Instructional discourse (PD-I)** and **Regulative discourse (PD-R)** is shown in Table 8 and Figure 9.

In order to answer the research question (5) *what are different teachers' professional dispositions,* as Professional Dispositions (PD) are analytically distinct (Bernstein, 1986), a summary and discussion of the within-case analyses of different teachers' accounts of their instructional and regulative discourses over time, in relation to TTU-SST, is first presented. Then as these discourses are in reality interrelated (Bernstein, 1986), a summary and discussion of the teachers' professional dispositions at School 3, are presented. Table 34 presents a summary of the findings for teachers' PD at School 3, and Appendix G-3 provides the detailed analyses for each teacher's account of PD.

7.8.1 Instructional Discourse

All teachers believe **school knowledge**, which is **interlinked** with **everyday knowledge**, **structures everyday knowledge** however, **Ben** maintains **school knowledge** can only be **acquired once everyday knowledge exists** *"school is there to explain some of the things they already know"* and others feel **acquisition** can take place in **either direction** *"bring school knowledge...link it to everyday...then link it back to school"* (Nombuso); *"they learn in school...they observe...learn from that as well"* (Kgomotso). According to Bernstein (1999; 2000), teachers' discourse, views of knowledge structures and acquisition procedures are horizontal when boundaries are weak and knowledge is context specific while discourses are vertical when boundaries are strong and knowledge is specialised.

Findings suggest that even though **all teachers** believe **boundaries** between **school** and **everyday knowledge** are **weakly classified**, both **horizontal** and **vertical discourses** are **being employed** to acquire, structure and apply knowledge.

In addition, Bernstein (1999; 2000) contends that vertical discourses that transmit knowledge in school settings can involve horizontal knowledge structures which do not need to build on each other and hierarchical knowledge structures that must be studied in sequence (Hoadley & Muller, 2010). Findings suggest a **combination** of **horizontal** and **hierarchical knowledge structures** are being used by teachers: **Nombuso** maintains **knowledge** needs to be **acquired vertically** but also requires **interaction** and **engagement** people *"take every day knowledge...give it structure...can't do grade 10 maths if you haven't done grade 8...also from interaction with other people"*; **Ben** believes knowledge is acquired from **experiencing the world** and then **structuring** and **applying** it to **everyday contexts** *"we experience...when they come to school we explain why this happens like this...relate it to their every day lives"* and **Kgomotso** feels knowledge is acquired by practically **doing things** and **learning from mistakes** *"doing things...if they don't get it right...try another way".*

7.8.2 Regulative Discourse

According to Bernstein (1996), teachers with clear boundaries and who strongly control the classroom context possess a performance-based pedagogy while teachers with less explicit boundaries and who share control of the classroom with learners have a competence-based pedagogy. However, findings suggest even though **all teachers** report **strong boundaries** are in place and they **control the classroom** context *"I'm the teacher...I'm in charge of my classroom"* (Ben); *"there are boundaries...I control the classroom"* (Nombuso); *"I am the teacher and they are the learners...I control what happens in the class"* (Kgomotso) and thus possess a **more performance-based** pedagogic modality, **aspects** of a **competence** based pedagogy are present for **Ben** and **Nombuso** as they maintain they are **approachable** and **provide a space for learners to share** *"I create a space where they can fully ask"* (Nombuso); *"can approach me to discuss any issues...I'm flexible"* (Ben). This is in keeping with literature which states although different pedagogic modalities are conceptually distinct. In reality, a combination of modalities can exist concurrently for a teacher (Morais, 2002; Bourne, 2004; 2006).

According to Bourne (2006), teachers' pedagogic modalities can change in response to shifts in circumstances and contexts. Bouhnik and Deshe (2014) claim that technology which enables learners to ask questions after school hours and be in more frequent contact with teachers can potentially lessen teacher–learner boundaries. When **remote**, while findings indicate **Ben** and **Nombuso** feel **boundaries have not changed**, in keeping with the literature, **Kgomotso** reports **boundaries** have become **less defined** and **more informal** *"they can text me anytime...write hey my lovely teacher...can't do that in class"* and **Ben** feels **communication has become less formal** *"it's just a manner of the way they talk in* WhatsApp*"*.

7.8.3 Different Teachers' Professional Dispositions

Although Bernstein's (1996; 2000) collection and integrated pedagogic codes offer a powerful way to conceptually describe teachers' PDs, in reality, it seems separation is not as clear since classification and framing function independently of each other (South African Institute for Distance Education, 2010). Findings concur as even though **Nombuso** appears to mainly possess **integrated codes** due to **weak knowledge classification**, her **blended regulative discourse** coupled with her belief of **hierarchical knowledge acquisition** suggest **aspects** of **collection codes** are also present whereas **Ben** and **Kgomotso** who appear to possess **collection codes** due to mainly **performance-based pedagogies** view **knowledge boundaries** as **weakly classified** and thus **aspects** of **integrated codes** are also present in their PDs.

Additionally, according to Fonseca-Chacana (2019), PDs are not constructed in a vacuum and change over time based on their social context (Bourdieu, 1974) and teaching environment (Dottin, 2009). This perspective may explain why, when **moving to a remote teaching** context, **Kgomotso**, who initially reported having **firm teacher-learner boundaries** in place, feels **boundaries** have become **less formal** and **defined**. Therefore, even though **codes** assist in conceptually **analysing** and **describing teachers' PDs**, in **reality,** it seems as if one is **not able to neatly categorise** teachers' **multifaceted** and **complex PDs**.

Table 34: Summary of Different Teacher's Professional Dispositions - School 3

Ben	Nombuso	Kgomotso
On Campus		
Instructional Discourse (IB-PDI)		
Boundaries of Knowledge (IB-PDI-B)		
•Everyday, school relate •Need everyday to acquire, build new	•Everyday, school relate, no boundary •Gives structure and scientific names	•Everyday, school interlinked
Knowledge Acquisition (IB-PDI-K)		
Direction of Knowledge Acquisition (PDI-KD)		
•Everyday first, then school	•Can acquire in both directions	•Can acquire in both directions
Ways to Acquire Knowledge (PDI-KW)		
•Structures existing knowledge •Experience	•Vertical manner	•Doing things, learn from mistakes
Involvement Needed (PDI-KI)		
•Application to everyday	•Interacting, engaging	•Active, but on learning style, subject
Regulative Discourse (IB-PDR)		
Teacher- Learner Boundaries (IB-PDR-B)		
•Strong boundaries, approachable	•Strong boundaries, space to ask	•Strong boundaries, need respect
Classroom Control (IB-PDR-C)		
•Teacher control, but flexible	•Teacher control	•Teacher control
Hybrid & Remote		
Regulative Discourse (IB-PDR)		
Teacher- Learner Boundaries (IB-PDR-B)		
•Not change, less formal comms	•No change, wok related	•Less formal and defined, shy learners engaging

7.9 ORIENTATION TOWARDS TECHNOLOGY - BY TEACHER AND CONTEXT

Orientation towards Technology (OTT) i.e., Agent's Practices (AP) and Outcomes (O) which have been conceptualised in this study as **Level of Adoption (AP-LA)**, **Manner of Adoption (AP-MA)**, **Adoption Activities (AP-AA)**, **Current (O-CTU)** and **Future (O-FTU) technology use** are shown in Table 8 and Figure 9.

In order to answer the research questions (6) *What are different teachers' orientations towards technology* and (7) *How do different teachers use technology*, summaries and discussions of the within-case analyses of different teachers' accounts of Orientation towards Technology (OTT), Level and Manner of Adoption (LA, MA), Current Adoption Activities and Outcomes (AP-AA, O-CTU) and Future Adoption Activities and Outcomes (AP-AA; O-FTU) over time and in relation to TTU-SST are presented. Thereafter, as belief systems are constructed from a combination of beliefs (Liu, 2011) an overall discussion of different teachers' OTT over time at School 3 is provided. Table 35 presents a summary of the findings for teachers' OTT at School 3 and Appendix G-4 provides the detailed analyses for each teacher's account of OTT.

7.9.1 Level and Manner of Adoption

Findings suggest, even though **Ben** believes technology can be **transformative** *"it's impossible for it not to change teaching"*, **LA** for **all teachers** at School 3 seems to include **familiarisation**, **utilisation**, **integration** and **reorientation** *"links to what I'm doing...makes it better...it's not the same"* (Ben); *"makes things easier...more interesting...much richer"* (Nombuso); *"things are a little bit easier...brings things they don't know about into class"* (Kgomotso) as teachers report they are familiar with the technology, are utilising it for routine functions, consciously incorporating technology into their practices and constantly assessing how technology can enrich the learning context (Hooper & Rieber, 1995; Rogers, 2000).

For **MA**, product technologies describe contemporary use of technology to support and enhance existing pedagogic practices through substitution and augmentation while idea technologies enhance and enrich teaching and learning experiences through modification and redefinition of tasks and pedagogic practices (Hooper & Rieber, 1995; Puentedura, 2006; Hamilton et al., 2016; Hilton, 2016). Findings indicate when **on campus,** all teachers appear to be using technology in both a **product** and **idea** manner to **support** and **enhance existing practices** by **changing mediums** *"it's just a medium change...this is just easier"* (Ben); *"just add to what you are doing"* (Kgomotso) and **augmenting existing practices** by making **classes richer** and **more interesting** *"makes lessons more interesting...much richer"* (Nombuso) and to **modify tasks** and for **tasks** that were **previously impossible** *"interactive activities...instant feedback"* (Kgomotso), *if you do the body system...can see the bodily fluids moving"* (Nombuso). Moreover, while Hooper and Rieber (1995) claim that using technology in a product manner is mainly due to teachers' historical beliefs and entrenched professional dispositions, it seems when **remote** teachers use technology in a **product manner** as a **partial substitute** for **face-to-face teaching** and to **modify some teaching tasks** for their **specific remote setting**, is mainly due to **learners' lack of access to technology resources** which is **limiting the tools** and **manner** in which **technology can be utilised** *"there's an issue of data...videos don't really work"* (Nombuso); *they do not have enough data...things need to be done in class...to avoid using more data"* (Kgomotso); *"there's a wide range of tools...they just take too much data"* (Ben). This is in keeping with Mailizar et al. (2020), Rasheed et al. (2020), and Giovannella et al. (2020) who claim that irrespective of beliefs, teachers' abilities to use technology is limited when learners are unable to access sufficient data.

7.9.2 Current Adoption Activities and Outcomes

On campus, teachers believe technology **supports** and **enhances existing practices** and **assists** with **administration** activities by enabling **content management** and **projection** (all teachers), **assessment** (Ben), **searching the internet** (Kgomotso) **showing videos** (Nombuso, Kgomotso), **recording lessons** for **review** and **better explanations** (Ben Nombuso), **communicating** with learners (Ben, Nombuso) and **posting work from home** (Ben). In addition, all teachers feel technology enables them to **transform** their pedagogy by **bringing the outside world into the classroom** (Ben; Kgomotso), offering **virtual experiences** (Ben) and **making abstract concepts real** (Nombuso). Notwithstanding these adoption activities, **Ben** maintains **learners still need to use pen and paper to write** and **technology** can be used as a **scapegoat for poor teaching**. Findings suggest although **all teachers mainly utilise technology** for **activities that support existing practices**, they also appear to **use technology** for some **transformative tasks**. While Ertmer et al. (2015) and Becker (2000) claim that teachers with more teacher-centred beliefs have less active and varied use of technology, Tondeur et al. (2017) claim that integration is not simply related to teachers' pedagogical beliefs but rather that complex and bidirectional relationships collectively shape teachers' technology integration choices. Therefore, even though **teachers** at School 3 appear to hold **more teacher-centred beliefs**, it seems as if their technology **adoption activities** are being **influenced by** the **pro-technology focus of the school**, **beliefs of sufficient access** to **quality technology resources** for both teachers and learners **high technology self-efficacy beliefs** and an **appreciation of technology affordances**.

That said, when **remote**, although teachers believe **remote education is not suitable for all learners** (Ben, Nombuso) and **learners' data constraints** severely **limit their ability to utilise remote technology** tools (all teachers), in an **attempt to continue with the academic project,** the teachers report using ***WhatsApp*** and ***Siyavula*** to **post guidelines** and **content** (all teachers), **assist learners** and **provide feedback** (all teachers), enable **online submissions** (Kgomotso), **assess learner progress** (Ben), **communicate with learners** (all teachers), **get support** (Ben, Kgomotso) and **attend meetings** (Kgomotso). So too, in a **hybrid** setting, teachers believe **learners' data access issues** are still **limiting the technology they can utilise** and thus while teachers report using ***WhatsApp*** to **distribute content** (Nombuso), **pre-record lessons for learners at home** (Ben), offer

assistance (Nombuso), **communicate with learners** (all teachers) and **attend meetings** (Ben Kgomotso), the **school has resorted to distributing content on memory sticks or paper** (Kgomotso) to reach **all learners**. This is in keeping with literature which states that irrespective of beliefs (Ertmer et al., 2012), the ability to utilise technology tools is limited if either teachers or learners lack access to the necessary technology resources (Bergdahl & Nouri, 2020; Mailizar et al., 2020; Rasheed et al., 2020; Giovannella et al., 2020).

7.9.3 Intended Future Adoption Activities and Outcomes

When **remote**, teachers indicate that when they return to campus they **intend to use technology** more effectively to **record lessons** (Ben), **communicate** with learners (Nombuso, Kgomotso), and **assist** and **provide feedback** to learners (Nombuso, Kgomotso). However, when **returning to campus**, while teachers report **utilising technology as intended**, teachers believe **resources access issues** require them to **use alternatives**. This finding concurs with Bergdahl and Nouri, (2020), Mailizar et al. (2020), Rasheed et al. (2020), Giovannella et al. (2020), and Hadijah and Shalawati (2017) who claim that the benefits of remote teaching and learning can only be realised when teachers and learners have adequate access to appropriate technology resources.

In **future**, **Ben** maintains there will be a **greater reliance on technology** *"relying more on technology...way we used to be as teachers is gone"*, and while **Nombuso** feels technology can **address teacher shortages** *"lessons playing...in three different classes at the same time"*, she believes a **blended approach** is needed *"a blended approach where physical and technological approaches are used"*. Even though potential benefits exist, teachers believe **major challenges** include teachers' l**ack of technology skills** *"you're gonna to need to learn all those things"* (Ben); **extra time** and **effort needed** when **remote** *"have to be teaching during my preparation...it takes time"* (Ben); *"it has to be very precise...it's challenging to track who's doing work"* (Nombuso) and **widespread infrastructure issues** within the country in regard to **hardware** and **lack of data access** (all teachers). Despite the potential of blended learning to reduce the limitations of time and space (Stein & Graham, 2020), findings concur with literature which claims teachers' lack of technology proficiency (Slutsky, 2016), additional time need to teach remotely (Hadijah & Shalawati, 2017; Mailizar et al., 2020; See et al., 2020), difficulty in tracking learners' progress (Chen et al., 2014) and infrastructure issues (du Plessis, 2014; Mhlanga & Moloi, 2020; Le Grange, 2020; Mailizar et al., 2020; Rasheed et al., 2020; Giovannella et

al., 2020) severely constrain the ability to realise the benefits afforded by technology integration.

7.9.4 Different Teachers' Orientation towards Technology

Findings indicate **teachers' OTT** at School 3 is **similar** with **all teachers** using technology to **support**, **enhance** and **transform existing activities** and for **administration**. However, when **remote** and using a **hybrid** approach, it seems as if even though teachers feel **ICT is valuable** they believe their **ability to utilise technology** for pedagogical activities is **primarily being constrained** by **learners' lack of access** and **other concerns** such as **self-efficacy** and teachers' **well-being**. While these findings concur with Tondeur et al. (2017) who claim that a barrier threshold exists irrespective of teachers' beliefs since systematic constraints such as a lack of access to technology resources (du Plessis, 2014; Mhlanga & Moloi, 2020; Le Grange, 2020; Mailizar et al., 2020; Rasheed et al., 2020; Giovannella et al., 2020) may prevent teachers from incorporating technology (Ertmer et al., 2012; Woodbridge, 2003), it appears impossible to attribute technology integration behaviour to any single factor as there are complex and bidirectional relationships between External Structures (ES), teachers' belief systems and contextual aspects (Chen, 2008; Tondeur et al., 2017).

Table 35: Summary of Different Teacher's Orientation toward Technology - School 3

Ben	Nombuso	Kgomotso
Level and Manner of Adoption (AP-LA; AP-MA)		
On Campus		
Supporting and Enhancing Pedagogic Practice (LA-SEP, MA-SEP)		
•Support, enhance existing pedagogy •Mainly medium change	•Supports, makes easier, saves time •Enhances as richer, more interesting	•Supports, makes easier •Enhances pedagogy •Not transforming, same teacher
Transforming Pedagogic Practice (LA-TP, MA-TP)		
•Assessment can transform teaching		
Remote		
Supporting and Enhancing Pedagogic Practice (LA-SEP, MA-SEP)		
•Only partial support as learners' lack data access, cannot use all tools	•Supporting, but limited due to learners' data access issues	•Partial support as learners' lack data access, cannot use all tools
Transforming Pedagogic Practice (LA-TP, MA-TP)		
•Can potentially transform with tools		
Adoption Activities (AP-AA) and Outcomes (O)		
On Campus		
Current Teaching Activities (AP-AA; O-CTU)		
Supporting Teaching Activities (AP-AAS, O-CTUS)		
•Prepare, present, push content •Assessment	•Prepare, present, push content •Show videos	•Prepare, present, push, content •Show videos •Search information
Enhancing Teaching Activities (AP-AAE, O-CTUE)		
•Record lesson for review	•Record lesson for review	
Transforming Teaching Activities (AP-AAT, O-CTUT)		
•Bring outside world into classroom •Virtual experiences	•Make abstract more real	•Bring outside world into classroom
Administration Activities (AP-AAA, O-CTUA)		
•Comms with learners •Post work from home	•Comms with learners	
Challenges (O-CTUC)		
•Scapegoat for bad teachers •Learners need to write on pen, paper		
Remote		
Current Teaching Activities (AP-AA; O-CTU)		
Supporting Teaching Activities (AP-AAS, O-CTUS)		
•At first record lessons, post on *Google Classroom* •Now for › Post guides, content, assist online › *Siyavula* for exercises	•At first record videos, review lessons •Now for › Prepare content, assist learners › Post, distribute content	•Post guides, content •Continue teaching •Online submission, feedback
Administration Activities (AP-AAA, O-CTUA)		
•Comms with learners •Teacher support	•Comms with learners	•Comms with learners •Teacher support, attend meetings
Challenges (O-CTUC)		
•Not suited to all learners •Data access issues	•Not suited to all learners •Data access issues	•Data access issues
Intended Future Technology Use (O-FTU)		
Supporting Role (O-FTUS)		
•Use tech more effectively to record lessons	•Comms with learners, assistance •Not for content distribution	•Feedback, comms with learners •Not for submission of work

Ben	Nombuso	Kgomotso
Adoption Activities (AP-AA) and Outcomes (O)		
Hybrid & Remote		
Current Teaching Activities (AP-AA; O-CTU)		
Supporting Teaching Activities (AP-AAS, O-CTUS)		
•Pre-record lessons for learners at home	•Distribute content distribution •Assist learners	•Distribute content on memory sticks or paper, not online
Administration Activities (AP-AAA, O-CTUA)		
•Comms with learners •Attend meetings	•Comms with learners •Attend Meetings	•Comms with learners
Future of Technology in Education (O-CTUF)		
•Rely more on tech	•Blended, technology and physical •Address teacher shortage	
Challenges of Online (O-CTUC)		
•Challenge if no tech skills •More time, effort to teach, assist learners with technology	•Instructions need to be precise •Hard to track learner progress •Infrastructure barrier	•Infrastructure barriers – hardware, software •Can't use tools, not transform

7.10 CONCLUSION – SCHOOL 3

This chapter presented the findings and discussion for School 3. First, an overview of the case study site, the school's response to the COVID-19 pandemic and a summary of the teachers interviewed were provided. Next, summaries of findings and discussions in relation to the micro- and meso-level theories[68] for each of the theoretical framework components i.e., ES and CSB, IB, PD, AP and O were presented in reference to prior literature reviewed or, where necessary, new literature in order to substantiate or counter findings. Initial codes were deductively formulated from the theoretical framework, and subcodes that emerged inductively from the data were then detailed in the summary tables.

[68] Figure 9 depicts the micro- and meso-level theories utilised for this chapter.

8 FINDINGS AND DISCUSSION – SCHOOL 4

In order to understand teachers' lived experiences within School 4, it is necessary to first contextualise the case study site and participants. Therefore, this chapter begins with a summary of the site visit to the school, followed by a summary of teachers' personal technology use, teaching experience, a brief description of each teacher interviewed and an overview of the school's response to the COVID-19 pandemic (Olivier, 2020). Next, to provide a holistic understanding of School 4 and its teachers' beliefs, findings and discussions are presented using within-case analyses for each of the relevant research questions, using codes drawn from the study's theoretical framework for the micro- and meso-level theories (see Table 8 for initial codes). In addition, as data was collected at three different intervals, teachers' accounts are presented in chronological order.

8.1 SUMMARY OF SITE VISIT

School 4 is a fee-paying, multi-racial, ex-Model C school with a reputation for good academic results. While the school is situated in a relatively affluent area and thus receives a low government subsidy, many parents are unable to afford school fees and the shortfall has to be raised by the SGB. Currently, 1200 learners are enrolled at the school with seven classes per grade and a maximum class size of 40 learners. There are 50 teaching staff across various subjects with specialised teachers for CAT, Visual Art and Design. To assist teachers in growing their skills, new teachers are usually allocated lower grades and encouraged to move up as they become more senior. The school has a very firm discipline policy by which parents and learners must abide. The school writes the NSC matric and although most of the learners are not native English speakers, the language of instruction at the school is English.

School 4 is not an ICT designated school and thus the school relies solely on fees and limited SGB funds to purchase and maintain technology resources. Therefore, much of the technology at the school is either outdated, limited in functionality or access, or simply broken. In addition, there is limited Wi-Fi coverage at the school and as the school has been able to give laptops to some teachers only, others have had to purchase their own devices. While there are ceiling-mounted projectors in most classrooms, whiteboards and in a few cases, SMART Boards, some of the projectors are broken and the SMART

Boards are not being utilised effectively. There is one computer laboratory with old desktop computers and shared tablets that is used exclusively by the CAT teacher and learners.

8.2 TEACHERS

Four teachers with different subject specialisations were interviewed at School 4. Two of the teachers have a wealth of teaching experience, one has only recently started teaching in secondary education and the other teacher is newly qualified. In relation to personal use of technology, teachers report using technology mainly for communication, social media, banking, transport and getting information. Table 36 provides a summary of teachers' experience and personal technology use.

Table 36: Teacher's Experience and Personal Technology Use - School 4

Pseudonym	Teaching Experience	Years at School 4	Subject Taught	Personal Use of Technology
Candice	30 years	14 years	CAT	Make phone calls...find out if my family members and my friends are ok...do banking see if I've got money in my bank account…*Facebook*…I've got an old cellphone specifically for games to relax.
Malefa	33 years	7 years	Maths Maths Lit	I can use my tablet...have my hone...not a social fan…like Googling, finding stuff online...developments…like to compare...I do banking…order food...Uber if I don't want to…feel like the traffic is too much.
Patrick	7 years	2 years	Design	Largely for communication...chat to my parents…keep in touch with family...the mobile banking app...don't use it for Uber or to order food…online shopping...I prefer going to the shops.
Thuli	2 years	2 years	Social Sciences	I'm using it to communicate mainly sending emails…calling people...to get information from the internet...also banking…shopping online…just about everything.

8.2.1 Candice

Candice is an experienced teacher who utilises technology where it makes sense to engage and empower learners and for administrative tasks. While Candice believes she is familiar with technology, she is constantly trying to extend her skills due to the ever-changing nature of technology. Although pressured for time, Candice maintains she is happy to assist her peers with technology issues in her role as CAT teacher but feels many teachers are not using technology effectively since they prefer externally facilitated training or are simply not interested in changing their existing pedagogic practices. While

Candice thinks it is feasible to utilise technology in the classroom, she feels she needs to plan lessons very carefully to ensure time is not wasted. To acquire knowledge in her subject Candice believes learners need to integrate school and everyday knowledge, with teachers acting as guides and mentors whilst still controlling the learning context.

8.2.2 Malefa

Malefa is a passionate and experienced teacher who believes technology can support and enhance teaching as it provides learners with access to a wealth of information, other teaching methods and learning resources. Malefa believes technology should only be used where it helps and not just for technology's sake. While she feels comfortable using technology in her teaching and personal life, she maintains the school should offer teachers more training on new technology developments as well as orientate newer teachers. Malefa believes that to acquire knowledge in maths, one needs to build skills vertically through applying abstract terms to everyday life and although she allows discussion to take place, she likes to control the classroom context and has firm boundaries between herself and the learners.

8.2.3 Patrick

Patrick, who is new to the secondary educational context, believes teaching is a partnership between teachers and learners and requires teachers to create and facilitate a positive and beneficial learning environment. While Patrick feels technology makes learning more interesting and enables learners to think differently, he maintains technology should only be used where it makes sense and saves time. Although Patrick feels comfortable using technology in his work and personal life he believes he could improve his skills if more training and access to resources were offered by the school. Patrick maintains that to acquire knowledge, one needs to make mistakes and then learn through practise until a level of knowledge or perfection is reached. Patrick prefers the facilitator role and thus encourages shared control of the learning context.

8.2.4 Thuli

Thuli is a newly qualified teacher who appreciates the benefits of technology in both her personal and work life but she maintains that the lack of access to resources, training and technology orientation at the school is limiting her ability to utilise technology effectively in her teaching. While Thuli believes she is familiar with technology, she finds setting up technology wastes valuable class time because she is a floating teacher and moves

between classes. Thuli feels teaching is about communicating with learners in order to promote learning and understanding and consequently believes acquiring knowledge requires learners to actively engage, observe and verbalise experiences. While Thuli encourages more interaction and shared control with the senior grades, she maintains firm boundaries and control with junior learners due to large class sizes and maturity concerns.

8.3 SCHOOL'S RESPONSE TO CHANGES IN EDUCATIONAL CONTEXT [69]

8.3.1 Start of COVID-19 Pandemic[70]

At the start of the COVID-19 pandemic, teachers at School 4 report that the **academic project could not continue** due to **teachers not been given access to learners' contact details** *"we are not in contact with our learners…we are not allowed to have their cell phone numbers…even getting emails was a real challenge"* (Patrick); *"there is no formal contact…the school did not give us any access to learners"* (Malefa); *"we don't have any contact with the learners"* (Thuli), the **inability of connecting school laptops to Wi-Fi outside of the school** *"I think the school laptop is only wired to connect to the Wi-Fi at the school…it won't connect"* (Patrick), **lack of technology resources** *"they never have any extra technology to assist us"* (Malefa); *"they didn't give any hardware or software"* (Candice) and **limited data** *"I even had to purchase extra data"* (Candice); *"they could have provided data…so that you can communicate"* (Malefa); *"there is a challenge with connectivity"* (Thuli).

8.3.2 During COVID-19 Pandemic[71]

During COVID-19, while **all teachers returned** to school the school implemented a mainly **staggered attendance model** to ensure social distancing amongst learners *"the grade 12s came every day but the grade 11s were split…one day only girls, the next day only boys…same with the other grades"* (Candice). In addition, the school adopted ***Google Classroom*** to teach learners that are either **never on campus** or are only **on campus on alternate days** *"the principal enrolled our school as a* Google Classroom *school…to physically teach those who's in class and then electronically those who are not"* (Candice);

[69] Prior to COVID-19, all teachers and learners were on campus, with some teachers utilising technology.
[70] At the start of COVID-19 pandemic, while some teachers tried to continue with the academic project, most were not in contact with learners and did not teach remotely.
[71] During the COVID-19 pandemic, School 4 adopted a hybrid and remote approach with all teachers returning to campus and learners attending on alternate days, with some learners continuing to work only remotely.

"we have Google Classroom*…where teachers and learners meet"* (Malefa); *"our school has adopted the* Google *platform…our classrooms are now online"* (Patrick); *"introduced* Google Classroom*"* (Thuli); **provided devices for teachers that did not have** *"the principal asked me to give tablets allocated to junior teaching…to those who didn't have devices"* (Candice); *"teachers who didn't have laptops, they managed to get them some"* (Malefa); **upgraded the Wi-Fi at the school** *"they fixed the short coverage of Wi-Fi at the school"* (Malefa); *"broadened the Wi-Fi so now it includes my classroom"* (Thuli); *"set up a fibre, Wi-Fi link into the school…so we can teach in our classes"* (Candice) and **purchased *MS Teams*** for **staff meetings** *"they introduced* MS Teams*"* (Thuli); *"installed* MS Teams*…to share information"* (Candice); *"we are registered on* MS Teams*…for peer to peer interaction"* (Patrick). Table 37 provides a summary of School 4's response to the change in the educational context.

Table 37: Summary of Response to Educational Context Change - School 4

Change in Educational Context	School's Response

Remote Teaching	• Academic project was barely able to continue as:
	  ◦ Teachers were not given access to learners' details given to teachers
	  ◦ School laptops do not connect to Wi-Fi outside of school
	  ◦ Technology resources lacking for teachers
	  ◦ Data limited as none was provided for teachers or learners

Remote and Hybrid Teaching	• All teachers on campus
	• Only grade 12s attend every day, other learners on alternate days
	• School invested in technology by:
	  ◦ Enrolling with *Google Classrooms*
	  ◦ Providing devices for teachers that did not have
	  ◦ Upgrading school Wi-Fi
	  ◦ Purchasing *MS Teams* for staff meetings

8.4 SCHOOL CONTEXT

Within this study, in order to understand School 4's context and answer research question (1) *What is the context at different schools,* findings are detailed in relation to **School Culture** C-SCu defined as **instrumental** or **expressive** (Bernstein, 1975), **Control** C-SC defined as **stratified** or **differentiated** (Bernstein, 1971a) and **Social Interaction** C-SI defined as **mechanical** or **organic** (Bernstein, 1971b). Next, a discussion of the findings in relation to the literature is presented. A summary of the findings for the context at School 4 is shown in Table 38.

8.4.1 Culture

Teachers report that although there is a **strong culture of discipline** at the school *"there is discipline, 100%...they have a code of conduct that is followed by the kids and parents"* (Malefa); *"it's a very discipline orientated school"* (Patrick), with a **hierarchical structure** and **racial tension evident amongst learners** *"there's a hierarchy system among the kids…grade 8s are seen as less…there's a white culture with black students"* (Thuli); *"have a weakness in terms of blending races with the learners"* (Patrick) and **staff** *"there's a hierarchical culture with the staff…HODs they see themselves as better than the admin staff…it's very diverse from ethnic groups through to skin colour…in some cases teachers don't want to learn from a white woman…or a normal level one teacher"* (Candice); teachers believe **there is a prevailing culture amongst teachers to care** and **empower learners to achieve** and **make a difference to others** *"to help and guide the kids in front of you…to be the best in the world* (Candice); *"there is communication with the parents and us…to help the child…not only when the child has done something wrong"* (Malefa); *"we promote integrity and being the best we can be for the world"* (Thuli); *"to empower students so they can help others whom we will not be able to touch"* (Patrick).

8.4.2 Control

Teachers report that learners are **grouped according to their age** group *"it's always based on age"* (Thuli); *"they are grouped according to their age"* (Patrick); *"all learners of the same age are in the same class"* (Malefa); *"classes are age based"* (Candice).

8.4.3 Social Integration

While Candice maintains **many teachers** at the school are **resistant to learning how to use technology in the classroom:** *"there's a lot of our staff that is against using new ways of doing things…they don't want to learn the features they need to know"*; others believe technology use is **influenced by age** with **mainly younger staff favouring technology:** *"the younger teachers…they are tech-savvy…are embracing the new technologies…those who are older, they tend to stick to their old ways"* (Patrick); *"most of them prefer using technology…especially the newer teachers…the older teachers…don't believe technology is needed"* (Thuli). In addition, while some teachers maintain the **school values using technology use in the classroom** but are **unable to implement it** *"I think they do because they say a school without a projector…laptop…tablet, is living in the olden days"* (Patrick); *"they think technology is important…but I don't think we are big*

on implementing" (Thuli), **others believe the school does not actively promote technology integration** *"I don't think the school really believes that the kids need to use technology in the class"* (Malefa); *"the school don't care if the teachers use technology in their classes"* (Candice).

8.4.4 Summary of School 4's Context

Findings indicate that School 4 has an **expressive culture** since teachers believe the focus of the school is on developing behaviour and character by transmitting values and norms (Bernstein, 1975; South African Institute for Distance Education, 2010) by achieving one's best and making a difference to others. In addition, the school displays **stratified control** since learners are grouped according to the fixed attribute of age and teachers' roles are clearly defined (Bernstein, 1971a; South African Institute for Distance Education, 2010). Furthermore, it appears that School 4 has **mechanical integration** as modes of control are positional and social roles are given, evidenced by teachers' reports of the strong discipline code and hierarchical structure within the school as well as social cohesion being based on a common set of beliefs (Bernstein, 1971b; South African Institute for Distance Education, 2010) related to race and age.

Table 38: Summary of School Context - School 4

Culture- Expressive (C-SCu-E)
• Strong discipline culture • Hierarchical structure and racial tension among learners and staff • Aims to empower learners to achieve their best, help others, provide holistic care
Control – Stratified (C-SC-S)
• Learners are grouped according to age
Social Integration – Mechanical (C-SI-M)

• Teachers report different beliefs about technology use based on:
  ◦ One believes many are resistant
  ◦ Others believe age is a factor with younger teachers more favourable
• Some teachers believe the school does not value technology while one teacher believes they do but are not able to implement

8.5 BELIEFS OF EXTERNAL TECHNOLOGY STRUCTURES - BY CONTEXT

External technology Structures (ES) and teachers' associated beliefs (CSB) about these structures which have been conceptualised in this study as **Resources (R)**, **Training (TR)**, **Support (S)** and **Time (T)** are shown in Table 8 and Figure 9.

In order to answer the research question (2) *what are the external structures at different schools,* a summary and discussion of the within-case analyses of teachers' general

accounts of external technology resources at School 4 and their associated beliefs over time for each part of the theoretical framework is presented. Table 39 provides a summary of findings for teachers' beliefs of External Structures (ES) at school 4 by context along with expanded subcodes drawn from the data (See Appendix D for expanded subcodes).

8.5.1 On-Campus Teaching

- **Resources**

According to Rogers (2000) and Johnson et al. (2016), to encourage technology integration, teachers and learners require regular access to appropriate technology resources for extended periods of time. Furthermore, du Plessis (2014) claims that schools with limited access to computer laboratories do little to promote technology use. In keeping with the literature, findings indicate teachers who believe they have **sufficient access to resources** report **using technology** while teachers who feel **access** to school-issued laptops, software and the computer laboratory is **limited** appear to be **integrating technology less** into their pedagogic practices. Resources at the school include school-issued laptops for some teachers, a computer laboratory only for the CAT teacher and learners, projectors and whiteboards in most classrooms and Wi-Fi in some parts of the school.

In addition, Topracki (2006) and Sicilia (2005) argue that poor resource quality such as slow internet and broken or outdated devices and unsuitable technology limit willingness to incorporate technology as teachers only incorporate technology if they believe it assists them in completing their lessons without disturbances (Chigona et al., 2014). Findings concur as reports of **Wi-Fi having limited reach** and **connection issues** coupled with **projectors being broken** for extended periods of time appear to be **discouraging teachers** from utilising technology extensively in their classrooms.

For the physical arrangement of resources, findings indicate that although teachers believe **ceiling-mounted projectors** and whiteboards facing the front of the class with **easy connection** to the teacher's laptop **motivate use**, some teachers feel the **current layouts (**in rows) of the classrooms and computer laboratory **constrain** offering assistance, learner interaction and creativity. These findings concur with Tondeur et al. (2008) who argue that classroom layout and the placement of technology can either promote or inhibit teachers'

technology integration, with traditional computer laboratories being seen as incongruent with current educational goals (Zandvliet, 2006).

- **Training and Support**

Findings indicate most teachers agree that **more training** on **how to use technology** and **affordances** is needed. Although teachers report that in the past, there had been some in-house and outside facilitated practical and demonstration-based technology training at the school; currently, teachers have to either self-teach or rely on their peers because no training is being provided. This concurs with literature which states for training to be sufficient, not only do teachers need consistent and frequent sessions (Ertmer et al., 2012) for them to keep up with the constant evolution of technology (Johnson et al., 2016) but training content also needs to be connected to their classroom practice (Wells, 2007). Interestingly, while Schrum (1999) contends that theoretical workshops given by experts are less effective than peer mentoring, one teacher maintains that even though peer mentoring is on offer at the school, **teachers are resistant** to learning about technology in this manner and **prefer outside trainers**. A possible reason for this finding may be attributed to the **lack of training** coupled with the **hierarchical** and **racial tensions** reported within school. This is in keeping with Chen (2008) and Tondeur et al. (2017) who claim that teachers' beliefs are complex as they are simultaneously influenced by multiple aspects such as external and contextual factors.

For technical support, even though one teacher reports she and her CAT learners are providing teachers with peer support, most teachers believe the twice-weekly, on-site **IT support** should be **more frequent** as a delayed response to technology issues impacts teaching efforts. Regarding **institutional support**, all teachers feel the technology support from the school is **inadequate** as there is insufficient funding and access to technology resources. Findings concur with Rogers (2000) and Ertmer et al. (2012) who claim that teachers can only effectively integrate technology when sufficient technical support to maintain technology and institutional support to fund technology associated costs are available. Furthermore, according to Johnson et al. (2016), although peer support may be sufficient as technology integration matures, initially educational technology professionals and technology support staff are needed. Findings suggest teachers at School 4 believe they are still in the **beginning phases** of technology integration and thus **less peer support** and **more expert assistance** is **required**.

- **Time**

Many teachers believe that although they are **familiar** with utilising the available technology, since technology constantly advances they feel **better access** to quality resources and more **frequent training is needed** to grow their skills. This finding concurs with literature which states that to be familiar with technology, teachers need regular access to quality resources (Sicilia, 2005; Toprakci, 2006; Johnson et al., 2016) and frequent training to keep their skills current as technology continuously evolves (Johnson et al., 2016).

In regard to feasibility, even though one teacher believes **technology saves time in class** others feel technology requires **substantial time to set up** and **use** and thus extensive **planning is required** beforehand, or that technology should be **used outside of school hours** where time is less constrained. This finding concurs with literature which states that even if teachers are familiar with technology they may believe incorporating technology into their pedagogic practices is impossible as it requires extensive planning (Condie et al., 2007). In addition, according to Cuban (2001) and Karasavvidis (2009), since teachers often feel using technology is more time consuming, they maintain it is unfeasible to effectively utilise technology during the school day due to the short duration of lesson times.

8.5.2 Remote Teaching

- **Resources**

Findings indicate that most teachers believe **lack of access** to appropriate hardware and data; **inability to connect** school-issued devices to outside networks and **learners' lack of access to data** is **hampering the academic project**. This concurs with literature which states that both teachers (Bergdahl & Nouri, 2020; Hadijah & Shalawati, 2017; du Plessis, 2014) and learners (Mailizar et al., 2020; Rasheed et al., 2020; Giovannella et al., 2020) need sufficient access to appropriate technology tools to successfully continue with educational activities, which Mhlanga and Moloi (2020) argue is not guaranteed in South Africa.

In addition, findings indicate that teachers believe their **inability to access learners' contact details** is **blocking remote teaching efforts** as School 4 has chosen not to share learners' details with teachers due to privacy concerns. According to Gunning and

Strachan (2020), although schools must comply with the Protection of Personal Information Act of 2013 (POPIA) and have to ensure learners' privacy by not divulging learners' personal details, schools should share learners' contact details with teachers with parental consent because remote teaching and learning cannot take place without communication between teacher and learner (Saltan, 2016).

- **Training and Support**

According to Bergdahl and Nouri (2020), Mailizar et al. (2020), Vandeyar (2014), Rogers (2000), and Ertmer et al. (2012), teachers cannot integrate technology without the provision of appropriate resources and the necessary technical and institutional support. However, Rogers (2000) claims that teachers place less focus on external barriers as they become more familiar with technology since those with higher technology self-efficacy are willing to expend effort in incorporating technology into their pedagogic practices. These perspectives may explain why **most teachers** maintain that they are **unable to use technology** effectively for remote teaching as they report having **little access to resources**, **no formal technology training** and **inadequate IT technical** and **institutional support**. In contrast, the **CAT teacher** who already uses technology extensively reports that she **offers peer support** by posting free online lessons and using communities of practice to gain technology skills – despite training and support issues at the school.

- **Time**

Teachers report that they are **familiar with technology tools** for remote teaching and maintain their **non-use** is simply because they **do not have access** to the required resources. This is in keeping with Bergdahl and Nouri (2020), Hadijah and Shalawati (2017) who claim that even if teachers are comfortable with technology, they are unable to continue with the academic project without access to the appropriate digital tools. Moreover, according to Bergdahl and Nouri (2020), since many schools were unable to plan a technology strategy due to the rapid move to remote teaching and learning teachers needed to invest large amounts of time exploring different technology options on their own which often resulted in disorganised and disjointed technology use. This perspective may account for findings that suggest some teachers feel **time is being wasted** due to the

complex remote technology setup and the school's **lack of a remote teaching strategy**.

8.5.3 Hybrid and Remote Teaching

- **Resources**

With teachers back on campus and learners often remote due to staggered attendance days, findings indicate that the school has **invested in additional technology resources** which include providing most teachers with devices, upgrading the Wi-Fi and purchasing software to assist with remote teaching, learning and administrative activities. Even though Vongkulluksn et al. (2018) claim that teachers amplify access and place less emphasis on barriers when they believe the technology is invaluable to their teaching, teachers are unable to continue teaching remotely without access to the required technology resources (Bergdahl & Nouri, 2020). These findings are in keeping with the literature because although some teachers report that they **still do not have school-issued devices** and access to sufficient **data at home**, teachers believe they are **able to continue teaching** as they now have **access to appropriate technology tools**.

Notwithstanding better access to resources for teachers, findings indicate teachers still believe **learners' lack of access** to data and devices is **hampering teaching efforts**. This is in keeping with literature which states remote and hybrid approaches cannot succeed without learners having access to appropriate hardware and sufficient data (Mailizar et al., 2020; Rasheed et al., 2020; Giovannella et al., 2020).

- **Training and Support**

According to Rogers (2000), teachers are only able to integrate technology when they have access to appropriate technology resources. Furthermore, Bergdahl and Nouri (2020) claim that in a remote and hybrid context it is impossible for teachers to continue with the academic project without the required digital tools. Despite varied reports of technology training and support at the school, including once-off *Google Classroom* training by outside facilitators, online links for self-paced learning, access to generic "how to" videos, no formal technical support and limited peer support, teachers indicate that they are teaching themselves how to utilise the new and upgraded technology tools. In keeping with the literature it is possible that **teachers are less focused on barriers** or lack of

training and limited technical support because the school has **upgraded technology resources**.

- **Time**

While all teachers report they are more familiar with remote tools as they are using technology extensively to continue teaching, they still believe one **needs to spend time learning** about the new technology in order to use it effectively. This concurs with Rasheed et al. (2020) who contend that even technologically competent teachers have to spend additional time in learning how to utilise technology best in a remote and hybrid educational context.

Table 39: Summary of Changes in Teachers' Beliefs of External Technology Structures - School 4

On Campus	Remote	Hybrid & Remote
Resources (ES-R and CSB-R)		
Access (ES-R-A, CSB-R-A);		
Hardware (R-AH, R-QH); Software (R-AS, R-QS)		
• Not all teachers have school laptops, use personal device, share • Most classes have projectors, wireless not used, many broken • Lab only accessible for CAT • No teaching software provided	• Not all teachers have devices	• All teachers given devices • Access to *Google Classroom*, *MS Teams*
Wi-Fi/Data (R-AW, R-QW)		
• Wi-Fi in school but limited range, only connects to school devices • Many websites blocked	• School devices cannot access outside networks • Learners, teachers lack data access	• Wi-Fi accessible on whole campus • Learners' data access still an issue • *Google Classroom* only at school due to teachers' lack of data
Information (R-AI)		
	• School does not share learners' contact information	
Quality and Suitability (ES-R-Q, CSB-R-Q)		
Hardware (R-QH); Software (R-QS)		
• Many projectors broken		
Wi-Fi/Data (R-QW)		
• Wi-Fi limited range, only connects to school devices		• Wi-Fi upgraded
Physical Arrangement (ES-R-P, CSB-R-P)		
Classroom/Lab Setup (R-PC, R-PL); Remote Setup (R-PR)		
• Wireless projector ceiling mounted • Whiteboard in front, desk face front • Lab devices in fixed rows • Want different class and lab layouts, dedicated design lab	• Create content on school device, but use personal laptop, cellphone to email content to learners	• Use *Google Classroom* on campus • Have virtual meetings on campus

On Campus	Remote	Hybrid & Remote
Training (ES-TR and CSB-TR)		
Extent (ES-TR-E, CSB-TR-E)		
Frequency (TR-EF)		
• No current training, induction • Used to offer in the past • Need more, will benefit education but many teachers not interested	• No formal technology training	• Once-off on *Google Classroom*
Training Provided (TR-EP)		
• Past by CAT teacher on how to and facilitators	• Online Links • Communities of practice	• Outside facilitators • Online and links
Quality and Type (ES-TR-Q, CSB-TR-Q)		
Professional Development (TR-QPD); Courses (TR-QC)		
• Self-funded courses		• On using *Google Classroom*
Peer Mentoring (TR-QP); Communities of Practice (TR-QCP)		
• Informally ask peers, self-teach	• Communities of practice	
Type of Training (TR-QT)		
Support (ES-S and CSB-S)		
Technical (ES-S-T, CSB-S-T); Institutional Support (ES-S-I, CSB-S-I)		
Location (S-TL, S-IL)		
• On-site technical support		• Peer support on-site
Function (S-TF, S-IF)		
• Fixes technology issues at school • School resource support lacking	• No technical support • School support inadequate	• Help peers with new tools
Response Time (S-TRT, S-IRT)		
• Delayed, only on campus a few times a week, need more		
Peer Support (S-TP); Communities of Practice (S-TC)		
• Some peer support from CAT teacher, learners	• Peer support, post online classes	• Help peers with new tools, but prefer videos
Nature of Support (ES-S-N, CSB-S-N)		
Technical Support (S-NT)		
• Fix technical issues • Setup and monitor devices		
Institutional Support (S-NI)		
• Little financial support	• No comms on teaching, technology	
Time (ES-T and CSB-T)		
Familiarity (ES-T-F, CSB-T-F)		
Use (T-FU)		
• Familiar, but could be more	• Familiar but not using new tools	•More familiar
Time and Effort (T-FT)		
• Learn as technology changes		• Have to use even if takes time
Support (T-FS)		
• Need more training • Better access to quality resources	• None, have to self-teach, explore	
Feasibility (ES-T-FE, CSB-T-FE)		
Time to Learn (T-FEL); Time to Use (T-FEU)		
• Classes are short, after school use • Setup can waste time, use books • Save time to show content	• Remote setup cumbersome, takes time to use	• Have to learn, use even if takes time
Time to Prepare (T-FEP)		
• Need to be prepared prior to class	• Time to prepare, not using tools	

8.6 BELIEFS OF EXTERNAL TECHNOLOGY STRUCTURES - BY TEACHER

According to Ertmer (1999), it is not only important to understand what External technology Structures (ES) exist within a particular context but one also needs to explore individual teachers' beliefs about these structures since this can influence teachers' willingness to integrate technology into the classroom (Van Der Ross & Tsibolane, 2017). Therefore, to answer Research Question 3 *What are different teachers' beliefs around external structures,* first, a summary and discussion of the within-case analyses of different teachers' accounts of each ES at School 4 and their associated beliefs in relation to TTU-SST is presented. Then, an overall discussion of different teachers' beliefs about ES at the school is provided. Table 40 presents a summary of the findings for ES and Appendix H-1 provides the detailed analyses for each teacher's account of ES.

8.6.1 Resources

While findings suggest **all teachers** feel **technology** plays a **supportive** role in their pedagogic practices, **Malefa** and **Thuli** report **using technology very seldom in class** as they maintain **on campus** there is **insufficient access** to **technology** *"only one laptop per department...so everyone lands up buying their own...kids needs access to the computer lab"* (Malefa), *"have internet...but not in places...not all websites connect...not all teachers get laptops...use my personal laptop...lab only setup for computer students"* (Thuli). Findings concur with Johnson et al. (2016) and du Plessis (2014) who maintain that without routine access to technology for extended periods of time technology integration is impossible. In relation to **quality**, while **Thuli** maintains she is **unable to utilise the Wi-Fi** as it has **limited reach** *"in some areas it's there and in others you can't connect"*, **Candice** reports that even though the **projector in the lab is broken** she has made an alternative **plan** *"I'm using a portable one from the lab"*. This finding is in keeping with Woodbridge (2003) and Vongkulluksn et al. (2018) who claim that only when teachers believe technology is invaluable will they place less emphasis on barriers and seek alternatives.

While **all teachers** are concerned about **learners' lack of data access** when **remote**, most teachers feel they are **unable to continue teaching** due to **teachers' insufficient access** to **resources** and **learners' contact details** *"the school did not give any extra access...they should have done more...needed access...to contact the parents"* (Malefa), *"don't have contact with the learners...because of the technology we have...the school has learners' contact details...that's not provided to us"* (Thuli), *"the school laptop is only wired*

to connect to the Wi-Fi at the school...it's a real challenge...we are not in contact with our learners" (Patrick. However, **Candice**, who believes she has **sufficient access to technology resources**, reports being **able to teach** despite needing additional data: *have my school laptop...set up* Gmail *accounts for the kids years ago...I'm busy teaching...had to buy my own data"*. When using a **hybrid** approach, even though **Thuli** reports she **does not have a school-issued device** *"I'm using my personal device, I never got any technology"*, **all teachers** believe **access to resources** at the school has **improved** and is **sufficient** for them to **continue with the academic programme:** *"Wi-Fi...they fixed that...managed to get laptops...*Google Classroom*"* (Malefa); *"Wi-Fi includes my classroom...*Google Classroom*"* (Thuli); *"our school has adopted* Google Classroom*"* (Patrick); *"tablets...to those who did not have...also setup fibre...enrolled in* Google Classroom*"* (Candice). However, **learners still lack access** to **data** and **technology resources** *"only issue is data"* (Malefa); *"very few learners are able to interact...because of the availability of data* (Patrick); *"many learners don't have data or devices"* (Candice); *"access and affordability is an issue"* (Thuli). Findings concur with literature which states teachers are only able to continue teaching remotely if they have access to the appropriate technology tools (Hadijah & Shalawati, 2017; Bergdahl & Nouri, 2020) and learners have access to data and devices (Giovannella et al., 2020; Mailizar et al., 2020; Rasheed et al., 2020).

8.6.2 Training and Support[72]

Findings indicate that while **all teachers** maintain, when **on campus,** that currently there is **no technology training** at the school for new or experienced teachers, some teachers believe **limited peer mentoring** and **self-teaching** *"have to ask other teachers...learn it yourself"* (Thuli) and **self-funded external courses** *"went to a college to learn how to use computers"* (Malefa) are **assisting them** in gaining technology skills. Furthermore, although most teachers believe **technical support** at the school should be **more responsive** and **frequent** *"your computer or projector breaks...you will have to wait"* (Malefa); *"if it breaks on Friday too bad...will have to wait a couple of days"* (Patrick); *"only here twice a week"* (Thuli) and more **financial support** is needed to provide **teachers with access** to **quality resources** *"I don't think they care"* (Malefa), *"we need a lot of*

[72] The summary of the findings and discussion have been combined to avoid repetition as much of the literature is related to both constructs.

help...hardware, software" (Patrick); *"it is difficult for them to say you must use technology, when they don't give it to us"* (Thuli); *"I don't think they care if we use it"* (Candice).

So too, when **remote** even though all teachers feel **training** and **support** at the school is **inadequate** as there is **no formal training** and **technology** and **school support is lacking** *"no one can*(sic) *any training...there is no support"* (Candice); *"did not say anything about training...have wasted a huge opportunity"* (Malefa); *"only communication was to go home and wait"* (Thuli), **Candice** reports using **communities of practice** to **learn about the new tools** and **posting online classes** to **assist her peers** *"part of* Facebook *group...belong to educational groups...soak up all the information...when I find a lesson for free...put them on* D6*"*. According to Rogers (2000), even though teachers' beliefs about external barriers are often mentioned separately there is a complex and overlapping relationship between them that collectively influences teachers. This perspective may explain why **Candice** holds **more positive beliefs** about training and support as she appears to have **better access to technology resources** than her **peers** when **on campus** and when **returning to campus** most teachers report **training** and **support have improved** as the school is providing **additional technology resources** (all teachers) and **temporary peer mentoring** *"have teachers employed temporarily who have knowledge of computers"* (Malefa); *"there is someone you can ask"* (Thuli); *"showed them how to do stuff informally"* (Candice).

Bernstein (1971b) further states that organic integration takes place when people are viewed as unique whereas mechanical integration occurs when teachers hold a common set of beliefs. While findings suggest there is some level of **organic integration** at School 4 with **individual teachers' opinions differing** in relation to the **nature of support**, it seems there is **greater mechanical integration** present at the school when **on campus** and **remote** since **most teachers'** beliefs are **unified** in relation to the **inadequacy of training** and **support** and **more positive** when using a **hybrid approach**. In addition, while Ertmer et al. (2012) claim that a barrier threshold exists which limits pedagogic practices irrespective of beliefs, Woodbridge (2003) argues that systematic barriers to technology exhausts teachers differently depending on how they value technology. It is possible this perspective may elucidate why **Candice**, who seems to **value technology** in her teaching, reports making a **consistent effort** to **access training** and **support alternatives despite challenges** while **other teachers** are **not as active**.

8.6.3 Time

On-campus findings indicate that even though all teachers believe they are **familiar** with using technology most feel **additional training** and **better access to resources** *"we don't have frequent training, means we don't know what's going on"* (Malefa); *"could be more familiar...with better access and training"* (Patrick) and **time to learn about more ways** in which they can utilise technology *"I'm not where I can be...CAT is*(sic) *very changing subject"* (Candice); *"if there's new developments"* (Malefa) is needed, as technology constantly evolves. In addition, while **Patrick** believes technology **saves time in class** *"it takes less time"* other teachers maintain **incorporating technology is often not feasible** as it **requires extensive planning** *"I have to plan very carefully...it takes time"* (Candice), is **time consuming to set up** *"it is a lot of time if want to display anything"* (Thuli) and **takes too much time to use** in the **time allocated during school lessons** *"I end up doing some extra classes...when there's no time constraints"* (Malefa). Findings concur with literature which states that even when teachers are familiar with technology, substantial time is needed to use, explore, plan and experiment with technology (Condie et al., 2007; Smeets et al., 1999; Conlon, 2004; Karasavvidis, 2009) which may result in teachers believing integration is unfeasible (Cuban, 2001; Karasavvidis, 2009).

When **remote,** most teachers maintain that even though they are **familiar with the technology tools** (Candice, Malefa, Thuli), some feel **using technology takes too much time** as **resource access constraints** make their **remote technology setup cumbersome** (Patrick) and there is **no technology strategy at the school** to guide teachers (Thuli). However, **Candice** reports actively **using technology** to continue teaching **even though** she believes it **takes time**. Kopcha (2012) claims that teachers believe time is the greatest external barrier as not only do teachers need time to become familiar and learn new skills but teachers who encounter consistent technology issues are more likely to complain about time needed for technology integration (Lim & Khine, 2006). This perspective may explain why **Patrick** and **Thuli**, who report being familiar with technology but have **issues with resource access** and **suitability**, believe **time needed** to utilise technology is a **barrier** while **Candice,** who maintains she has **adequate access** to appropriate resources, is **less focused on time barriers**.

When **back on campus,** some teachers believe their **use of the technology** has made them **more familiar** with the remote teaching tools *"the world is changing...it's dangerous to be left behind"* (Patrick), *" I know how to use the tools"* (Thuli). This is in keeping with the literature which states that spending time utilising and exploring technology affordances often results in teachers being more familiar and confident in utilising the technology (Condie et al., 2007; Van Der Ross & Tsibolane, 2017). According to Hadijah and Shalawati (2017), Mailizar et al. (2020), even though many teachers are finding the extra time needed challenging they are willing to invest the time (See et al., 2020) as they understand using technology is the only way teaching and learning can continue (Mhlanga & Moloi, 2020). This concurs with findings as **Malefa** maintains even though **learning "how to"** effectively use the new tools is **taking time,** *"it is something we need to be using to teach...even*(sic) *it takes time"* teachers have **no other choice** if they want to continue with the academic project.

8.6.4 Summary of Different Teachers' Beliefs of External Structures

Overall findings suggest that whether **on campus** or **remote**, even though teachers hold **many similar beliefs** regarding **ES** at the school being **mainly insufficient**, **Candice,** who believes technology can **enhance education**, **utilises technology extensively** and has **better access** to technology resources than most of her peers and seems to **find ways** to **overcome most external barriers** while **Thuli** and **Malefa,** who also feel **using technology is essential** but **do not have access to school-issued devices** and **Patrick,** who believes **technology is needed** to inspire learners and has **access to a school device**, maintain that they are **unable to incorporate technology** into most of their classroom practices due to the **external technology constraints**. Although Ertmer (1999) claims that technology integration cannot occur without the provision of sufficient and appropriate ES, Tondeur et al. (2017) argue that it is not the barriers themselves but rather the importance given to them by teachers that influence technology integration because forming beliefs is an iterative process that results in overlapping and bidirectional relationships that collectively influence teachers within a specific social context. So too, the relationship between first- and second-order barriers may influence teachers' beliefs of ES (Ertmer et al., 2012). For example, according to Woodbridge (2003) and Vongkulluksn et al. (2018), teachers amplify access and focus less on external barriers when they believe technology provides value to their pedagogic practices. Tondeur et al. (2017) argue that these perspectives suggest that a more multidimensional approach is needed, as

attributing teachers' beliefs about ES at School 4 to any single external factor simplifies the complex relationship contextual aspects have with teachers' beliefs and subsequent technology integration choices.

However, when **remote** and using a **hybrid approach** it seems as if the **school's provision** of **additional resources** and some **training** and limited **support** has resulted in all **teachers' general beliefs of ES** at the school being **more positive**. Findings concur with Johnson et al. (2016) and Jung (2005) who claim that technology integration can only occur when schools provide teachers with access to quality technology resources .

Table 40: Summary of Different Teachers' Beliefs of External Structures - School 4

Candice	Malefa	Patrick	Thuli
Resources (ES-R and CSB-R)			
On Campus			
Access (ES-R-A, CSB-R-A), Quality (ES-R-Q, CSB-R-Q) and Suitability (ES-R-S, CSB-R-S)			
Hardware (R-AH, R-QH, R-SH)			
•Most teachers have access to devices, projectors in class, but some broken •Tablets, desktops in lab, limited access, and devices	•Access mainly sufficient, adequate quality •Sharing laptops among teachers is an issue	•Access sufficient •Most teachers have laptops •Have projectors •Need dedicated design lab	•Access basic, can do more •Some teachers get laptops •Have projectors, wireless not used •Lab inaccessible
Wi-Fi/Data (R-AW, R-QW, RSW)			
•Wi-Fi available but only connects to school issued devices	• Wi-Fi available in class • Learner lab access needed for internet	• Wi-Fi available	• Wi-Fi range limited • Many websites blocked
Software (R-AS, R-QS, R-SS)			
• No software	•No software	•No software	•Want teaching software
Physical Arrangement (ESR-R-P, CSB-R-P)			
Classroom (RP-C) and Lab Setup (R-PL)			
• Devices in fixed rows, want class with lab setup • Hard to assist, distract	• Devices well placed, but class overcrowded	• Less traditional class needed, for creative thinking	• Desks in rows, little interaction • Prefer round tables
Remote			
Access (ES-R-A, CSB-R-A); Quality (ES-R-Q, CSB-R-Q) and Suitability (ES-R-S, CSB-R-S)			
Hardware (R-AH, R-QH, R-SH)			
• Access sufficient for some, but only if have device • No extra hardware given		• Access insufficient • Must give teachers tablets • Devices do not connect	• Access insufficient • Teachers lack access • Need better devices
Wi-Fi/Data (R-AW, R-QW, R-SW)			
•No data to teacher, learner •Needed to buy extra data	•Learners lack data access		•Learners lack data access
Information (R-AI)			
	• No learners' contact details	• No learners' contact details	• No learners' contact details
Physical Arrangement (ESR-R-P, CSB-R-P)			
Remote Setup (R-PR)			
•*Gmail* accounts for comms •*Google Classroom* used	•Limited contact by phone, messages, *Skype*	•School device to create, personal to send, email	•Content only uploaded to *D6* before going remote
Hybrid & Remote			
Access (ES-R-A, CSB-R-A), Quality (ES-R-Q, CSB-R-Q) and Suitability (ES-R-S, CSB-R-S)			
Hardware (R-AH, R-QH, R-SH)			
• Access improved • Devices to teachers who did not have, not to learners	• Access improved • Devices to teachers who do not have		• Not given school device
Wi-Fi/Data (R-AW, R-QW, R-SW)			
• Wi-Fi upgraded at school • No data given to learners	• Wi-Fi upgraded at school • No data teachers, learners		• Wi-Fi upgraded at school • No data given to learners
Software (R-AS, R-QS, R-SS)			
•Use *Google Classroom*, *MS Teams* on campus	•Use *Google Classroom* on campus	•Use *Google Classroom*, *MS Teams* on campus	•Use *Google Classroom* on campus

Candice	Malefa	Patrick	Thuli
Training (ES-TR and CSB-TR)			
On Campus			
Extent (ES-TR-E, CSB-TR-E)			
Frequency (TR-EF)			
•No training, need more but most not interested	•Was in the past, but no current training, induction •Want training for teaching	•No technology training •Training would benefit teachers, learners	•No technology training, induction
Provided by (TR-EP)			
•Used to train, now no time •Want external trainers	•Past training by outside facilitators		
Quality (ES-TR-Q, CSB-TR-Q)			
Professional Development (TR-QP), Courses (TR-QC), Peer Mentoring (TR-QP), Communities of Practice (TR-QCP)			
•Peer mentoring for some	• Self-funded IT course		•Informal peer mentoring •Self-teach
Type (TR-QT)			
•Demo-based, practical	•Demo-based, practical		
Remote			
Extent (ES-TR-E, CSB-TR-E)			
Frequency (TR-EF)			
•No formal training	•No technology training	•No formal training	•No technology training
Provided by (TR-EP)			
•Communities of Practice		•Online content sent	
Quality (ES-TR-Q, CSB-TR-Q)			
Professional Development (TR-QPD); Courses (TR-QC); Peer Mentoring (TR-QPM) Communities of Practice (TR-QCP)			
•Communities of Practice		•Communities of practice	
Type (TR-QT)			
•To get skills, content		•Other schools are doing	
Hybrid & Remote			
Extent (ES-TR-E, CSB-TR-E), Quality (ES-TR-Q, CSB-TR-Q)			
Frequency (TR-EF)			
•No formal training	•Once-off		•Once-off, not using fully
Professional Development (TR-QPD), Courses (TR-QC), Peer Mentoring (TR-QPM) Communities of Practice (TR-QCP)			
•Principal gave links	•Professional Development	•Peer mentoring	•Professional Development
Type (TR-QT)			
•Links to online content	•Technical "how to" use *Google*		•Technical "how to" use *Google*

Candice	Malefa	Patrick	Thuli
Support (ES-S and CSB-S)			
On Campus			
Technical (ES-S-T, CSB-S-T); Institutional Support (ES-S-I, CSB-S-I)			
Location (S-TL, S-IL)			
•On-site technical support	•On-site technical support	•On-site technical support	•On-site technical support
Function (S-TF, S-IF)			
•Fix general IT issues •School support is lacking, don't care	•Fix general IT issues •School resource support is lacking	•Fix general IT issues •School resource support is lacking	•Setup, fix computers •School resource support is lacking
Response Time (S-TRT, S-IRT)			
•Delay as on campus few times a week	•Delay as on campus twice a week, need more	•Delay as on campus twice a week, need more	•Delay, as on campus twice a week, need more
Peer Support (S-TP); Communities of Practice (S-TCP)			
•Peer support from CAT teacher, learners			
Nature of Support (ES-S-N, CSB-S-N)			
Technical (S-NT)			
•Fix issues, how to use	•Fix issues	•Fix issues	•Setup, fix computers
Remote			
Technical (ES-S-T, CSB-S-T); Institutional Support (ES-S-I, CSB-S-I)			
Location (S-TL, S-IL)			
•No technical support •School support inadequate	•No technical support •School support inadequate	•No technical support	•No technical support •School support inadequate
Peer Support (S-TP); Communities of Practice (S-TCP)			
•Peer support by posting online classes			
Hybrid & Remote			
Technical (ES-S-T, CSB-S-T); Institutional Support (ES-S-I, CSB-S-I)			
Peer Support (S-TP); Communities of Practice (S-TCP)			
•Still try to offer peer support, learners	•Temporary peer support being offered		•Some peer support, videos better

Candice	Malefa	Patrick	Thuli
Time (ES-T and CSB-T)			
On Campus			
Familiarity (ES-T-F, CSB-T-F)			
Use (T-FU); Time and Effort (T-FTE)			
•Familiar, could know more as tech changes a lot	•Familiar, need to know more as tech changes •Need training	•Familiar, could know more as tech changes a lot •Need access, training	•Familiar
Feasibility (ES-T-FE, CSB-T-FE)			
Time to Learn (T-FEL); Time to Use (T-FEU); Time to Prepare (T-FEP); Time to Administer (T-FEA)			
•Time to learn all the time •Need to be prepared so time not wasted	•Time for set up and use •Classes short, so use after school	•Saves time in class	•Time to create, show content, set up •Access, quality issues
Remote			
Familiarity (ES-T-F, CSB-T-F)			
Use (T-FU); Time and Effort (T-FTE)			
•Familiar, self-learn and explore all the time	•Familiar with new tools, but not using		•Familiar, but not using
Feasibility (ES-T-FE, CSB-T-FE)			
Time to Learn (T-FEL); Time to Use (T-FEU); Time to Prepare (T-FEP); Time to Administer (T-FEA)			
•Takes time to learn		•Setup complex, takes time	•Lacks content distribution strategy, wastes time
Hybrid & Remote			
Familiarity (ES-T-F, CSB-T-F)			
Use (T-FU); Time and Effort (T-FTE)			
		•More familiar	•More familiar
Feasibility (ES-T-FE, CSB-T-FE)			
Time to Learn (T-FEL); Time to Use (T-FEU); Time to Prepare (T-FEP); Time to Administer (T-FEA)			
	•Have to use even if it takes time to learn		

8.7 INTERNAL BELIEFS OF TECHNOLOGY – BY TEACHER

Internal Beliefs (IB) have been conceptualised in this study as **Pedagogy (P)**, **Norms (N)**, **Knowledge (K)**, **Value of ICT (V)** and **Self-efficacy (SE)**, are shown in Table 8 and Figure 9.

In order to answer the research question (4) *What are different teachers' internal beliefs about technology,* first, a summary and discussion of the within-case analyses of different teachers' accounts of Internal Beliefs (IB) at School 4 in relation to the changing educational context and TTU-SST is presented. Thereafter, as belief systems are constructed from a combination of beliefs (Liu, 2011) an overall discussion of different teachers' IBs at the school is provided. Table 41 presents a summary of the findings for IB, and Appendix H-2 provides the detailed analyses for each teacher's account of IB.

8.7.1 Pedagogical Beliefs

While teachers seem to agree their **main aim** is to **guide** and **mentor future generations** *"their guide...mentor"* (Candice); *"make them the people you want for the future"* (Malefa); to **achieve their best** *"ensuring we turn them into the best students"* (Thuli) by **creating a conducive learning environment** *"an environment where they can learn"* (Patrick) **opinions differ** concerning their **roles.** These include using technology so learners can **gain knowledge** *"using technology to gain knowledge"* (Candice), *"know the child's mind...impart this knowledge"* (Malefa), **facilitating learning** *"you're the facilitator...a partnership between you and the learners"* (Patrick) and promoting **active engagement** and **communication** *"involve my students actively"* (Thuli). While much educational technology literature argues that pedagogical beliefs are one-dimensional since they are either teacher- or learner-centred, Ertmer and Ottenbreit-Leftwich (2010) argue that teachers can hold a variety of pedagogical beliefs at the same time. Findings are in keeping with **both perspectives** as **Patrick** and **Thuli** seem to hold **one-dimensional**, **learner-centred** beliefs while **Candice** and **Malefa** appear to have a **blend of beliefs** as they feel their aim is to **mentor** and guide when their role is mainly to **give over knowledge**.

While Rapanta et al. (2020) claim that remote teaching can be as effective as face-to-face situations if teachers have a faciliatory and social presence and offer learners active mentoring, support and enhanced learner–teacher interaction; Stein and Graham (2020) contend that because the shift can result in the loss of human connection and important discoveries made during traditional face-to-face classes it is preferable to use a blended approach that combines both mediums. The findings are in keeping with the literature as **all teachers** report **teaching has changed** with the move to remote and hybrid approaches and while most feel their **role** is now more about **giving over content** *"teaching is more about content"* (Candice), *"now it's just about content"* (Thuli) and **technology skills** *"helping learners with technology"* (Malefa) since the personal **teacher-learner connection has been lost** *"the offsite mother...I cannot do that via technology"* (Candice) and it is **harder** to sense if **learners understand** the content *"when the child is in front of you...can deduce what is happening"* (Thuli), **Patrick** maintains there needs to be a **balance** between **traditional** and **digital pedagogies** *"needs to be a balance...we need both"*.

According to Rapanta et al. (2020), when using a remote or hybrid approach disadvantaged learners without access to appropriate technology and infrastructure may be unable to continue with their schooling (du Plessis, 2014; Mhlanga & Moloi, 2020; Le Grange, 2020; Mailizar et al., 2020). This is in keeping with **Thuli** who believes **using technology exclusively** only **exacerbates existing inequalities** *"we will have to disregard this as not every student as access"*.

8.7.2 Normative Beliefs

Vandeyar (2014), Ertmer et al. (2012), and Hadijah and Shalawati (2017) claim that institutional support which includes sufficient funding and the subsequent provision of technology is essential for technology integration. In keeping with the literature it is possible that the **lack of investment** *"we need a lot of help"* (Patrick) and **limited access to quality resources** *"my projector broke last year...still don't have one"* (Candice) may be due to the school **not believing technology is important** *"they don't care if we use technology"* (Candice), *"don't think they care...only thing they want is you to submit your work"* (Malefa), *"need hardware and software"* (Patrick). Yet, according to **Thuli,** the **school does value technology** but **implementation is an issue** *"they think technology is important...don't think we are big on implementing it"*. An alternative explanation may be that even though the **school values technology**, **limited funds** are **available** as many **learners come from disadvantaged homes** and are **unable to pay fees**. This is in keeping with du Plessis (2014), Mhlanga and Moloi (2020), and Le Grange (2020) who contend that many disadvantaged schools in South Africa do not have enough money to purchase, upgrade and repair technology.

When **remote**, all teachers feel the **school does not believe using technology is essential** as **extra resources** have **not been given** *"teachers without technology access...no training"* (Candice), *"never gave any extra access to technology...could have done more"* (Malefa), *"don't have a school laptop"* (Thuli); that **access issues with existing resources** are **not being addressed** *"can't use the school laptop to email learners"* (Patrick) and that there is **no communication on technology initiatives** *"only thing...update on PPE"* (Malefa). In addition, while **Candice** maintains **peers are not utilising available resources** because they are simply **disinterested** *"they are not worried about the kids"*; other teachers report they are **unaware of their peers' beliefs** due to **lack of communication** *"we're not communicating that much"* (Malefa), *"we don't*

communicate...because of the limitations" (Patrick). Although the **inability to fund additional technology** still **appears to be an issue** at the school, it seems as if the **lack of strategy** and **communication from the school** in regard to **technology** is believed to be a **bigger barrier**. This concurs with Zhao and Frank (2003) and Hennessy et al. (2010) who claim that teachers are less likely to be motivated to incorporate technology in a school where beliefs around technology integration are not favourable and there is no technology plan (Bergdahl & Nouri, 2020).

8.7.3 Knowledge Beliefs

All teachers maintain one needs to be **actively involved** in the learning process **to acquire knowledge:** *"speaking...interaction...looking at social media"* (Candice), *"being active in the thing you want to learn...observing others...writing it out"* (Thuli), *"reading...can analyse...organise"* (Malefa) and *"make a mistake...keep on working until you get it right...practice"* (Patrick). Findings suggest that teachers at School 4 possess **knower codes** since teachers believe knowledge is acquired either naturally or socially rather than through specialised knowledge i.e., knowledge codes (Howard & Maton, 2011). Furthermore, findings indicate a **code clash** exists as teachers appear to **disagree with policies** and **goals being pursued** at school (Howard & Maton, 2011).

In regard to types of knowledge, Ertmer and Ottenbreit-Leftwich (2010), Angeli and Valanides (2009), and Taimalu and Luik (2019) claim that teachers need both utilisation knowledge and knowledge of affordances to be able to effectively integrate technology into their pedagogic practices. Findings concur as **all teachers** feel both **knowledge on utilisation** and **affordances** are needed to **incorporate technology** *"don't realise using technology makes life easier...if you don't how to use it...won't feel comfortable"* (Candice), *"have to know how to use...about what technology can do"* (Malefa), *"more they know about using it...more they will use...need to know how technology can benefit"* (Patrick). In addition, according to Zhao et al. (2002), for teachers to choose to incorporate technology they must be aware of the affordances of technology since they often feel exposed due to their lack of competence and the unpredictability of technology. This agrees with findings that suggest teachers who **do not possess utilisation knowledge** are **unable to appreciate affordances** *"if you don't know how to use...can't think about using technology to keep them interested"* (Thuli). So too, when **remote**, **Candice** feels that **knowing how to use technology** enables her to **utilise it more** *"I'm using it more than someone who*

doesn't really know technology". This is in keeping with Slutsky (2016) who claims that enhanced technology self-efficacy beliefs are necessary for technology integration to occur.

8.7.4 Value of ICT Beliefs

On campus, teachers believe technology can be used to **support** and **enhance teaching** (all teachers), improve **administration**, **productivity** (all teachers) and **learning** *"they understand better...able to give a clearer description"* (Thuli), *"can compare his method...see which is better"* (Malefa), *"allows them to think differently"* (Patrick) by **evaluating learners' progress** *"make use of immediate feedback...see...how they are performing"* (Candice); **preparing learners for the technological future** *"we are living in a technological world...they need to know"* (Malefa); **empowering** *"can look and find out for themselves"* (Thuli), **inspiring**, and **engaging learners** *"with technology learners will be more interested"* (Patrick). Findings are in keeping with literature which states teachers choose to incorporate technology into their pedagogic practices (Zhao et al., 2002; Ertmer & Ottenbreit-Leftwich, 2010) as they believe it's their teaching that enables them to achieve their learning objectives (Cheok et al., 2016; Taimalu & Luik, 2019).

When **remote, all teachers** believe technology **supports** teaching, however, only **some** feel it **enhances** teaching *"it's less boring"* (Candice), assists with **productivity** and **administration** (Candice, Malefa, Patrick) and **improves learning** *"go through it on their own time"* (Candice), *"can just go back to recording and listen and understand"* (Malefa). However, when **back on campus** all teachers believe technology is **enabling the academic project** and is **enhancing** teaching and learning *"we can physically teach...even those that are not in class"* (Candice), *"you can do so many things with technology"* (Malefa), *"classes can be online...give additional documents...enables feedback"* (Patrick), *"do live classes...they can ask questions"* (Thuli). A possible reason for the **change** in **teachers' value beliefs** could be related to their **perceptions** of **access** and **quality** of **technology resources**, **training** and **support at the school** as being **inadequate** when **remote** and **improving** due to the **provision of additional technology** when **returning to campus**. Therefore, even though Vongkulluksn et al. (2018) claim that teachers tend to amplify access and place less emphasis on barriers when they believe the technology is invaluable to their teaching, it seems as if findings concur with Bergdahl

and Nouri (2020) and Hadijah and Shalawati (2017) who argue that without access to the necessary technology resources teachers are unable to continue teaching remotely.

Notwithstanding benefits, according to Giovannella et al. (2020) and Chui et al. (2016), online education lacks human connection and cannot be used to replace teachers since it is harder to motivate and track learner engagement without face-to-face classes (Graham, 2006). Findings agree because when **remote** and using a **hybrid** approach, **some teachers** feel technology is **unsuited to practical subjects** *"part of the curriculum we are really not going to explore"* (Patrick); **unable to monitor learner engagement** *"can't sense how they are doing"* (Thuli) and **responsible for loss of teachers' personal connection** with learners *"we have lost something...when we teach over the internet"* (Thuli). Furthermore, as teachers often feel exposed due to their lack of technological competence (Ertmer & Ottenbreit-Leftwich, 2010) Angeli and Valanides (2009) argue that teachers need to understand how to utilise the available technology in order to realise the associated benefits. **Candice** agrees as she reports teachers **need to know technology very well** in order to **realise benefits** *"know in detail how the technology will help me...help the kids"*. In addition, most teachers believe their **lack of access** to **learners' contact details** *"could let us have access to learners' details"* (Malefa), *"not in contact with our learners"* (Patrick), *"don't have contact with the learners"* (Thuli), is **limiting possible technology affordances**. Findings concur with Saltan (2016) who contends that remote teaching and learning cannot take place unless teachers are able to communicate with learners.

Moreover, according to du Plessis (2014), Mhlanga and Moloi (2020), and Le Grange, (2020), enormous inequalities exist within developing countries concerning access to technology resources which disadvantages poorer learners and can even prevent such learners from continuing with their schooling (Mailizar et al., 2020; Rasheed et al., 2020; Giovannella et al., 2020; Bergdahl & Nouri, 2020). Findings are in keeping with the literature as **all teachers** maintain **using technology within South Africa** is **disadvantaging less affluent learners** *"just over half the class can attend...because of access"* (Thuli); *"the digital divide is a reality in South Africa"* (Patrick); *"if you don't have resources...it will actually be a loss"* (Malefa); *"biggest worry...divide between rich and poor...is emphasised"* (Candice).

8.7.5 Self-Efficacy Beliefs[73]

According to Bandura (2000), technology self-efficacy influences whether one thinks positively or negatively about technology in one's personal life and at work. These can include perceptions of local support, the amount of time technology is used and opportunities to gain technology skills. In a personal context, these may be the extent of home access, beliefs about the value of technology, perception of ease of use and convenience afforded by the technology (Farah, 2011). Findings partly disagree because despite most teachers feeling their ability to **grow technology skills** is **limited** by **lack of training** *"can be more training...help teachers know more"* (Malefa) and **resource access** and **quality issues** *"needs to be better access"* (Patrick), *"often it doesn't work or I don't have access"* (Thuli), **all teachers** maintain **that** they are **confident using technology** at **work** and for **personal tasks** *"use it for just about everything"* (Thuli), *"confident in my personal life"* (Patrick), *"I'm confident"* (Malefa), *"am 100% comfortable using technology in my teaching"* (Candice).

Interestingly, **Candice,** who reports having **high technology** self-efficacy, appears to **value** the role **technology** plays in her teaching and maintains she **explores technology** and **self-teaches** and prefers using **little technology** in her **personal life** *"I'm not only living for technology...use it for major things"*. A possible reason for this could be that although enhanced technology self-efficacy beliefs are a necessary condition for technology integration, they do not automatically translate into actual use (Slutsky, 2016) as beliefs do not exist in isolation but are rather shaped by particular cultural and societal factors (Sherman & Howard, 2012).

8.7.6 Different Teachers' Internal Beliefs

Findings indicate, as with ES, most teachers (Malefa, Patrick, Thuli) hold both **similar IBs** in relation to technology. According to Ertmer (1999), teachers' beliefs and frustrations with first-order barriers are often closely related to their IBs since the incorporation of technology is an iterative process involving bidirectional relationships (Tondeur et al., 2017). Based on this perspective, it is possible **IBs** are being **negatively influenced** by teachers' beliefs of **insufficient** and **inadequate ES** when **on campus** and **remote** coupled with teachers' **code clash** with the **school's normative beliefs**. So too, when

[73] Teachers at School 4 did not comment on Self-Efficacy Beliefs when remote.

returning to campus teachers' **IBs** of technology appear to be **more positive** due to the **school's commitment** and provision of **additional technology resources** and **training**. Nevertheless, it is also possible **IBs may not play such a crucial role** in teachers' **technology integration choices** but rather that **persistent** and **pervasive ES barriers** may be **influencing teachers' integration choices** because teachers see **barriers** as **insurmountable**. This is in keeping with literature which states that a barrier threshold that may exhaust teachers and limit technology integration exists irrespective of teachers' IBs (Ertmer et al., 2012; Woodbridge, 2003).

Additionally, according to Liu (2011), teachers' IBs are constructed from a synergy of overlapping IBs which results in them collectively influencing teachers' technology integration (Rogers, 2000) thus, no single IB can be understood in isolation. Findings are in keeping with the literature, for example, even though **teachers** at the school appear to possess **technology self-efficacy** it seems as if teachers' **code clash** with the **school's normative beliefs** is **negatively influencing** some teachers' **ICT value beliefs**.

Table 41: Summary of Different Teacher's Internal Beliefs - School 4

Candice	Malefa	Patrick	Thuli
Pedagogy (IB-P)			
On Campus			
Aims of Teaching (P-TA, P-LA)			
•Guide, mentor learners	•Create next generation	•Create conducive learning environment	•Make a difference, help learners achieve their best
Role of Teacher (P-TRT, P-LRT)			
•Use tech for learners to gain knowledge	•Get learners to understand, interact, get knowledge	•Facilitate learning, create a partnership	•Learners to understand, by active engaging, comms
Hybrid & Remote			
Role of Teacher (P-TRT, P-LRT)			
•More about content now •Lost personal connection	•Need to give technology skills and content	•More adaptable to change •Solution focus	•More about content now •Cannot sense immediately how learners are doing
Sustainability of Change (PS)			
•Changed, will use tech more in the future	•Changed forever	•Changed forever •Need balance of both	•Not sustainable due to inequalities

Candice	Malefa	Patrick	Thuli
Norms (IB-N)			
On Campus			
School Norms (IB-N-S)			
•Do not care if use tech •Not required to use, broken tech not fixed	•Do not believe need to use tech for teaching, admin or for learners	•Say tech is important, but do not invest in resources	•Believe it is important •Implementing an issue
Peer Norms (IB-N-P)			
•Lots do not want to use tech •Have to change practices, learn new things	•Most favourable to tech •Teach learners how to use, for their benefit	•Younger tech-savvy •Older do not want to change practices	•Value tech, try use where possible
Remote			
School Norms (IB-N-S)			
•Do not value tech •No extra resources given	•Do not promote tech use •No comms, extra resource	•Do not support tech •School devices restricted	•Do not believe in tech •Resource access issues
Peer Norms (IB-N-P)			
•Many not using resources available, are disinterested	•Do not know, not tech related comms	•Do not know, no comms due to tech issues	
Knowledge (IB-K)			
On Campus			
Classification of Knowledge (IB-K-N)			
Acquisition of Knowledge (K-NA)			
•Speak, interact, search info	•Engage people, read, organise, analyse, make sense	•Practice, make mistakes, correct them	•Actively engage, observe, write
Knowledge Utilisation and Affordances (IB-K-U)			
•How to use, fix issues key •Affordances also important	•How to use key •Affordances also important	•How to use key •Affordances also important	•How to use is first, then affordances
Remote			
Knowledge Utilisation and Affordances (IB-K-U)			
•Know more, so use it more			

Candice	Malefa	Patrick	Thuli
Value of ICT (IB-V)			
On Campus			
Ways to Use Technology (IB-V-U); Affordances (IB-V-A)			
Place for Technology in Education (V-UP)			
•Evaluate learning progress •Engage learners	•Prepare learners for technological future	•Inspires, increases interest •Opens up the world	•Empower learners
Supports Teaching (V-UST, V-EST)			
•Create content •Makes teaching easier	•Present content •Show videos	•Present content	•Present content
Enhances Teaching (V-UET, V-AET)			
•More interesting lessons •Teachers can self-reflect	•Compare other methods •Search extra information	•More interesting lessons •Search extra information •Use videos	•Makes abstract real •Use videos for emotion
Productivity (V-UP); Administration (V-AA)			
•Comms with learners •Prepare, mark at home	•Submit digitally, easier to read	•Saves time	•Capture marks •Set assessments
Enhances Learning (V-AEL)			
	•Access practice materials	•Promotes creative thinking	•Better understanding •More empowered
Remote			
Ways to use Technology (IB-V-U) and Affordances (IB-V-A)			
Supports Teaching (V-UST, V-AST)			
•Carry on academic project •Assist learners	•Distribute content	•Distribute content •Live or pre-record classes	•Distribute content
Enhances Teaching (V-UET, V-AET)			
•Access extra content	•Assist learners more		
Productivity (V-UP); Administration (V-AA)			
•Comms with learners, staff	•Comms with leaners	•Comms with staff	
Enhances Learning (V-UEL, V-AEL)			
•Review content in own time	•Review content few times		
Challenges (V-AC)			
•Data access issues	•Data access issues •No learner contact details	•Resource access issues •No learner contact details •Practical nature of subject	•Resource access issues •No learner contact details •No monitoring of learners
Hybrid & Remote			
Affordances of Technology (IB-V-A)			
Supports Teaching (V-AST)			
•Carry on academic project	•Carry on academic project •Distribute content	•Present, distribute content	•Carry on academic project •Live or pre-recorded lesson
Enhances Teaching (V-AET)			
	•Assist learners better •Pre-record lessons	•Make abstract more real •Provide extra information	
Administration (V-AA)			
•Attend meetings	•Cater for absent learners	•Comms with learners •Staff interaction, share info	•Comms with learners •Staff interaction
Enhances Learning (V-AEL)			
	•Review lessons few times •Better understanding		
Challenges (V-AC)			
•Unequal for poor learners •Need to know tech well	•Unequal for poor learners	•Unequal for poor learners •Prac subject, need contact	•Resource access issues •Lost personal connection

Candice	Malefa	Patrick	Thuli
Self-Efficacy (IB-SE)			
On Campus			
Work-Related Activities (IB-SE-W)			
•Feel confident	•Feels confident	•Feels confident	•Skills are adequate
Ways to gain Self-Efficacy (IB-SE-WA)			
•Explore, self-teach	•Frequent training	•More training, access	•Better access, quality
Personal-Related Activities (IB-SE-P)			
•Feel comfortable, not only technology driven	•Feels comfortable, uses it extensively	•Feels comfortable, not for everything	•Feels very comfortable, uses it extensively
Remote			
Work-Related Activities (IB-SE-W)			
•Improving skills, help peers			

8.8 PROFESSIONAL DISPOSITION - BY TEACHER AND CONTEXT

Professional Disposition (PD) which has been conceptualised in this study as **Instructional discourse (PD-I)** and **Regulative discourse (PD-R)** is shown in Table 8 and Figure 9.

In order to answer the research question (5) *what are different teachers' professional dispositions,* since Professional Dispositions (PD) are analytically distinct (Bernstein, 1986), first, a summary and discussion of the within-case analyses of different teachers' accounts of their instructional and regulative discourses over time, in relation to TTU-SST, is presented. Then, since these discourses are in reality interrelated (Bernstein, 1986) a summary and discussion of the teachers' professional dispositions at School 4 are presented. Table 42 presents a summary of the findings for teachers' PD at School 4 and Appendix H-3 provides the detailed analyses for each teacher's account of PD.

8.8.1 Instructional Discourse

Hoadley and Ensor (2009) and Wheelahan (2005) contend that teachers construct symbolic boundaries between different types of knowledge to determine what is considered valid. Findings suggest that although teachers feel **school knowledge** is more **structured** (all teachers) they seem to feel **boundaries** between different types of knowledge are **weak** as **school** and **everyday knowledge** is **interlinked** *"in my subject there are no boundaries"* (Candice); *"there are connections...meaning between them"* (Patrick); *"there's a bridge between them"* (Malefa); *"they help each other"* (Thuli). This finding is in keeping with Bernstein (1999; 2000) who defines weak classification as knowledge with flimsy symbolic boundaries resulting in the integration between subject

knowledge of different disciplines with everyday knowledge (Scott, 2008). Interestingly, **Malefa** maintains **boundaries do exist for learners** between different types of knowledge *"crossing the boundary is very difficult...especially in maths"*. A possible explanation may be that **even though teachers may choose not to erect symbolic boundaries** between school and everyday knowledge, in **reality, actual boundaries exist**.

Furthermore, according to Bernstein (1999; 2000), vertical discourses are horizontal when knowledge structures do not depend on previous knowledge acquired while hierarchical knowledge structures need to be studied in sequence (Hoadley & Muller, 2010). Findings suggest **Malefa** and **Patrick** feel **hierarchical knowledge structures** are mainly needed to **transmit knowledge** as they maintain one **first** needs to **acquire school knowledge** in a **vertical manner** and **then practically apply** it to what **learners already know** *"you teach them content...apply it...so they can make the connection"* (Malefa) and with **continual practise** and **repetition** *"needs to do an illustration 1000 times...become better at it"* (Patrick). **Candice** seems to believe mainly that **horizontal knowledge structures** are needed as she maintains **everyday knowledge** is needed **first** *they need outside knowledge to start"* and **Thuli** who feels knowledge can be **acquired in either direction**, appears to utilise a **combination of knowledge structures:** *"what they read at home...comes into direct contact with what they learn at school"*.

8.8.2 Regulative Discourse

According to Bernstein (1996), the regulative discourse describes teacher–learner boundaries and control of the classroom in terms of content sequencing, timing and pace. While **all teachers** agree **professional boundaries** are in place and they **mainly control the classroom context**, **strength of boundaries** and **amount of control** appear to **differ** amongst teachers. Bernstein (1996) defines clear teacher–learner boundaries coupled with strong teacher control as a performance-based pedagogic modality with strong framing whereas less explicit teacher-learner boundaries and greater learner control of content sequencing, timing and the classroom result in a competence pedagogic modality with weak framing. However, Morais (2002) and Bourne (2004; 2006) contend that even though these pedagogic modalities are defined at opposite ends of the spectrum (Bernstein, 1996), a blend of modalities can concurrently exist for teachers within a specific context. While findings suggest that although discussion is allowed, **Malefa** has a **performance**-based pedagogic modality as she reports **boundaries** are **strict** and **firm**

and she **controls** the classroom *"know that's there's a teacher and they are learners...I run the class"* and **Patrick** possesses a more **competence**-based pedagogy as he reports having **few boundaries** because he **prefers to facilitate** and **share classroom control** with learners *"don't like these teacher-student boundaries...give them a platform to speak to their fellow learners"* whereas **Candice,** who maintains she has **moderate boundaries** but believes **strong teacher control** is needed *"there's a respect for each other...control what happens in my class"* and **Thuli,** who feels **stronger boundaries** and **greater control** is needed for **younger grades** and **less strict boundaries** and **more shared control** is appropriate for **higher grades**, possess a **blend of pedagogic modalities** *"with younger grades...have firmer boundaries...try and keep control...with grade 10s...boundaries are less strict...share control"*.

According to Bourne (2006), context, circumstances, and timing influence the nature of teachers' pedagogic modalities. Furthermore, Bouhnik and Deshe (2014) claim that using technology can potentially lessen boundaries as learners can not only ask questions after school hours but may also be in more frequent contact with teachers. Findings concur as the **move to remote learning** seems to have resulted in **less strict boundaries** for **Malefa** *"there's no boundary anymore"* and **Thuli** *"boundaries are blurred"*, with even **Patrick**, who **preferred less strict boundaries** when **on campus**, now feeling **boundaries need** to become **more formal** *"want to bring them back that this is class"*. A possible reason **Candice** believes **boundaries have not changed** *don't think boundaries have changed"* may be that she was **already using technology** to teach and communicate prior to moving off campus and thus **learners' expectations** as regards **medium** and **frequency of communication** remain the **same**.

8.8.3 Different Teachers' Professional Dispositions

To conceptually analyse teachers' PDs, Bernstein (1996; 2000) defined two distinct codes to describe the strength of boundaries of knowledge and power relations. Collection codes allow for the development of specialised knowledge through strong boundaries and teacher control while integrated codes have blurred boundaries and shared control of the classroom (Bernstein, 2000; Morais, 2002; South African Institute for Distance Education, 2010). However, as classification and framing function independently of each other it seems separation is not so clear (South African Institute for Distance Education, 2010). Findings concur as although **Patrick** appears to mainly possess **integrated codes** due to

moderate teacher–learner boundaries and a preference for **shared classroom control** and **Malefa** possesses mainly **collection codes** due to her **performance-based pedagogic modality** and beliefs of **hierarchical knowledge acquisition**, it appears that aspects of **other codes** are also present since **Malefa** views **knowledge boundaries** as **weakly classified** and **Patrick** believes **knowledge acquisition** is **hierarchical**. In addition, findings indicate that although **Candice** possesses a **combination of codes** as she believes **knowledge is horizontal** and **weakly classified**, she reports having **strong teacher control** of the classroom. Therefore, it seems that while **codes** may assist in conceptually **analysing** and **describing teachers' PDs**, it is **not possible** to **neatly categorise** teachers' **multifaceted** and **complex PDs**.

Fonseca-Chacana (2019) also contend that PDs are not fixed and can change based on the teaching environment (Dottin, 2009) and the social context (Bourdieu, 1974). This perspective may explain why **Thuli** appears to possess **different codes** depending on the **grades** being taught with **collection codes** for **younger grades** and more **integrated codes** for more **senior learners** and most teachers maintain that **teacher–learner boundaries** have become **less strict** since being **remote**.

Table 42: Summary of Different Teacher's Professional Dispositions - School 4

Candice	Malefa	Patrick	Thuli
On Campus			
Instructional Discourse (IB-PDI)			
Boundaries of Knowledge (IB-PDI-B)			
•Everyday, school integrate	•Everyday, school connect •Boundaries, hard to cross	•Everyday, school connect	•No boundaries between everyday, school
Knowledge Acquisition (IB-PDI-K)			
Direction of Knowledge Acquisition (PDI-KD)			
•Everyday first	•School first, then everyday	•School to everyday	•Either direction
Ways to Acquire Knowledge (PDI-KW)			
•Apply school knowledge to outside world	•Vertical with base •Relate to what they know	•Apply concepts outside	•History analyse, opinions •Geography interact content
Involvement Needed (PDI-KI)			
•Show how to apply across contexts	•Understand abstract •Apply practically	•Continual practice	•Apply skills
Regulative Discourse (IB-PDR)			
Teacher-Learner Boundaries (IB-PDR-B)			
•Moderate boundaries •Likes to mentor, guide	•Strong professional boundaries	•Boundaries, but facilitates	•Strong boundaries with young grades, older less
Classroom Control (IB-PDR-C)			
•Teacher controls, as otherwise misbehave	•Teacher controls, but allows discussion	•Share control with learners, so can help peers	•More teacher control in young grades, older share
Hybrid & Remote			
Teacher-Learner Boundaries (IB-PDR-B)			
•No change in boundaries	•No boundaries anymore •Contact anytime, anything	•Boundaries more informal •Want them more formal	•Fewer boundaries •Content anytime, anything

8.9 ORIENTATION TOWARDS TECHNOLOGY - BY TEACHER AND CONTEXT

Orientation towards Technology (OTT) i.e., Agent's Practices (AP) and Outcomes (O), which have been conceptualised in this study as **Level of Adoption (AP-LA)**; **Manner of Adoption (AP-MA) Adoption Activities (AP-AA), Current (O-CTU)** and **Future (O-FTU) technology use** are shown in Table 8 and Figure 9.

In order to answer the research questions (6) *What are different teachers' orientations towards technology* and (7) *How do different teachers use technology*, summaries and discussions of the within-case analyses of different teachers' accounts of Orientation towards Technology (OTT): Level and Manner of Adoption (LA, MA), Current Adoption Activities and Outcomes (AP-AA, O-CTU) and Future Adoption Activities and Outcomes (AP-AA, O-FTU) over time and in relation to TTU-SST are presented. Thereafter, as belief systems are constructed from a combination of beliefs (Liu, 2011) an overall discussion of different teachers' OTT over time at School 4 is provided. Table 43 presents a summary of

the findings for teachers' OTT at School 4 and Appendix H-4 provides the detailed analyses for each teacher's account of OTT.

8.9.1 Level and Manner of Adoption

According to Hooper and Rieber, (1995), Dwyer et al. (1991), and Sandholtz et al. (1997), the different LA include familiarisation, where teachers are aware of the basics but have little experience in teaching with the tools; utilisation, where teachers believe technology supports traditional pedagogic practices and are less focused on external barriers (Cuban, 2012); integration, where teachers believe technology is essential and fully integrate it into traditional practices; reorientation, where teachers are confident in using the technology and rethink educational goals and evolution, where teachers discover and try out new ways of teaching due to benefits offered by technology (Yucel et al., 2010). Findings suggest **LA** for **most teachers** at School 4 are at the **familiarisation** and **utilisation** levels as they report being **comfortable using technology** to **support existing pedagogic practices** *"it hasn't changed me as a teacher"* (Malefa), *"doesn't really change it a lot"* (Patrick), *"you can't move away from basic teaching methods"* (Thuli) while for **Candice** it seems as if levels of **integration** and **reorientation** are being **reached** as she feels **confident using the technology**, believes she is **unable to continue teaching without it** and feels technology can **change pedagogic goals** by **empowering learners** *"it has transformed my ways"*.

Puentedura (2006), Hamilton et al. (2016), and Hilton (2016) define different **MAs** and Hooper and Rieber (1995) differentiate between product and idea technologies i.e., when teachers utilise technology for substitution and augmentation it is considered a product technology whereas when teachers use technology to modify and redefine tasks and pedagogic practices it is seen as an idea technology. Findings suggest when **on campus** while **most teachers** seem to utilise technology in a **product manner** with **substitution** and **augmentation** as they feel technology is simply a **medium change** *"in the past you used a typewriter...now you just print"* (Malefa); makes some **tasks easier** and **faster** *"just makes things easier and faster"* (Patrick); with **basic teaching methods** and several **traditional skills** still **being needed** *"doesn't mean you can abandon normal teaching"* (Thuli), **Candice** appears to be utilising technology in an **idea manner** to **modify** certain pedagogic **practices** as she believes technology **empowers learners** and is **more engaging** *"can use technology...empower your little person"*. However, when **remote**

while **Candice** appears to be using technology in a **product** and **idea manner**, **Malefa**, **Patrick** and **Thuli** report **using technology minimally** or **not at all** due to **resource access issues** for both **teachers** and **learners**. This is in keeping with Mailizar et al. (2020), Rasheed et al. (2020), and Giovannella, et al. (2020) who claim that teachers' abilities to use technology are limited when they do not have access to the appropriate digital tools and learners are unable to access sufficient data, irrespective of beliefs,.

8.9.2 Current Adoption Activities and Outcomes

Similar to LA and MA, **all teachers** report using technology for **activities** that **support existing practices** and **administration** tasks like **creating**, **presenting** and **distributing content** (all teachers); **searching the internet** (Malefa); **showing videos** (all teachers); **setting assessments** (Thuli); **marking** and **recording marks** (Candice); **communication with learners** (Candice, Patrick, Thuli) and **managing the school's computer resources** (Candice), with only **Candice** using technology to **transform** teaching by **making lessons more engaging**. So too when **remote**, findings indicate **Candice** uses **technology** extensively to give **remote classes**, send **learners content** and **tasks, communicate** and provide **learners with assistance** while other teachers who maintain **no access to learners' contact details** (Malefa, Patrick, Thuli), **learners' lack of data** (Patrick) and **insufficient technology resources for teachers** (Thuli) are severely **limited in their ability to utilise technology** (Malefa, Patrick, Thuli). According to Mama & Hennessy (2013), teachers' external and internal beliefs influence technology integration choices concurrently. While this perspective may explain why **Candice**, who has **more access to technology resources** at the school as she is the CAT teacher and believes **technology benefits her teaching** reports using **technology more extensively** than her peers and for **transformative activities**, it is possible that even though other teachers believe technology is valuable systematic resource barriers are exhausting them (Woodbridge, 2003) since using technology for pedagogic activities is impossible unless one has sufficient access to appropriate digital resources (Bergdahl & Nouri, 2020). This may also explain why when **back on campus**, **all teachers** maintain they are able to **expand their technology activities** to include **pre-recording** and **sending lessons** (Malefa, Thuli), **giving live lesson for learners at home** (all teachers), **posting content** (Malefa), **searching** and **sharing extra online resources** (Candice, Patrick), providing **remote learner assistance** (all teachers), **communicating with learners** (Candice, Malefa, Patrick), **attending staff meetings** (Candice, Patrick, Thuli) and for **peer interactions**

(Patrick) because the **school has provided** them with **appropriate technology resources** and thus they seem to feel **barriers to resource access** have been **reduced**.

8.9.3 Intended Future Adoption Activities and Outcomes

When **returning to campus**, Candice indicated she **does not intend to change** the **way or extent** to which she is **using technology** but other teachers did not comment. It is possible teachers were **unable to comment** as they are **incapable of envisioning future technology use** because they feel **access issues will continue** to **constrain technology integration** since there are **limited funds** and **technology focus at the school**. This is in keeping with Zhao and Frank (2003) and Hennessy et al. (2010) who claim that teachers are less likely to be motivated to incorporate technology into their pedagogic activities at schools where technology access and integration are not prioritised.

While blended learning offers significant advantages to teaching and learning as it engages tech-savvy learners (Hadijah & Shalawati, 2017) and requires learners to take more responsibility for their academic work (Bergdahl & Nouri, 2020), according to du Plessis (2014), Mhlanga and Moloi (2020), Le Grange (2020), Mailizar et al. (2020), Rasheed et al. (2020), and Giovannella et al. (2020), using technology magnifies disparities between learners, especially in developing countries where access to technology resources is often scarce and thus the benefits afforded by technology integration may be limited. Findings concur because although **all teachers** believe that in **future technology must be used more** since **integrating technology** can **empower learners** *"to empower themselves more"* (Candice) and **caters** to **technologically inclined learners** *"they already know technology...understand it...love it"* (Patrick), **teachers** maintain a **balanced** and **hybrid approach** should be adopted *"have to balance to two"* (Patrick) as an **exclusively online approach** only **amplifies inequalities** between **advantaged** and **disadvantaged learners** and **schools within South Africa** (all teachers).

8.9.4 Summary of Different Teachers' Orientation towards Technology

While Johnson et al. (2016) claim integration is not possible without access to technology, Voogt and Knezek (2013) contend that increasing technology does not automatically result in greater utilisation but rather that teachers need to believe they have routine access to

suitable resources in order execute their intended pedagogic activities (Ertmer & Ottenbreit-Leftwich, 2010; Rogers, 2000) since systematic barriers to technology integration may exhaust teachers (Woodbridge, 2003). Furthermore, Vanderlinde et al. (2010) and Ertmer (2005) contend that context plays an important role in influencing teachers' abilities to translate beliefs into practice and thus technology integration can differ even for the same teacher within different contexts (Hamilton et al., 2016). In keeping with the literature, findings suggest **OTT** at School 4 is **primarily influenced** by teachers' **beliefs of ES barriers** since **Candice,** whether **on campus** or **remote**, who believes fewer **external barriers exist** appears to be **utilising technology** more **consistently** and in a **greater variety of ways** while other teachers (Malefa, Patrick, Thuli) seem to be **utilising technology** for **similar activities,** with the **provision of greater access to technology resources** when **returning to campus** .

However, it is also possible that **other factors** may be shaping teachers' OTT, since **Candice,** who is **aware of external barriers** at the school but has **strong beliefs** as to the **importance of ICT** and **high technology self-efficacy** reports **using technology** for **varied pedagogic activities** whereas **other teachers** appear to be **mainly focused** on the **lack of resources** (Patrick, Malefa, Thuli). This perspective concurs with Tondeur et al. (2017) who contend that teachers' technology integration choices are not influenced by any single factor but rather are collectively moulded by the complex and bidirectional relationships that exist between teachers' OTT and their beliefs of ES, IB and PD.

Table 43: Summary of Different Teacher's Orientation toward Technology - School 4

Candice	Malefa	Patrick	Thuli
Level and Manner of Adoption (AP-LA; AP-MA)			
On Campus			
Supporting and Enhancing Pedagogic Practice (LA-SEP, MA-SEP)			
•Support existing pedagogy •Not disengage from world	•Support existing pedagogy •Different medium	•Support existing pedagogy •Makes it easier, faster	•Support existing pedagogy •Basic teaching methods, certain skills still needed
Transforming Pedagogic Practice (LA-TP, MA-TP)			
•Engage, empower learners			
Remote			
Supporting and Enhancing Pedagogic Practice (LA-SEP, MA-SEP)			
•Supporting pedagogy	•Partial support of pedagogy	•Partial support of pedagogy	

Candice	Malefa	Patrick	Thuli
Adoption Activities (AP-AA) and Outcomes (O)			
On Campus			
Current Teaching Activities (AP-AA; O-CTU)			
Supporting Teaching Activities (AP-AAS, O-CTUS)			
•Prepare, present, send content •Show videos •Mark assessments	•Present content Show videos •Search information	•Prepare, present content •Show videos •Enable learners to research	•Prepare, present content •Show videos •Set assessments
Transforming Teaching Activities (AP-AAT, O-CTUT)			
•Animated explaining for more engagement			
Administration Activities (AP-AAA, O-CTUA)			
•Comms with learners •Recording marks •Manage lab resources		•Comms with learners	•Recording marks
Remote			
Current Teaching Activities (AP-AA; O-CTU)			
Supporting Teaching Activities (AP-AAS, O-CTUS)			
•Remote, online classes •Send content, tasks •Remote learner assistance •Search, share online info	•Send content •Remote learner assistance	•Create, send content •Remote learner assistance	•Uploaded content prior to moving off-campus
Administration Activities (AP-AAA, O-CTUA)			
•Comms with learners •Comms with some staff	•Comms with few learners	•Comms with few learners	
Challenges (O-CTUC)			
	•Only a few learners as no contact details	•No learner contact details, data access issues	•No learner contact details, access to technology
Intended Future Technology Use (O-FTU)			
Supporting Role (O-FTUS)			
•No change, in same way and to same extent			
Hybrid & Remote			
Current Teaching Activities (AP-AA; O-CTU)			
Supporting Teaching Activities (AP-AAS, O-CTU-S)			
•Live lessons to those home •Remote assistance •Share website content •New features to engage learners	•Pre-record lessons •Live lesson for those home •Post content •Remote assistance	•Lessons for those home •Post content •Remote assistance •Search for extra resources	•Pre-record, upload lessons •Live lessons to those home •Remote assistance
Administration Activities (AP-AAA, O-CTUA)			
•Comms with learners •Attend staff meetings	•Comms with learners	•Comms with learners •Attend staff meetings, peer interaction	•Attend staff meetings
Future of Technology in Education (O-CTUF)			
•Tech will be used more •Empower learners	•Need to integrate more •Option for hybrid mode	•Tech must be used more •For technological learners •Must be balanced	•Must be more IT inclined •Not sustainable
Challenges of Only Online (O-CTUC)			
•Amplify current inequalities	•Amplify current inequalities	•Amplify current inequalities •Learners need in-person	•Amplify current inequalities

8.10 CONCLUSION – SCHOOL 4

This chapter presented the findings and discussion for School 4. First, an overview of the case study site, the school's response to the COVID-19 pandemic and a summary of the teachers interviewed were provided. Next, summaries of findings and discussions in relation to the micro- and meso-level theories[74] for each of the theoretical framework components i.e., ES and CSB, IB, PD, AP and O were presented in reference to prior literature reviewed or, where necessary, new literature in order to substantiate or counter findings. Initial codes were formulated from the SST-TTU Theoretical Framework, and subcodes that emerged inductively from the data were then detailed in the summary tables.

[74] Figure 9 depicts the micro- and meso-level theories utilised for this chapter.

9 UTILISING THE THEORETICAL FRAMEWORK - TEACHERS' TECHNOLOGY USE–STRONG STRUCTURATION THEORY (TTU-SST)

In order to understand how the theoretical framework for this study, TTU-SST, enables a deep understanding of the relationships between teachers' beliefs, professional dispositions and technology use within different South African schools, this chapter begins with a brief overview of Structuration Theory (ST) and Strong Structuration Theory (SST), which forms the foundation of TTU-SST. Next, for ease of reference, a summary of the application of SST concepts to the study's research questions is provided. Thereafter, cross-case analyses of the findings in Chapters 5 to 8 for each of the SST concepts are presented to provide a holistic view of all schools and teachers from a micro and meso perspective. Lastly, insights gained from the data using TTU-SST as a meta-theory are provided for all schools and selected teachers.

9.1 STRUCTURATION THEORY (ST)

ST utilises the core principles of duality of structure and structuration to explore the belief that a recursive relationship exists between structures i.e., virtual rules and resources and human agency (Giddens, 1984; Walsham & Han, 1990; Rose, 1998; Stones, 2005). Giddens (1984) claims that the relationships between human interaction and social structures are contextual and consist of agents drawing on their own internal structures of signification through interpretative schema to communicate meaning, agents drawing on their own internal structures of domination through facilities i.e., resources to exercise power and agents drawing on their own internal structures of legitimation to sanction the norms and rules of society or those of their peers[75] (Walsham & Han, 1990; Feeney & Pierce, 2016). However, Giddens (1984) contends that structures are not static and can be challenged or reproduced by humans because a dual relationship exists between structure and agency and therefore, structuration occurs as structures reproduce or evolve over time while concurrently, agents produce, reproduce or transform the social structures that enable or constrain them (Rose, 1998).

[75] Figure 7 in Chapter 3 section 3.1.2 graphically depicts the three dimensions of signification, domination and legitimation.

9.2 STRONG STRUCTURATION THEORY (SST)

In response to criticisms of ST being too philosophical, abstract and difficult to use empirically (Thrift, 1985; Whittington, 2015), Stones (2005) developed a strengthened version of ST i.e., SST to support and inform empirical research from design through to analysis by breaking down the duality of structure, dissecting Gidden's concept of methodological bracketing and providing researchers with a set of steps to assist in exploring and understanding specific phenomena within a specific context (Feeney & Pierce, 2016).

Firstly, Stones (2005) employs the central tenet of the duality of structure from ST to enable a more guided analysis but SST organises this concept into analytically separate constructs, referred to as the *quadripartite nature of structuration* and includes (1) external structures, (2) internal structures, (3) active agency and (4) outcomes. According to Stones (2005), **external structures** which limit or enable agents i.e., degrees of control, can result from *independent causal influences* which affect the agent but are reproduced or changed independently of the agent themselves or from *irresistible causal influences* that occur when the agent has the capacity to resist but feels a lack of ability do so. Further, **internal structures** consist of *conjuncturally-specific beliefs* focused on a specific task, role or position of the agent and *general dispositions* which include skills, world views and habits. Then, **active agency** describes an agent's noticeable behaviour in relation to external structures and driven by his/her own internal structures and **outcomes** refer to the result of active agency on production, reproduction or transformation of an agent's internal and external structures (Feeney & Pierce, 2016)[76].

Secondly, Stones (2005) addresses criticisms of Giddens' methodological bracketing by utilising a **sliding ontological scale** to explore the "connecting tissue" between agency and structure by defining the concepts of conduct and context analysis. *Conduct analysis* focuses inwards and provides the link between external and internal structures as it describes an agent's general dispositional frame alongside the rules, norms and interpretative schema of the agent's conjuncturally-specific structures used when performing a specific task or role whereas *context analysis* focuses outwards on the external structures affecting the agent (Stones, 2005; Feeney & Pierce, 2016).

[76] Figure 8 in Chapter 3, section 3.1.3 graphically depicts Stones (2005) quadripartite nature of structuration.

Lastly, Stones (2005) provides researchers with iterative steps to organise and conduct an analysis. The composite research strategy includes first performing a conduct analysis on the agent's general dispositions followed by identifying the agent's conjuncturally-specific structures. Secondly, performing a context analysis by identifying relevant external structures available to the agent and lastly, identifying the opportunities for action and structuration enabled or constrained by the external structures[77].

Before utilising these steps to report and analyse the relationships between different constructs in this study using the theoretical framework, to refresh the reader's understanding of TTU-SST, a review of the research questions mapping is provided, along with a summary and cross-case analysis of the micro and meso findings for each construct.

9.3 MICRO- AND MESO-THEORY PERSPECTIVE OF TEACHERS' TECHNOLOGY USE - STRONG STRUCTURATION THEORY (TTU-SST)

As this study was interested in understanding teachers' technology integration across different school contexts in a structured and theoretically grounded way, literature reviewed in relation to first- and second-order barriers and beliefs, teachers' professional dispositions and teachers' orientations towards technology was first mapped onto Stones' (2005) Strong Structuration Theory (SST) to answer the study's subquestions from a micro and meso perspective.

For (1) **external structures**[78], the prevalent first-order barriers identified in the literature: resources, training, support and time (Ertmer et al., 2012) were used to understand the nature of technology structures at different schools.

For (2) **internal structures**[79], *conjuncturally-specific structures* (a) were used to understand teachers' beliefs about their specific technology structures. For *general*

[77] Figure 10 in Section 3.2.3 provides an overview of Stones' (2005) composite research strategy.
[78] External structures was used to answer subquestions (q1) What are the external technology structures at different schools and (q8) How do the external technology structures differ between technology-rich and technologically disadvantaged schools?
[79] Conjuncturally-specific internal structures (a) was used to answer subquestion (q2) What are different teachers' beliefs around external technology structures in their school?; General dispositions (b1) was used to was used to answer subquestion (q3) What are different teachers' internal beliefs about technology? and (b2) was used to answer subquestion (q4) What are different teachers' professional dispositions?

dispositions (b), teachers' knowledge about technology, which according to the literature reviewed includes pedagogy, norms, knowledge, the value of ICT and self-efficacy (Liu, 2011) was used to understand teachers' second-order, internal beliefs (b1), while teachers' conceptions of their professional dispositions (Dottin, 2009; Hoadley & Ensor, 2009) were used to understand teachers' internal beliefs of pedagogic practice (b2).

For **(3) active agency**[80], teachers' orientation towards technology was used to explore teachers' level and manner of technology adoption and related activities (Hooper & Rieber, 1995).

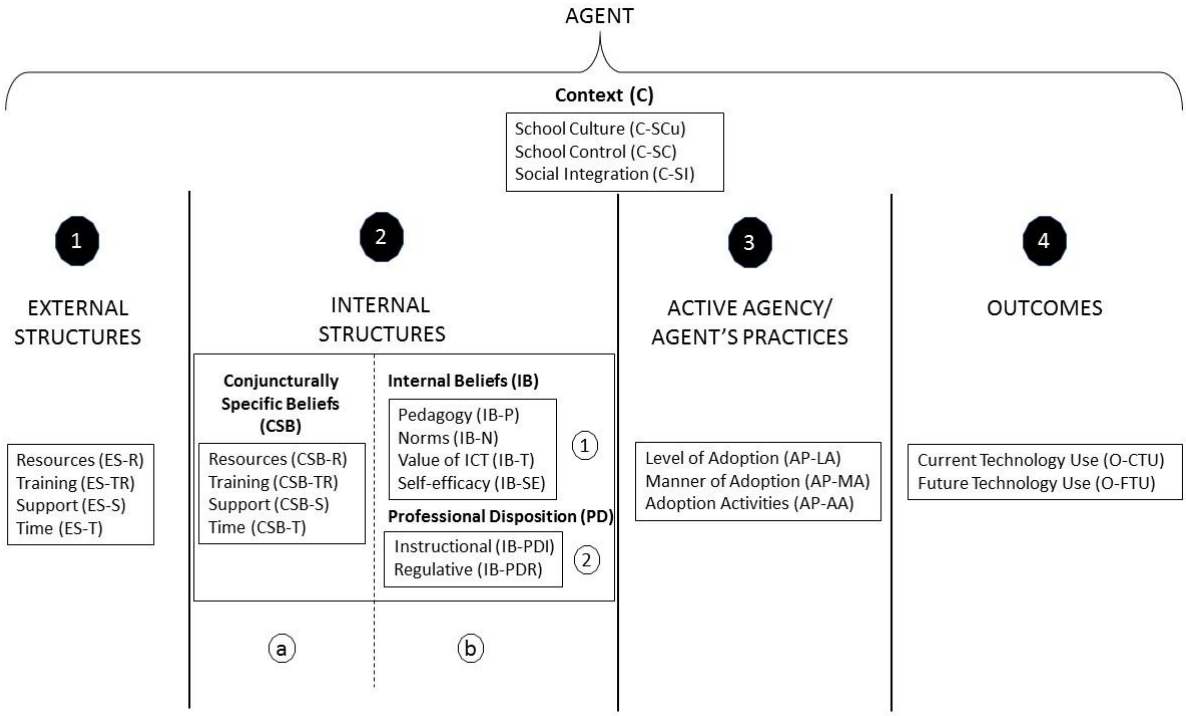
For **(4) outcomes**[81], teachers' current and intended future technology use in the classroom was used to understand the context of school structures, consequences and agency (Stones, 2005).

For **context**[82], Bernstein's theory of social class, the different types of school culture (Bernstein, 1975), control (Bernstein, 1971a) and social integration (Bernstein, 1971b) were used to understand the different schools and social contexts.

For ease of reference, the graphical representation of the TTU-SST originally presented in Figure 9 is shown in Figure 21.

[80] Active agency was used to answer subquestion (q5) What are different teachers' orientations towards technology?
[81] Outcomes was used to answer subquestions (q6) How do different teachers use technology and (q9) How does technology use differ between teachers at technology rich and technologically disadvantaged schools?
[82] Context was used to answer subquestion (q7) What is the context at different schools?

Figure 21: TTU-SST Theoretical Framework adapted from Stones (2005)



9.3.1 Cross-Case Analyses and Summary of Micro- and Meso-Theory Findings

- **Context**

Findings indicate that all schools have expressive cultures with stratified control as teachers report focusing more on the holistic growth of learners than academic proficiency and all learners are grouped according to age. However, findings suggest that **most schools** (1,2,3) possess a combination of mechanical and organic integration as teachers within each school appear to hold similar beliefs around technology use. Whilst still believing decisions to use technology are personalised and subject-based, integration at **School 4** appears to be mainly mechanical with a strong discipline code and hierarchical structure based on race and position.

- **External Structures**

Findings suggest although **School 1** is a technology-rich environment, teachers who believe technology simply supports their teaching activities appear more focused on ES barriers while teachers who believe technology can greatly enhance the educational experience seem to find ways to work around these barriers. Similarly, in **School 2**, teachers who prefer not to use technology and feel technology is not suited to specific disciplines appear more focused on ES barriers whereas teachers who believe technology can greatly enhance the educational experience seem to find ways to address most

challenges. So too in **School 3** where teachers who consider themselves technological competent value the role of technology hold positive beliefs about ES at the school and seem to focus less on external barriers. However, findings suggest that even though most teachers in **School 4** feel using technology is essential to prepare and empower learners, they believe the lack of sufficient ES makes it impossible to incorporate technology. Yet, the CAT teacher who has better access to technology resources than most of her peers, seems to find ways to overcome most external barriers.

School 1's and **School 4's** provision of additional ES when using a hybrid and remote approach seems to have resulted in all teachers' beliefs of ES at these schools being more positive. Although providing better ES may result in more positive technology beliefs the inverse may not be true because teachers at **School 3** still appear to hold positive ES beliefs despite very limited ES when remote. Furthermore, even though **School 2** provided additional ES when schools closed, teachers who had previously focused on external barriers only seemed to be less concerned as they spent more time exploring and utilising technology and appreciating the affordances.

- **Internal Beliefs**

Findings indicate that teachers' beliefs of ES and IBs at **School 1** are aligned since those who believe first-order barriers are present at the school also appear to hold less positive IBs. However, while the shift to remote and hybrid teaching and learning has resulted in more positive beliefs in regard to the value of ICT and self-efficacy for all teachers at the school, even teachers who previously held pro-technology pedagogical beliefs now feel technology cannot replace face-to-face teaching. Similarly, findings suggest teachers' ES beliefs and IBs at **School 2** are also aligned, with better provision of ES when using remote and hybrid approaches positively influencing some teachers' IBs. However, teachers at **School 2** report that despite their IBs being more positive, ES barriers for learners are limiting their technology integration. So too in **School 3** where although teachers' beliefs of ES and IBs also appear to be aligned, teachers report that despite their positive IBs of high technology self-efficacy and an appreciation of ICT, ES barriers are hindering their technology integration efforts when off campus. Likewise, teachers' beliefs of ES and IBs at **School 4** seem to be aligned because whether on campus or remote, beliefs of insufficient and inadequate ES appear to be negatively influencing IBs. When back on campus with the provision of additional technology resources and training for

teachers, IBs seem to be more positive. However, as with **Schools 2** and **3**, teachers at **School 4** report that despite now holding more positive IBs, persistent and pervasive ES barriers are influencing their technology integration efforts.

Moreover, findings indicate that any particular IB cannot be understood in isolation. For example, while teachers at **School 1** and **School 3** report that the school's pro-technology policy is positively influencing their other IBs; teachers at **Schools 2** and **4** report a code clash with the school's normative beliefs which seem to be influencing their other IBs negatively. In addition, findings suggest even though teachers' IBs are mainly aligned, this may not hold for all teachers and schools. For example, at **School 2** teachers with strong teacher-centred beliefs report having high technology self-efficacy and value ICT while a teacher who holds more learner-centred pedagogical beliefs feels technology has limited value.

- **Professional Disposition**

Findings indicate it is not always possible to neatly define and categorise teachers PDs as the distinction between collection and integrated codes is not so distinct since most teachers **(Schools 1–4)** who appear to possess mainly collection codes also have parts of integrated codes present in their PDs and inversely, teachers who possess more integrated codes also have aspects of collection codes present. In addition, it seems as if teachers PDs can change depending on the social and teaching context. For example, some teachers at **Schools 1** and **4** report they possess collection codes for younger grades and more integrated codes for senior learners and the shift to remote teaching and learning has resulted in teachers **(Schools 1–4)** who (on campus) possessed mainly or only collection codes now having greater aspects of integrated codes present. Interestingly, findings also indicate that the subject taught may play a role in shaping teachers' PDs **(Schools 1–4)**, with those involved in teaching more structured and scientific subjects such as maths, accounting, and IT possessing mainly collection codes whereas teachers of subjects like English, social science and design mainly possess integrated codes.

- **Orientation towards Technology**

Findings indicate although teachers' OTTs at **School 1** are similar with all teachers using technology to support existing activities and for administration, with greater use for supportive tasks in remote and hybrid contexts, it appears as if teachers with more positive IBs and ES beliefs also utilise technology to transform their existing pedagogic practices. So too in **School 2** when on campus, even though teachers' OTT are similar in regard to using technology to support and enhance existing pedagogic practices, teachers with positive IBs and ES beliefs appear to be utilising technology more consistently and in a greater variety of ways. In addition, it seems the change in educational context, coupled with the provision of additional ES at **School 2** is positively influencing teachers' OTT even for those teachers who originally held less positive IBs and ES beliefs. Likewise in **School 3**, because teachers hold more positive IBs and ES beliefs, OTTs are similar and all teachers use technology to support, enhance and transform existing activities as well as for administration. However, when remote and using a hybrid approach, teachers at **School 3** report that despite holding positive IBs, the lack of ES is preventing them from using technology in their teaching. In the same vein, findings for **School 4** indicate that both on campus and remote, regardless of teachers' positive IBs, teachers' OTTs are being negatively influenced by beliefs of ES being inadequate while the provision of additional ES when returning to campus appears to be shifting teachers' OTTs towards utilising technology more extensively for teaching activities.

Table 44 provides a cross-case analysis and summary for micro and meso findings for Schools 1–4[83].

[83] Relationships identified between the different parts of TTU-SST in the micro- and meso-analysis are listed at the end of the Table 44. The structured analysis of the relationships according to SST principles is detailed in section 9.4 and 9.5.

Table 44: Cross-Case Analysis and Summary of Micro- and Meso- Findings for Schools 1–4

School 1	School 2	School 3	School 4
Context			
Expressive Stratified Combined Integration	Expressive Stratified Combined Integration	Expressive Stratified Combined Integration	Expressive Stratified Mechanical Integration
External Structures (1) and Conjuncturally-Specific Beliefs (2-a)			
On Campus			
Teachers more focused on barriers when believe technology mainly supports teaching and not suited to specific subjects	Teachers more focused on barriers when prefer not using technology or believe technology is not suited to specific subjects	Teachers less focused on barriers as are technically competent and value ICT	Teachers focused on barriers but believe ICT has value as access is a major issue, less focus on barriers with better access
Hybrid and Remote			
Provision of additional ES resulted in more positive beliefs about ES	Provision of extra ES but more positive beliefs seem to result from time spent and appreciation of ICT	Teachers still appear to hold positive technology beliefs despite lack of ES in place	Provision of additional ES when back on campus resulted in more positive beliefs about ES
Internal Beliefs (2-b1)			
On Campus			
IBs aligned with ES beliefs and teachers with positive IBs focusing less on ES barriers	IBs aligned with ES beliefs with teachers with positive IBs focusing less on barriers	School's pro-technology policy is positively influencing other IBs	Code clash between teachers and school's normative beliefs is negatively influencing IBs
Hybrid and Remote			
IBs aligned with ES beliefs and are mainly positive	Despite IBs more positive with better ES, barriers for learners are an issue	Despite positive IBs, ES barriers are hindering technology integration	Despite IBs more positive with better ES, barriers for learners are an issue
Professional Dispositions (2-b2)			
On Campus			
Combined codes with more collection code for scientific type subjects and younger grades	Combined codes exist but more collection codes with science-type subjects	Combined codes exist but more collection codes with science-type subjects	Combined codes with more collection code for scientific-type subjects and younger grades
Hybrid and Remote			
Boundaries have blurred due to any-time-any-place teaching and learning	Boundaries have blurred due to any-time-any-place teaching and learning	Boundaries have blurred due to any-time-any-place teaching and learning	Boundaries have blurred due to any-time-any-place teaching and learning
Orientation towards Technology (3 and 4)			
On Campus			
Teachers use technology for support and admin activities, but with more positive IBs and ES beliefs also use technology to transform existing tasks	Teachers use technology to support and enhance tasks, but with more positive IBs and ES beliefs also use technology to transform existing tasks	Teachers have positive IBs and ES beliefs and use technology to support, enhance, and transform existing tasks	Teachers have positive IBs, but poor ES prevents teachers from using technology
Hybrid and Remote			
Greater use of technology for supportive tasks	Providing additional ES is positively influencing OTT	Despite positive IBs, lack of ES negatively impacts OTT	Providing additional ES is positively influencing OTT
Relationships			
IBs cannot be viewed in isolation from each other or from ES beliefs			
School's pro-technology belief positively influences other IBs	School's technology policy negatively influences other IBs	Teachers with positive IBs also focus less focus on ES barriers	Beliefs of insufficient ES negatively influence IBs
IBs may not align with each other			
Valuing ICT does not mean pedagogy beliefs support technology use	Teacher-centred beliefs do not mean ICT is not valued and skills are poor	Teacher-centred beliefs do not mean ICT is not valued and skills are poor	Valuing ICT does not mean pedagogical beliefs support technology use

9.4 META-THEORY PERSPECTIVE OF TEACHERS' TECHNOLOGY USE - STRONG STRUCTURATION THEORY (TTU-SST)

Since this study was also interested in understanding the complexity of relationships influencing teachers' technology integration in a structured manner, drawing on Giddens' (1984) notion of the duality of structure — which was later refined by Stones (2005) in SST as the quadripartite nature of structuration, provides a powerful way for TTU-SST to broadly analyse these relationships within particular schools, which can then be used to explore the data from a meta-theory perspective.

9.4.1 Mapping Duality of Structure

For **duality of structure**[84] (Giddens, 1984), the quadripartite nature of structuration (Stones, 2005) as defined by the structures of signification, domination and legitimation (Giddens, 1984) with a conduct and context analysis was used to explore the relationships between the different parts of TTU-SST.

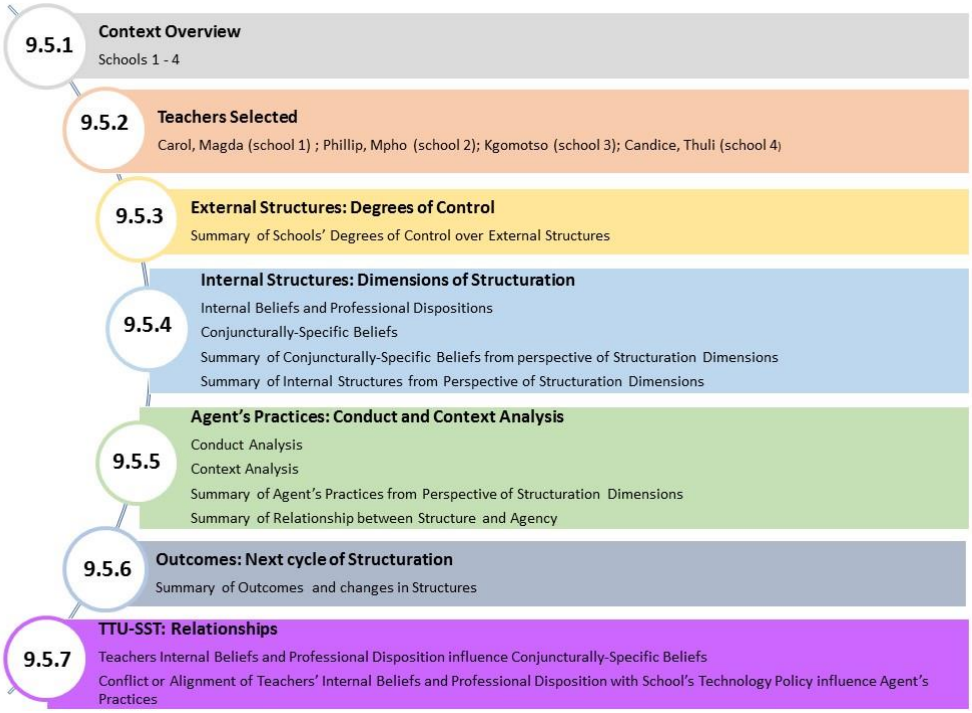
9.5 META-THEORY FINDINGS AND DISCUSSION USING TTU-SST[85]

To explore teachers' technology use and understand the factors, conditions and relationships as well as to assess the value of the theoretical framework i.e., TTU-SST, the chapter begins with a brief review of the context i.e., C for each school and a summary of agents-in-focus chosen for the meta-analysis along with reasons for the selection and a summary in Table 45. Thereafter, insights gained after applying Stones' composite research strategy[86] which involved a series of recurrent steps where the data for each agent-in-focus was analysed multiple times from different perspectives, are discussed for each part of Stones' (2005) quadripartite nature of structuration. First, ES (1) are considered to understand the different degrees of control at each school. Second, descriptions of the general dispositional frames of meaning i.e., IBs (2b-1) and PDs (2-b2), for teachers selected are presented, followed by teachers' conjuncturally-specific internal structures i.e., CSB (2a) which offer insights into how each teacher perceives external structures at their school. Next, a summary of teachers' CSB from the perspective of

[84] Duality of structure was used to answer subquestions (q10) How do different school contexts influence teachers' use of technology and (q11) How do external structures, beliefs, professional dispositions, and orientation towards technology influence technology use in the classroom?
[85] To indicate to the reader how the micro- and meso-analysis has informed the findings for the meta-perspective, initial codes are appended to each claim. As using subcodes makes the reading too complex, a table of these codes can be found in Appendix E.
[86] Details and steps for Stones' composite research strategy can be found in Section 3.2.3, with a graphical representation shown in Figure 10.

dimensions of structuration are presented followed by a summary of relationships between IS also using the dimensions of structuration. Third, Agent's Practices i.e., AP (3) are presented in relation to conduct and context analysis followed by a summary of agent's practices and insights into the relationship between structure and agency. Fourth, Outcomes i.e., O (4) in relation to the preservation, modification or transformation of structures are presented. Lastly, important relationships identified using TTU-SST are discussed. In order to engage with Stones' (2005) sliding ontological scale, findings and discussions shift between focusing on schools and/or teachers as the unit of analysis. Figure 22 provides a diagrammatic view of the structure for the meta-theory findings and discussion.

Figure 22: Structure of Meta-Theory Findings and Discussion



9.5.1 Context

- **School 1**

School 1 is a middle range, technology-rich, e-learning, independent IEB school with most learners coming from advantaged homes and aims to provide a family-like and caring environment for both teachers and learners. The school has a pro-technology stance and while all teachers at the school utilise technology there are variations in the nature of their use. The move to remote learning was almost seamless as the school invested in

additional resources, training and support and when schools opened a hybrid approach was employed.

- **School 2**

School 2 is a lower range, pay-only, ICT-enabled independent school with learners coming from low-income homes. The school has a mandatory technology policy that seems to restrict rather than motivate teachers. While the academic project was able to continue for most learners when remote, the school employed a staggered attendance model when schools opened to accommodate social distancing.

- **School 3**

School 3 is a non-fee-paying, e-learning, government-funded school with learners from very disadvantaged backgrounds who have an aptitude for the sciences. While the school has a strict discipline policy, teachers tend to favour technology use, are extremely dedicated and view themselves as mentors. When remote, the academic project was severely restricted due to learners' inability to purchase data and the school employed a staggered attendance model when schools opened due to large class sizes.

- **School 4**

School 4 is a non-ICT designated, fee-paying, multi-racial, ex-Model C school with mainly disadvantaged learners. As the school receives limited government subsidies, it relies solely on fees and limited SGB funds to purchase and maintain technology resources. While some teachers maintain that the school values technology use, others believe the school does little to actively promote technology integration. The school has a hierarchical structure with a firm discipline policy and underlying positional and racial tensions are evident between staff. While the academic project basically ceased when remote, upon opening, a staggered attendance model was employed by the school to accommodate social distancing and the school invested in additional technology for teachers.

9.5.2 Selected Teachers

The rationales behind selecting a representation of teachers at each school for the meta-perspective using TTU-SST are: Firstly, comprehensive within-case findings and discussions for all teachers interviewed at each school relative to the change in

educational context[87] and cross-case analyses[88] and summary of micro and meso findings have already been presented. Secondly, after applying Stones' (2005) composite research strategy[89], where the data for all teachers was analysed using the steps in relation to the quadripartite nature of structuration, it was evident teachers with similar IS within each school could be grouped together to make the volume of data for the meta-theory analysis more manageable. Thirdly and most importantly, as the focus of a meta-analysis is to assess whether TTU-SST offers a novel, valuable and meaningful way to understand teachers' technology use whilst considering SST's quadripartite nature of structuration, duality of structure and the relationships of structuration, presenting a detailed data analyses for each teacher is not necessary.

To gain a rich understanding of similar and diverse views within each school and facilitate comparison across schools, after analysing all the teachers using Stones' composite research strategy, the following criteria adapted from Feeney and Pierce (2016) were used to select teachers: (1) teachers holding similar opinions or teaching comparable type subjects were grouped together and within the grouping, the teacher who provided the most interesting and in-depth insights was selected and (2) teachers holding different views from most of the other teachers in the school or teaching a different type of subject were selected. Using these criteria resulted in a total of seven teachers being selected: School 1 with two teachers, School 2 with two teachers, School 3 with one teacher and School 4 with two teachers. The rationale for selection is detailed below.

- **Carol and Magda - School 1**

Findings indicate that besides PDs, Lennie, Carol and Shirley hold comparable ES beliefs, IBs and OTTs. Likewise, Maxine and Magda hold similar beliefs and possess similar PDs. **Carol** has been selected from the first grouping as she teaches social science and possesses a more integrated code and thus her insights may provide support for pervasive claims within much of the educational technology literature. **Magda** has been selected from the second grouping since she is the most experienced teacher interviewed at School 1 and thus not only has current beliefs but also has historical insights to share.

[87] See Chapters 5 to 8 for detailed micro and meso within-case analyses for each school.
[88] See Chapter 9, Section 9.3.1 for micro and meso cross-case analyses.
[89] A detailed description of Stones' (2005) composite research strategy can be found in Chapter 3 section 3.2.3 and is graphically depicted in Figure 10.

- **Phillip and Mpho - School 2**

Findings indicate that besides different PDs, Phillip and Chantal hold many similar ES beliefs, IBs and OTTs. So too hold Mpho and Mattie similar beliefs despite possessing different PDs. **Phillip** has been selected from the first grouping since, although he teaches maths and possesses only collection codes, he favours technology use contrary to educational technology literature and thus his insights may provide novel and interesting insights. Likewise, **Mpho** has been selected from the second grouping because she teaches English and possesses mainly integrated codes but prefers not to utilise technology contrary to prevalent claims in educational technology literature.

- **Kgomotso - School 3**

Findings indicate that besides different PDs, Ben, Nombuso and Kgomotso hold many similar ES beliefs, IBs and OTTs. **Kgomotso** has been selected from the first grouping as she teaches civil technology which consists of theory and practical work and thus may provide interesting insights about teachers' technology use for more mixed subjects.

- **Candice and Thuli - School 4**

Findings indicate that besides different PDs, Thuli, Malefa, and Patrick hold many similar ES beliefs, IBs and OTTs, while **Candice** holds vastly different views from her peers. **Thuli** has been selected as she is relatively new to teaching, possesses a combination of codes depending on grades and favours technology use but reports being unable to utilise technology due to the lack of ES at the school and thus her insights may provide a better understanding of the importance of addressing external barriers within the country.

Table 45: Summary of Micro and Meso Findings of Schools and Selected Teachers

School 1
Technology-rich school with mainly advantaged learners, extensive technology infrastructure, pro-technology views and strong school, peer support and technical assistance – almost seamless move to remote and hybrid with significant investment made in training and resources access
Carol, Social Science, 15 years' experience
Carol has learner-centred beliefs and high technology self-efficacy. Carol appreciates the school's pro-technology policy as she values technology and focuses on different ways to incorporate it. With the context change, while Carol still believes technology is essential, she feels face-to-face teaching is critical.
Magda, Maths, 38 years' experience
Magda has teacher-centred beliefs and medium technology self-efficacy. While Magda values technology, she uses it to simply support teaching, focuses on barriers, and finds the school's technology policy constraining. With the context change, while Magda now appreciates technology more, she still believes face-to-face teaching is preferable.
School 2
Independent e-learning with more disadvantaged learners, limited technology infrastructure, mandatory technology use policy, and mainly sufficient school and technical assistance – moved platforms and trained teachers to enable remote and hybrid approaches
Phillip, Maths, 10 years' experience
Phillip has teacher-centred beliefs and high technology self-efficacy. While Phillip values technology and focuses on different ways to use it, he believes it is not always suited to his subject and the school's technology use policy is not effective. With the context change, he feels his role is more facilitative, but feels learners' technology issues are a concern.
Mpho, English, 6 years' experience
Mpho has mainly learner-centred beliefs and low technology self-efficacy. Mpho has mixed beliefs about technology, resents being forced to use it and thus utilises it minimally. With the context change, even though she is more positive about the value of technology, she prefers face-to-face teaching and is concerned with learners' technology barriers.
School 3
Government school with an e-learning strategy with mainly disadvantaged learners, teachers very committed to mentoring the learners, mainly good technology infrastructure, peer and technical assistance available – move to remote and hybrid hampered by learners' technology issues.
Kgomotso, Civil Technology, 4 years' experience
Kgomotso has a mixed pedagogical stance with high technology self-efficacy. Kgomotso values technology, and uses it extensively where it makes sense, with little focus on barriers. With the context change, Kgomotso still values technology, despite learners' technology barriers.
School 4
Non-ICT designated government school with mainly disadvantaged learners, limited government subsidies, very limited technology infrastructure, and minimal support, training and technical assistance – due to technology issues the academic project ceased when moving remote, resuming to a degree when using a hybrid approach as extra technology infrastructure was provided
Candice, CAT, 30 years' experience
Candice has a mixed pedagogical stance with high technology self-efficacy. While Candice values technology and tries to utilise it wherever she can, the lack of technology resources at the school frustrate her. With the context change, Candice continued to use technology wherever possible, and welcomed the school's provision of additional resources when using a hybrid approach, but is concerned about learners' technology issues.
Thuli, Social Science, 2 years' experience
Thuli has a mixed pedagogical stance with high technology self-efficacy. While Thuli values technology, she reports being unable to incorporate it when on campus and remote, due to lack of resources at her school. With the school's provision of additional technology resources, Thuli is utilising technology more extensively but still feels learners' technology issues are barriers.

9.5.3 External Structures: Degrees of Control[90]

According to Stones (2005), ES consist of independent causal influences over which the agent has no control and irresistible causal influences where the agent can choose to resist or comply as there is some degree of control. The relationship being discussed in this section is between the school's (agent) context and degrees of control which limit or enable an agent's ability to influence their ES.

Carol and Magda report **School 1** has a wide range of suitable and good quality technology resources (ES-R), dedicated on-site and remote technical assistance, peer mentoring and supports teachers attending technology courses (ES-S). However, both agree technology training (ES-TR) at the school is erratic and not always useful and learning and using technology takes time (ES-T). When moving to remote and hybrid learning, although Carol and Magda report using technology is taking extra time, both report the school ensured teachers and learners had appropriate technology (ES-R), set up small support teams (ES-TR; ES-S) and provided additional training (ES-TR) to assist with the transition.

Phillip and Mpho report **School 2** actively supports technology use (ES-S), has mainly appropriately arranged, suitable and good quality technology resources (ES-R), on-site and remote technical assistance. However, both agree technology training (ES-TR) at the school is not useful and should rather focus on how to use technology for teaching specific subjects, and learning and using technology takes time (ES-T). When moving to remote and hybrid learning, although Phillip and Mpho report using technology is taking extra time (ES-T) and data access is an issue for some teachers and most learners (ES-R), they report the school has changed to a less data intensive e-learning system (ES-R) and provided teachers with ongoing support and training (ES-S; ES-TR).

Kgomotso reports **School 3** actively supports technology use (ES-S), has mainly appropriately arranged, suitable and good quality technology resources (ES-R) and adequate on-site technical assistance. However, Wi-fi is slow (ES-R), technology training (ES-TR) is too infrequent and initially learning to use technology takes time (ES-T). When moving to remote and hybrid teaching, Kgomotso reports even though time is needed to

[90] Codes for External Structures (ES) can be found in Table 8 in Section 3.2.2.

learn new technology skills (ES-T) and there is limited technology training and support (ES-TR; ES-S), it is learners' inability to purchase data that is severely constraining teaching efforts.

Candice and Thuli report many technology resources (ES-R) at **School 4** are unsuitable, technology training is non-existent (ES-TR), technical and school support is lacking (ES-S) and learning and using technology takes time (ES-T). Yet, while Candice maintains most teachers have access to devices (ES-R), Thuli disagrees. When remote, both report only some teachers have access to devices (ES-R), no additional hardware or data (ES-R) or training has been given (ES-TR) and there is little school support (ES-S). However, upon returning to campus, even though Candice and Thuli report the school has funded (ES-S) access to *Google Classroom* and *MS Teams*, upgraded the school Wi-Fi, given devices to teachers (ES-R), arranged some training (ES-TR) and is offering limited peer support (ES-S) – learners' inability to purchase data is still severely constraining teaching efforts.

- **Summary of Schools' Degrees of Control over ES**

Findings indicate that **on campus** even though technology training (ES-TR) at **Schools 1-3** is not ideal and learning and using technology takes time (ES-T), technology resources (ES-R) and support (ES-S) are sufficient. While **School 1** and **2**, which are privately funded schools, have some degree of control over ES i.e., irresistible causal influences, **School 3** which is a government funded school with no-fee-paying learners has no control over ES i.e., independent casual influences. Similarly, **School 4** which is also government funded but receives little subsidy, for the most part has no control over ES i.e., independent casual influences, with very basic resources (ES-R), no technology training (ES-TR) and very little support (ES-S) as it is a non-ICT designated school.

When moving to **remote** and **hybrid** approaches, it seems as if **School 1**, which has significant private funding and an advantaged learner population, was able to transition almost seamlessly as control of ES exists i.e., irresistible casual influences, with extensive investments in additional resources (ES-R), training and support (ES-S; ES-TR) being made whereas even though **School 2**, which has limited funds and a more disadvantaged learner population, managed to keep the academic project afloat as there is some degree of control of ES i.e., irresistible casual influences, with additional resources (ES-R), training (ES-TR) and support (ES-S) being provided, independent causal influences, such

as learners' inability to purchase data and social distancing requirements with large classes are barriers. However, due to ES challenges over which the school has no control i.e., independent causal influences, **School 3** has barely been able to keep the academic project going, and while initially, when remote, the academic project almost ceased in **School 4** due to a lack of ES i.e., independent causal influences, when moving back to campus the school utilised its limited funds (ES-S) to provide additional resources (ES-R), training (ES-TR), thus exercising some degree of control over ES i.e., irresistible casual influences and enabling teaching and learning to continue.

While Stones (2005) contends ES are either irresistible or independent casual influences, it seems as if changes in the educational context, such as the COVID-19 pandemic which forced schools to shift to remote and hybrid approaches, may result in more complex and progressive combinations. Furthermore, although these ES exist outside of the agent, they are not entirely objective as they encapsulate each agent's goals, dispositions and priorities of concerns (Feeney & Pierce, 2016) and influence the way in which agents within their professional and personal context draw on the available ES (Stones, 2005). Therefore, to understand how teachers utilise technology and engage with ES within their school it is necessary to explore teachers' Internal Structures (IS), which includes their conjunctural-specific beliefs (CSB) and general dispositions i.e., Internal Beliefs (IB) and Professional Dispositions (PD).

9.5.4 Internal Structures: Dimensions of Structuration

According to Stones (2005), Internal Structures (IS) which describe all aspects of an agent's internal knowledge are used by in numerous situations and context and are completely subjective, and thus differ for every agent (Feeney & Pierce, 2016). The relationship being discussed in this section is between the teacher's (agent) context, IS and ES, through the dimensions of structuration.

- **Internal Beliefs (IB) and Professional Dispositions (PD)[91]**

Stones (2005) states an agent's dispositional frame is often not responsive to change as it describes a person's worldviews, skills, attitudes and beliefs – formed over a long period of time (Greenhalgh & Stones, 2010) through the actions and events of everyday life

[91] Codes used for Internal Beliefs (IB) and Professional Disposition (PD) can be found in Table 8 in Section 3.2.2.

(Feeney & Pierce, 2016). As this study was interested in understanding teachers' technology use, general dispositions include internal beliefs (IB) which describe teachers' second-order beliefs about technology and professional disposition (PD) which describes the way teachers feel about their pedagogic practices.

Carol, an experienced social science teacher, has a more integrated PD with weak classification (PD-I) and a knower code (IB-K) as she maintains teachers should facilitate learning (IB-P) by actively engaging learners (PD-I) through collaboration (IB-P) as knowledge is acquired in any direction (PD-I) by interacting with the world (IB-K; PD-I) as school knowledge on its own is meaningless (PD-I). Carol's PD also has aspects of collection codes present as she believes strong teacher–learner boundaries exist (PD-R) and she controls the classroom (PD-R). Carol reports most of her peers (IB-N) and the school (IB-N) are pro-technology and while she is expected to use technology in her teaching (IB-N) she maintains using technology is essential and thus a code match (IB-K) is evident. Furthermore, Carol feels very comfortable integrating technology into her teaching (IB-SE) and personal life (IB-SE) and where necessary, is able to teach herself (IB-K; IB-SE). Although Carol feels technology is even more important (IB-V) due to the shift in the educational context, she believes some of her peers are not managing (IB-N) as they lack knowledge of technology affordances and utilisation (IB-K; IB-V). She maintains face-to-face teaching is preferable as learners now need more support (IB-P) and have to put in considerably more effort (IB-V) to succeed in the online space.

Magda, a very experienced maths teacher, has a more collection PD and aspects of integration codes also present as she believes that, although strong teacher–learner boundaries exist (PD-R) and she controls the classroom (PD-R), teachers should actively engage learners (PD-I) as knowledge can be acquired in any direction (PD-I) by applying school knowledge outside (PD-I) and thus, she possesses a knower code (IB-K) with weak classification (PD-I). Magda reports the school expects teachers to use technology (IB-N) and even though she feels incorporating technology is valuable (IB-V), a code clash (IB-K) exists as she simply uses technology for what is needed by the school (IB-N). Furthermore, while Magda feels comfortable with technology (IB-SE) and can teach herself (IB-SE), she maintains that strong utilisation knowledge (IB-K) is needed prior to integrating technology into her teaching (IB-SE) and reports using technology in a very limited manner in her personal life (IB-SE). With the shift in educational context, Magda

feels using technology is more important (IB-V) and she reports using technology more effectively as she has gained more utilisation knowledge (IB-K) and has been able to build up a bank of future resources (IB-V) but she maintains face-to-face teaching is preferable since online can be isolating (IB-P; IB-V).

Phillip, an experienced maths teacher, has a collection PD as he believes strong teacher–learner boundaries exist (PD-R) and he controls the classroom (PD-R) in order to impart skills and ensure learners do their work (IB-P). Furthermore, Phillip maintains that school knowledge is more essential (PD-I) and should be acquired first in a vertical manner (PD-I) with constant repetition (PD-I) and thus, he possesses a knower code (IB-K) with strong classification (PD-I). Phillip maintains although technology is a core value of the school (IB-N), not all his peers are favourable towards integrating technology (IB-N) as they lack knowledge of technology utilisation (IB-K) and affordances (IB-K) and thus more training is needed (IB-N; IB-K). In addition, even though Phillip is comfortable using technology extensively (IB-SE) and believes technology is valuable (IB-V), a code clash (IVB-V) exists because Phillip feels technology should only be used to benefit learners (IB-V; IB-P) and not just to conform with the school's technology policy (IB-N). With the educational context shift, Phillip believes as technology has become more essential (IB-V), his role is more facilitative (IB-P) as teacher–learner boundaries have blurred (PD-R). Furthermore, Phillip reports he is using technology more extensively and thus feels more confident (IB-SE). However, he maintains the change is challenging for older teachers (IB-N), requires considerably more learner self-motivation (IB-V) and parental involvement (IB-V) as well as disadvantages learners from less privileged backgrounds (IB-V).

Mpho, an English teacher, has an integrated PD and aspects of collection codes are also present, as even though she believes strong teacher-learner boundaries exist (PD-R) and she controls the classroom (PD-R), she feels mutual respect is essential (PD-R) as it allows her to share and engage with learners and enable their growth (IB-P), with knowledge acquired in any direction (PD-I) and thus she possesses a knower code (IB-K) with weak classification (PD-I). While Mpho feels technology is valuable (IB-V) and believes many of her peers are favourable towards technology (IB-N), a code clash exists (IB-K) as she resents the school pushing technology use (IB-N) and she maintains teachers need to mindful of use (IB-V). In addition, while Mpho feels comfortable using technology in her personal life (IB-SE), she prefers not to (IB-V) and reports she is not

confident using technology in her work life (IB-SE) as she lacks utilisation knowledge (IB-V). With the educational context shift, Mpho feels that even though she values (IB-V) and uses technology more (IB-P; IB-SE), she is still reluctant to use technology extensively as she feels she needs more time to gain utilisation knowledge (IB-K; IB-SE), believes technology-based approaches are not suitable for all learners (IB-V) because engaging and motivating learners are more challenging (IB-V) and technology use disadvantages less affluent learners (IB-V).

Kgomotso, a relatively newly qualified civil technology teacher has more collection PD and aspects of integration codes are also present as she believes that even though strong teacher–learner boundaries exist (PD-R) and she controls the classroom (PD-R), she aims to impact learners' lives positively by providing guidance (IB-P). Furthermore, although she believes school knowledge provides structure to everyday knowledge (PD-I), she maintains knowledge can be acquired in either direction (PD-I) by practically doing things (PD-I) and thus she possesses a knower code (IB-K) with weak classification (PD-I). Kgomotso believes the school promotes technology use (IB-N) by providing access to resources (IB-N) and encouraging and supporting technology use (IB-N) and while most younger teachers are favourable (IB-N) older teachers seem more resistant (IB-N). A code match (IB-K) seems to exist as Kgomotso values technology in her teaching (IB-V; IB-SE) and feels comfortable using technology in her personal life (IB-SE). With the educational context shift, Kgomotso reports teacher–learner boundaries have become less formal (PD-R) and even though she believes technology has become essential (IB-V) it should be used more extensively (IB-V) and require teachers to upskill (IB-SE; IB-K) and be aware of the affordances (IB-K), Kgomotso feels a blended approach is needed (IB-V; IB-P) as technology cannot replace teachers (IB-V; IB-P) because it is hard to motivate learners online (IB-V) and technology simply amplifies current inequalities between advantaged and disadvantaged schools and learners (IB-V; IB-N).

Candice, a very experienced CAT teacher, has a combination of collection and integrated codes present in her PD as although she believes moderate teacher–learner boundaries exist (PD-R), she strongly controls the classroom (PD-R) but maintains her teaching role is to guide and mentor learners (IB-P) by providing skills (IB-P). In addition, Candice believes knowledge is horizontal (PD-I) and can only be applied once everyday knowledge is acquired (PD-I) and thus Candice possesses a knower code (IB-K) with weak classification

(PD-I). While Candice feels technology is valuable for teaching (IB-V; IB-SE) and is comfortable using technology in her personal life (IB-SE), a code clash (IB-K) exists as she maintains the school does not promote technology integration actively (IB-N) because available funds are often not allocated to resources (IB-N). Furthermore, Candice feels that many of her peers are not in favour of using technology (IB-N) as they do not want to change their existing practices (IB-P), learn new skills (IB-N; IB-K) and become more aware of technology affordances (IB-V). When remote, Candice maintains her peers are still disinterested (IB-SE) and feels the school does not value technology use (IB-N) since no additional resources have been provided. However, when back on campus, Candice's belief seems to have shifted due to the school's investment in additional resources (IB-N). In addition, while Candice feels her role is now more about giving over content (IB-P) and maintains she is using technology more than her peers due to her extensive utilisation knowledge (IB-K), she believes technology use only amplifies inequalities between advantaged and disadvantaged learners (IB-V).

Thuli, a newly qualified social science teacher, has different PD codes (PD-R), with collection codes i.e., stronger boundaries and greater teacher control (PD-R) for younger grades and more integrated codes i.e., less strict boundaries and more shared control (PD-R) for higher grades. Furthermore, she aims to help learners achieve their best (IB-P) by promoting active engagement and communication (IB-P), as she believes knowledge can be acquired in either direction (PD-I) with different knowledge structures needed depending on the subject being taught (PD-I) and thus she possesses a knower code (IB-K) with aspects of weaker and stronger classification (PD-I). Thuli values technology (IB-V) and feels comfortable using technology in her personal life (IB-SE) and in her teaching (IB-SE) but maintains that while the school (IB-N) and her peers (IB-N) believe technology is important, it does not prioritise funding technology (IB-N) which makes it challenging for teachers (IB-N) and thus a code clash (IB-K) exists. Although Thuli reports the school did little to enable technology use and teacher–learner communication when remote (IB-N; IB-V), when using a hybrid approach Thuli's belief seems to have shifted due to the school's investment in additional resources (IB-N). However, Thuli maintains using technology has resulted in weaker teacher–learner boundaries (PD-R) and personal connection with learners (IB-P; IB-V) and believes the current inequalities between advantaged and disadvantaged schools and learners are only being amplified by extensive technology use (IB-V; IB-N).

While agents bring generic capabilities and dispositions to any particular situation, what an agent actually does in a specific context and why depends on a combination of various factors within different conjunctures (Stones, 2005; Greenhalgh & Stones, 2010; Feeney & Pierce, 2016; Elbasha & Wright, 2017) and therefore teachers' CSB need to be discussed.

- **Conjuncturally-Specific Beliefs (CSB)[92]**

Stones (2005) states that conjuncturally-specific beliefs (CSB) which are particular to a specific time, place, role or task, provide the link between ES and IS as agents-in-focus continually interact with ES and the surrounding context in their day-to-day activities (Feeney & Pierce, 2016). Within this study, each different educational context, school and teacher constitutes a conjuncture by encapsulating a particular arrangement of events and situations.

In **School 1** Carol and Magda believe the school provides access to a wide range of resources (ES-R) that are appropriately arranged (ES-R) with responsive on-site technical support (ES-S) but both agree the quality of the Wi-Fi (ES-R) could be improved. While Carol who maintains she is constantly spending time learning new technology skills (ES-T) feels technology training at the school is insufficient (ES-TR), Magda believes training is sufficient (ES-TR) as she is familiar enough with technology to do what is needed (ES-T) and thus is not keen to spend extra time exploring and learning about new ways to utilise technology (ES-T). When remote, despite the extra time spent on preparing lessons (ES-T) and extending technology skills (ES-T), both Carol and Magda believe school support (ES-S), peer mentoring (ES-S) and additional "how to" training (ES-TR) has really assisted teachers, however, while Carol maintains the school has provided excellent access to resources (ES-R) and head office training has addressed pedagogic challenges (ES-TR), Magda feels the school could have done more to provide teachers with data access (ES-R) and maintains that physically arranging the desktop camera is challenging (ES-R). On returning to campus, both teachers report training (ES-TR) is mainly being provided informally by their peers (ES-TR), and while Magda believes too much extra time is needed to set up resources to record live lessons (ES-T), Carol maintains that even though she is more familiar since she utilises technology more consistently in her teaching

[92] Codes for Conjuncturally-Specific Beliefs (CSB) can be found in Table 8 in Section 3.2.2.

(ES-T), the time needed to pre-record lessons and record live lessons (ES-T) is not sustainable.

In **School 2** when on campus, Phillip and Mpho believe teachers have sufficient access to quality resources (ES-R) that are appropriately arranged (ES-R) with responsive on-site and remote support (ES-S) but feel training needs to focus more on incorporating technology into specific subjects (ES-TR). In addition, even though Phillip feels *ITSI* is unsuitable for maths (ES-R), learners need access to Wi-Fi (ES-R) and technology training is too infrequent (ES-TR), he believes the school supports technology use by providing additional apps where needed (ES-S). Both Phillip and Mpho believe even though they are quite familiar with technology (ES-T), extra time is needed to use and explore technology affordances (ES-T). However, while Mpho feels technology saves time inside and outside of class (ES-T), she maintains time is wasted when switching between subjects on the tablet (ES-T) and Phillip believes technology slows him down (ES-T). When remote, even though Phillip and Mpho feel teachers have access to school laptops (ES-R), a less data intensive e-learning system (ES-R) "how to" training (ES-TR) and peer and school support (ES-S), they believe data access issues have not been adequately addressed (ES-R) and significant amounts of extra time is needed to prepare and teach additional lessons (ES-T). On returning to campus, both teachers report technical "how to" training (ES-TR) and peer support (ES-S) is still being offered and while they believe they have had to spend time extending their technology skills (ES-T), Phillip maintains the extra time needed to teach in class and remotely is not sustainable (ES-T).

In **School 3** Kgomotso believes that besides the slow Wi-Fi (ES-R) and sometimes irrelevant technology training (ES-TR), teachers and learners have sufficient access to quality resources which are appropriately placed (ES-R), with good on-site technical support, an ICT steering committee and dedicated interns (ES-S). While Kgomotso maintains she is familiar with technology, she feels initially using technology takes time (ES-T) but believes it is worthwhile as it saves time in the future and provides more explanation time in class (ES-T). When remote, Kgomotso reports even though formal technology training (ES-TR) has not been provided, peer support (ES-S) is available and she feels familiar with the new technology tools (ES-T) but reports even though she has a school laptop (ES-R) she is unable to utilise the remote tools due to learners' resource constraints (ES-R) and thus is using *WhatsApp*. When back on campus, Kgomotso reports

learners' data access issues still exist (ES-R) and extra time (ES-T) is needed to upskill and reskill teachers.

In **School 4,** while Candice reports on campus most teachers have access to resources (ES-R) Thuli maintains resources at the school are very limited (ES-R). However, both agree that many of the resources are unsuitable (ES-R), the physical arrangement of some resources is not conducive (ES-R), technology training is non-existent (ES-TR), school support of technology is lacking (ES-S) and more responsive technical assistance is needed (ES-S). In addition, even though Candice and Thuli feel familiar with using technology in their teaching (ES-T), Thuli believes extra time is needed when utilising technology due to resource constraints (ES-T) and Candice maintains extra time is needed to learn how to use and incorporate technology in lessons (ES-T). When remote, both Candice and Thuli report no additional technology resources (ES-R), technical and institutional support (ES-S) and technology training (ES-R) were provided. Notwithstanding these barriers, Candice reports she has spent time becoming familiar with new technology tools (ES-T) while Thuli maintains even though she is familiar with technology tools for remote teaching (ES-T) she has been unable to utilise them due to lack of access (ES-R). On returning to campus, both believe teachers' access to resources has improved (ES-R), and some peer support (ES-S) and online training is taking place (ES-TR), however Thuli reports she still does not have a school issued device (ES-R).

- **Summary of CSB from Perspective of Structuration Dimensions**

In **School 1** when **on campus**, **Carol**, who enjoys using technology, is always looking to gain new skills, and believes ES structures at the school are supportive of technology use, draws on the technology structures of *signification* as a means to educate learners and *legitimation* structures to sanction her actions based on the normative expectations of technology use within education whereas **Magda**, who values technology and believes ES structures at the school support technology use but maintains she mainly incorporates technology to conform with school policy, draws on *legitimation* structures in relation to the normative expectations of technology use in the classroom and the structures of *domination* to abide by the school's technology policy. However, when **remote** and using a **hybrid** approach, **Magda** also begins to draw on *signification* structures to make meaning of her increased technology interactions as she believes currently utilising technology is the only viable way to educate learners.

In **School 2** when **on campus**, **Phillip**, who values technology but feels there are limitations for using technology in his subject, and the school's technology policy is not motivating integration, draws on the technology structures of *legitimation* to sanction his actions based on the normative expectations around using technology within education and structures of *domination* to obey the school's technology use policy. So too, **Mpho**, who values technology but believes one needs to be mindful of technology use, prefers not to use technology in her personal life and maintains the school's mandatory technology is restrictive, draws on *domination* structures in order to comply to the school's expectation of technology use. Yet, when **remote** and using a **hybrid** approach, **Phillip** utilises technology more as a *signification* structure to make sense of his increased technology use while **Mpho** draws on *legitimation* structures to sanction her increased technology use in relation to the changing normative rules of the educational context.

In **School 3** when **on campus**, **Kgomotso**, who enjoys using technology is always looking to gain new skills and believes ES structures at the school are supportive of technology use, draws on the technology structures of *signification* as a means to educate learners. However, when **remote** and using a **hybrid** approach, even though **Kgomotso** believes technology is now even more valuable, she feels technology amplifies current inequalities, and thus draws on *legitimation* structures to sanction her decreased technology use in relation to the changing normative rules of the educational context.

In **School 4** when **on campus**, **Candice**, who teaches CAT, believes using technology is essential and has better access to ES than her peers but feels the school does not prioritise technology, draws on the technology structures of *legitimation* to sanction her actions based on the normative expectations around using technology within her subject and structures of *domination* to exercise power and exert influence over her peers in regard to technology resources whereas **Thuli**, who values technology and feels it really enhances teaching but maintains that the lack of ES at the school inhibits utilising technology in her teaching, draws on the technology structures of *signification* as a means to educate learners and structures of *legitimation* to sanction her inability to use technology. When **remote** and using a **hybrid** approach, **Candice** utilises technology as a *signification* structure to make sense of her increased technology use while **Thuli** once again draws on *legitimation* structures to sanction her inability to use technology when

remote and on technology structures of *signification* as a means to educate learners when using a **hybrid** approach.

- **Summary of Relationships between Internal and External Structures from Perspective of Structuration Dimensions**

From analysing teachers' IS through the TTU-SST lens it seems that teachers with **IS commonalities** react **similarly to ES** while teachers who possess **different IS** may react **differently to ES**, even within the same school. For example **Magda** (School1) and **Mpho** (School 2) who possess similar IS, draw on structures of *domination* when on campus as even though they value technology, they believe their schools' technology integration policies restricts them and thus they simply utilise technology because they are required to, while **Kgomotso** (School 3) and **Thuli** (School 4) who also possess similar IS and believe technology is essential as it enhances their teaching, draw on structures of *signification* when on campus to communicate their value of using technology in education and structures of *legitimation* to sanction their inability to utilise technology due to lack of ES at their schools. On the other hand, in **School 1** where ES support technology integration, while both teachers draw on *legitimation* structures to sanction use of technology in education due to the normative expectations, **Carol** draws on technology structures of *signification* as she believes technology enhances education whereas **Magda** draws on *domination* structures to abide by the school's technology policy.

Furthermore, it seems as if teachers' **IS do not exist in a vacuum** as they can be shaped and modified through interactions. For example, findings indicate extreme changes in the educational context is shifting teachers' IS, even for those teachers with very entrenched IB and PDs such as **Phillip** (School 2), who when on campus possesses a strong collection code PD and draws on technology structures of *domination* as he believes using technology is limited in his subject but when remote and using a hybrid approach Phillip draws on technology structures of *signification* as he believes technology is now essential to education. Similarly, **Magda** (School 1) who, when on campus, also draws on structures of *domination* as she simply uses technology to abide by school policy, now believes using technology is the only way to carry on with the academic project and thus also draws on structures of *signification*.

While analysing the agent-in-focus' ES and IS provides an understanding of why teachers behave in a certain manner, it is also necessary to explore teachers' actions to make

sense of teachers' technology use in particular situations (Stones, 2005; Greenhalgh & Stones, 2010; Feeney & Pierce, 2016; Elbasha & Wright, 2017).

9.5.5 Agent's Practices: Conduct and Context Analyses[93]

Stones (2005) contends Agent's Practices (AP) refers to those instances when agents take action i.e., when teachers use technology. While the action results from agent's practices at a particular time or place, it is the understanding of an agent's external and internal structure that provide meaning to the action (Feeney & Pierce, 2016). To counter Giddens' separation of structure and agency during analysis, Stones (2005) utilises conduct analysis to explore an agent's IS and context analysis to examine the external environment i.e., ES and Context (C) to ensure the interaction between structures and agency is considered (Feeney & Pierce, 2016). For conduct analysis, teachers with similar LAs, MAs and AP-AAs are discussed together and then, for context analysis, teachers' technology activities (AP-AA) are discussed per school. The relationship being discussed in this section is between the outside context where the school is the agent-in-focus and IS where teacher's conduct is the focus, which results in AP.

- **Conduct Analysis[94]**

Carol (School 1), **Phillip** (School 2), **Kgomotso** (School 3) and **Candice** (School 4) report that **on campus** they use technology in a product manner (AP-MA) to support their teaching and for administrative tasks (AP-LA, AP-AAS, AP-AAA) and also as an idea technology (AP-MA) to modify and redefine their existing pedagogic practices (AP-LA; AP-AAT). Whereas **Magda** (School 1), **Mpho** (School 2) and **Thuli** (School 4) report only using technology in a product manner (AP-MA) to support and improve their existing pedagogic practices and administrative tasks (AP-LA, AP-AAS, AP-AAA). When **remote,** while **Mpho** (School 2) reports she is now also using technology at an integration level (AP-LA, AP-AAS) to modify and redefine her teaching (AP-MA), **Carol** (School 1), **Phillip** (School 2) and **Candice** (School 3) report they are only using technology to support online teaching and administration (AP-AAS AP-AAA), **Thuli** (School 4) reports she is not using technology at any level (AP-LA), and **Kgomotso** (School 3) reports only utilising technology in a limited product manner (AP-MA; AP-AAS). When **back on campus**, in addition to **Carol** (School 1), **Phillip** (School 2), and **Candice** (School 3), **Thuli** (School 4)

[93] Codes for Agent's Practices (AP) can be found in Table 8 in Section 3.2.2.
[94] A description of each teacher's Internal Structures is detailed in section 9.5.4, and therefore is not repeated when discussing Agent's Practices.

also reports using technology to support teaching and administration (AP-AAS, AP-AAA), whereas **Kgomotso** (School 3) reports using less technology to support teaching.

- **Context Analysis**[95]

In **School 1**[96], Carol's and Magda's technology activities **on campus** both support teaching (AP-AAS) and administrative tasks (AP-AAA) and include content management, and searching information while Carol also reports using technology to access videos, conduct assessments and provide information to parents, as well as for virtual field trips and augmented reality activities (AP-AAT) that she believes transform her existing practice. However, when **remote** and using a **hybrid** approach, both Magda's and Carol's technology activities simply support online teaching (AP-AAS) and administrative tasks (AP-AAA) but Magda's administrative activities only include attending meetings and getting teacher support whereas Carol's also include virtual open days, catching up and communicating with learners.

In **School 2**[97], Phillip's and Mpho's technology activities **on campus** both support teaching (AP-AAS) and administrative tasks (AP-AAA) and include content management, showing videos and communication. In addition, Phillip also reports using technology to assist with marking as well as to transform his existing practice by exposing learners to other teaching approaches and providing individual learning experiences (AP-AAT). However, when **remote**, both Phillip and Mpho's technology activities simply support online teaching (AP-AAS) and administrative tasks (AP-AAA) and when **back on campus,** while both use technology to communicate with learners (AP-AAA), Phillip only uses technology to cater to learners at home (AP-AAS) whereas Mpho reports she is also using technology to record live lessons and conduct remote sessions (AP-AAS).

In **School 3**[98], Kgomotso's technology activities **on campus** support teaching (AP-AAS) and include content management, showing videos and searching for information as well as transform her pedagogic practices by bringing the outside world into the classroom (AP-

[95] A description of each school's External Structures is detailed in section 9.5.3, and therefore is not repeated when discussing Agent's Practices.
[96] School 1 has sufficient ES in place for teachers in all educational contexts, as well as for most learners.
[97] School 2 has mostly sufficient ES in place for teachers in all educational contexts, but learners lack access to technology when remote and using a hybrid approach.
[98] School 3 has mostly sufficient ES in place for teachers in all educational contexts, but learners severely lack access to technology when remote and using a hybrid approach.

AAT). However, when **remote**, Kgomotso's technology activities simply support limited online teaching (AP-AAS) and administrative tasks (AP-AAA) as learners lack access to data. Similarly, when **back on campus** with many learners remote, Kgomotso reports she is not using technology for teaching activities due to resources constraints but rather distributes content on paper or memory sticks.

In **School 4**[99], Candice's and Thuli's technology activities **on campus** both support teaching (AP-AAS) and administrative tasks (AP-AAA) which include content management, showing videos, assessments and recording marks. In addition, Candice also reports using technology to manage the lab resources (AP-AAA) and to communicate with learners (AP-AAA) as well as to transform her existing practice by animating explanations (AP-AAT). However, when **remote**, while Candice's technology activities support online teaching (AP-AAS) and administrative tasks (AP-AAA), Thuli reports not using technology for any activities due to resources constraints. When **back on campus**, with the provision of additional ES, both Thuli and Candice report using technology to support hybrid and online teaching and learning activities (AP-AAS) and administrative tasks (AP-AAA).

- **Summary of AP from Perspective of Structuration Dimensions**

On campus, while **all teachers** (Schools 1–4) draw on structures of *legitimation* in relation to the normative expectations of using technology to support teaching and administration activities, the nature of **activities** and **mode of use** seems to **differ** depending on teacher's **LA** and **MA**, with teachers like **Carol** (School 1), **Phillip** (School 2), **Kgomotso** (School 3), **Candice** (School 4) also drawing on structures of *signification* as they report using technology for a greater variety of supportive activities, as well as in an idea manner for activities that transform educational experiences.

However when **remote**, it appears as if the nature of supportive activities is **primarily** being **influenced by ES**, with teachers who have access to sufficient and appropriate ES utilising technology for more extensive supportive and administrative activities. For example **Carol** (School 1), **Magda** (School1), **Phillip** (School 2), **Mpho** (School 2) and **Candice** (School 4) draw on structures of *signification* to employ their school's technology

[99] School 4 has mostly insufficient ES for teachers when on campus and remote which improves when using a hybrid approach, but learners lack access to technology in all educational contexts.

resources and structures of legitimation to sanction the normative expectation to use technology to **support online teaching** and **administrative activities,** such as pre-recording lessons, online classes, posting learners' guides and content, assisting learners online, submission and feedback of learners' work, catching up absent learners, teacher support, attending meetings; and communicating with learners, whereas **Kgomotso** (School 3) reports even though learners' access to technology is constrained she is drawing on structures of *signification* to **support limited teaching activities** such as posting learners' guides and content, giving feedback, and allowing learners to submit work online, yet structures of *domination* are also present as she is only able to use certain tools and is unable to do anything to change learners' resource constraints. However, while structures of *domination* are also present for **Thuli** (School 4) as she reports being unable to utilise technology for any teaching or administration activities as there is no access to learners' contact details or technology resources, unlike Kgomotso (School 3) she draws on structures of *legitimation* to sanction her inability to use technology.

When **back on campus**, teachers at **Schools 1** and **2** continue to draw on structures of *signification* and *legitimation* and report they now are using technology to **support teaching** and **administrative** activities while for **Kgomotso** (School 3) structures of *domination* are now even more pronounced as she has resorted to using **paper** or **memory sticks** to distribute content due to resources constraints. However with the provision of additional ES at **School 4**, **Candice** reports she is still drawing on structures of *signification* and *legitimation* to **extend technology activities** and **Thuli** reports she is **now using technology** for activities such as pre-recording lessons, conducting live lessons, remote learner assistance and attending meetings and thus is also drawing on structures of *legitimation* and *signification*.

- **Summary of Relationship between Structure and Agency**

While Giddens (1984) claims in **routine** situations **structures dominate agency** and in situations characterised by abrupt **changes** that disturb established routines **agency** tends to **dominate**, the **analysis of AP** within this study seem to **suggest otherwise**. When **on campus**, **agency seems to dominate** as teachers technology activities (AP) seems to align more with their IS whereas in response to the COVID-19 pandemic and the immediate need for schools to shift to **remote** and **hybrid** type approaches **structures appear to dominate** as the difference in ES seems more important in influencing

teachers' technology activities. It is possible these findings that are in contradiction to Giddens (1984) can be attributed to the unprecedented nature of the pandemic which forced all schools and teachers to immediately engage with remote and hybrid educational approaches (Olivier, 2020) irrespective of their existing IS, ES and technology strategy as well as the inability of teachers in poorly resourced schools to exercise agency as the mandatory technology only amplified the vast inequalities amongst advantaged and disadvantaged schools and learners within South Africa (Mhlanga & Moloi, 2020; Le Grange, 2020).

As the effects of agency can modify, transform, or reproduce the ES and IS that constitute the beginning of the next cycle of structuration it is necessary to consider the Outcomes (O) of Agents' Practices (Stones, 2005; Feeney & Pierce, 2016; Elbasha & Wright, 2017).

9.5.6 Outcomes: Next Cycle of Structuration[100]

According to Stones (2005) outcomes (O) are the effects of action and interactions that result from the structuration cycle on ES and/or IS through which structures are reproduced, changed, or preserved and become the starting point for the next cycle of structuration (Feeney & Pierce, 2016; Elbasha & Wright, 2017). By analysing teachers' Current Technology Use (O-CTU) and Future Technology Use (O-FTU) it is possible to understand whether AP have resulted in structures being reproduced, modified or transformed. The relationships being discussed in this section are between ES, IS and AP and the resulting O.

Structural changes are evident in the **ES** of all schools due to change in educational context. In **Schools 1** and **2**, ES were **modified** when using a **remote** and **hybrid** approach as investments were made to provide additional technology and upgrade existing resources (ES-R) and more training (ES-TR) and support (ES-S) was given to assist teachers with the transition. In **School 4**, while initially the **lack of ES** resulted in structures being **reproduced**, when moving **back onto campus** some of the **ES** (ES-R) were **transformed** as teachers were given devices, new technology tools were purchased and some of the existing resources at the school were upgraded, yet, **structures** for **training** (ES-TR) and **support** (ES-S) at the school were basically **preserved**. However,

[100] Codes for Outcomes (O) can be found in Table 8 in Section 3.2.2.

in **School 3**, despite sufficient ES being in place when on campus, when **off campus** and using a **hybrid** approach, the school's and learners' inabilities to fund data and other required resources (ES-R) i.e., independent casual influences resulted in **ES** being **modified** as the technology-driven approach to teaching and learning became a more paper-based traditional format.

Structural changes are also evident in **teachers' IS** due to the mandatory requirement of using technology in order to continue with the academic project. For example, IS for **Magda** (School 1) and **Mpho** (School 2) who, prior to the pandemic did not hold strongly positive IBs around technology use within teaching, have been **modified** as they report not only are they using technology more, for a wider range of teaching activities (AP-AAS) and administrative tasks (AP-AAA), but they also report they value technology more (IB-V) as they believe technology is playing a crucial role in enabling teaching and learning while at the same time their IS are also being **preserved** as they believe technology cannot replace good teaching (IB-P) and their role in education is even more crucial. So too for teachers' like **Carol** (School 1), **Phillip** (School 2), **Kgomotso** (School 3), **Candice** (School 4), and **Thuli** (School 4) who strongly favoured integrating technology into their pedagogic practice prior to the pandemic (IB-V), their IS are also being **modified** by their use of technology, or lack thereof, for remote and hybrid teaching and learning. However, it seems these teachers IS are also being **transformed** as they now report technology is not the primary artefact engaging and motivating learners (IB-P) but rather they believe despite the massive benefits of using technology (IB-V), it is the teacher and the role they play in the classroom that makes a difference.

- **Summary of Outcomes and Structural Changes**

The analyses of Outcomes (O), which details and describes the effects of active agency, through the lens of TTU-SST, are critical as they help make meaning of the complex process involved in particular teacher's technology use within specific social and educational contexts. While findings indicate **Agent's Practices** (AP) i.e., teachers' use of technology is being **influenced** by the **changes in ES** in respective schools, with ES and AP being modified (O) in Schools 1 and 2, transformed (O) in School 4 due to the provision of additional ES and modified (O) in School 3 because of the lack of ES, it appears **teachers' IS** are also being **influenced** by the **changing educational context**. Furthermore, findings reveal how an **individual teacher utilises technology** depends on

the **interactions between ES and IS**, with duality of structure evident in the modified, transformed, or preserved **structures** resulting from **different APs**. For example, as Kgomotso's (School 3) IS align with the ES at the school when on campus, she incorporates technology into her teaching in a variety of ways, however when remote and using a hybrid approach ES barriers result in Kgomotso having to modify her behaviour. Whereas Thuli's (School 4) IS do not align with the school's ES when on campus and thus she reports using little technology in her teaching while when back on, campus the provision of additional resources results in Thuli using more technology and modifying her behaviour.

These findings are in keeping with Giddens (1984) and Stones (2005) who contend that structures are both the medium and outcome of interactions i.e., duality of structure, and thus it seems as if a **teachers' use of technology** is influenced as much by their **subjectivity** as it is by the **objective nature of the structures** with which they interact.

9.5.7 TTU-SST: Relationships

Using TTU-SST to analyse the relationships between different parts of Stones' (2005) quadripartite nature of structuration offers important and novel insights: firstly, teachers' general dispositional frames (IB and PD) influence their conjuncturally-specific beliefs (CSB) and secondly, conflict or alignment of teachers' general dispositions (IB and PD) with the school's technology policy can influence their use of technology (AP).

- **Teachers' IB and PD influence CSB**

Findings indicate teachers' IB and PD influence their CSB, with teachers who hold more **negative technology beliefs** tending to **focus on ES barriers** and teachers with more **positive beliefs** trying to **work around ES barriers**. For example, on campus teachers like Magda (School 1) and Mpho (School 2), who value technology (IB-V) but prefer not to incorporate it extensively into their teaching, tend to focus more on ES barriers (CSB) at their respective schools whereas Carol (School 1) and Kgomotso (School 3), who value technology (IB-V) and use it to support (AP-AAS) and transform their teaching (AP-AAT), tend to focus less on ES barriers (CSB).

- **Conflict or Alignment of Teachers' IB and PD with School's Technology Policy influence AP**

Findings suggest conflict or alignment of teachers' IB and PD with their schools technology use policy, influences how extensively and for what activities teachers utilise technology (AP). For example, Magda's (School 1), Phillip's (School 2) and Mpho's (School 2) IB and PD are in conflict with their school's technology use policy (IB-N; ES-S) i.e., **code clash**, and therefore they believe technology is an imposing influence, which results in them **utilising technology** for more **limited activities** (AP-AA) whereas Carol's (School 1) and Kgomotso's (School 3) IB and PD are **less conflicted** (IB-N; ES-S) and thus they perceive technology at their schools as enabling and consequently **incorporate** it **more extensively** and in a **greater variety of ways**. In School 4, both Candice's and Thuli's IB and PD are in conflict with their school's policy (IB-N; ES-S) i.e., code clash and hence, they believe the lack of technology resources (ES-R) constrains their technology activities.

Figure 23 shows a graphical representation of TTU-SST with arrows depicting relationships discussed and Table 46 provides a summary of the meta-theory findings and discussions.

Figure 23: TTU-SST (Meta-Theory Relationships)

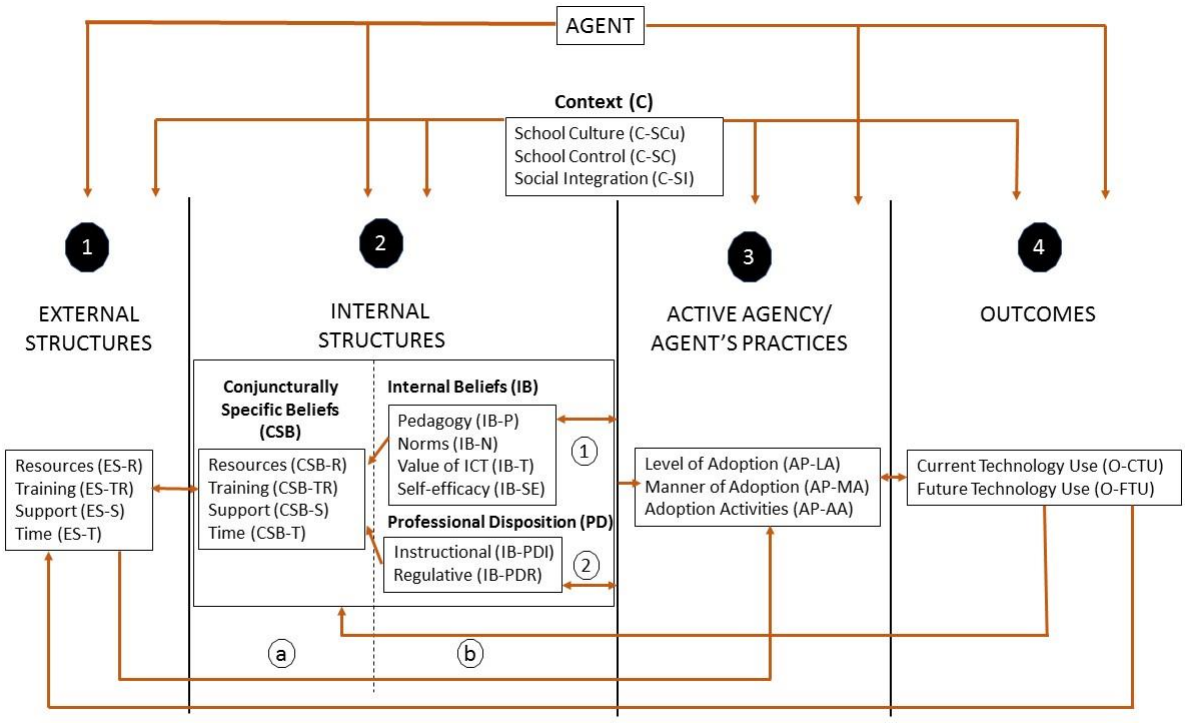


Table 46: Summary of Meta-Theory Perspective using TTU-SST

External Structures (ES)
External structures are not static and can shift between independent to irresistible casual influences depending on the surrounding context, and can also differ for teachers and learners at the same school
Internal Structures (IS)
Teachers with similar IS react in comparable ways to ES, whereas teachers with varied IS react differently to the same ES, even within the same school due to the alignment of teachers' CSB and general dispositional beliefs
Agents Practices (AP)
On campus teachers' IS, LA, and MA influence the nature of teachers' activities, as well as the mode in which technology is used, whereas due to the vast inequalities in ES at schools when remote and using a hybrid approach, ES primarily influences AP. Thus on campus agency dominates, and when remote and back on campus structures dominate
Outcomes (O)
Teachers' use of technology is being preserved, modified or transformed depending on the control the school has over ES, with the provision of additional ES i.e. irresistible casual influences resulting in modification, and the inability to provide the required technology i.e. independent causal influences resulting in preservation and modification of existing structures. In addition, teachers' IS and AP are being modified due to the change in educational context which requires all teachers to use technology
Relationships
• Teachers' IB and PD influence CSB, with teachers with positive beliefs focusing less on ES barriers and teachers with more negative beliefs focusing more on ES barriers • Conflict or alignment of teachers' IB and PD with the school's technology policy influences AP, with conflict limiting AP and alignment motivating AP

9.6 CONCLUSION OF META-PERSPECTIVE ANALYSIS USING TTU-SST

This chapter provided a summary of Structuration Theory (ST) and Strong Structuration Theory (SST) in order to review the motivation and construction of the theoretical framework, TTU-SST. Next, a summary of the application of SST concepts was provided, along with a high level cross-case overview of the micro and meso findings. Then, the context for each school and teachers selected to illustrate a meta-theory analysis were detailed. Next, using the findings from the micro and meso analysis along with TTU-SST, analyses of each part of the quadripartite nature of structuration were presented, followed by a discussion on the relationships between each part of the TTU-SST.

10 REFLECTIONS ON RESEARCH

To conclude, this chapter first provides an overview of the study by briefly detailing the research problem, gaps in the literature, research objectives and the theoretical framework TTU-SST developed for this study. Next, reflections on the subquestions posed are presented, along with micro and meso insights. Then, reflections on the main research question and on TTU-SST as a meta-theory, are discussed. Thereafter, the theoretical and practical contributions of the study in are detailed, followed by the limitations. Finally, recommendations for future research are presented.

10.1 OVERVIEW OF THE STUDY

Incorporating technology not only has the potential to improve teaching and the quality of education (Ertmer et al., 2012; Lim et al., 2013; Vandeyar, 2014; Nkula & Krauss, 2015; Avidov-Ungar & Forkos-Baruch, 2018) but within a South African context technology is also being advocated as a way to resolve the country's educational challenges (South African Department of Education, 2004; 2005; Motshekga, 2015; Padayachee, 2017; Van Der Ross and Tsibolane, 2017; Adukaite et al., 2016). Despite the government investing large amounts in technology infrastructure at public schools (Communications Directorate, 2019), many initiatives have been unsuccessful in addressing educational issues for the majority of learners in the country (Ford & Botha, 2010; Sherman & Howard, 2012; Adukaite et al., 2016; Van Der Ross & Tsibolane, 2017). Educational technology researchers claim teachers are responsible as their beliefs about technology and pedagogic practices are misaligned (Ertmer et al., 2015; Ertmer, 1999; Hennessy et al., 2010; Sherman & Howard, 2012) thus, they are unwilling to utilise technology to meet current educational requirements (Cuban, 2001; Prensky, 2010). However, Vannatta and Fordham (2004), Chen (2008), Tondeur et al. (2017), Padayachee (2017), and Altan et al. (2019) contend that teachers do not simply incorporate technology but that the underlying reasons for teachers' choices (Lawrence & Tar, 2018) and the critical role teachers' beliefs play in integration efforts (Vandeyar; 2014) must be better understood.

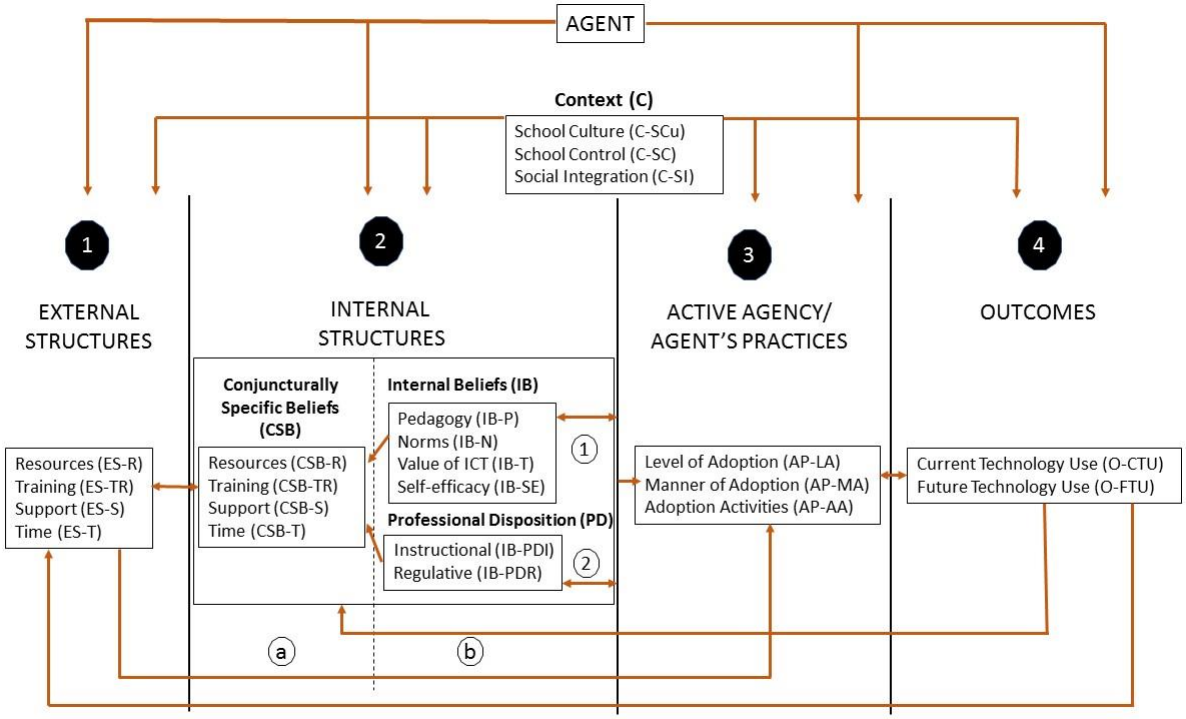
While these reasons for the study are still important, the global COVID-19 pandemic forcing teachers into a unique situation of utilising technology in order to continue with the academic project, has made this research even more crucial as there is little literature dealing with teachers' mandatory integration of technology during a pandemic (Ash &

Davis, 2009; Mhlanga & Moloi, 2020; Mailizar et al., 2020). In addition, while much of the world is slowly moving back to more face-to-face contact, the pandemic still rages in South Africa by the middle of 2021, with many public schools and teachers struggling to incorporate technology as a way to make remote and hybrid education more feasible in a country where large inequalities are pervasive (Davids, 2020; Le Grange, 2020; Mhlanga & Moloi, 2020).

Therefore, this study aimed to address gaps in the current literature by answering the main research question: *What is the relationship between external structures, beliefs, professional dispositions, and orientation towards technology in relation to their integration of technology within South African secondary schools in different school and educational contexts* in order to understand more deeply how internal and external barriers, teachers' beliefs, and social context influence teachers' subsequent technology use within South Africa. Furthermore, the study also aimed to provide a structured and theoretically grounded approach to exploring these complex relationships from a micro-, meso- and meta-perspective since many studies within educational technology tend to be conducted unsystematically and without appropriate frameworks—resulting in inconsistent, contradictory and unconvincing findings (Hennessy et al., 2005; Mama & Hennessy, 2013).

By adapting Stones' (2005) Strong Structuration Theory (SST), alongside Bernstein's theoretical lens of pedagogic practice and context (Bernstein, 1971; 1971a; 1996; 2000), Hoadley and Ensor's (2009) work on pedagogical discourses and Hooper and Rieber's (1995) description of technology integration, the theoretical framework *Teachers Technology Use-Strong Structuration Theory (TTU-SST)* was developed and utilised to analyse data collected at South African secondary schools with diverse social contexts. To assist the reader in reflecting on the discussions of the sub- and main research questions in relation to the theoretical framework, TTU-SST with the relationships identified is shown in Figure 24.

Figure 24: TTU-SST



10.2 REFLECTION ON SUBQUESTIONS AND MICRO AND MESO FINDINGS

10.2.1 Subquestions on Context[101]

Findings indicate that schools possess **stratified control** as all schools *group learners according to age* (Bernstein, 1971a; South African Institute for Distance Education, 2010), and **expressive cultures** are dominant because all teachers believe that providing formal school knowledge is important (Bernstein, 1975; South African Institute for Distance Education, 2010) although their primary aim is to *educate learners holistically*. Furthermore, while Bernstein (1971b) differentiates between mechanical and organic integration and findings show that schools with *strong discipline codes* and *hierarchical structures* possess **mechanical integration**, it seems as if it is more common for **combinations to exist** since teachers can *share opinions* as to school values and technology policies whilst at the same time believing their decision to *incorporate*

[101] Subquestion (q7) What is the context at different schools? was used to understand Context (C).

technology is personal, influenced by the *subject* they teach, established *pedagogic practices* and *technology skills*.

10.2.2 Subquestions on External Resources[102]

Findings indicate, similar to existing literature, that for integration to occur, teachers need regular access to suitable and quality resources (Ertmer & Ottenbreit-Leftwich, 2010; du Plessis, 2014; Johnson et al., 2016) and adequate technical and institutional support (Ertmer and Ottenbreit-Leftwich, 2010; Vongkulluksn et al., 2018; Hew & Brush, 2007; Rasheed et al., 2020; Vandeyar, 2014; Ertmer et al., 2012; Hadijah & Shalawati, 2017).

- **Resources and Support**

Findings indicate *on-campus* **resources** (ES-R) and **support** (ES-S) *vary greatly* between *different schools* and *exist on a continuum* from advantaged, independent schools with access to an abundance of suitable and quality technology resources and extensive support to less advantaged, independent schools and ICT-designated government schools with appropriate resources and adequate support and non-ICT designated government schools with little support and access to very scant technology resources of which much is broken or outdated. So too, when *moving off-campus, differences* in technology **resources** and **support** appear to be even *more amplified* with little or no technology resources or support being offered at government schools for teachers or learners while significant additional resources and support are provided at independent schools to assist teachers and learners with the shift to remote and hybrid approaches.

- **Training**

While frequent and relevant technology **training** (ES-TR) is essential for integration to occur (Tondeur et al., 2011; Ertmer et al., 2012; Johnson et al., 2016), findings indicate that although *peer support* is more consistent at advantaged, independent schools and ICT-designated government schools, *on-campus* training at all schools is lacking because it is mainly *technical*, *infrequent* and *theoretically based*. Nonetheless, when *moving off-campus*, as with resources and support, only *schools who have control of ES* i.e., irresistible casual influences, have been able to *provide teachers with the training* needed

[102] Subquestion (q1) What are the external technology structures at different schools and (q8) How do external technology structures differ between technology-rich and technologically disadvantaged schools? were used to understand External Structures (ES).

to learn how to use the new technology tools and effectively integrate technology into remote and hybrid teaching approaches.

- **Time**

Teachers also need time to become familiar with technology as well as sufficient time in class to make integrating technology feasible (ES-T) (Rogers, 2000; Cuban, 2001; Karasavvidis, 2009; Ertmer et al., 2012). Findings indicate that *on-campus*, **familiarity,** i.e., the time needed to learn how to utilise technology *does not vary much between schools* but differs instead based on teachers' *beliefs* about the *value of ICT* and their *self-efficacy* with less time needed for teachers who value technology and report having a high technology self-efficacy. Conversely, with **feasibility,** time needed seems to be influenced by the *school's technology resources, training* and the *subject being taught,* meaning that teachers at technology-rich schools find feasibility less of an issue and that most maths and accounting teachers find that time to incorporate technology is unfeasible. Similarly, when using a *remote* and *hybrid* approach, although **familiarity** still seems to be affected by teachers' value and self-efficacy beliefs, **feasibility** is almost *entirely dependent* on teachers' access to their *school's resources*, *training* and *support*.

10.2.3 Subquestions on Internal Structures[103]

Internal Structures (IS) are constructed from teachers' Conjuncturally-Specific Beliefs of External Structures (CSB) (Stones, 2005) as well as their general dispositions which consist of Internal Beliefs (IB) about technology (Liu & Johnson, 2000; Liu, 2011) and Professional Dispositions (PD) which describe the nature of their instructional and regulative discourses (Bernstein, 1971; 1986; 1996; 2000; Hoadley & Ensor, 2009; Hoadley & Muller, 2010; Morais, 2002; Singh, 2002).

- **Conjuncturally-Specific Beliefs**

Notwithstanding the importance of External Structures (ES) for technology integration, findings indicate that **Internal Beliefs** (IB) play an *equally important role* in shaping teachers' accounts of External Structures, i.e., **Conjuncturally-Specific Beliefs** (CSB), since teachers with Internal Beliefs (IB) that *value and support technology use tend to hold*

[103] Subquestion (q2) What are different teachers' beliefs around external technology structures? was used to understand conjuncturally-specific beliefs (CSB); (q3) What are different teachers' internal beliefs about technology and (q4) What are different teachers' professional dispositions? were used to understand teachers' general dispositions (IB and PD).

more positive beliefs about **External Structures** (CSB), even when External Structures (ES) are *insufficient*.

- **General Dispositions: Internal Beliefs and Professional Dispositions**

A number of important insights emerged in relation to teachers' IB and PD. Firstly, *conflict* between teachers' **normative** (IB-N), **value of ICT** (IB-V) and technology **self-efficacy** (IB-SE) **beliefs** and the **school's technology policy** result in a *code clash that discourages technology integration* whereas *alignment results in a code match* and *motivates teachers to incorporate technology* into their practices. Secondly, in contrast to much of the educational technology research that claims *teacher-centred pedagogical beliefs*, *teacher control* of the classroom and *strong teacher–learner boundaries* result in teachers choosing to *incorporate technology in a limited way*, findings indicate that **pedagogical beliefs** (IB-P) and **Professional Disposition** (PD) by themselves *do not seem to influence teachers' technology integration* as even teachers with strong teacher-centred pedagogical beliefs and performance-based pedagogies are integrating technology to support and enhance their pedagogic practices. It seems that teachers' **Internal Beliefs** (IB) relating to the *value of ICT*, technology *self-efficacy* and technology *affordance and utilisation knowledge* are indeed *essential*. Thirdly, findings indicate that it is impossible to neatly categorise teachers' **Professional Dispositions** (PD) because even though most are predominantly constructed from either **integrated** or **collection codes**, *many teachers possess a combination* thereof, including those who believe *knowledge is weakly classified* while at the same time maintaining that *strong framing of boundaries and control* are important and teachers who believe knowledge is strongly classified while simultaneously maintaining weaker framing of boundaries and control is needed.

- **Internal Structures can shift**

Teachers' **Internal Structures** (IS) are often seen as core beliefs formed over years and thus are hard to change (Ertmer, 2005; Fives & Gill, 2015). However, it seems the rapid *change in educational context* due to the COVID-19 pandemic which required all teachers to incorporate technology to continue with the academic project, has not only *challenged many teachers'* **Internal Beliefs** (IB) and resulted in *more positive beliefs* about technology use but has also shifted numerous teachers' **Professional Dispositions** (PD) to *more integrated codes* with less strongly framed teacher–learner boundaries and a

facilitative approach. Furthermore, it is evident teachers' **Internal Structures** (IS) and **External Structures** (ES) are *interconnected* as the provision of additional External Structures (ES) by certain schools appears to have resulted in more positive Internal Structures (IS).

10.2.4 Subquestions on Agent's Practices and Outcomes[104]

Teachers' Level and Manner of Adoption (AP-LA; AP-MA) (Hooper & Rieber, 1995; Sandholtz et al., 1997; Yucel et al., 2010; Cuban, 2012) can influence current and future Adoption Activities (AP-AAA; O-CTU; O-FTU) (Puentedura, 2006, 2013; Hamilton et al., 2016).

- **Agent's Practices, Outcomes, External Structures and Internal Structures**

While teachers at technology-rich schools who have sufficient **External Structures** (ES) utilise technology *more frequently* and for a *wider range of supportive* **Adoption Activities** (AP-AA), findings indicate teachers' **Internal Structure** (IS) *play an equally important role* in shaping **Agent's Practice** (AP) and their resulting **technology use** (O-CTU), because although all teachers utilise technology to *support* their *teaching and administrative tasks*, teachers who possess *positive* **Internal Beliefs** (IB) about technology and *perceive* **External Structures** *support technology integration* (CSB) tend to *use technology at higher* **Levels** and **Manners of Adoption** (AP-LA, AP-MA) to *enhance* and *transform* their existing practices, as well as for *more varied* **Adoption Activities** (AP-AA). However, it is important to note **Resources** (ES-R) are a *prerequisite for technology utilisation*, as even if teachers hold *positive* technology **Internal Beliefs** (IB), integration at any **Level** or **Manner** (AP-LA, AP-MA), or for any **Adoption Activities** (AP-AA) is *very limited without the appropriate technology*. Similarly, **External Structures** (ES) also appear to influence teachers' **Future Intended Use** (O-FTU), as many teachers believe that *without adequate* **External Structures** (ES) in place for *themselves* as well as for the *learners*, technology utilisation is impossible.

[104] Subquestion (q5) What are different teachers' orientation towards technology? was used to understand Agent's Practices (AP); (q6) How do you different teachers' use technology and (q9) How does technology use differ between teachers at technology-rich and technologically disadvantaged schools? were used to understand Outcomes (O).

- **Agent's Practices, Outcomes, and School and Educational Context**

School Context and the school's **technology policy** (S-C) are important in shaping teachers' **Adoption Activities** (AP-AA) and subsequent **technology use** (O-CTU), as findings indicate teachers who believe the school is *not supportive of technology* or *monitors use* tend to utilise technology at a *lower* **Level** and **Manner** (AP-LA; AP-MA) and for *more limited* **Adoption Activities** (AP-AA, O-CTU). The surrounding **educational context** also appears to be influencing teachers' **Level** and **Manner** (AP-LA, AP-MA) and **Adoption Activities** (AP-AA, O-CTU), with the change to *remote and hybrid* teaching and learning resulting in all teachers using technology for a *wider range of supportive* **Adoption Activities** (AP-AA). However, due to the *immediate need to accommodate off-campus approaches,* most teachers who were previously using technology at a higher **Level** and **Manner** (AP-LA, AP-MA) and for **Adoption Activities** (AP-AA) to enhance and transform their practices, it seems that **Current Technology Use** (O-CTU) is only supporting *teaching and administrative activities*.

10.2.5 Subquestions on Duality of Structure[105]

The concept of duality of structure aims to explain the contextual, recursive and constantly changing relationships that exist between structures and human agency (Giddens, 1984; Walsham & Han, 1990; Rose, 1998; Stones, 2005; Walsham & Han, 1990; Feeney & Pierce, 2016).

- **Importance of Context**

Findings suggest the **school context** (C) shapes teachers' **technology use** (AP-AA, O-CTU) in various ways: Firstly, *alignment* between teachers' **Internal Beliefs** (IB) and the *school's technology policy is essential* as conflict between these demotivates and discourages teachers from integrating technology into their practices, Secondly, schools with strong **peer mentoring support** (ES-S) cultures only serve to *motivate and encourage technology use* amongst its teachers. Thirdly, schools only have the ability to support teachers' incorporation of technology when they *possess a degree of control over ES* i.e., irresistible causal influences, as schools with *no control over teachers' or learners' ES* i.e., independent casual influences ultimately result in **teachers not using technology** (AP-AA O-CTU) despite *valuing ICT* and holding *strong technology self-efficacy beliefs*.

[105] Subquestions (q10) How do different school contexts influence teachers' use of technology and (q11) How do external structures, beliefs, professional dispositions, and orientation towards technology influence technology use in the classroom? were used to understand Duality of Structure.

Lastly, changes in **school context** (C) such as the *provision of additional* **resources** (ES-R) and **support** (ES-S) when off campus, can positively influence teachers' **technology use** (AP-AA, O-CTU), while the *lack* of **resources** (ES-R) *negatively impacts* **technology activities** (AP-AA, O-CTU).

- **Interaction between External Structures, Internal Structures and Agent's Practices**

Findings indicate teachers' **technology use** (AP) is not simply shaped by either a school's **External Structures** (ES) or teachers' **Internal Structures** (IS) but rather by the *interactions between these structures* which provide clarity and give meaning to individual teacher's **technology behaviour** (AP), as teachers tend to incorporate technology less and in more limited ways when their **Internal Structures** (IS) are opposed to technology integration, even within technology-rich schools.

10.3 REFLECTION ON MAIN RESEARCH QUESTION AND META-THEORY FINDINGS

Using TTU-SST to answer the main research question for this study *What is the relationship between external structures, teachers' beliefs, professional dispositions, and orientation towards technology in relation to their integration of technology within South African secondary schools in different school and educational contexts,* provided a structured theoretical lens at a methodological or meta-level that facilitated a deeper understanding of teachers' technology use and the relationships being studied. Key insights are: the nature of reflexive relationships in influencing teachers' technology use and an explanation of how the interactions between agency and structure result in the preservation, modification, and transformation of existing structures.

10.3.1 Reflexive Relationships

This study provides empirical evidence in support of the foundational tenet of Structuration Theory (ST) and Strong Structuration Theory (SST) which contends humans are purposeful agents that intentionally draw on structures through their interactions while at the same time preserving, modifying and transforming structures within a specific context (Giddens, 1984; Walsham & Han, 1990; Stones, 2005; Ma, 2010; Whittington, 2015) as findings suggest one cannot understand teachers' technology use by using a one-dimensional approach or by viewing relationships as unidirectional because interactions between structures and agency are reflexive and complex as duality exists.

Reflexive relationships identified within this study include teachers' Internal Beliefs (IB) and Professional Dispositions (PD) influence Conjuncturally-Specific Beliefs (CSB) and Agent's Practices (AP) while concurrently Conjuncturally-Specific Beliefs (CSB), Agent's Practices (AP) and Outcomes (O) are being influenced by External Structures (ES) and Agent's Practices (AP) influence Outcomes (O) while concurrently Outcomes (O) influence Agent's Practices (AP), teachers' Internal Structures (IS and External Structures (ES).

10.3.2 Preservation, Modification, and Transformation

Outcomes (O) are a result of **Agent's Practices** (AP) and describe the result of action and interaction on **Internal** (IS) and **External Structures** (IS) (Stones, 2005; Feeney & Pierce, 2016). By using TTU-SST to understand the relationships between agency and structure this study offers clarity as to why and how **Internal Structures** (IS), **External** (IS) **Structures** and **Agent's Practices** (AP) are preserved, modified, or transformed (O). Findings indicate the nature and extent to which teachers integrate technology into their pedagogic practices are not simply related to any single factor (Tondeur et al., 2017) but rather teachers' technology use is a consequence of the complex, multidimensional and recursive relationships that exist and continuously shift, between external structures, teachers' beliefs, professionals dispositions and orientation towards technology.

10.4 CONTRIBUTION OF THE RESEARCH

10.4.1 Theoretical

- **Non-advocacy and theory-based research**

While much educational technology literature aims to convince teachers to incorporate technology and claims teachers need to change their existing practices to accommodate technology, this study simply offers an understanding of teachers' technology use and how the context and relationships between external structures, intrinsic beliefs and pedagogic practice influence teachers' technology integration. Furthermore, as educational technology research mainly relies on anecdotal evidence with little attention to studying research phenomenon in a structured and theoretically grounded way, much of the evidence is contradictory and inconsistent. While this study contributes to an understanding of the complexities surrounding teachers' technology integration, it also illustrates the importance of utilising a theory to underpin research from design to interpretation of findings as it provides evidence that is more consistent, robust, rigorous and relevant.

- **Review of Technology Research Models**

The IS field draws on multiple disciplines and thus, while researchers are faced with an abundant choice of technology adoption theories to guide their studies, there are very few reviews that categorise and provide a holistic view of these theories. This study provides a detailed, comprehensive, and thorough picture of the common technology adoption theories, sociological theories, structuration theories and educational technology theories used within IS to assist researchers in navigating this expansive landscape of theories.

- **Research during a Pandemic**

This study was initially conceptualised before the outbreak of COVID-19 and the first interview took place prior to the closure of schools in South Africa, however, following the declaration of a global pandemic and the unprecedented change in educational contexts around the world which forced all teachers to utilise technology irrespective of their technology beliefs and skills, this study was adjusted to accommodate this shift and thus provides an important contribution to an emerging body of knowledge where considerations of mandatory technology use, shifting of teachers' established pedagogic practices, challenging core beliefs, and a radically different educational context are now a reality.

- **Value of TTU-SST as a Theoretical Framework**

Unlike positivist technology adoption frameworks that aim to predict teachers' technology use in a unidirectional manner like the Theory of Planned Behaviour (TPB) which was considered for this study, and Tondeur's (2020) Pedagogical Beliefs – Technology Model (PBT) which identifies factors influencing teachers' technology use but does not provide a structured way to understand recursive interactions between these factors, Strong Structuration Theory (SST) enables researchers to study recursive relationships between humans and technology in a structured manner by considering the duality of structures. This study, which adapted SST to focus on education and technology, not only provides a novel and powerful way to explore teachers' technology use by considering the reflexive relationship between agency and structures whilst bearing in mind the surrounding context, but as SST has not been used extensively within empirical educational technology research, this study also offers a valuable and structured theoretical framework that can be used to conduct further research into technology adoption within an educational context.

10.4.2 Practical

- **Government**

The government's vision of using technology to improve the quality of education in the country and prepare learners for the future has only been amplified by the current pandemic's need to use technology to enable remote and hybrid approaches, as the majority of teachers and learners at government schools in South Africa lack adequate access to appropriate technology resources. To enable the academic project to continue short-term due to the pandemic and to realise their vision in the longer term, the government needs to make substantial investments in upgrading current technology infrastructure for all schools and teachers; to find a way in which disadvantaged learners can be given the data and devices needed to access content and participate in online classes and provide more consistent technical support and training to facilitate effective use of technology.

- **Schools**

Schools play an important role in teachers' technology use: Firstly technology use policies that mainly monitor and enforce use and require teachers to utilise technology in all situations often result in teachers not incorporating technology into their classroom practice, and thus schools need to be mindful when constructing these policies to ensure that they motivate and support technology use. Secondly, to enable teachers to realise the benefits that technology offers, frequent training covering both technical and pedagogical aspects of utilising technology needs to be provided. Thirdly, while responsive technical support is a prerequisite to address technology problems so that teachers do not expend time and effort on technicalities, it is essential for the school to also create a peer mentoring culture to support teachers in exploring and utilising technology more effectively. Fourthly, schools need to ensure there is sufficient access to suitable and quality technology resources as it is unlikely that integration will take place without teachers and learners having these resources. Lastly, schools need to appreciate that all teachers do not necessarily need to use technology to change or transform their pedagogic practices but rather teachers need to incorporate technology where it makes sense and benefits their teaching.

- **Teachers**

As the use of technology to facilitate remote and hybrid education is the only way in which teachers can continue with the academic project, teachers need to consider how they can incorporate technology more effectively into their existing pedagogic practices. Furthermore, teachers need to invest time in growing their technology self-efficacy by becoming more skilled in technology utilisation within their subject and aware of the possibilities technology offers.

- **Technologists**

Teachers do not simply incorporate technology into their teaching because they are required or because other people believe they need to. Teachers utilise technology where it makes sense to support, enhance and where appropriate, transform their pedagogic and administrative practices. Therefore, while technologists believe technology can only improve education, they need to appreciate that educational goals and objectives and not technology drives teachers' technology integration behaviour.

10.5 LIMITATIONS

- **Sample**

As this research aimed to explore the influence of social contexts on teachers' technology integration, data was collected at technology advantaged and disadvantaged schools. However, while schools may differ in terms of their level of technology endowment, teachers may come from similar social contexts irrespective of the school at which they teach and thus a deep understanding of the influence of teachers' social context may be limited. Furthermore, even though teachers were interviewed until saturation was reached at each school it is possible that only teachers who felt strongly about using or not using technology agreed to take part in the study and therefore the findings may not be representative of all teachers at a particular school.

- **Research Design**

This study began prior to the COVID-19 pandemic and thus while the initial research design included teacher interviews and subsequent observations to triangulate methods and data, the closure of schools in South Africa followed by limited people being allowed on campuses made conducting observations impossible and thus a set of three interviews

conducted at prior, at the start, and during the pandemic was used. Therefore, only data triangulation was achieved. In addition, when using interviews to collect data, it was assumed that participants not only provided accurate accounts of the research phenomenon but were also aware of and able to articulate their beliefs or opinions. Although semistructured protocols were used and interviews were assessed for quality, it is possible participants self-reports of espoused use may not be consistent with their enacted use or may not have provided a comprehensive account to all questions posed.

10.6 FUTURE RESEARCH

A number of future studies would be beneficial: Firstly, this study only collected data in the Gauteng as the South African government has mainly focused on providing technology to public schools within the province and thus it would be beneficial to carry research in other provinces within the country where technology initiatives are less prevalent. Secondly, as this study only utilised teachers' self-reported accounts of technology use, collecting data via observations would provide a more accurate picture of whether teachers' espoused beliefs and technology integration align with their enacted practices. Thirdly, as the pandemic is still raging in South Africa and the pervasive use of technology within education is still essentially mandatory, conducting further longitudinal research within the country would be beneficial in understanding how technology will influence educators in the future; fourthly, while TTU-SST appears to be a useful theoretical framework for understanding teachers' technology use within a developing country with vast technology inequalities, such as South Africa, carrying out research in more developed countries with greater equality of technology infrastructure can assess whether TTU-SST is a valuable guide for studies interested in understanding teachers' technology use. Lastly, using alternative concepts to define and describe teachers' pedagogic practices may provide greater insights as to why educational technology literature claims teachers' professional dispositions on their own can influence teachers' technology use.

10.7 AFTERWORD

At the start of this study, the world looked different, a place where masks were only worn by health care workers and concepts like flatten the curve, social distancing, lockdowns, and waves of infection were mostly unknown. So too within education. Although technology was already being used pervasively, face-to-face classes were the norm and

remote and hybrid teaching and learning were the exception. With the global COVID-19 pandemic, things that we could never even imagine became a reality, as teachers' entrenched pedagogical practices and beliefs about technology were challenged. Furthermore, while technology enabled the academic project to continue for the most part, it also amplified the vast technology inequalities that exist between schools' within South Africa. Although it remains to be seen whether recent changes in technology use within education will become the new normal, my journey over these last two-and-a-half years has only served to confirm my beliefs that teachers' integration of technology cannot simply be attributed to sufficient resources or alignment of beliefs, but rather that teachers' technology use consists of a myriad of complex, interrelated and multifaceted relationships.

REFERENCES

Abbott, J. & Faris, S., 2000. Integrating technology into pre-service literacy instruction: A survey of elementary education students' attitudes toward computers. *Journal of Research on Computing in Education,* Volume 33, pp. 149-182.

Admiral, W., Louws, M., Lockhorst, D., Paas, T., Buynsters, M., Cviko, A., Janssen, C., de Jonge, M., Nouwens, S., Post, L. & van der Ven, F., Kester., 2017. Teachers in school-based technology innovations: A typology of their beliefs on teaching and technology. *Computers and Education,* Volume 114, pp. 57-68.

Adukaite, A., van Zyl, I. & Cantoni, L., 2016. The role of digital technology in tourism education: A case study of South African secondary schools. *Journal of Hospitality, Leisure, Sport & Tourism Education,* Volume 19, pp. 54-65.

Agyei, D. D. & Voogt, J. M., 2011. Exploring the potential of the will, skill, and tool model in Ghana: predicting prospective and practicing teachers' use of technology. *Computers & Education,* Volume 56, pp. 91-100.

Al-Jabri, I. & Sohail, M. S., 2012. Mobile Banking Adoption: Application of Diffusion of Innovation Theory. *Journal of Electronic Commerce Research,* 13(4), pp. 379-391.

Altan, S. & Lane, J. F., 2019. Teachers' narratives: A source for exploring the influences of teachers' significant life experiences on their dispositions and teaching practices. *Teaching and Teacher Education,* Volume 74, pp. 238-248.

Altan, S., Lane, J. F. & Dottin, E., 2019. Using Habits of Mind, Intelligent Behaviors, and Educational Theories to Create a Conceptual Framework for Developing Effective Teaching Dispositions. *Journal of Teacher Education,* p. 169–183.

Al-Yateem, N., 2012. The effect of interview recording on quality of data obtained: a methodological reflection. *Nurse Researcher,* 19(4), pp. 31-35.

Anderson, C., 2010. Presenting and Evaluating Qualitative Research. *American Journal of Pharmaceutical Education,* 78(4), pp. 1-7.

Anderson, S. E. & Maninger, R. M., 2007. Preservice teachers' abilities, beliefs, and intentions regarding technology integration. *Journal of Educational Computing Research,* 37(2), pp. 151-172.

Anderson, T., 2011. Towards a theory of online learning. In: T. Anderson, ed. *The theory and practice of online learning.* Edmonton: Athabasca University Press, pp. 45-74.

Angeli, C. & Valanides, N., 2009. Epistemological and methodological issues for the conceptualization, development, and assessment of ICT-TPCK: Advances in technology and pedagogical content knowledge. *Computers and Education,* Volume 52, pp. 154-168.

Anthony, A. B., 2012. Activity Theory as a Framework for Investigating District-Classroom System Interactions and Their Influences on Technology Integration. *Journal of Research on Technology in Education,* 44(4), pp. 335-356.

Anyon, J., 1982. Adequate social science, curriculum investigations, and theory. *Theory into Practice,* 21(1), pp. 34-37.

Archambault, L. M. & Barnett, J. H., 2010. Revisiting Technological Pedagogical Content Knowledge: Exploring the TPACK Framework. *Computers & Education,* 55(4), pp. 1656-1662.

Artino, A. & Stephens, J., 2009. Academic motivation and self-regulation: A comparative analysis of undergraduate. *Internet and Higher Education,* Volume 12, pp. 146-151.

Ash, K. & Davis, M. R., 2009. E-Learning's Potential Scrutinized in Flu Crisis. *Education Week,* 28(31), pp. 1-12.

Assarroudi, A., Nabavi, F H., Armat, M R., Ebadi, A. & Vaismoradi., 2018. Directed qualitative content analysis: the description and elaboration of its underpinning methods and data analysis process. *Journal of Research In Nursing,* 23(1), pp. 42-55.

Atieno, P., 2009. An Analysis of the Strengths and Limitations of Qualitative and Quantitative Research Paradigms. *Problems of Education in the 21st Century,* Volume 13, pp. 13-18.

Atkinson, R. & Flint, J., 2011. Snowball Sampling. In: M. Lewis-Beck, A. Bryman & T. F. Liao, eds. *The SAGE Encyclopedia of Social Science Research.* Thousand Oaks, CA: SAGE Publications, p. 1044.

Ayres, L., Kavanaugh, K. & Knafl, K., 2003. Within-Case and Across-Case Approaches to Data Analysis. *Qualitative Health Research,* Volume 13, pp. 871-883.

Ayres, L., 2012. Grand Theory. In: L. M. Given, ed. *The SAGE Encyclopedia of Qualitative Research Methods.* Thousand Oaks, CA: SAGE Publications, p. 374.

Azjen, I., 1985. From intentions to actions: A theory of planned behavior. In: J. Kuhl & J. Beckman , eds. *Action-control: From cognition to behavior.* Heidelberg: Springer, pp. 11-39.

Azjen, I., 1991. The theory of planned behavior. *Organizational behavior and Human Decision Processes,* 50(2), pp. 179-211.

Azjen, I., 2002. *Constructing a TPB questionnaire: conceptual and methodological considerations.* Available at: https://people.umass.edu/aizen/pdf/tpb.measurement.pdf [Accessed 19 May 2019].

Azjen, I., 2005. *Attitudes, Personality and Behaviour.* 2nd ed. New York, NY: Open University Press.

Azjen, I., 2006. *Behavioral Interventions Based on the Theory of Planned Behavior,* Amherst: University of Massachusetts.

Azjen, I., 2016. The theory of planned behaviour is alive and well, and not ready to retire: a commentary on Sniehotta, Presseau, and Araújo-Soares.. *Health Psychology Review,* 9(2).

Azjen, I. & Fishbein, M., 1980. *Understanding attitudes and predicting social behaviour.* Englewood Cliffs, NJ: Prentice Hall.

Bandura, A., 2000. Exercise of human agency through collective efficacy. *Current directions in psychological science,* 9(3), pp. 75-78.

Bandura, A., 2004. Health Promotion by Social Cognitive Means. *Health Education & Behavior,* 31(2), pp. 143-164.

Bannon, L. & Kaptelinin, V., 2000. From human-computer interaction to computer-mediated activity. In: C. Stephanidis, ed. *User interfaces for all: Concepts, methods, and tools.* Mahwah, NJ: Lawrence Erlbaum, pp. 183-202.

Barbour, R. S., 2001. Checklists for Improving Rigour in Qualitative Research: A Case of the Tail Wagging the Dog?. *BMJ Clinical Research,* Volume 322, pp. 1115-1117.

Beal, G. M. & Rogers, E. M., 1960. *The adoption of two farm practices in a central Iowa community*. Iowa State University.

Becker, M. R., 2000. *Faculty development model: addressing the disparity between pre-service and in-service educators in technology integration of the public school classroom.* Chesapeake, VA, Society For Information Technology and Teacher Education.

Becta, 2004. *What the research says about using ICT in Geography,* Coventry: British Educational Communications and Technology Agency.

Bellamy, R., 1996. Designing educational technology: Computer-mediated change. In: B. Nard, ed. *Context and consciousness: Activity theory and human-computer interaction.* Cambridge: The MIT Press, pp. 123-145.

Benbasat, I., Dexter, A. S. & Todd, P., 1986. An Experimental Program Investigating Color-Enhanced and Graphical Information Presentation: An Integration of the Findings. *Communications of the ACM,* 29(11), pp. 1094-1105.

Bengtsson, M., 2016. How to plan and perform a qualitative study using content analysis. *Nursing PlusOpen,* Volume 2, pp. 8-14.

Bergdahl, N. & Nouri, J., 2020. Covid-19 and Crisis-Promoted Distance Education in Sweden. *Technology, Knowledge and Learning.*

Berliner, D. C., 2002. Comment: Educational research: the hardest science of all. *Educational Researcher,* 31(8), pp. 18-20.

Bernstein, B., 1971a. On the classification and framing of educational knowledge. In: M. F. Young, ed. *Knowledge and Control: New directions for the sociology of education.* London: London: Collier MacMillan, pp. 47-69.

Bernstein, B., 1971b. Open schools, open society? .. In: B. R. Cosin , I. R. Dale, G. Esland & D. F. Swift, eds. *School and society: a sociological reader.* Cambridge, Massachusetts: MIT Press, pp. 66-69.

Bernstein, B., 1975. *Sources of consensus and disaffection in education. Class, Codes and Control.* London: Routledge and Kegan Paul.

Bernstein, B., 1986. On pedagogic discourse. In: I. J. Richardson, ed. *Handbook of theory and research in sociology of education.* Westport, CT, pp. 205-239.

Bernstein, B., 1996. Pedagogizing Knowledge: A study in recontextualisation. In: *Symbolic Control and Identity: Theory, Research, Critique.* Taylor & Francis, pp. 54-81.

Bernstein, B., 1999. Vertical and horizontal discourse: An essay. *British Journal of Sociology of Education ,* Volume 20, pp. 157-173.

Bernstein, B., 2000. *Symbolic Control and Identity: Theory, Research, Critique.* Lanham, Maryland: Rowman & Littlefield.

Blackstone, A., 2012. Micro, Meso, and Macro Approaches. In: *Sociological Inquiry Principles: Qualitative and quantitative methods.* Creative Commons.

Blackwell, C. K, Lauricella, A R., Wartella, E., Robb, M. & Schomburg, R., 2013. Adoption and use of technology in early education The interplay of extrinsic barriers and teacher attitude. *Computers and Education,* Volume 69, pp. 310-319.

Bladergroen, M. & Buckley, S., 2016. *Management of ICT in education: A meta-study on the local South African and International research landscape.* Paper 37, CONF-IRM 2016 Proceedings.

Blair, E., 2015. A reflexive exploration of two qualitative data coding techniques. *Journal of Methods and Measurement in the Social Sciences,* 6(1), pp. 14-29.

Borg, M., 2001. Teachers' Beliefs. *English Language Teaching Journal,* 55(2), pp. 186-188.

Borko, H., Liston, D. & Whitcomb, J., 2007. Apples and fishes: The debate over dispositions in teacher education. *Journal of Teacher Education,* 14(5), pp. 1-6.

Bostrom, R. P., Gupta, S. & Thomas, D., 2009. A meta-theory for understanding Information Systems within sociotechnical systems. *Journal of Management Information Systems,* 26(1), pp. 17-47.

Boucke, O. F., 1923. The limits of social science: II. *American Journal of Sociology,* 28(4), pp. 443-460.

Boudon, R., 1991. What Middle-Range Theories Are. *Contemporary Sociology,* 20(4), pp. 519-522.

Bouhnik, D. & Deshe, M., 2014. WhatsApp Goes to School: Mobile Instant Messaging between Teachers and Students. *Journal of Information Technology Education: Research,* Volume 13, pp. 217-231.

Bourdieu, P., 1974. The school as a conservative force: scholastic and cultural inequalities. In: J. Eggleston, ed. *Contemporary research in the sociology of education.* London: Methuen.

Bourne, J., 2004. Framing talk: Towards a 'radical visible pedagogy'. In: J. Muller, B. Davies & A. Morais , eds. *Reading Bernstein, Researching Bernstein.* London: Routledge-Falmer, pp. 61-74.

Bourne, J., 2006. Official pedagogic discourses and the construction of learners' identities. In: M. Martin-Jones, M. A. de Mejia & N. H. Hornberger, eds. *Encyclopedia of Language and Education.* 2nd ed. New York: Springer, pp. 41-52.

Bowen, G. A., 2009. Document Analysis as a Qualitative Research Method. *Qualitative Research Journal,* 9(2), pp. 27-40.

Boyatzis, R. E., 1998. *Transforming qualitative information: Thematic analysis and code.* Thousand Oaks, CA: Sage.

Bradley, J., 1993. Methodological issues and practices in qualitative research. *Library Quarterly,* 63(4), pp. 431-449.

Bradshaw, L., 1997. Technology-supported change: A staff development opportunity. *NAASP Bulletin,* 81(593), pp. 86-92.

Brantley-Dias, L., Kinuthia, W., Shoffner, M B., DeCastro, C. & Rigole, N., 2007. Developing pedagogical technology integration content knowledge in preservice teachers: A case study approach. *Journal of Research on Computing in Teacher Education,* Volume 23, pp. 143-149.

Braun, V. & Clarke, V., 2006. Using thematic analysis in psychology. *Qualitative Research Psychology,* Volume 3, pp. 77-101.

Brickner, D., 1995. *The effects of first and second order barriers to change on the degree and nature of computer usage of secondary mathematics teachers: A case study.* West Lafayette, IN: Purdue University.

Brinkmann, S. & Kvale, S., 2015. *Interviews: Learning the craft of qualitative research interviewing.* 3rd ed. Thousand Oaks: CA: Sage Publications.

Brodie, R., 2004. *Virus of the mind: The new science of the meme.* Seattle, WA: Integral Press.

Buell, J., 2004. *Learning to teach with laptops: A case study of teacher change.* Chesapeake, VA, AACE, pp. 1984-1985.

Burant, T. J., Chubbuck, S. M. & Whipp, J. L., 2007. Reclaiming the moral in the dispositions debate. *Journal of Teacher Education,* 58(5), pp. 397-411.

Burns, J., 2010. Middle Range Theory. In: A. J. Mills, G. Durepos & E. Wiebe, eds. *Encyclopedia of case study research.* Thousand Oaks, CA: SAGE Publications, pp. 560-561.

Burrell, G. & Morgan, G., 1979. *Sociological paradigms and organizational analysis.* Heinemann Educational Books. Callahan, G., 2020. *Rev.* Available at: https://www.rev.com/blog/what-is-a-hybrid-learning-model [Accessed 20 Aug 2020].

Callon, M., 1986. Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay. In: J. Law, ed. *Power, Action and Belief: A New Sociology of Knowledge.* London: Routledge & Kegan Paul, pp. 196-223.

Calloway, D. L., n.d. *Adaptive Structuration Theory: Understanding How Advancing Technologies Drive Organizational Change.* Available at: https://www.academia.edu/667633/ [Accessed 3 June 2019].

Cambridge Dictionary, 2019. *Cambridge English Dictionary.* Available at: https://dictionary.cambridge.org/dictionary/english/orientation [Accessed 28 May 2019].

Carroll, D., 2012. Examining the development of dispositions for ambitious teaching: One teacher candidate's journey. *The New Educator,* 8(1), pp. 38-64.

Carter, N., Bryant-Lukosius, D., DiCenso, A., Blythe, J. & Neville, A J., 2014. The Use of Triangulation in Qualitative Research. *Methods & Meanings: Oncology Nursing Forum,* 41(5), pp. 545-547.

Castillo-Montoya, M., 2016. Preparing for Interview Research: The Interview Protocol Refinement Framework. *The Qualitative Report,* 21(5), pp. 811-831.

Cecez-Kecmanovic, D., Davison, R M., Fernandez, W., Finnegan, P., Pan, S. & Sarker, S., 2020. Advancing Qualitative IS Research Methodologies: Expanding Horizons and Seeking New Paths. *Journal of the Association for Information Systems,* 21(1), pp. 246-263.

Chen, C. H., 2008. Why do teachers not practice what they believe regarding technology integration?. *The Journal of Educational Research,* 102(1), pp. 65-75.

Chen, L., Gillenson, M. & Sherrell, D., 2004. Consumer acceptance of virtual stores: A Theoretical Model and Critical Success Factors for Virtual Stores. *ACM SIGMIS,* 35(2), pp. 8-31.

Chen, Y., Wang, Y. & Chen, N., 2014. Is FLIP enough? Or should we use the FLIPPED model instead?. *Computers & Education ,* Volume 79, pp. 16-27.

Cheok, M. L., Wong, S. L., Mohd Ayub, A. F. & Mahmud, R., 2016. Understanding teacher educators' beliefs and use of information and communication technologies in teacher training institute. In: J. Luaran, J. Sardi, A. Aziz & N. Alias, eds. *Envisioning the future of online learning.* Singapore: Springer, pp. 11-21.

Cheung, W., Chang, M. K. & Lai, V. S., 2000. Prediction of internet and world wide web usage at work: a test of an extended Triandis model. *Decision Support Systems,* 30(1), pp. 83-100.

Chien, S., Wu, H. & Hsu, Y., 2014. An investigation of teachers' beliefs and their use of technology-based assessments. *Computers in Behaviour,* Volume 31, pp. 198-210.

Chigona, A. & Chigona, W., 2010. Capability approach on pedagogical use of ICT in school. *Journal for Transdisciplinary Research in Southern Africa,* 6(1), pp. 209-224.

Chigona, A., Chigona, W. & Davids, Z., 2014. Educators' motivation on integration of ICTs into pedagogy: case of disadvantaged areas. *South African Journal of Education,* 34(3), pp. 1-8.

Childers, G. & Jones, M. G., 2017. Learning from a distance: high school students' perceptions of virtual presence, motivation, and science identity during a remote microscopy investigation. *International Journal of Science Education,* 39(3), pp. 257-273.

Christie, P., 2008. *Schools and Classrooms as places of learning. In: Changing Schools in South Africa: Opening doors of learning.* South Africa: Heineman.

Chua, W. M., 1986. Radical Developments in Accounting Thought. *The Accounting Review,* 61(4), pp. 601-632.

Chui, M., Manyika, J. & Miremadi, M., 2016. *Where machines could replace humans and where they can't (yet),* McKinsey Quarterly.

Clandinin, D. J. & Connelly, F. M., 2000. *Narrative Inquiry Experience and Story in Qualitative Research.* San Francisco, CA: Jossey-Bass.

Clark, K., 2006. Practices for the use of technology in high schools: a Delphi study. *Journal of Technology and Teacher Education,* 14(3), pp. 481-499.

Clark, U., 2005. Bernstein's theory of pedagogic discourse: Linguistics, educational policy and practice in the UK English/literacy classroom. *English Teaching: Practice and Critique,* 4(3).

Clark, V. L. & Creswell, J. W., 2014. *Understanding research: A consumer's guide.* 2nd ed. London: UK: Pearson Higher Ed.

Cohen, L. & Manion, L., 1994. *Research Methods in Education.* 4th ed. London: Routledge.

Collinson, V., 2001. Intellectual, Social, and Moral Development: Why Technology Cannot Replace Teachers. *The High School Journal,* Volume 85, pp. 35-44.

Communications Directorate, 2019. *2019 Estimate of National Expenditure,* Pretoria: National Treasury.

Compeau, D. R. & Higgins, C. A., 1995. Computer self-efficacy: Development of a measure and initial test. *MIS Quarterly,* 19(2), pp. 189-211.

Compeau, D., Higgins, C. & Huff, S., 1999. Social cognitive theory and individual reactions to computing technology: A longitudinal study. *MIS Quarterly,* 23(2), pp. 145-158.

Condie, R., Munro, B., Seagraves, L. & Kenesson, S., 2007. *The impact of ICT in schools – A landscape review,* BECTA.

Conlon, T., 2004. A failure of delivery: The United Kingdom's New Opportunities Fund programme of teacher training in information and communication technology. *Journal of In-service Education,* 30(1), pp. 115-140.

Corbin, J. & Strauss, A., 1990. Grounded Theory Research: Procedures, Canons, and Evaluative Criteria. *Qualitative Sociology,* 13(1), pp. 3-21.

Costa, A. L., 1991. The search for intelligent life. In: A. Costa, ed. *Developing minds: A resource book for teaching thinking.* Alexandria, VA: Association for Supervision and Curriculum Development, pp. 100-106.

Cox, S. & Graham, C. R., 2009. Using an Elaborated Model of the TPACK Framework to Analyze and Depict Teacher Knowledge. *Tech Trends,* 53(5), p. 60–69.

Cressman, D., 2009. *A Brief Overview of Actor-Network Theory: Punctualization, Heterogeneous Engineering & Translation*. School of Communication, Simon Fraser University.

Creswell, J. & Creswell, J. D., 2018. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches.* 5th Edition ed. Thousand Oaks, United States: SAGE-Publications Inc.

Creswell, J. W., 1998. *Qualitative inquiry and research design: Choosing among five traditions.* Thousand Oaks, CA: Sage Publications.

Creswell, J. W., 2007. *Qualitative Inquiry and Research Design: Choosing among Five Approaches.* 2nd ed. Thousand Oaks: SAGE Publications.

Cuban, L., 1993. *How teachers taught: Constancy and change in American classrooms, 1890–1990.* 2nd ed. New York: Teachers College Press.

Cuban, L., 2001. *Oversold and Underused Computers in the Classroom.* Cambridge: Harvard University Press.

Cuban, L., 2012. *Larry Cuban on School Reform and Classroom Practice.* [Online] Available at: https://larrycuban.wordpress.com/2016/09/11/stages-of-technology-integration-in-classrooms-part-3/
[Accessed 2 June 2019].

Czerniak, C. M., Lumpe, A. T. & Haney, J. J., 1999. Teacher's beliefs about thematic units in science. *Journal of Science Teacher Education,* 10(2), pp. 123-145.

D'Ambra, J., Wilson, C. & Akter, S., 2013. Application of the task-technology fit model to structure and evaluate the adoption of e-books by academics. *Journal of the American Society for Information Science and Technology,* 64(1), pp. 48-64.

Davids, N., 2020. *Maybe the coronavirus will set SA on a path to a more equitable education system.* Available at: https://news24/Columnists/GuestColumn/opinion-maybe-the-coronavirus-will-set-south-africa-on-the-path-to-a-more-equitable-education-system-20200327

Davis, F. D., 1989. Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly,* 13(3), pp. 319-342.

Davis, F. D. & Venkatesh, V., 1996. A critical assessment of potential measurement biases in the technology acceptance model: Three experiments. *International Journal of Human-Computer Studies,* 45(1), pp. 19-45.

De Vaus, D., 1993. *Surveys in Social Research.* 3rd ed. London: UCL Press.

De Wet, W., Koekemoer, E. & Nel, J. A., 2016. Exploring the impact of information and communication technology on employees' work and personal lives. *SA Journal of Industrial Psychology,* 42(1), p. a1330.

Dede, C., 1998. *Learning with technology: The 1998 ASCD Yearbook.* Alexandria, VA: Association for Supervision and Curriculum Development.

Deligiannaki, A. & Ali, M., 2011. *Cross-Cultural Influence on Diffusion and Adoption of Innovation: An Exploratory Case Study Investigate the Social-Cultural Barrier.* Athens, Greece, European, Mediterranean & Middle Eastern Conference on Information Systems.

DeLone, W. H. & McLean, E. R., 1992. Information Systems Success: The Quest for the Dependent Variable. *Information Systems Research,* 3(1), pp. 60-95.

Denessen, E., 2000. *Beliefs about education.* Apeldoorn: Garant.

Deng, F., Chai, C. S., Tsai, C. C., Lee, M. H. & Deng, M., 2014. The relationships among Chinese practicing teachers' epistemic beliefs, pedagogical beliefs and their beliefs about the use of ICT. *Journal of Educational Technology & Society,* 17(2), pp. 245-256.

Denzin, N., 1978. *Sociological methods: A sourcebook.* New York, NY: McGraw-Hill.

Denzin, N. K. & Lincoln, Y. S., 1998. *Collecting and interpreting qualitative materials.* London, UK: Sage Publications.

Department of Basic Education, 2015. *Education Statistics in South Africa 2013,* Pretoria.

Department of Education, 2007. *Guidelines for Teacher Training and Professional Development in ICT.* Available at: http://www.thutong.doe.gov.za/ResourceDownload.aspx?id=35998 [Accessed 18 November 2018].

Department of Education, 2020. *Minister Angie Motshekga on Basic Education Sector Plans to Support Learners during Coronavirus COVID-19 Lockdown.*

Derrington, M., 2019. *Qualitative Longitudinal Methods: Researching Implementation and Change.* SAGE Publications, Inc.

DeSanctis, G. & Poole, M. S., 1994. Capturing the Complexity in Advanced Technology Use Adaptive Structuration Theory. *Organization Science,* 5(2), pp. 121-147.

Desy, J. R., Reed, D. A. & Wolanskyj, A. P., 2017. Milestones and Millennials: A Perfect Pairing Competency-Based Medical Education and the Learning Preferences of Generation Y. *Mayo Clinic Proceedings,* 92(2), p. 243–250.

Dewey, J., 1922. *Human nature and conduct: An introduction to social psychology.* New York: Henry Holt & Company.

Dewey, J., 1938. *Experience and education.* New York: Collier.

Dickson, G. W., DeSanctis, G. & McBride, D. J., 1986. Understanding the Effectiveness of Computer Graphics for Decision Support: A Cumulative Experimental Approach. *Communications of the ACM,* 29(1), pp. 40-47.

Diez, M. E., 2006. Assessing dispositions: five principles to guide practice. In: *Teacher dispositions: Building a teacher education framework of moral standards.* Washington, DC: American Association of Colleges for Teacher Education, pp. 49-68.

Diez, M. E., 2007. Looking back and moving forward: three tensions in the teacher dispositions discourse. *Journal of Teacher Education,* pp. 388-396.

Diez, M. E. & Raths, J., 2007. *Dispositions in teacher education.* Charlotte, NC: Information Age Publishing Inc.

Dobson, P. J., 2001. The Philosophy of Critical Realism - An Opportunity for Information Systems Research. *Information Systems Frontiers,* Volume 3, pp. 199-210.

Donnelly, D., McGarr, O. & O Reily, J., 2011. Computers and Education. *A framework for teachers' integration of ICT into their classroom practice,* Volume 57, pp. 1469-1483.

Dottin, E. S., 2009. Professional judgment and dispositions in teacher education. *Teaching and Teacher Education,* Volume 25, pp. 83-88.

du Plessis, P., 2014. Problems and Complexities in Rural Schools: Challenges of Education and Social Development. *Mediterranean Journal of Social Sciences,* 5(20), pp. 2039-2117.

Duram, L. A., 2012. Pragmatic Study. In: N. Salkind, ed. *Encyclopedia of Research Design.* Thousand Oaks: Sage Publications, pp. 1073-1075.

Dwyer, C., 1996. The imperative to change our schools. In: C. Fisher, D. C. Dwyer & K. Yocam, eds. *Education and technology: Reflections on computing in classrooms.* San Francisco: Jossey-Bass, pp. 15-33.

Dwyer, D. C., Ringstaff, C. & Sandholtz, J. H., 1991. Changes in Teachers' Beliefs and Practices in Technology-Rich Classrooms. *Educational Leadership,* pp. 45-52.

Earle, R. S., 2002. The integration of instructional technology into public education: Promises and Challenges. *ET Magazine,* 42(1), pp. 5-13.

Elbasha, T. & Wright, A., 2017. Reconciling structure and agency in strategy-as-practice research: Towards a strong-structuration theory approach. *Management,* 20(2), pp. 107-128.

Elliot, V., 2018. Thinking about the Coding Process in Qualitative Data Analysis. *The Qualitative Report,* 23(11), pp. 2850-2861.

Emerson, R. M., Fretz, R. I. & Shaw, L. L., 1995. *Writing ethnographic fieldnotes.* Chicago: University of Chicago Press.

Engeström, Y., 1987. *Learning by expanding: An activity-theoretical approach to developmental research.* Helsinki: Orienta-Konsultit.

Engeström, Y., 2001. Expansive learning at work: Toward an activity theoretical reconceptualization. *Journal of Education and Work,* 14(1), pp. 133-156.

Engeström, Y., 2009. The Future of Activity theory: A rough draft. *Learning and expanding with activity theory,* pp. 303-328.

Ertmer, P. A., 1999. Addressing first- and second-order barriers to change. Strategies for technology integration. *Educational Technology Research and Development,* 47(4), pp. 47-61.

Ertmer, P. A., 2005. Teacher pedagogical beliefs: The final frontier in our quest for technology integration?. *Educational Technology Research and Development,* 53(4), pp. 25-39.

Ertmer, P. A., Addison, P., Lane, M., Ross, E. & Woods, D., 1999. Examining teachers' beliefs about the role of technology in the elementary classroom. *Educational Technology Research and Development,* 47(1), pp. 81-96.

Ertmer, P. A., Gopalakrishnan, S. & Ross, E. M., 2001. Technology-using teachers: comparing perceptions of exemplary technology use to best practice. *Journal of Research on Computing in Education,* 33(5).

Ertmer, P. A. & Ottenbreit-Leftwich, A., 2010. Teacher Technology Change: How Knowledge, Beliefs, and Culture Intersect. *Journal of Research on Technology in Education,* 42(3), pp. 255-284.

Ertmer, P. A., Ottenbreit-Leftwich, A. & Tondeur, J., 2015. Teacher beliefs and uses of technology to support 21st century teaching and learning. In: H. R. Fives & M. Gill, eds. *International handbook of.* New York: Routledge, Taylor & Francis., pp. 403-418.

Ertmer, P. A., Ottenbreit-Leftwich, A T., Sadik, O., Sendurur, E. & Sendurur, P., 2012. Teacher beliefs and technology integration practices: A critical relationship. *Computers and Education,* Volume 59, pp. 423-435.

Fanni, F., Rega, I., van Zyl, I., Tardini, S. & Cantoni, L., 2010. *Investigating perception changes in teachers attending ICT curricula through self-efficacy.* International conference on information and communication technologies and development.

Farah, C. A., 2011. *Factors Influencing Teachers' Technology Self-Efficacy.* Lynchburg, VA: Liberty University.

Feeney, O. & Pierce, B., 2016. Strong Structuration Theory and Accounting Information: An Empirical Study. *Accounting, Auditing & Accountability Journal,* 29(7), pp. 1152-1176.

Fenwick, T. & Edwards, R., 2011. Introduction: Reclaiming and Renewing Actor Network Theory for Educational Research. *Educational Philosophy and Theory,* Volume 43, pp. 1-14.

Firestone, W. A., 1987. Meaning in Method: The Rhetoric of Quantitative and Qualitative Research. *Educational Researcher,* 16(7), pp. 16-21.

Fishbein, M. & Ajzen, I., 2010. *Predicting and Changing Behavior: The Reasoned Action Approach. Psychology Press.* New York: Taylor & Francis.

Fisher, C., Dwyer, D. C. & Yocam, K., 1996. *Education and Technology: Reflections on computing in classrooms.* San Francisco: Jossey-Bass.

Fives, H. & Gill, M. G., 2015. *International handbook of research on teachers' beliefs.* New York: Routledge, Taylor & Francis.

Flick, U., 2014. *An Introduction to Qualitative Research.* 5th ed. London: Sage Publications.

Flick, U., 2018. Triangulation in Data Collection. In: U. Flick, ed. *The sage handbook of qualitative data collection.* London: SAGE Publications, pp. 527-544.

Fonseca-Chacana, J., 2019. Making teacher dispositions explicit: A participatory approach. *Teaching and Teacher Education,* pp. 266-276.

Ford, M. & Botha, A., 2010. *Pragmatic framework for integrating ICT into education in South Africa,* IST- Africa.

Fowler, F. J., 1995. *Improving survey questions: Design and evaluation.* Thousand Oaks, CA: Sage Publications.

Friederichs, S., 2003. *Teachers' and learners' perceptions, from four ex-Model C primary schools in Cape Town, on how and why computers are used in the Grade 7 classroom,* University of Cape Town.

Fuller, R. M. & Dennis, A. D., 2009. Does Fit Matter? The Impact of Task-Technology Fit and Appropriation on Team Performance in Repeated Task. *Information Systems Research,* 20(1), pp. 2-17.

Galvis, H. A., 2012. Profile Issues in Teachers` Professional Development. *Issues in Teachers' Professional Development Journal,* 14(2), pp. 95-112.

Garet, M. S., Porter, A C., Desimone, L., Birman, B F. & Yoon, K S., 2001. What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal,* 38(4), pp. 915-945.

Geertz, C., 1973. *The Interpretation of Cultures: Selected Essays.* New York: Basic Books, Inc.

Gess-Newsome, J., Bloche, M., Clark, J., Menasco, J. & Willis, E., 2003. Technology Infused Professional Development: A Framework for Development and Analysis. *CITE Journal,* Volume 3, pp. 324-340.

Gibbons, M., 1987. Introduction: the Politics of Interpretation. In: G. M, ed. *Interpreting Politics.* New York: New York University Press, pp. 1-31.

Giddens, A., 1984. *The Constitution of Society.* Cambridge: Polity Press.

Giddens, A., 1989. *A reply to my critics.* Cambridge: Cambridge University Press.

Giddens, A., 1990. *The Consequences of Modernity..* Cambridge: Polity Press.

Gill, P., Stewart, K., Treasure, E. & Chadwick, B., 2008. Methods of data collection in qualitative research: interviews and focus groups. *British Dental Journal,* Volume 204, pp. 291-295.

Giovannella, C., Passarelli, M. & Persico, D., 2020. Measuring the effect of the Covid-19 pandemic on the Italian Learning Ecosystems at the steady state: a school teachers' perspective. *Interaction Design and Architecture(s) Journal,* Volume 45, pp. 264 - 286.

Given, L., 2008. Data Storage. In: *The SAGE encyclopedia of qualitative research methods.* Thousand Oaks, CA: SAGE Publications.

Goldkuhl, G., 2012. Pragmatism vs interpretivism in qualitative information systems research. *European Journal of Information Systems,* 21(2), pp. 135-146.

Goodhue, D. L., 1988. IS Attitudes: Toward Theoretical and Definition Clarity. *Database,* 19(3/4), pp. 6-15.

Goodhue, D. & Thompson, R., 1995. Task-technology fit and individual performance. *MIS Quarterly,* 19(2), pp. 213-236.

Gopal, A., Bostrom , R. P. & Chin , W. W., 1992. Applying Adaptive Structuration Theory to Investigate the Process of Group Support Systems Use. *Journal of Management Information Systems,* 9(3), pp. 45-69.

Gorder, L. M., 2008. A study of teacher perceptions of instructional technology integration in the classroom. *Delta Pi Epsilon Journal,* 50(2), pp. 63-76.

Government of South Africa, 2020. *Minister Angie Motshekga: Basic Education Sector Recovery Plans for the Reopening of Schools following the Coronavirus COVID-19 Lockdown adjustment of regulations.*

Graham, C., 2006. Blended learning systems: Definition, current trends, and future directions. In: C. J. Bonk & C. R. Graham, eds. *The Handbook of blended Learning: Global perspectives, local designs .* San Francisco: Pfeiffer, pp. 3-21.

Greenhalgh, T. & Stones, R., 2010. Theorising big IT programmes in healthcare: Strong structuration theory meets actor-network theory. *Social Science and Medicine,* Volume 70, pp. 1285-1294.

Greenhalgh, T., Swinglehurst, D. & Stones, R., 2014. Rethinking resistance to 'big IT': a sociological study of why and when healthcare staff do not use nationally mandated information and communication technologies. 2(39).

Greyling, E., 2016. *The Applicability of the Theory of Planned Behaviour to Choosing a Career as a Rural Physician in South Africa.* Pretoria: University of Pretoria.

Grover, V. K., 2015. Research Approach: An Overview. *Golden Research Thoughts,* 4(8).

Guest, G., Namey, E. & Mitchell, M. M., 2017. Qualitative Research: Defining and Designing. In: *Collecting Qualitative Data: A Field Manual for Applied Research.* 55 City Road: SAGE Publications, pp. 1-40.

Gunning, E. & Strachan, W., 2020. *Mondaq.com.* Available at: https://www.mondaq.com/southafrica/data-protection/933554/coronavirus-covid-19-and-privacy-concerns-in-your-school-
[Accessed 8 February 2021].

Hadijah, S. & Shalawati, 2017. *Investigating teachers' barriers to ICT in teaching english at senior high schools in PEKANBARU.* Proceedings of the Fifth International Seminar on English Language and Teaching (ISELT-5).

Halawi, L. & McCarthy, R., 2006. Which Theory Applies: An Analysis of Information Systems Research. *Issues in Information Systems,* 7(2), pp. 252-256.

Hamilton, E. R., Rosenberg, J. M. & Akeaoglu, M., 2016. The Substitution Augmentation Modification Redefinition (SAMR) Model: a Critical Review and Suggestions for its Use. *Tech Trends,* Volume 60, pp. 433-441.

Hamilton, L. & Corbett-Whittier, C., 2014. Key Purposes. In: *Using Case Study in Educational Research.* London: SAGE Publications, pp. 35-50.

Hammersley, M., 2013. *What is Qualitative Research?.* London and New York: Bloomsbury.

Hannafin, R. D. & Savenye, W. C., 1993. Technology in the classroom: The teacher's new role and resistance to it. *Educational Technology,* 33(6), pp. 26-31.

Harrell, M. C. & Bradley, M. A., 2009. *Data Collection Methods: Semi-Structured Interviews and Focus Groups.* Santa Monica, CA: RAND Corporation.

Harris, J. B. & Hofer, M., 2011. Technological Pedagogical Content Knowledge (TPACK) in Action: A Descriptive Study of Secondary Teachers' Curriculum-Based, Technology-Related Instructional Planning. *Journal of Research on Technology in Education,* 43(3), pp. 211-229.

Hasan, H. & Kazlauskas, A., 2014. Activity Theory: who is doing what, why and how. In: H. Hasan, ed. *Being Practical with Theory: A Window into Business Research.* Wollongong, Australia: THEORI, pp. 9-14.

Hashim, N. H. & Jones, M. L., 2007. *Activity Theory: A framework for qualitative analysis.* Malaysia, 4th International Qualitative Research Convention.

Hawkins, J., 1997. Imagine the possibilities: The world at your fingertips. In: P. Burness & W. Snider, eds. *Learn & live.* Nicasio, CA: The George Lucas Educational Foundation, pp. 212-215.

Hazzan, O., 2003. Prospective high school mathematics teachers' attitudes toward integrating computers in their future teaching. *Journal of Research on Technology in Education,* Volume 35, pp. 213-246.

Hennessy, S., Harrison, D. & Wamakote, L., 2010. Teacher factors influencing ICTclassroom use in Sub-Saharan Africa. *Itupale online journal of African studies,* 2(1), pp. 39-54.

Hennessy, S., Ruthven, K. & Brindley, S., 2005. Teacher perspectives on integrating ICT into subject teaching: Commitment, constraints, caution, and change. *Journal of Curriculum Studies,* Volume 37, pp. 155-192.

Henson, R. K., 2002. From adolescent angst to adulthood: Substantive implications and measurement dilemmas in the development of teacher efficacy research. *Educational Psychologist,* 37(3), pp. 137-150.

Hew, K. F. & Brush, T., 2007. Integrating Technology into K-12 Teaching and Learning: Current Knowledge Gaps and Recommendations for Future Research. *Educational Technology Research and Development,* 55(3), pp. 223-252.

Hew, K. F., Lan, M., Tang, Y., Jia, C. & Lo, C. K., 2019. Where is the “theory” within the field of educational technology research?. *British Journal of Educational Technology,* 50(3), pp. 956-971.

Hilton, J. T., 2016. A Case Study of the Application of SAMR and TPACK for Reflection on Technology Integration into Two Social Studies Classrooms. *The Social Studies,* 107(2), pp. 68-73.

Hoadley, U., 2007. The reproduction of social class inequalities through mathematics pedagogies in South African primary schools. *Journal of Curriculum Studies,* 39(6), pp. 679-706.

Hoadley, U. & Ensor, P., 2009. Teachers’ social class, professional dispositions and pedagogic practice. *Teaching and Teacher Education,* Volume 25, p. 876–886.

Hoadley, U. & Muller, J., 2010. Codes, pedagogy and knowledge: Advances in Bernsteinian Sociological approaches to education. In: M. Apple, S. Ball & L. Gandin, eds. *The Routledge International Handbook of the Sociology of Education.* Abingdon: Routledge, pp. 69-78.

Hodges, C., Moore, S., Lockee, B., Trust, T. & Bond, A., 2020. The difference between emergency remote teaching and online learning. *EDUCAUSE Review.*

Holland, J., Thomson, R. & Henderson, S., 2006. *Qualitative Longitudinal Research: A Discussion Paper*. Families & Social Capital ESRC Research Group Working Paper No. 21.

Holloway, I. & Todres, L., 2003. The status of method: Flexibility, consistency and coherence. *Qualitative Research,* Volume 3, pp. 345-357.

Hooper, S. & Rieber, L. P., 1995. Teaching with Technology. In: A. C. Ornstein, ed. Needham Heights, MA: Ally and Bacon, pp. 154-170.

Hopper, R., 1992. *Conversation.* Bloomington, IN.

Hsieh, H. F. & Shannon, S. E., 2005. Three approaches to qualitative content analysis. *Qualitative Health Research,* 15(9), pp. 1277-1288.

Hsu, P., 2016. Examining current beliefs, practices, and barriers about technology integration: A Case study. *Tech Trends,* 60(1), pp. 30-40.

Hughes, J., 2005. The role of teacher knowledge and learning experiences in forming technology-integrated pedagogy. *Journal of technology and teacher education,* 13(2), pp. 277-302.

Hurst, S., Arulogun, O.S., Owolabi, A. O., Akinyemi, R., Uvere, E., Warth, S. & Ovbiagele, B., 2015. Pretesting Qualitative Data Collection Procedures to Facilitate Methodological Adherence and Team Building in Nigeria. *Journal of Qualitative Methods,* Volume 14, pp. 53-64.

Irvine, A., Drew, P, P. & Sainsbury, R., 2013. I not answering your questions properly?' Clarification, adequacy and responsiveness in semi-structured telephone and face-to-face interviews. *Qualitative Research,* Volume 13, pp. 87-106.

ITSI, n.d. Available at: https://www.itsieducation.com/ [Accessed 27 July 2020].

Jack, L. & Kholeif, A., 2007. Introducing Strong Structuration Theory for case studies in Organisation, Management and Accounting Research. *Qualitative Research in Organizations and Management: An International Journal,* 2(3), pp. 208-225.

Jimoyiannis, A. & Vassilis, K., 2007. Examining teachers' beliefs about ICT in education: implications of a teacher preparation programme. *Teacher Development,* 11(2), pp. 149-173.

Johnson, A. M., Jacovina, M. E., Russell, D. E. & Soto, C. M., 2016. Challenges and solutions when using technologies in the classroom. In: S. A. Crossley & D. S. McNamara, eds. *Adaptive educational technologies for literacy instruction.* New York: Taylor & Francis, pp. 13-29.

Johnson, B., Dunlap, E. & Benoit, E., 2010. Structured QualitativeResearch: Organizing “Mountains of Words” for Data Analysis, both Qualitative and Quantitative. *Substance Use and Misuse,* 45(5), p. 648–670.

Johnson, D. L. & Lui, L., 2000. First steps toward a statistically generated information technology integration model. *Computers in Schools,* 16(2), pp. 3-12.

Johnson, L. E. & Reiman, A. J., 2007. Beginning Teacher Disposition: Examining the moral/ethical domain. *Teaching and Teacher Education,* 23(5), pp. 676-687.

Johnson, D. R., Scheitle, C. P. & Ecklund, E. H., 2019. Beyond the In-Person Interview? How Interview Quality Across In-person, Telephone, and Skype Interviews. *Social Science Computer Review,* pp. 1-17.

Jones, C. & Czerniewicz, L., 2011. Theory in learning technology. *Research in Learning Technology,* 19(3), pp. 173-177.

Jones, M. R. & Kartsen, H., 2008. Giddens's Structuration Theory and Information Systems Research. *MIS Quarterly,* 32(1), pp. 127-157.

Jones, S. R., Torres, V. & Arminio, J., 2014. Issues in analysis and interpretation. In: *Negotiating the complexities of qualitative research in higher education: Fundamental elements and issues.* 2nd ed. New York: NY: Routledge, pp. 157-173.

Kaptelinin, V. & Nardi, B., 2006. *Acting with technology: Activity theory and interaction design.* Cambridge, MA: MIT Press.

Karasavvidis, I., 2009. Activity Theory as a conceptual framework for understanding teacher approaches to Information and Communication Technologies. *Computers and Education,* Volume 53, pp. 436-444.

Katz, L. G. & Raths, J. D., 1985. Dispositions as goals for teacher education. *Teaching and Teacher Education,* pp. 301-307.

Kerr, S. T., 1996. Visions of sugarplums: The future of technology, education, and the schools. In: S. T. Kerr, ed. *Technology and the future of schooling: Ninety-fifth yearbook of the National Society for the Study of Education.* Chicago: University of Chicago Press, pp. 1-27.

Khan, I. U., Hameed, Z., Yu, Y., Islam, T., Sheikh, Z. & Khan, S. U., 2018. Predicting the acceptance of MOOCs in a developing country: Application of task-technology fit model, social motivation, and self-determination theory. *Telematics and Informatics,* 35(4), pp. 964-978.

Kim, C., Kim, M. K., Lee, C., Spector, J. M. & DeMeester, K., 2013. Teacher beliefs and technology integration. *Teacher and Teacher Education,* Volume 29, pp. 76-85.

King, K. P., 2002. Educational technology professional development as transformative learning opportunities. *Computers and Education,* 39(3), pp. 283-297.

King, N. & Horrocks, C., 2019. *Interviews in Qualitative Research.* 2nd ed. London: Sage Publications.

Kirkland, A., 2014. Models for Technology Integration in the Learning Commons. *School Libraries in Canada,* 32(1), pp. 14-18.

Knabe, A., 2009. *Applying Azjen's Theory of Planned Behavior to a Study of Online Course Adoption in Public Relations Education.* Marquette University.

Koehler, M. J. & Mishra, P., 2009. In Koehler, Matthew J., and Punya Mishra. “What Is Technological Pedagogical Content Knowledge?. *Contemporary Issues in Technology and Teacher Education,* 9(1), pp. 60-70.

Kopcha, T. J., 2012. Teachers' perceptions of the barriers to technology integration and practices with technology under situated professional development. *Computers & Education,* Volume 59, pp. 1109-1121.

Kort, W. & Gharbi, J. E., 2013. Structuration theory amid negative and positive criticism. *International Journal of Business and Social Research,* 3(5), pp. 92-104.

Kriek, J. & Stols, G., 2010. Teachers' beliefs and their intention to use interactive simulations in their classrooms. *South African Journal of Education,* 30(3), pp. 439-456.

Krippendorff, K., 2004. *Content Analysis: An Introduction to Its Methodology.* 2nd ed. London: SAGE Publications.

Lapadat, J. C., 2012. Thematic Analysis. In: A. J. Mills, G. Durepos & E. Wiebe, eds. *Encyclopedia of Case Study Research.* Thousand Oaks: SAGE Publications, pp. 926-927.

Latour, B., 1992. Where are the missing masses? The sociology of a few mundane artifacts. In: W. Bijker & J. Law , eds. *Shaping technology/building society: Studies in sociotechnical change.* Cambridge(MA): MIT Press, pp. 225-264.

Latour, B., 1993. *We have never been modern.* Hertfordshire, England: Harvester Wheatsheaf.

Lavonen, J., Lattu, M., Juuti, K. & Meisalo, V., 2006. Strategy-based development of teacher educators' ICT competence through a co-operative staff development project. *European Journal of Teacher Education,* 29(2), pp. 241-265.

Law, J., 1987. The social construction of technological systems. In: W. Bijker, T. Hughes & T. Pinch, eds. *Technology and heterogeneous engineering: The case of Portuguese expansion.* Cambridge, MA: MIT Press, pp. 111-134.

Law, J., 1997. *Traduction/Trahison: Notes on ANT,* Lancaster: Department of Sociology: Lancaster University.

Lawless, K. A. & Pellegrino, J. W., 2007. Professional Development in Integrating Technology into Teaching and Learning: Knowns, Unknowns, and Ways to Pursue Better Questions and Answers. *Review of Educational Research,* 77(4), pp. 575-614.

Le Grange, L., 2020. Covid-19 pandemic and the prospects of education in South Africa. *Prospects*. https://doi.org/10.1007/s11125-020-09514-w.

Lee, A. S., 2001. Editorial. *MIS Quarterly,* 25(1), pp. iii-vii.

Lee, A. S., 2004. Thinking about Social Theory and Philosophy for Information Systems. In: J. Mingers & L. Willcocks, eds. *Social Theory and Philosophy for Information System.* Chichester, UK: Wiley & Sons, pp. 1-26.

Lee, J., Cerreto, F. A. & Lee, T., 2010. Theory of Planned Behaviour and Teachers' Decisions Regarding Use of Educational Technology. *Journal of Educational Technology and Society,* 13(1), pp. 152-164.

Leont'ev, A. N., 1978. *Activity, consciousness, and personality.* Englewood Cliffs, NJ: Prentice-Hall.

Levin, T. & Wadmany, R., 2005. Changes in educational beliefs and classroom practices of teachers and students in rich technology-based classrooms. *Technology, Pedagogy and Education,* Volume 14, pp. 281-307.

Lewin, K., 1951. *Field theory in social science: selected theoretical papers.* New York: Harper and Row.

Lewis, W., Agarwal, R. & Sambamurthy, V., 2003. Sources of influence on beliefs about information technology use. *MIS Quarterly,* 27(4), pp. 657-678.

Lim, C. P. & Chan, B. C., 2007. MicroLESSONS in teacher education: Examining pre-service teachers' pedagogical beliefs. *Computers and Education,* Volume 48, pp. 474-494.

Lim, C. P. & Hang, D., 2003. An activity theory approach to research of ICT integration in Singapore Schools. *Computers and Education,* 41(1), pp. 49-63.

Lim, C. P. & Khine, M., 2006. Managing teachers' barriers to ICT integration in Singapore schools. *Journal of Technology and Teacher Education,* 14(1), pp. 97-125.

Lim, C. P., Zhao, Y., Tondeur, J., Chai, C. S. & Tsai, C. C., 2013. Bridging the Gap: Technology Trends and Use of Technology in Schools. *Educational Technology & Society,* 16(2), pp. 59-62.

Lim, L., 2017. Regulating the unthinkable: Bernstein's pedagogic device and the paradox of control. *International Studies in Sociology of Education,* 26(4), pp. 353-374.

Lincoln, Y. S. & Guba, E. G., 1985. *Naturalistic Inquiry.* Beverly Hills, CA: Sage.

Lin, T. C. & Huang, C. C., 2008. Understanding knowledge management system usage antecedents: an integration of social cognitive theory and task technology fit. *Journal of Information Management,* 45(6), pp. 410-417.

Liu, S., 2011. Factors related to pedagogical beliefs of teachers and technology integration. *Computers and Education,* Volume 56, pp. 1012-1022.

Mackenzie, N. & Knipe, S., 2006. Research dilemmas: Paradigms, methods and methodology. *Issues In Educational Research,* 16(2), pp. 1-13.

Mack, N., Woodsong, C., MacQueen, K. M., Guest, G. & Namey, E., 2005. *Qualitative Research Methods: A Data Collector's Field Guide,* North Carolina: Family Health International.

MacVaugh, J. & Schiavone, F., 2010. Limits to the diffusion of innovation: A literature review and integrative model. *European Journal of Innovation Management,* 13(2), pp. 197-221.

Mail and Guardian, 2020. *Schools to close for a month due to Covid infection surge — Ramaphosa.* Available at: https://mg.co.za/coronavirus-essentials/2020-07-23-schools-to-close-for-a-month-due-to-covid-infection-surge-ramaphosa/ [Accessed 29 July 2020].

Mail and Guardian, 2018. *The future of ICT is in Gauteng's classrooms.* Available at: https://mg.co.za/article/2018-06-15-00-the-future-of-ict-is-in-gautengs-classrooms/ [Accessed 15 May 2020].

Mailizar, Almanthari , A., Maulina, S. & Bruce, S., 2020. Secondary School Mathematics Teachers' Views on E-learning Implementation Barriers during the COVID-19 Pandemic:

The Case of Indonesia. *EURASIA Journal of Mathematics, Science and Technology Education,* 16(7).

Mama, M. & Hennessy, S., 2013. Developing a typology of teacher beliefs and practices concerning classroom use of ICT. *Computers and Education,* 68(October), pp. 380-387.

Marcinkiewicz, H. R., 1994. Computers and teachers: Factors influencing computer use in the classroom. *Journal of Research in Computing Education,* 26(2), pp. 220-237.

Marshall, M. N., 1996. Sampling for qualitative research. *Family Practice,* 13(6), pp. 522-525.

Martin, S. & Vallance, M., 2008. The impact of synchronous inter-networked teacher training in Information and Communication Technology integration. *Computers and Education,* Volume 51, pp. 34-53.

Maton, K. & Howard, S. K., 2018. Taking autonomy tours: A key to integrative knowledge-building. *LCT Centre Occasional Paper,* 1(June), pp. 1-35.

Maxwell, J., 2013. *Qualitative research design: An interactive approach.* 3rd ed. Thousand Oaks, CA: Sage Publications.

McCloskey, D. W., 2006. The Importance of Ease of Use, Usefulness, and Trust to Online Consumers: An Examination of the Technology Acceptance Model with Older Consumers. *Journal of Organizational and End User Computing,* 18(3), pp. 47-65.

McGill, T. & Hobbs, V. J., 2006. *E-Learning and Task-Technology Fit: A Student and Instructor Comparison.* Adelaide, ACIS 2006 Proceedings.

McGill, T. J. & Klobasb, J. E., 2009. A task–technology fit view of learning management system impact. *Computers and Education,* 52(2), pp. 496-508.

McLean, C. & Hassard, J., 2004. Symmetrical absence / symmetrical absurdity: Critical notes on the production of actor-network accounts. *Journal of Management Studies,* 41(3), pp. 493-519.

Mercier, E. M., Higgins, S. E. & Joyce-Gibbons, A., 2014. The effects of room design on computer-supported collaborative learning in a multi-touch classroom.. *Interactive Learning Environments,* pp. 1-19.

Merriam, S. B., 1985. The Case Study in Educational Research: A Review of Selected Literature. *The Journal of Educational Thought,* Volume 3, pp. 204-217.

Merriam, S. B., 2009. *Qualitative research A guide to design and implementation.* San Francisco, CA : Jossey-Bass.

Mertens, D., 2005. *Research and Evaluation in Education and Psychology: Integrating diversity with quantitative, qualitative, and mixed methods.* 2nd ed. Boston, MA: Sage.

Merton, R., 1967. *On Theoretical Sociology.* New York, NY: Free Press.

Meyer, G., 2010. Diffusion Methodology: Time to Innovate?. *Journal of Health Communications,* 9(1), pp. 59-69.

Mhlanga, D. & Moloi, T., 2020. COVID-19 and the Digital Transformation of Education: What Are We Learning on 4IR in South Africa? *Education Sciences,* 10(180), p. doi:10.3390/educsci10070180.

Mills, A. J., Durepos, G. & Wiebe, E., 2010. *Encyclopedia of case study research (Vols. 1-0).* Thousand Oaks, CA: SAGE Publications.

Mishra, P. & Koehler, M. J., 2006. Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record,* 108(6), pp. 1017-1054.

Misirli, Z. A., 2016. Integrating Technology into Teaching and Learning Using a Variety of Models. *IHEAD,* 1(2), pp. 37-48.

Moersch, C., 1997. Computer efficiency: Measuring the instructional use of technology. *Learning and Leading with Technology,* pp. 52-56.

Monaco, M. J. & Martin, M., 2007. The millennial student: A new generation of learners. *Athletic Training Education Journal,* 2(April-June), pp. 42-46.

Monteiro, E., 2000. Actor-network theory and information infrastructure. In: C. U. Ciborra, K. Braa & A. Cordella, eds. *From Control to Drift: The Dynamics of Corporate Information Infrastructures.* Oxford: Oxford University Press.

Moore, G. C. & Benbasat, I., 1991. Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research,* 2(3), pp. 192-222.

Morrow, S. L., 2005. Quality and Trustworthiness in Qualitative Research. *Journal of Counseling Psychology,* 52(2), pp. 250-260.

Moustakas, C. E., 1994. *Phenomenological research methods.* Thousand Oaks, CA: Sage Publications.

Mueller, B. & Urbach, N., 2013. *The Why, What, and How of Theories in IS Research.* Milan, Thirty Fourth International Conference on Information Systems.

Murphy, E. & Rodriguez-Manzanares, M. A., 2008. Using activity theory and its principle of contradictions to guide research in educational technology. *Australasian Journal of Educational Technology,* 24(4), pp. 442-457.

Murphy, C. A., Coover, D. & Owen, S. V., 1989. Development and validation of the computer self-efficacy scale. *Educational and Psychological Measurement,* 49(4), pp. 893-899.

Mutch, A., 2002. Actors and networks or agents and structures: towards a realist view of information systems. *Organization,* 9(3), pp. 477-496.

Naidoo, D., 2011. Analysing pedagogy: visibility and meanings. *Journal of Education,* Volume 52, pp. 1-18.

Ndlovu, N., 2016. *The pedagogical integration of ICTs by seven South African township secondary.* Johannesburg: University of the Witwatersrand: Doctoral dissertation.

Negishi, M., Elder, A. D., Hamil, J. B. & Mzoughi, T., 2003. *Predicting elementary education candidates' technology integration during their field placement instruction.* Mississippi, MS, Mid-South Educational Research Association.

Neumann, A., 2008. *The craft of interview research.* New York: NY: Graduate course at Teachers College, Columbia University.

Newman, I. & Ridenour, C., 1998. Qualitative-Quantitative Research Methodology: Exploring the Interactive Continuum. *Educational Leadership Faculty Publications,* Volume 122.

Niederman, F., Briggs , R. O., de Vreede , G. & Kolfschoten , G. L., 2008. Extending the Contextual and Organizational Elements of Adaptive Structuration Theory in GSS Research. *Journal of the Association of Information Systems,* 9(10/11), pp. 663-652.

Nieuwenhuis, J., 2010a. Chapter 5: Qualitative Research Designs and Data Gathering Techniques. In: K. Maree, ed. *First Steps In Research.* Pretoria: Van Schaik Publishers.

Nieuwenhuis, J., 2010b. Chapter 6: Analysing Qualitative Data. In: K. Maree, ed. *First Steps In Research.* Pretoria: Van Schaik Publishers.

Nisbet, R., 1976. *The social philosophers.* Frogmore: Paladin.

Nkula, K. & Krauss, K. E., 2015. *The integration of ICTs in marginalized schools in South Africa: Considerations for understanding the perceptions of in-service teachers and the role of training.* Port Elizabeth, South Africa, 8th International Development Informatics Association.

Norris, C., Sullivan, T., Poirot, J. & Soloway, E., 2003. No access, no use, no impact: snapshot surveys of educational technology in K-12. *Journal of Research on Technology in Education,* 36(1), pp. 15-27.

Norton, S., McRobbie, C. J. & Cooper, T. J., 2000. Exploring secondary mathematics teachers' reasons for not using computers in their teaching: Five case studies. *Journal of Educational Computing Research,* 33(1), p. 87–109.

Novick, G., 2008. Is There a Bias Against Telephone Interviews in Qualitative Research?. *Research in Nursing & Health,* Volume 31, pp. 391-398.

Nunkoosing, K., 2005. The problems with interviews. *Qualitative Health Research,* Volume 698-706, p. 15.

Nussbaumer, D., 2012. An overview of cultural historical activity theory (CHAT) use in classroom research 2000 to 2009. *Educational Review,* 64(1), pp. 37-55.

O'Leary, Z., 2004. *The essential guide to doing research.* London: Sage.

Olivier, W., 2020. *The Conversation.* Available at: https://theconversation.com/education-post-covid-19-customised-blended-learning-is-urgently-needed-138647
[Accessed 27 July 2020].

Orlikowski, W. & Baroudi, J., 1991. Studying Information Technology in Organizations: Research Approaches and Assumptions. *Information Systems Research,* 2(1), pp. 1-28.

Orlikowski, W. J., 1992. The Duality of Technology: Rethinking the Concept of Technology in Organizations. *Organisation Science,* 3(3), pp. 398-427.

Oxford Dictionaries, 2019. *English Oxford Living Dictionaries.* Available at: https://en.oxforddictionaries.com/definition/theory [Accessed 14 May 2019].

Padayachee, K., 2017. A Snapshot Survey of ICT Integration in South African Schools. *South African Computer Journal,* 29(2), pp. 36-65.

Pajares, M., 1992. Teachers' beliefs and educational research: cleaning up a messy construct.. *Review of Educational Research,* Volume 62, p. 307–332.

Patton, M., 1999. Enhancing the quality and credibility of qualitative analysis. *Health Sciences Research,* Volume 34, pp. 1189-1208.

Patton, M., 2002. *Qualitative research and evaluation methods.* 3rd ed. Thousand Oaks: Sage.

Patton, M. Q., 2015. *Qualitative Evaluation and Research Methods.* Thousand Oaks, CA: SAGE Publications.

Pedersen, S. & Lui, M., 2003. Teachers' beliefs about issues in the implementation of a student-centered learning environment. *Educational Technology Research and Development,* 51(2), pp. 57-76.

Pettigrew, A. M., 1990. Special Issue: Longitudinal Field Research Methods for Studying Processes of Organizational Change. *Organization Science,* 1(3), pp. 267-292.

Pham, L., 2018. *A Review of key paradigms: positivism, interpretivism and critical inquiry,* Adelaide, Australia: University of Adelaide.

Phillips, M., 2015. Digital technology integration. In: M. Henderson & G. Romeo, eds. *Teaching and Digital Technologies: Big Issues and Critical Questions.* Australia: Cambridge University Press, pp. 318-331.

Pierson, M., 2001. Technology practice as a function of pedagogical expertise. *Journal of Research on Computing in Education,* 33(4), pp. 413-430.

Pinnegar, S. & Daynes, J. G., 2006. Locating Narrative Inquiry Historically. In: D. J. Clandinin, ed. *Handbook of Narrative Inquiry: Mapping a Methodology.* Thousand Oaks, CA: SAGE Publications, pp. 3-34.

Ponelis, S. R., 2015. Using interpretive qualitative case studies for exploratory research in doctoral studies: A case of Information Systems research in small and medium enterprises. *International Journal of Doctoral Studies,* Volume 10, pp. 525-550.

Ponticell, J. A., 2003. Enhancers and inhibitors of teacher risk taking: A case study. *Peabody Journal of Education,* 78(3), pp. 5-24.

Prensky, M., 2010. *Partnering. Teaching digital natives: Partnering for real learning.* CA: Corwin: Thousand Oaks.

Prestridge, S. & de Aldama, C., 2016. A classification framework for exploring Technology-Enabled Practice–Frame TEP. *Journal of Educational Computing Research,* 54(7), pp. 901-921.

Puentedura, R. R., 2006. *The SAMR Model: Background and Exemplars.* Available at: http://www.hippasus.com/rrpweblog/archives/2006_11.html [Accessed 31 May 2019].

Puentedura, R., 2013. *SAMR: A Contextualised Introduction.* [Available at:hhttp://www.hippasus.com/rrpweblog/archives/2013/10/25/SAMRAContextualizedIntroduction.pdf [Accessed 28 May 2019].

Putnam, L., 1983. The Interpretive Perspective: An Alternative to Functionalism. In: L. Putnam & M. E. Pacanowsky, eds. *Communication and Organisation.* Beverly Hills, CA: Sage Press, pp. 31-54.

Rai, R. S. & Selnes, F., 2019. Conceptualizing task-technology fit and the effect on adoption – A case study of a digital textbook service. *Information and Management.*

Rapanta, C., Botturi, L., Goodyear, P., Guàrdia, L. & Koole, M., 2020. Online University Teaching During and After the Covid-19 Crisis: Refocusing Teacher Presence. *Postdigital Science and Education*. https://doi.org/10.1007/s42438-020-00155-y.

Rapley, T., 2013. Sampling Strategies in Qualitative Research. In: U. Flick, ed. *The SAGE Handbook of Qualitative Data Analysis.* London: SAGE Publications, pp. 49-63.

Rasheed, A. R., Kamsin, A. & Abdullah, N. A., 2020. Challenges in the online component of blended learning: A. *Computers & Education,* Volume 144.

Rashid, Y., Rashid, A., Warraich, M., Sabir, S. & Waseem, A., 2019. Case Study Method: A Step-by-Step Guide for Business Researchers. *International Journal of Qualitative Methods,* Volume 18, pp. 1-13.

Reeves, S., Albert, M., Kuper, A. & Hodges, B. D., 2008. Why use theories in qualitative research. *British Medical Journal,* Volume 337, pp. 631-634.

Reiser, R. A. & Dempsey, J. V., 2012. *Trends and issues in instructional design and technology.* 3rd ed. Boston: Pearson.

Richardson, V., 2003. Preservice teachers' beliefs. In: J. McAninch & A. C. Rath, eds. *Advances in Teacher Education Series 6.* Greenwich, CT: Information Age, pp. 1-22.

Rieber, L. P. & Welliver, P. W., 1989. Infusing Educational Technology into Mainstream Educational Computing. *International Journal of Instructional Media,* 16(1), pp. 21-32.

Ritchhart, R., 2002. *Intellectual character: What it is, why it matters, and how to get it..* San Francisco, CA: Jossey-Bass.

Ritchhart, R., 2001. From IQ to IC: A dispositional view of intelligence. *Roeper Review,* 23(3), pp. 143-150.

Ritchie, D. & Wiburg, K., 1994. Educational variables influencing technology integration. *Journal of Technology and Teacher Education,* 2(2), pp. 143-153.

Rogers, E. M., 1993. *Diffusion of Innovations.* 2nd ed. New York: The Free Press.

Rogers, E. M., 1995. *Diffusion of Innovations.* 4th ed. New York: Free Press.

Rogers, E., 2003. *Diffusion of Innovations.* New York: Free Press.

Rogers, P., 2000. Barriers to adopting emerging technologies in education. *Journal of Educational Computing Research,* pp. 455-472.

Rokeach, M., 1968. *Beliefs, attitudes, and values.* San Francisco: Jossy-Bass.

Rose, J., 1998. *Evaluating the contribution of Structuration Theory to the Information Systems Discipline.* Granada, Euro-Arab Management School.

Rosen, L. H. & Underwood, M. K., 2012. Observations. In: N. J. Salkind, ed. *Encyclopedia of Research Design.* Thousand Oaks: SAGE Publications, pp. 953-953.

Rosenberg, J. M. & Koehler, M. J., 2015. Context and teaching with technology in the digital age. In: M. L. Niess & H. Gillow-Wiles, eds. *Handbook of research on teacher education in the digital age.* Hershey: IGI Global, pp. 440-465.

Roulston, K. & Choi, M., 2018. Qualitative Interviews. In: U. Flick, ed. *The SAGE Handbook of Qualitative Data Collection.* 55 City Road: SAGE Publications, pp. 233-249.

Roulston, K., 2014. Analyzing interview data. In: U. Flick, ed. *Handbook of Qualitative Data Analysis.* London: Sage, p. 297–312.

Rousseau, N., 2014. Integrating different forms of knowledge in the teaching qualification Diploma in Grade R Teaching. *South African Journal of Childhood Education,* 4(1), pp. 167-186.

Russell, D. L. & Schneiderheinze, A., 2005. Understanding innovation in education using activity theory. *Educational Technology and Society,* 8(1), pp. 38-53.

SABC, 2020a. *Basic education's staggered approach aims to minimise overcrowding.*
SABC, 2020b. *SABC Education—Virtual Teaching Becomes a Reality through New Education Technology.*

Sackstein, S. L. & Slonimsky, L., 2017. A conceptual framework to understand teachers' Professional Dispositions and Orientation towards tablet technology in secondary schools. *South African Journal of Computing,* 29(2), pp. 66-86.

Sackstein, S., Spark, L. & Turner, B., 2019. Technology in the Classroom: Teachers' Technology Choices in Relation to Content Creation and Distribution. *Issues in Informing Science and Information Technology,* Volume 16, pp. 235-254.

Sadaf, A., Newby, T. J. & Ertmer, P. A., 2012. Exploring pre-service teachers' beliefs about using Web 2.0 technologies in K-12 classroom. *Computers and Education,* 59(3), pp. 937-945.

Sadeck, O. & Cronjé, J., 2017. A Continuum of Teachers' e-Learning Practices. *The Electronic Journal of e-Learning Volume,* 15(5), pp. 395-408.

Sahin, I., 2006. Detailed Review of Rogers' Diffusion of Innovations Theory and Educational Technology-Related Studies based on Rogers' Theory. *The Turkish Online Journal of Educational Technology,* 5(2), pp. 14-23.

Saltan, F., 2016. Blended Learning Experience of Students Participating Pedagogical Formation Program: Advantages and Limitations of Blended Education. *International Journal of Higher Education,* 6(1), pp. 63-73.

Saldaña, J., 2003. *Longitudinal qualitative research : analyzing change through time.* Walnut Creek, California: AltaMira Press.

Sandelowski, M., 1995. Qualitative Analysis: What it is and how to begin. *Reseearch in Nuring and Health,* 18(4), pp. 371-375.

Sandelowski, M. & Leeman, J., 2012. Writing usable qualitative health research findings.. *Qualitative Health Research,* Volume 13, pp. 1404-1413.

Sandholtz, J. H., Ringstaff, C. & Dwyer, D. C., 1997. *Teaching with Technology: Creating Student-Centered Classroom.* New York: Teachers College.

Sanjek, R., 1990. *Fieldnotes: The makings of anthropology.* Ithaca, NY: Cornell University.

Schensul, J. J., 2008. Methods. In: L. M. Given, ed. *The SAGE Encyclopedia of Qualitative Research Methods.* Thousand Oaks: SAGE Publications, pp. 522-526.

Schommer-Aikins, M. & Hutter, R., 2002. Epistemological beliefs and thinking about everyday controversial issues. *The Journal of Psychology,* 136(1), pp. 5-20.

Schommer, M., 1990. Effects of beliefs about the nature of knowledge on comprehension. *Journal of Educational Psychology,* 82(3), pp. 498-504.
Schreier, M., 2012. *Qualitative Content Analysis in Practice.* London: SAGE Publications.

Schreier, M., 2013. Qualitative Content Analysis. In: U. Flick, ed. *The SAGE Handbook of Qualitative Data Analysis.* Thousand Oaks: SAGE Publications, pp. 170-183.

Schrum, L., 1993. Tales from the trenches: Educators' perspective on technology implementation. *Journal of Teacher Education and Technology,* 1(4), pp. 409-421.

Schrum, L., 1999. Technology Professional Development for Teachers. *Educational Technology Research and Development,* 47(4), pp. 83-90.

Schütz, A., 1962. *The Problem of Social Reality: Collected Papers I.* The Hague: Martinus Nijhoff.

Scott, D., 2008. *Critical Essays on major curriculum theorists.* New York, NY: Routledge.

Sedgwick, P., 2014. Unit of observation versus unit of analysis. *BMJ Clinical Research,* Volume 348, pp. 1-2.

See, B. H., Wardle, L. & Collie, P., 2020. *Teachers' wellbeing and workload during Covid-19 lockdown,* Durham, UK: Durham University Evidence Centre for Education.

Sherman, K. & Howard, S. K., 2012. *Teachers' beliefs about first-and second-order barriers to ICT integration: preliminary findings from a South African study.* Charlottesville, VA, Association for the Advancement of Computing in Education., pp. 2908-2105.

Shulman, L., 1986. Those Who Understand: Knowledge Growth in Teaching.". *Educational Researcher,* 15(2), pp. 4-14.

Shulman, L. S., 1987. Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review,* 57(1), pp. 1-22.

Sicilia, C., 2005. *The Challenges and Benefits to Teachers' Practices in Constructivist Learning Environments Supported by Technology,* McGill University, Montreal: Unpublished master's thesis.

Singh, P., 2002. Pedagogising knowledge: Bernstein's theory of the pedagogic device. *British Journal of the Sociology of Education,* 23(4), pp. 571-582.

Siyavula - Technology Powered Learning, n.d. Available at: https://www.siyavulaeducation.com/ [Accessed 27 July 2020].

Slutsky, A., 2016. *Factors Influencing Teachers' Technology Self Efficacy,* Unpublished Dissertation: Gardner-Webb University.

Smarkola, C., 2008. Efficacy of a planned behavior model: Beliefs that contribute to computer usage intentions of student teachers and experienced teachers. *Computers in Human Behavior,* 24(3), pp. 1196-1215.

Smeda, N., Dackich, E. & Sharda, N., 2014. The effectiveness of digital storytelling in the Classroom: A comprehensive study. *Smart Learning Environment.*

Smeets, E., Mooij, T., Bamps, H., Bartolome, A., Lowyck, J. & Redmond, D., 1999. *The impact of information technology on the teacher,* Institute of Applied Sciences.

Sniehotta, F. F., Presseau, J. & Araujo-Soares, V., 2014. Time to retire the Theory of Planned Behaviour. *Health Psychology Review,* Volume 8, pp. 1-7.

Snoeyink, R. & Ertmer, P. A., 2001. Thrust into technology: How veteran teachers respond. *Journal of Educational Technology Systems,* 30(1), pp. 85-111.

Somekh, B., 2008. Factors affecting teachers' pedagogical adoption of ICT. In: J. Voogt & G. Knezek, eds. *International Handbook of Information Technology in Primary and Secondary Education.* New York: Springer, pp. 449-460.

South African Department of Education, 2004. *White Paper 7 on e-Education: transforming learning and teaching through Information and Communication Technology (ICTs).* Pretoria: DoE.

South African Department of Education, 2005. *Report of the ministerial committee on teacher education,* Pretoria: DoE.

South African Government, 2020. *President Cyril Ramaphosa: Measures to combat Coronavirus COVID-19 epidemic.* Available at: https://www.gov.za/speeches/statement-president-cyril-ramaphosa-measures-combat-covid-19-epidemic-15-mar-2020-0000 [Accessed 27 July 2020].

South African Institute for Distance Education, 2010. *Draft outline of Bernstein's concepts.* Available at: https://www.saide.org.za/ [Accessed 18 June 2019].

Stake, R., 1995. *The art of case study research T.* Thousand Oaks, CA: Sage.

Steel, C. & Levy, M., 2009. *Creativity and constraint: Understanding teacher beliefs and the use of LMS technologies.* Auckland, New Zealand, Ascilite 2009.

Stein, J. & Graham, C., 2014. *Essentials for Blended Learning: A Standards-Based Guide.* New York, NY: Taylor and Francis.

Stones, R., 2005. *Structuration Theory.* Macmillan International Higher Education.

Sturges, J. E. & Hanrahan, K. J., 2004. Comparing telephone and face-to-face qualitative interviewing: A research note. *Qualitative Research,* Volume 4, pp. 107-118.

Swales, J., 2004. *Research Genres: Explorations and Applications.* Cambridge: Cambridge University Press.

Sztompka, P., 1993. *The Sociology of Social Change.* Oxford: Wiley-Blackwell.

Taherdoost, H., 2018. A Review of technology acceptance and adoption models and theories. *Procedia Manufacturing,* Volume 22, pp. 960-967.

Taimalu, M. & Luik, P., 2019. The impact of beliefs and knowledge on the integration of technology among teacher educators: A path analysis. *Teaching and Teacher Education,* Volume 79, pp. 101-110.

Tan, C., 2019. Competence or performance? A Bernsteinian analysis of Basic Competency Assessment in Hong Kong. *British Journal of Educational Studies,* 67(2), pp. 235-250.

Tan, M. & Teo, T., 2000. Factors influencing the adoption of internet banking. *Journal of the Association for Information Systems,* 1(5), pp. 1-44.

Tan, C., Hassali, M., Saleem, F., Shafie, A., Aljadhey, H. & Gan, V., 2015. Development, test-retest reliability and validity of the Pharmacy Value-Added Services Questionnaire (PVASQ). *Pharm Practice,* 13(3).

Taylor, S. & Todd, P. A., 1995. Understanding information technology usage: A test of competing models. *Information Systems Research,* 6(2), pp. 144-176.

Teo, T., 2009. Examining the relationship between student teachers' self-efficacy beliefs and their intended use of technology for teacher: A structural equation modeling approach. *The Turkish Online Journal of Educational Technology,* 8(4), pp. 7-16.

Teo, T., Cha, C. S., Hung, D. & Lee, C. B., 2008. Beliefs about teaching and uses of technology among pre-service teachers. *Asia-Pacific Journal of Teacher Education,* 36(2), pp. 163-174.

Teo, T., & Lee, C. B. 2010. Explaining the intention to use technology among student teachers: An application of the Theory of Planned Behavior (TPB). *Campus-Wide Information Systems*, 27(2), pp. 60-67.

Tessier, S., 2012. From Field Notes, to Transcripts, to Tape Recordings: Evolution or Combination?. *International Journal of Qualitative Methods,* 11(4), pp. 446-460.

The World Bank Education Global Practice, 2020. *Guidance Note: Remote Learning & COVID-19.* Washington, DC: The World Bank.

Thornton, H., 2006. Dispositions in action: Do dispositions make a difference in practice?. *Teacher Education Quarterly,* 33(2), pp. 53-68.

Thrift, N., 1985. Bear and mouse or bear and tree? Anthony Giddens' reconstruction of social theory. *Sociology,* 19(4), pp. 609-623.

Tichenor, M. S. & Tichenor, J. M., 2004/2005. Understanding teachers' perspectives on professionalism.. *The Professional Educator,* 27(1,2), pp. 89-95.

Tiilikainen, M., Toom , A., Lepo, J. & Husu, J., 2019. Reconstructing choice, reason and disposition in teachers' practical theories of teaching (PTs). *Teaching and Teacher Education,* Volume 19, pp. 124-136.

Tobin, G. A. & Begley, C. M., 2004. Methodological rigour within a qualitative framework.. *Journal of Advanced Nursing,* Volume 48, pp. 388-396.

Tondeur, J., Hermans, R., Valcke, M. & van Braak, J., 2008. Exploring the link between teachers' educational belief profiles and different types of computer use in the classroom. *Computers in Human Behavior,* 24(6), pp. 2541-2553.

Tondeur, J., Van Keer, H., van Braak, J. & Valcke, M., 2008. ICT Integration in the Classroom: Challenging the potential of a school policy. *Computers & Education,* Volume 51, pp. 212-223.

Tondeur, J., van Braak, J., Sang, G., Voogt, J., Fisser, P. & Ottenbreit-Leftwich, A., 2011. Preparing pre-service teachers to integrate technology in education: A synthesis of qualitative evidence. *Computers & Education,* pp. 1-11.

Tondeur, J., Kershaw, L., Vanderlinde, R. & van Braak, J., 2013. Getting inside the black box of technology integration in education. *Australasian Journal of Educational Technology,* 29(3), pp. 434-449.

Tondeur, J., van Braak, J., Ertmer, P. A. & Ottenbreit-Leftwich, A., 2017. Understanding the relationship between teachers' pedagogical beliefs and technology use in education: A systematic review of qualitative evidence. *Educational Technology Research and Development*, 65(3), pp. 555-575.

Tondeur, J., 2020. Teachers' pedagogical beliefs and technology use: A chicken and the egg dilemma. In: M. A. Peters, ed. *Encyclopedia of Teacher Education.* Singapore: Springer.

Toomela, A., 2000. Activity theory is a dead end for cultural psychology. *Culture and Psychology,* Volume 6, pp. 353-364.

Toomela, A., 2008. Activity theory is a dead end for methodological thinking in cultural psychology too. *Culture and Psychology,* Volume 14, pp. 289-303.

Toprakci, E., 2006. Obstacles at integration of schools into information and communication technologies by taking into consideration the opinions of the teachers and principals of primary and secondary schools in Turkey. *Journal of Instructional Science and Technology,* 9(1), p. 1-16.

Travers, M., 2011. What is Qualitative Research?. In: *Qualitative Research Through Case Studies.* London: SAGE Publications, pp. 2-14.

Trinidad, S., Newhouse, P. & Clarkson, B., 2005. *A Framework for Keading School Change in using ICT: measuring change.* Parramatta, Australian Association for Research in Education Annual Conference.

Trochim, W., 2006. *Unit of Analysis,* Web Centre for Social Research Methods.

Turner, J. R., Morris, M. & Atamenwan, I., 2019. A Theoretical Literature Review on Adaptive Structuration Theory as Its Relevance to Human Resource Development. *Advances in Developing Human Resources,* pp. 1-4.

University of Pretoria, 2017. *Research Management Policy,* Office of the Vice-Principal: Research and Postgraduate Education.

Vahdati, H., Mousavi, N. & Tajik, Z. M., 2015. The Study of Consumer Perception on Corporate Social Responsibility towards Consumers Attitude and Purchase Behavior. *Asian Economic and Financial Review,* 5(5), pp. 831-845.

Vaismoradi, M., Turunen, H. & Bondas , T., 2013. Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing and Health Sciences,* Volume 15, pp. 398-405.

van Braak, J., Tondeur, J. & Valcke, M., 2004. Explaining different types of computer use among primary school teachers. *European Journal of Psychology of Education,* Volume 14, p. 407–422.

Van Der Ross, D. & Tsibolane, P., 2017. *The Influence of Teacher Attitudes and Beliefs on Information and Communications Technology Integration Behavior in South African High Schools*, CONF-IRM 2017.

van Teijlingen, E. R. & Hundley, V., 2001. *The importance of pilot studies,* Guildford: Department of Sociology, University of Surrey.

Vanderlinde, R., van Braak, J. & Tondeur, J., 2010. Using an online tool to support school-based ICT policy planning in primary education. *Journal of Computer Assisted learning,* 26(5), pp. 296-306.

Vandeyar, T., 2014. 'Windows' on Teachers' Beliefs and Attitudes about School ICT Policy Statements. *Mediterranean Journal of Social Sciences,* 5(14), pp. 339-351.

Vannatta, R. A. & Fordham, N., 2004. Teacher Dispositions as Predictors of Technology Use. *Journal of Research on Technology in Education,* pp. 253-271.

Venkatesh, V. & Davis , F. D., 2000. A theoretical extension of the technology acceptance model: four longitudinal field studies. *Management Science,* 46(2), pp. 186-204.

Venkatesh, V., Morris, M., Davis, G. & Davis, F., 2003. User acceptance of information technology: Toward a unified view. *MIS Quarterly,* 27(3), pp. 425-478.

Very PC, n.d. *Smart Kapp.* Available at: https://very-pc.co.uk/products/interactive-hardware/smart-kapp [Accessed 27 July 2020].

Vongkulluksn, V., Xie, K. & Bowman, M., 2018. The role of value on teachers' internalization of external barriers and externalization of personal beliefs for classroom technology integration. *Computers & Education,* Volume 11, pp. 70-81.

Voogt, J. & Knezek, G., 2013. Building a global community of policymakers, researchers and educators to move education systems into the digital age. *Journal of Computer Assisted Learning,* Volume 29, pp. 399-402.

Vygotsky, L., 1978. *Mind and society: The development of higher mental processes.* Cambridge: MA: Harvard University Press.

Wacker, J. G., 1998. A Definition of Theory: research guidelines for different theory-building research methods in operations management. *Journal of Operation Management,* Volume 16, pp. 361-385.

Waite, S., 2004. Tools for the job: a report of two surveys of information and communications technology training and use for literacy in primary schools in the West of England. *Journal of Computer Assisted Learning,* Volume 20, pp. 11-20.

Walliman, N., 2011. *Research Methods: The Basics.* New York: Routledge.

Walsham, G. & Han, C., 1990. *Structuration Theory and Information Systems Research.,* AIS Electronic Library, pp. 53-59.

Walsham, G., 2002. Cross-Cultural Software Production and Use: A Structurational Analysis. *MIS Quarterly,* 26(4), pp. 359-380.

Wang, L., Ertmer, P. A. & Newby, T. J., 2004. Increasing preservice teachers' self-efficacy beliefs for technology integration. *Journal of Research on Technology in Education,* 36(3), pp. 231-250.

Watson, G., 2006. Technology professional development: Long-term effects on teacher self-efficacy. *Journal of Technology and Teacher Education,* 14(1), pp. 151-165.

Weick, K., 1979. *The Social Psychology of Organizing.* Reading, MA: Addison-Wesley.

Welch, A. & Napoleon, L., 2015. Professional Teaching Dispositions of Online Instructors: Why They Matter. *Procedia - Social and Behavioral Sciences,* Volume 171, pp. 584-589.

Wells, J., 2007. Key design factors in durable instructional technology professional development. *Journal of Technology and Teacher Education,* 15(1), pp. 101-122.

Western Cape Department of Education, 2011. *The Khanya Technology in Education project.* Available at: ttps://wcedonline.westerncape.gov.za/documents/abuse_no_more/summary_document/khanya.html [Accessed 19 November 2018].

Wheelahan, L., 2005. *The Pedagogic Device: The relevance of Bernstein's analysis for VET.* Queensland, Griffith University.

Whittington, R., 2015. Giddens, structuration theory and strategy as practice. In: D. Golsorkhi, L. Rouleau, D. Seidl & E. Vaara , eds. *Cambridge Handbook of Strategy as Practice.* Cambridge: Cambridge University Press, pp. 145-163.

Williamson, B., Eynon, R. & Potter, J., 2020. Pandemic politics, pedagogies and practices: digital technologies and distance education during the coronavirus emergency. *Learning Media and Technology,* 45(2), pp. 107-114.

Willis, G. B., 2004. *Cognitive interviewing: A tool for improving questionnaire design.* Thousand Oaks, CA: Sage Publications.

Wilson-Strydom, M., Thomson, J. & Hodgkinson-Williamson, C. A., 2005. Understanding ICT integration in South African Classrooms. *Perspectives in Education,* 23(4), pp. 71-85.

Windschitl, M. & Sahl, K., 2002. Tracing teachers' use of technology in a laptop computer school: The interplay of teacher beliefs, social dynamics, and institutional culture. *American Educational Research Journal,* Volume 39, pp. 165-205.

Woodbridge, J., 2003. *Technology Integration as a Teaching Strategy.* Minneapolis, MN: Walden University.

Yeong, M., Ismail, R., Ismail, N. & Hamzah, M., 2018. Interview Protocol Refinement: Fine-Tuning Qualitative Research Interview Questions for Multi-Racial Populations in Malaysia. *The Qualitative Repor,* 23(11), pp. 2700-2713.

Yin, R. K., 2009. *Case Study Research: Design and Methods.* 4th ed. Thousand Oaks, CA: SAGE Publications.

Yin, R. K., 2012. Analytic Generalization. In: A. J. Mills, G. Durepos & E. Wiebe, eds. *Encyclopedia of Case Study Research.* Thousand Oaks, CA: SAGE Publications, pp. 21-22.

Yin, R. K., 2014. *Case Study Research Design and Methods.* 5th ed. Thousand Oaks, CA: SAGE.

Yucel, C., Acun, I., Tarman, B. & Mete, T., 2010. A Model to explore Turkish Teachers' ICT integration Stages. *The Turkish Online Journal of Educational Technology,* 9(4), pp. 1-9.

Zandvliet, D., 2006. *Education is not rocket science: The case for deconstructing computer labs in schools.* Rotterdam: Sense Publishers.

Zhang, Y. & Wildemuth, B. M., 2009. Qualitative Analysis of Content. In: *In: B. M. Wildemuth, Ed., Applications of Social Research Methods to Questions in Information and Library Science*. Libraries Unlimited, pp. 1-12.

Zhao, Y. & Frank, K. A., 2003. Factors affecting technology uses in schools: An ecological perspective. *American Educational Research Journal,* Volume 40, pp. 807-840.

Zhao, Y., Pugh, K., Sheldon, S. & Byers, J., 2002. Conditions for classroom technology innovations. *Teachers College Record,* Volume 104, pp. 482-515.

APPENDICES

APPENDIX A INTERVIEW PROTOCOLS

Appendix A-1: First Interview Protocol

School: (Number) _____

Teacher: (Pseudonym) _____

There are **FIVE (5) sections** to this interview.

The 1st is general questions; the 2nd is about technology at your school and your beliefs in this regard; 3rd is about your beliefs in relation to teaching in general and your own pedagogic practice; 4th is about your technology activities, past and current use; and 5th is about the context of your school.

There are no right or wrong answers, I am simply trying to understand teachers' use of technology within SA secondary schools. Please stop me at any time if there is anything you don't understand or need me to clarify.

Insights from the Interview

Section 1 – General Questions

Demographic Questions

1. How long have you been teaching?

2. How long have you been teaching at this school?

3. Please briefly describe how you make use of technology in your personal life?

Section 2 – Technology and Beliefs

External Structures (ES): acknowledged or unacknowledged conditions of action which may result in unintended consequences of action that constrain or enable the agent i.e., teacher (Stones, 2005).

Internal Structures – Conjuncturally-Specific Beliefs (CSB): draws on ST concepts of legitimation and domination relative to the specific role or position of the agent in focus i.e., teacher (Stones, 2005).

4. *Resources (ES-R)*

(1) Access

a. Please describe what access teachers have to technology at your school (ES-R-A).

b. Please explain whether you believe teachers' access to technology at your school is adequate to perform their job (CSB-R-A).

(2) Suitability and Quality

a. Please describe the suitability and quality of the technology resources at your school (ES-R-Q).

b. Please explain whether you believe the technology resources at your school are suitable and of adequate quality (CSB-R-Q).

(3) Physical Arrangement (probe: labs, a laptop per child etc)

a. Please describe how the technology resources at your school are physically arranged (ES-R-P) .

b. Please explain whether you believe that the arrangement of technology resources at your school is appropriate (CSB-R-P).

5. *Training (ES-TR)*

(1) Extent (probe: amount, level, time)

a. Please describe the extent of teacher technology training available at your school (ES-TR-E).

b. Please explain whether you believe the extent of teacher technology training available at your school is adequate (CSB-TR-E).

(2) Quality and Type (probe: professional development, practical, peer mentoring)

a. Please describe the quality and type of teacher technology training at your school (ES-TR-Q).

b. Please explain whether you believe the quality and type of teacher technology training available at your school is appropriate (CSB-TR-Q).

6. *Support (ES-S)*

(1) Types of Support

a. Please describe the types of technology support available at your school (ES-S-N).

b. Please explain whether you believe the types of technology support available at your school are adequate (CSB-S-N).

(2) Technical Support

a. Please describe the technical support available to assist teachers at your school with technology (ES-S-T).

b. Please explain whether you believe the technical support available at your school is adequate to assist teachers in making use of technology in the classroom (CSB-S-T).

(3) Institutional Support

a. Please describe how your school supports teachers' technology use in the classroom (ES-S-I).

b. Please explain whether you believe the schools' support of teachers' technology use in the classroom is adequate (CSB-S-I).

7. *Time (ES-T)*

(1) Familiarity

a. Please describe how familiar you are with using technology in the classroom (ES-T-F).

b. Please explain whether you believe that you are familiar enough with using technology in order to effectively use it in your teaching (CSB-T-F).

(2) Feasibility

a. Please describe how feasible it is for you to make effective use of technology in the classroom, given the time available (ES-T-FE).

b. Please explain whether you believe it is feasible for you to make use of technology for your teaching, given the time needed to make effective use of it (CSB-T-FE).

Section 3 - Pedagogy

Internal Structures – General Dispositions (IB) which relate to internal beliefs (Stones, 2005)

8. *Pedagogy (IB-P)*

Please describe your beliefs about your own pedagogy and pedagogy in general

9. *Norms (IB-N)*

(1) School

Please explain the school's beliefs around technology use within the classroom (IB-N-S)

(2) Peers

Please explain the beliefs of your peers within your school around technology use in the classroom (IB-N-P)

10. *Knowledge (IB-K)*

(1) Nature of Knowledge

Please explain how you believe one acquires knowledge (IB-K-N)

(2) Knowledge of Use

Please explain whether your knowledge of how to use technology influences your use of technology in the classroom (IB-K-U).

11. *Value of ICT (IB-V)*

(1) Use

Please describe how you believe technology should be used (IB-V-U) in the classroom.

(2) Benefits of Use

Please explain what affordances (i.e., benefits) you believe technology provides for your teaching (IB-V-A).

12. *Self-efficacy (IB-SE)*

(1) Work

Please describe how confident you feel about using technology in your teaching (IB-SE-W).

(2) Personal

Please describe how confident you feel about using technology in your personal life (IB-SE-P).

Internal Structures – general dispositions/internal beliefs (IB-PD): related to instructional and regulative discourse (Bernstein, 1986; 1999; 2000; Hoadley & Ensor, 2009; Naidoo, 2011).

13. *Instructional Discourse (IB-PDI)*

(1) Boundaries of Knowledge

Please explain whether you believe boundaries exist between everyday knowledge and knowledge learnt at school (IB-PDI-B).

(2) Nature of Knowledge

Please explain how you believe knowledge is acquired in your discipline (IB-PDI-K)

14. *Regulative Discourse (IB-PDR)*

(1) Boundaries between teachers and learners

Please describe your beliefs as to the appropriate boundaries that should exist between yourself and the learners (IB-PDR-B).

(2) Teacher Control

Please explain your beliefs as to the teacher's control of the learning context (IB-PDR-C).

Section 4 –Technology Activities and Current Use

Agent's Practices (AP): the active and dynamic moment of structuration (Stones, 2005).

15. *Level of Adoption (AP-LA)*

Please explain your approach to integrating technology into your work.

16. *Manner of Adoption (AP-MA)*

Do you believe that your use of technology supports or transforms your existing pedagogic practice. Please explain.

17. *Adoption Activities (AP-AA)*

Please can you provide examples of the way in which you have integrated technology into your work.

Outcomes (O): results of active agency through which structures are reproduced and transformed (Stones, 2005).

18. *Current Technology Use (O-CTU)*

Currently, how do you make use of technology for your work activities

Section 5 – School Context

Context (C): specific circumstances that form the setting (Stones, 2005).

19. *School Culture (C-SCu) (probe: ethos)*

Please describe the culture of the school in which you are currently teaching.

20. *School Control (C-SC)*

How are learners at your school grouped for learning activities. For example, are they grouped on personal abilities or age group?

21. *Social Integration (C-SI)*

Please explain whether your beliefs around technology use are similar to other teachers' in the school.

General Question

22. Are there any other comments you wish to make in relation to technology use by you and your peers at the school that you believe may be relevant for this study?

Appendix A-2: Second Interview Protocol

School: (Pseudonym will be used) _____

Teacher: (Pseudonym will be used) _____

Due to the COVID-19 global pandemic, it is becoming increasingly important to understand what role technology is playing in relation to remote teaching. As this is a follow-up interview due to the current COVID-19 pandemic, it is focused on the technology infrastructure now available at your school to facilitate remote teaching as well as your beliefs around using technology within such a context. As with the first interview, there are no right or wrong answers.

Insights from the Interview

Section 1: Technology and Beliefs

External Structures / Internal Structures: Conjuncturally-Specific Beliefs

1. Resources (ES-R)

a. Access

Please describe what access teachers at your schools currently have to technology (ES-R-A) and whether you believe this is adequate to perform their job remotely (CSB-R-A).

b. Suitability and Quality

Please explain whether you believe the technology resources provided by your school are suitable and of sufficient quality for you to perform your job remotely (CSB-R-Q).

c. Physical Arrangement (probe: zoom, free data, etc.)

Please describe what physical technology arrangements have been put in place by your school to facilitate remote teaching (ES-R-P) and whether you believe these are appropriate to assist you (CSB-R-P).

2. *Training (ES-TR)*

Extent and Quality (probe: amount, level, type)

Please describe what technology training has been made available by your school to facilitate remote teaching (ES-TR-E; ES-TR-Q) and whether you believe that this sufficient (CSB-TR-E; CSB-TR-Q).

3. *Support (ES-S)*

Types of Support and Technical Support and Institutional Support

Please describe the types of technology (ES-S-N), technical (ES-S-T) and institutional support (ES-S-I) that have been made available by your school to assist the current need for increased technology use and whether you believe it is adequate (CSB-S-N; CSB-T-T; CSB-T-I).

4. *Time (ES-T)*

a. Familiarity

Please describe how familiar you are with using the technology tools needed to teach remotely (ES-T-F) and whether you believe that you are familiar enough to make effective use of these tools (CSB-T-F).

b. Feasibility

Please describe how feasible it is for you to make use of technology for remote teaching, given the time available to prepare and deliver lessons (ES-T-FE) and whether you believe it is feasible for you to make effective use of the technology (CSB-T-FE).

Section 2 - Pedagogy

Internal Structures – General Dispositions (IB)

5. *Norms (IB-N)*

Peers and School

Please explain your peers' (IB-N-P) and school's beliefs around technology use for remote teaching (IB-N-S).

6. *Knowledge (IB-K)*

Knowledge of Use

Please explain whether your knowledge of how to use technology is influencing your current use of technology for remote teaching (IB-K-U).

7. *Value of ICT (IB-V)*

Use and Benefits of Use

Please describe how you believe technology should be used (IB-V-U) to teach remotely and what affordances (i.e., benefits) you believe technology is providing (IB-V-A).

8. *Self-efficacy (IB-SE)*

Work

Please describe how confident you feel about using technology for remote teaching (IB-SE-W).

Section 3 –Technology Activities, Past and Current Use

Agent's Practices/Outcomes

9. *Adoption Activities (AP-AA), Current Technology Use (O-CTU)*

Please explain how you are currently using technology to facilitate remote teaching.

10. *Manner of Adoption (AP-MA)*

Please explain whether you believe that your current use of technology for remote teaching is supporting or transforming your existing pedagogic practice.

General Questions

11. Please explain whether you intend to continue using technology so extensively after school returns to face-to-face teaching.

12. Are there any other comments you wish to make in relation to technology use during the COVID-19 pandemic that you believe may be relevant for this study?

Appendix A-3: Third Interview Protocol

School: (Number) _____

Teacher: (Pseudonym) _____

As teaching remotely becomes an increasing reality due to the unknown trajectory and implications of the COVID-19 pandemic, I am trying to understand what has changed since we last chatted in regard to your technology setup and beliefs around teaching and utilisation of technology. As with the other interviews, there are no right or wrong answers.

Insights from the Interview

External Structures

Resources ES-R: Access (A), Suitability (Q), Arrangement (A); Training ES-TR; Support: ES-S

1. Practically, what has changed since we last spoke in relation to technology access, your technology resources, training provided, and school support of technology use?

Support/Time: ES-T Familiarity(F); Self Efficacy (IB-SE); Knowledge (IB-K-U)

2. Has the current situation motivated you to become more familiar with technology and improve your technology skills and if so, how?

Agent Practices/ Outcomes

Adoption Activities: AP-AA; Current Technology Use: O-CTU

3. Describe the different ways in which you are now using technology?

Internal Structures/General Dispositions

Pedagogy: IB-P

4. Have your beliefs around teaching as a profession changed and if so, how?

Value of ICT: IB-V; Benefits of Use: IB-V-A

5. Have your beliefs around the value and benefits of using technology for teaching changed since and if so, how?

Regulative Discourse: IB-PDR-B

6. Have the boundaries changed between you and the learners and if so, how?

Pedagogy: IB-P

7. Do you believe that teaching has changed forever and if so, how?

General

8. How do you envision the future of education in relation to technology use? Do you see it as being blended or moving totally online?

APPENDIX B ETHICAL FORMS AND CLEARANCES

Appendix B-1: Teacher Participation Letter

(Date to be inserted)

Dear Teacher,

I am currently doing my PhD at the University of Pretoria in the faculty of Engineering, Built Environment and IT. The introduction and use of technology by teachers within (school name) has presented me with an opportunity to carry out academic research to understand more about teachers' beliefs, professional dispositions, orientation towards technology and technology use in South African secondary schools. The study holds no preconceived notions as to whether technology must be used in secondary educational contexts, but rather aims to explore the issue and therefore, your opinions, experiences and beliefs in relation to technology integration at (school name) are important. There are no right or wrong answers. Aside from its academic value, the study findings may also help inform educational institutions, government and teachers as to the complexities involved with integrating technology in the classroom.

As a teacher, you are invited to take part in this study so we can capture what you think, believe and feel about your teaching and using technology in the classroom. Your participation is entirely voluntary and involves no risk, penalty or loss of benefits whether or not you participate. If you agree to take part, you will be asked to first participate in an initial in-person interview, thereafter you will be asked whether you are willing to participate in a further two rounds of telephonic interviews. During the interview you may refuse to answer any questions that you feel uncomfortable with answering.

The interviews are confidential, your name will not be disclosed as a pseudonym will be used to report any of the findings. If you agree to participate in the interview, arrangements for the interview will be made at a time and place that is suitable for you. The initial in-person interview will last approximately between forty-five and sixty minutes. The second and third telephonic interviews will last approximately twenty minutes each. You may withdraw from the interview at any time, and you may also refuse to answer any questions that you feel uncomfortable with answering.

With your permission, the interviews will be recorded and notes will be taken. No one other than the researchers will have access to the recordings or notes taken. To ensure your confidentiality, your name and personal details will not be disclosed. It will not be possible to trace responses back to any individuals. The recordings and notes will be kept until no longer needed for producing publications.

Your honest answers are important and there are no right or wrong answers.

This survey was approved unconditionally by the University of Pretoria EBIT Research Ethics Committee (Non-Medical), Protocol Number: EBIT/215/2019.

Thank you for considering participating. Should you have any questions, or should you wish to obtain a copy of the results of the survey, please contact me on 011 717 8158 or email suzanne.sackstein@wits.ac.za or my supervisors Prof Machdel Matthee on 012-420-3365 or machdel.matthee@up.ac.za or Dr Lizette Weilbach on 012-420-3376 or lizette.weilbach@up.ac.za

Regards

Suzanne Sackstein, Principal Tutor
School of Economic and Business Sciences, University of the Witwatersrand, Johannesburg

Appendix B-2: Informed Consent

Project information

1.1 **Title of research project:** Understanding Teachers' Beliefs, Professional Dispositions, Orientation towards Technology and Technology Use in South African Secondary Schools

1.2 Researcher details: Suzanne Lee Sackstein, Faculty of Engineering, Built Environment and IT, email: suzanne.sackstein@wits.ac.za, phone: 082-771-4226

1.3 **Research study description:**

(i) The research aims to understand the relationship between teachers' beliefs, professional dispositions and orientations towards technology in relation to their integration of technology within South African secondary schools. The objective is to explain the nature of this relationship in relative to the social context of teachers.

(ii) Participants will be invited to take part in an initial in-person interview lasting approximately between forty-five and sixty minutes in which questions will be asked related to their beliefs, professional dispositions and orientations relative to their technology use. In addition, participants will also be invited to participate in a second and third round of telephonic interviews that will last approximately twenty minutes each. Interviews will only be recorded with the consent of the participant.

(iii) There are no risks to participants as no names and personal details will be disclosed and it will not be possible to trace responses back to any individuals.

2. Informed consent

2.1 I, *(name of participant)* _____ hereby voluntarily grant my permission for participation in the research as explained to me by Suzanne Lee Sackstein.

2.2 The nature, objective, possible safety and health implications have been explained to me and I understand them.

2.3 I understand my right to choose whether to participate in the research and that the information furnished will be handled confidentially. I am aware that the results of the investigation may be used for the purposes of publication.

2.4 Upon signature of this form, the participant will be provided with a copy.

Signed: _____ Date: _____

Witness: _____ Date: _____

Researcher: _____ Date: _____

Appendix B-3: Permission Letters from Private Schools

1. Title of the research project: Understanding teachers' beliefs, professional dispositions, orientation towards technology and technology use in South African secondary schools.

2. I, _____ (name of principal), principal of _____ (name of school), hereby voluntarily grant permission for the participation in this research project, as explained to me by Suzanne Lee Sackstein (name of researcher).

3. The nature and objective of the research have been explained to me and I understand them.

4. I understand my right to choose whether to participate in the project and that information collected will be handled confidentially.

5. I understand that my name, the name of the school and the names of the participating teachers will not be disclosed in the findings.

6. I am aware that the findings of this research will be used for the purposes of academic publication.

Please complete the following:

I _____ (name of principal), principal of _____ (name of school) agree to distribute an email from Suzanne Lee Sackstein (name of researcher) inviting teachers at _____ (name of the school) to participate in interviews and observations in relation to technology use in the classroom.

School Principal	_____	Signature	_____	Date _____
Witness	_____	Signature	_____	Date _____
Researcher	Suzanne Sackstein	Signature	_____	Date _____

Appendix B-4: Permission Letter from Gauteng Department of Education

GAUTENG PROVINCE
Department: Education
REPUBLIC OF SOUTH AFRICA

8/4/4/1/2

GDE RESEARCH APPROVAL LETTER

Date:	10 September 2019
Validity of Research Approval:	04 February 2020 – 30 September 2020 2019/267
Name of Researcher:	Sackstein S.L
Address of Researcher:	12 Chilton Avenue
	Kew
	2090
Telephone Number:	082 771 4226
Email address:	Suzanne.sackstein@wits.ac.za
Research Topic:	Understanding Teacher's Beliefs, Professional Dispositions, Orientation towards Technology and Technology Use in South African Secondary Schools.
Type of qualification	PhD
Number and type of schools:	Four Secondary Schools
District/s/HO	Johannesburg East, Ekurhuleni South, Johannesburg Central and Tshwane South

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the conditions listed below be flouted:

10/09/2019

1

Making education a societal priority

Office of the Director: Education Research and Knowledge Management
7th Floor, 17 Simmonds Street, Johannesburg, 2001
Tel: (011) 355 0488
Email: Faith.Tshabalala@gauteng.gov.za
Website: www.education.gpg.gov.za

1. *Letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.*
2. *The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.*
3. *A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.*
4. *A letter / document that outline the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.*
5. *The Researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.*
6. *Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.*
7. *Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.*
8. *Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.*
9. *It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.*
10. *The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.*
11. *The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.*
12. *On completion of the study the researcher/s must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.*
13. *The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.*
14. *Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.*

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards

.....

Mr Gumani Mukatuni
Acting CES: Education Research and Knowledge Management

DATE: 10/09/2019

Office of the Director: Education Research and Knowledge Management
7th Floor, 17 Simmonds Street, Johannesburg, 2001
Tel: (011) 355 0488
Email: Faith.Tshabalala@gauteng.gov.za
Website: www.education.gpg.gov.za

Appendix B-5: Ethical Clearance from EBIT Committee of the University of Pretoria

Faculty of Engineering, Built Environment and Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en Inligtingtegnologie / Lefapha la Boetšenere, Tikologo ya Kago le Thekenološi ya Tshedimošo

Reference number: EBIT/215/2019

Mrs SL Sackstein
Department: Informatics
University of Pretoria
Pretoria
0083

Dear Mrs SL Sackstein

FACULTY COMMITTEE FOR RESEARCH ETHICS AND INTEGRITY

Your recent application to the EBIT Research Ethics Committee refers.

Approval is granted for the application with reference number that appears above.

1. This means that the research project entitled "UNDERSTANDING TEACHERS' BELIEFS, PROFESSIONAL DISPOSITIONS, ORIENTATION TOWARDS TECHNOLOGY AND TECHNOLOGY USE IN SOUTH AFRICAN SECONDARY SCHOOLS" has been approved as submitted. It is important to note what approval implies. This is expanded on in the points that follow.

2. This approval does not imply that the researcher, student or lecturer is relieved of any accountability in terms of the Code of Ethics for Scholarly Activities of the University of Pretoria, or the Policy and Procedures for Responsible Research of the University of Pretoria. These documents are available on the website of the EBIT Research Ethics Committee.

3. If action is taken beyond the approved application, approval is withdrawn automatically.

4. According to the regulations, any relevant problem arising from the study or research methodology as well as any amendments or changes, must be brought to the attention of the EBIT Research Ethics Office.

5. The Committee must be notified on completion of the project.

The Committee wishes you every success with the research project.

Prof JJ Hanekom
Chair: Faculty Committee for Research Ethics and Integrity
FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

APPENDIX C SAMPLE TRANSCRIPT

Interview 3 – Thuli (School 4)[106]

Suzanne Sackstein 00:00
How are you? How are you keeping?

Thuli 00:07
Good thanks

Suzanne Sackstein 00:13
I just want to ask a few questions, as our reality becomes that we are going to be doing some online teaching for a while now. I just wanted to ask you a few questions to just follow up on the interview. Can you tell me practically what has changed since we last spoke in relation to **technology access your technology resources, the training and school support?**

Thuli 00:46
They introduced *Google Teams* and *Google Classroom* and broaden the Wi-Fi so it included my classroom. In terms of orientations on these software, there was a little on what to do but I'm still not able to fully work on it.

Suzanne Sackstein 01:26
So what can you do if you can't fully work on it? Is there someone you can ask?

Thuli 01:30
There is someone you can ask but the problem is that they don't know, I rather use videos

Suzanne Sackstein 01:45
So you're looking up on *YouTube* or like what do you do?

Thuli 01:49
Yes

Suzanne Sackstein 01:50
Okay, in terms of the support from the school did you get a device because I remember the last time we spoke using have a **school issued device like how did they expect to do this**?

Thuli 02:02
My own personal laptop, I never got any technology now to assist me

Suzanne Sackstein 02:29
So they actually haven't given you any extra access. The only thing is when you're at school you using your personal laptop and a Wi-Fi is better and they've given you *Google Classroom*.

Thuli 02:40
Yes

Suzanne Sackstein 02:40
Okay. And the current situation that we found ourselves in has it motivated you to **become more familiar with the technology and improve your technology skills**?

Thuli 02:55
Yes and no, I feel like most of the software that we are currently using, I have had a taste in using them, it's just like I can now broaden it.

[106] To enable coding and analysis of the interviews, questions asked in relation to TTU-SST were highlighted in blue, with words used in the reporting the interview are highlighted in purple.

Suzanne Sackstein 03:12
So you were familiar anyway but you using more? Are you using more of the software that you did before just know more about the features, how has that changed?

Thuli 03:26
Yes I am using it more

Suzanne Sackstein 03:31
Can you tell me about **different ways that you're using it than you were using it before**?

Thuli 03:39
In terms of *Google Classroom* I'm using the video feature, I prefer not to do live classes but I have conducted one live class, but I prefer to record the video and upload it

Suzanne Sackstein 03:53
How did the live class go?

Thuli 03:56
The live class, most of the students were able to log in and the class didn't take that long because of other issues and conflicting issues with other teacher's schedule and I felt like most of the time I would be teaching and kids would not wait until I was done talking to pose the question. Do I carry on talking about what I was talking about, or do I go back and answer the child? They're using the own internet at home, so the going back and forth, do I go back and answer what the child is answering and wait until the end and answer them.

Suzanne Sackstein 04:53
So when you **record lessons now and then you upload them, how do the students then ask questions**?

Thuli 05:01
They post them underneath the video

Suzanne Sackstein 05:05
Okay and then you can answer whenever you want, so you can give the lesson and then they listen and then you answer. Is that why you prefer it?

Thuli 05:13
Yes

Suzanne Sackstein 05:14
So you're using recordings, you're using posts of questions. **What else are you using that you hadn't used before?**

Thuli 05:25
The *Google Teams*, **I think it's called Microsoft and we're using that to have our staff briefing, and we are supposed to be doing online classes.**

Suzanne Sackstein 05:44
In classes, you know what percentage of the students are actually attending or logging in and watching?

Thuli 05:54
Okay, I'm only I'm in charge of the Grade 8s and all the Grade 9s, there are about 300 to 400 students in each grade, and then in each class there are about 170

Suzanne Sackstein 06:15
So you're saying that this like **just over half or sometimes under half**?

Thuli 06:20
Yes

Suzanne Sackstein 06:21
So what's gonna happen with those students that aren't online or aren't engaging?

Thuli 06:29
I'm not really sure to be honest, I feel like when they come back to class, I still have to begin from the beginning, regardless of what happens

Suzanne Sackstein 06:40
Have your **beliefs around teaching as a profession changed**?

Thuli 06:45
Yes **I feel like I need to be more IT inclined, to make sure I'm more IT inclined.**

Suzanne Sackstein 06:56
And in **terms of your role as a teacher, is it now mainly about just giving content**? Or is it about this holistic learning experience? Or do you feel like you now just about content?

Thuli 07:13
I feel like now it's just about content.

Suzanne Sackstein 07:18
So **have we lost something in the teaching profession** because of this or not?

Thuli 07:25
I feel like we have lost something because when a child is in front of you, you can sort of deduct what is happening. When they are not in front of you, you have to teach them through the internet, what I'm relying on basically giving them quizzes every week and having to go back and analyse that, so it's not immediate stimulation to adjust or reflect on something, it is a while for me to go and reflect on a particular issue or note that they don't understand it.

Suzanne Sackstein 08:01
So you are saying that it's not as immediate as well?

Thuli 08:04
Yes

Suzanne Sackstein 08:06
Have your **beliefs around the value and benefits of using technology for teaching changed?**

Thuli 08:21
No. In my learning or in my thoughts about **technology that it's important, it adds to education, but it can't be the main thing**

Suzanne Sackstein 08:41
Okay, which maybe then leads me to another question, which is do you believe **teaching has changed forever?**

Thuli 08:53
Yes, if we manage to keep it in place, but where it is now, probably if we went back to normal classes, we would just disregard it on the basis that not every student has access to it and if I do something online, I have to do it again in class anyway.

Suzanne Sackstein 09:14
So do you think it's particular **in the South African context where we've got such a huge differential between advantaged and disadvantaged schools and learners**?

Thuli 09:25
Yes

Suzanne Sackstein 09:30
Do you think it might be different in another context, where there's more similar, access and all of that?

Thuli 09:39
No,

Suzanne Sackstein 09:40
You still think that because we've been forced to do it right now, this is where we are at, but it's going to go back to as people's behaviour isn't going to change forever.

Thuli 09:49
I don't think it's going to change forever, considering that our school is a bit more privileged than most public schools and our school is not exactly having 60 to 70 per cent of the students online anyway, so we can't establish it and we are seen as a privileged public school, how do other public schools manage to do that?

Suzanne Sackstein 10:21
Have the **boundaries change between you and the learners**?

Thuli 10:26
Yes, they now feel they can talk directly to me or they post weird questions on the online system, now it's more like one-on-one interaction is able to happen, so if students know you on a personal level, they'll be asking Ma'am how was your lockdown, and they forget that this is actually a teaching aid.

Suzanne Sackstein 11:00
So the **boundaries are blurred a little bit?**

Thuli 11:03
Yes

Suzanne Sackstein 11:05
Do they contact you at any time, you're saying they contact you about anything but they do they contact you out of school hours, has that changed?

Thuli 11:19
I can say they do contact me out of school hours, meaning I can receive messages from the Google platform while I'm at home, but I usually do not respond to them.

Suzanne Sackstein 11:34
So you want to still keep those boundaries in place?

Thuli 11:38
Yes

Suzanne Sackstein 11:42
Last question is how do you **envision the future of education in relation to technology use**? Do you think it's going to be blended with going to move totally online?

Thuli 11:55
I would love it to be blended and for assessments, not formal assessments, those tiny assessments you have to do to prove that they are working in class, if those could be done online, I can see how helpful it would be, with keeping track and marking and all that. But as for formal assessments and tasks, I would prefer they be the way they used to be.

Suzanne Sackstein 12:26
Do you think it won't move online just because in the South African context we have you know, this disparity or do you anyway it wouldn't move online?

Thuli 12:38
I feel like globally, it will all move online.

Suzanne Sackstein 12:43
And here in South Africa?

Thuli 12:46
It's going to take some time. Even if we move onto online, I feel like they will be disadvantaging most of our students basically.

Suzanne Sackstein 13:03
Because of access issues and affordability?

Thuli 13:06
Yes

Suzanne Sackstein 13:10
Very interesting, thank you so much for your time and your insights. This hasn't been an easy time for anyone. I think it's amazing that you got it in.

Thuli 13:55
I'm sure they will do an extension based on Coronavirus and all that.

Suzanne Sackstein 14:00
I think we interest you know, we entering interesting times. And I think the South African context because it is so diverse, and you have schools where it's almost seamless, they they've continued the academic project and in fact benefited, and then the other schools which like have not had contact with their learners, at all. We will be in contact and best of luck for the results.

APPENDIX D EXPANDED SUBCODES

SST Concept	Initial Code	Description	Subcodes
External Structures/ Internal Structures (a)	ES-R/CSB-R	**Resources**: (see section 2.4.1)	
		• Access (ES-R-A, CSB-R-A) • Quality and Suitability (ES-R-Q, CSB-R-Q)	• Hardware (R-AH, R-QH) • Wi-Fi/Data (R-AW, R-QW) • Software (R-AS, R-QS)
		• Physical Arrangement (ES-R-P, CSB-R-P)	• Classroom Setup (R-PC) • Remote Setup (R-PR)
	ES-TR/CSB-TR	**Training:** (see section 2.4.1)	
		• Extent (ES-TR-E, CSB-TR-E)	• Frequency (TR-EF) • Training Provided (TR-EP)
		• Quality (ES-TR-Q, CSB-TR-Q)	• Professional Development (TR-QPD) • Courses (TR-QC) • Peer Mentoring (TR-QPM) • Communities of Practice (TR-QCP) • Type (TR-QT)
	ES-S/CSB-S	**Support:** (see section 2.4.1)	
		• Technical (ES-S-T, CSB-S-T) • Institutional Support (ES-S-I, CSB-S-I)	• Location (S-TL, S-IL) • Function (S-TF, S-IF) • Response Time (S-TRT, S-IRT) • Peer Support (S-TP) • Communities of Practice (S-TCP)
		• Nature of Support (ES-S-N, CSB-S-N)	• Technical Support (S-NT) • Pedagogical Support (S-NP)
	ES-T/CSB-T	**Time:** (see section 2.4.1)	
		• Familiarity (ES-T-F, CSB-T-F)	• Use (T-FU) • Time and Effort (T-FTE) • Support (T-FS)
		• Feasibility (ES-T-FE, CSB-T-FE)	• Time to Learn (T-FEL) • Time to Use (T-FEU) • Time to Prepare (T-FEP) • Time to Administer (T-FEA)

SST Concept	Initial Code	Description	Subcodes
Internal Structures (b1)	IB-P	**Pedagogy**: (see section 2.4.2 and 2.5.2)	
		• Teacher-centred (IB-P-T) • Learner-centred (IB-P-L)	• Aims of Teaching (P-TA, P-LA) • Role of Teacher (P-TRT, P-LRT) • Role of Collaboration (P-TRC, P-LRC) • Role of Learner (P-TRL; P-LRL) • Sustainability of Change (P-S)
	IB-N	**Norms**: (see section 2.4.2 and 2.5.2)	
		• Schools (IB-N-S) • Peers (IB-N-P**)**	
	IB-K	**Knowledge**: (see section 2.4.2 and 2.5.2)	
		• Classification of Knowledge (IB-K-N)	• Acquisition of Knowledge (K-NA) • Learner Role (K-NLR)
		• Knowledge Utilisation and Affordances (IB-K-U)	
	IB-V	**Value of ICT**: (see section 2.4.2 and 2.5.2)	
		• Ways to Use Technology (IB-V-U) • Affordances (IB-V-A)	• Place for Technology in Education (V-UP) • Supports Teaching (V-UST, V-AST) • Enhances Teaching (V-UET, V-AET) • Productivity (V-UP) • Administration (V-AA) • Enhances Learning (V-UEL, V-AEL) • Challenges (V-AC)
	IB-SE	**Self-Efficacy**: (see section 2.4.2 and 2.5.2)	
		• Work-Related Activities (IB-SE-W)	• Ways to gain Self-Efficacy (IB-SE-WA)
		• Personal-Related Activities (IB-SE-P)	
Internal Structures (b2)	IB-PDI	**Instructional Discourse**: (see section 2.6)	
		• Boundaries of Knowledge (IB-PDI-B)	
		• Knowledge Acquisition (IB-PDI-K)	• Direction of Knowledge Acquisition (PDI-KD) • Ways to Acquire Knowledge (PDI-KW) • Involvement Needed (PDI-KI)
	IB-PDR	**Regulative Discourse**: (see section 2.6)	
		• Teacher–Learner Boundaries (IB-PDR-B) • Classroom Control (IB-PDR-C)	

SST Concept	Initial Code	Description	Subcodes
Agent's Practices/ Outcomes	AP-LA/AP-MA AP-AA O-CTU/O-FTU	**Level and Manner of Adoption**: (see section 2.3.6, 2.7.2, and 2.7.3)	
		• Level of Adoption (AP-LA) • Manner of Adoption (AP-MA)	• Supporting and Enhancing Pedagogic Practice (LA-SEP, MA-SEP) • Transforming Pedagogic Practice (LA-TP; MA-TP)
		Adoption Activities and Outcomes: (see section 2.3.6, 2.7.2, and 2.7.3)	
		• Current Teaching Activities (AP-AA; O-CTU)	• Supporting Teaching Activities (AP-AAS, O-CTUS) • Enhancing Teaching Activities (AP-AAE, O-CTUE) • Transforming Teaching Activities (AP-AAT, O-CTUT) • Administration Activities (AP-AAA, O-CTUA) • Future of Technology in Education (O-CTUF) • Challenges of Only Online (O-CTUC)
		• Intended Future Technology Use (O-FTU)	• Supporting Role (O-FTUS)
Context	C-S	**School Culture**: (see section 2.6.8)	
		• Instrumental (C-SCu-I) • Expressive (C-SCu-E)	
		School Control: (see section 2.6.8)	
		• Stratified (C-SC-S) • Differentiated (C-SC-D)	
		Social Integration: (see section 2.6.8)	
		• Mechanical (C-SI-M) • Organic (C-SI-O)	

APPENDIX E DETAILED MICRO AND MESO ANALYSES OF SCHOOL 1

Appendix E-1: Teachers' accounts of External Structures at School 1

Resources

Carol reports **access** to **hardware** *"we're a tablet school…it's BYOD, bring your own device…but have to buy within specifications…there are two computer labs for the learners to use…we each have a laptop…projector in our class…laser cutter and 3D printers…the entire school is on the generator"* and **software** *"we use the ITSI software with the* miEbooks *app"* at the school is **sufficient**, however she believes **Wi-Fi access** is an **issue** *"struggling at the moment with our data line…it's obviously a data intensive system"*. In addition, while Carol feels the **quality** and **suitability** of most resources are **adequate** *"they are more than sufficient"*, she indicates the quality of the **Wi-Fi is an issue** *"when the Wi-Fi stops working…it is hard"*. Carol believes most of the **physical arrangement** of resources is **appropriate** *"it is sufficient as everyone is pretty much constantly having technology with them…learners all have device with them"* with **desks** in her classroom arranged in **pods** *"I arrange the class desks in groups of four…to keep them focused*", however she reports being unable to **remotely control the projector** and **laptop** and **move between learners classroom due to lack of access to an Apple TV** *"now I am stuck behind my desk because I have to press the button to go to the next slide…with the Apple TV I could move around the class…be amongst them while I present"*.

When **remote** Carol feels **resources** provided by the school are **more than adequate** *"I think we are in a good space"* as she has access to a **school issued laptop** *"we already had laptops and all that stuff, so now we just have them at home"*, ***miEbooks*** **software** *"we've got that software with their textbooks"*, **data supplied by the school** *"they gave us Rain unlimited sim cards so we can still teach and do all our meetings"* and ***MS Teams*** from head office *"we are relying on* MS Teams*"*. While Carol believes ***MS Teams*** is **suitable** *"I can just record with* MS Teams*"*, she feels the **poor quality of internet for some learners**, **does not allow her to really engage** and **keep in touch** with the learners *"you lose touch with some of them…when you can't see them"*. For subjects where learners need to see what the teacher is doing, Carol reports the school made **stands** to assist with **physical arrangement** for **recording** "*those kinds of subjects…need*

to show how they do different steps, where they've got to make a video…we used a laser cutter to make like a stand that you put your phone or camera on top of it".

Now **back on campus**, Carol feels **data access is no longer an issue** *"we see each other face-to-face now"* and she reports **utilising** and **integrating all available technology resources** to **accommodate learners in the classroom** and those **working at home**, *"I'm recording every lesson…all lessons have the data projector, electronic textbooks,* PowerPoint *and* MS Teams *running through a webcam"*.

Lennie believes even though teachers have **access to a wide range of hardware** *"we have everything we need…we have laptops…there are five tablets that can be used at any time…we have a school sound system which everyone use…we use a laser cutter…3D printer…robotics"* and **software** *"we use* miEbooks*"*, he feels the **limited number of specialised devices** *"there is only one laser cutter and 5D printers…even if your group learners…you'll have 10 people maximum and the others won't know what to do"* and **slow Wi-Fi** *"we are battling at the moment with our Wi-Fi…the nuisance of slow internet…as we have more kids, we have to increase the speed"*, are **challenges**. According to Lennie the **quality** and **suitability** of resources depends on **which technology you are referring to** "*it goes from average to exceptional…the sounds system is probably one of the best in the world…the 3D printers are average…they are not the greatest quality"* and while he believes **Wi-Fi issues are being addressed** *"it is only okay if there's not a lot of traffic…but it is being sorted"*, he feels the **poor quality of some specialised devices** still **need to be dealt with** *"3D printers were a bit of a mistake…I'm starting to rebuild…to make them usable"*. Lennie believes the physical arrangement of technology is suitable as he can **project to each learner's tablet** *"I can project to their tablets"* and learners' **desks** are in **pods** "*they work in groups around the desks"*.

When **remote**, Lennie believes **access** to **suitable resources** is **sufficient** *"everything we have is more than sufficient"* and reports using: the **school laptop** *"I already have a work computer that I could take home*"; **Wi-Fi at home** *"I have internet at home"*, ***ITSI*** *"can go to* ITSI *or* miEbooks*"*; and ***MS Teams*** *"they actually bought* MS Teams*"*. While Lennie reports using the **laser cutter to make stands** so that teachers can **physically arrange their devices** when recording videos or conducting live lessons "*we used the laser cutter to make stands for the teachers"*, he still believes **physically setting up devices to**

facilitate remote teaching requires a lot of effort *"it takes a lot of effort, more than what it used to"*.

Now **back on campus**, although Lennie believes **resource access at the school has not really changed** *"everything is still plus or minus the same"* and **data access is no longer an issue** as *"we only had to go back to online schooling for yesterday and today"*, he reports **seeking alternative resources for technology subjects** due to being **unable to access specialised devices during remote teaching** *"looking for technology where we can move from physical robots to online coding, so that we can reach all learners…even those at home"*. Furthermore, Lennie reports he is **struggling** with **physically arranging technology** in his classroom as he now needs to **accommodate hybrid teaching** and **learning** *"recording live lessons for the few learners that stayed at home…have to start balancing the arrangement of the physical classroom and online classes"*.

While Maxine believes the school provides **sufficient access** to resources *"we've all got laptops…in the class there is a whiteboard and projector…we've got Wi-Fi everywhere…a big enough generator…with load shedding we still have power…my laptop can still connect to the projector"*, she feels issues with **Wi-Fi access** and **quality** *"Wi-Fi is a problem…it lets us down…the quality of the Wi-Fi…it works but it's just slow…you struggle…the kids struggle to download…it doesn't refresh fast enough"* and **lack of access to an accounting package** *"I wish I could expose, especially my seniors…but funding is a problem"* impacts her teaching. Although Maxine reports **lack of access to Apple TVs** in the classroom limits her **mobility** *"mobility is better with the tablets…you can walk around the class"* and **ability to control the projector** from her **phone** *"with Apple TVs…I can then work from my phone…directly with the projector…I have to stand at my desk and scroll"*, she maintains she is able to **use her laptop** *"so I work through my laptop and with the Wi-Fi it connects to the projector"* **even when the Wi-Fi is not working** *"it is not overcomable but it does require making a few physical arrangements… I use an HDMI cable, I put my laptop right underneath the projector"* .

When **remote,** while Maxine reports using ***ITSI*** *"we've got access to* miEbooks*"* and ***MS Teams*** *"they've set us and the kids up with* MS Teams*"* she believes ***MS Teams*** can be **unreliable**, **wastes class time** and **requires a lot of effort** *"*MS Teams *is so overwhelmed with everybody in the wide world using it…just collapses now and*

then…freezes up…you have to leave the meeting and then reconnect". Maxine also feels **data access is a challenge** *"I really feel it is inadequate"* and believes the **school should assist teachers** *"I really thought the school would actually supplement us"*. Furthermore, Maxine reports even though **physically setting up devices** for remote teaching **takes time** *"you have to actually set up devices, create the video, just everything…it takes time"* the school has provided **teachers with stands** *"with the laser cutter, they cut out frames…teachers can place their cell phones there to record a lesson…have a whiteboard situation in front of your piece of paper".*

Since **returning to campus**, while Maxine feels **access**, **quality** and **suitability** of resources has **reverted back to what it was** *"there are no significant changes…everything is still the same"*, she now **needs to accommodate learners at home** by **physically arranging the class** so they can dial in and participate *"I'm teaching live in my classes and the ones at home just dial in".*

Magda believes **access to resources** at the school are **sufficient** *"for me it is sufficient…I have a laptop…with the Wi-Fi it connects to the projector"* but **would like an Apple TV** in her classroom to highlight on the screen *"I miss Apple TVs…I could use my iPad to make it big enough to highlight on"*, however she feels **current software is not suitable for her subject** and makes **setting online assessments challenging** *"we can't type the different formulas…they say you cut and paste but then the quality is sometimes not as good…it is too difficult to have an exam on the tablet…the technology is not suitable…so I just use paper"*. Magda believes the **physical arrangement** of resources in the classroom enables **effortless projection** *"whiteboards and projectors are in the class so I can project easily".*

When **remote**, Magda reports even though she has **access** to a **desk camera** *"they bought these desk cameras for us"*, she believes it is **unsuitable** *"the camera takes away words while I'm recording for no reason…as soon as I move my hand because I'm writing and recording it makes it blurry on the camera"* and thus has **made a box to improve the video quality** *"I made something…like a little typing box"* and is using her phone *"using my cell phone with the little contraption that I made".* For software while Magda believes *MS Teams* is suitable for **remote teaching** *"we've got the system with* MS Teams *and everything...my classes are in front of me"*, she maintains **access to data is a real issue** as she **does not have uncapped internet at home** and thus has needed to **purchase**

her own data *"I've got a big problem…we don't have uncapped Wi-Fi at home…I've really run out of data…I had to go and buy…I am not the only one at the school…I am very frustrated with that".*

Now **back on campus**, Magda believes it **takes a lot of extra time to physically arrange her classroom** everyday for **recording live lessons** *"it's not actually a video of the lesson, it's more a recording of the lesson…when I am teaching the learners at home can see my camera…but it takes time as the previous day I will go and set up the meeting on* MS Teams*".*

Shirley believes while **access, quality** and **suitability of resources** at the school are **more than sufficient** *"it is more than sufficient, it really helps us do our job…we have projectors…we are given laptops…we have a system which we place work for the kids and they can access it…everything is good quality"*, she feels **slow** and **unreliable Wi-Fi** really **impacts** her **use of technology** in classroom *"we have all the tools but it is frustrating when the internet doesn't work or it's off…it works against you…have to revert to chalk and talk"*. In addition to general resources, Shirley believes **access** and the **physical arrangement** of the **visualiser assists teaching** and enables **greater learner engagement** as she is able to **face the learners while teaching** *"basically that old transparency stuff that we grew up with…now they have a digital one where you write in your book and it records then projects on the screen…I can see their faces…because if you turn your back you don't see them not concentrating"*.

When **remote**, Shirley believes she has **access to sufficient resources** *"I have everything that I need"* with a **school issued laptop** *"we had our laptops that we were already given"*; **uncapped fibre** at home *"I have uncapped data, so I don't have a problem"*; and ***MS Teams*** *"we decided on* MS Teams*"*. However, Shirley feels **different quality of internet connections** *"being on a live session can be frustrating…I would not be able to follow anything…their line is so slow"*; needing to **find a quiet space** *"the thing is my husband is also working from home…I can't record any of these lessons during the day…it has to be very quiet around me"*; and **physically arranging hardware** to record videos *"you have actually set up devices, create a video, just everything…takes time"* are **challenges**.

Now **back on campus**, Shirley reports technology in the classroom needs to be arranged so both **learners at home** and **in the classroom** can take part *"now it's not just the class that sits in front of me, I also have to accommodate the students that are still at home"* as she is **recording all lessons** *"I am recording all my live lessons now"*.

Training

Carol believes although **training is now more erratic** *"when we started there was a lot…but now sometimes once a month"* and only deals with **new functionality** *"with* ITSI *every time they bring out new functionality, new stuff we need to know…they come show us how it works"*, **it is sufficient** for her as she is naturally inclined to technology and **often finds training a waste of time** *"I get it in the first two to three minutes…then you need to sit through the rest of the training…it is mainly tutorials, videos and hardcopies…just email me a video and I'll watch it and ask if I don't understand"* as **she is happy to teach herself** or **ask her peers** *"can ask other teacher or go onto the website and the get the information yourself"*. Carol reports the **school is supportive of her attending courses** to grow her skills *"there is always money for training…if I see a course I can really use…they'll find a way to get me there"*. In addition, Carol is involved in **mentoring her peers** *"I'm what they used to call a champion…I can train people…if they don't understand they phone me and ask me to come and show them"*.

When **remote**, Carol feels **training learners** *"we trained the kids…we had to get them accustomed to* MS Teams*"*, **videos from the IT teacher** *"our IT teacher is amazing…there were videos on how to set up assignments, how to use* MS Teams*"* and **small teams** assisting less technical teachers *"we have small team groups…before we closed we sat with our small team and did training",* really helped. In addition to technical training provided by head office, Carol feels **training given on changing pedagogic approaches** has been **useful** *"so there is training from head office…they do the same training session a few times…have to register for one of those times...I did one on assessment…one on quality versus quantity, tells us to slow down instead of just getting through the syllabus...teach skills"*.

Now teachers are **back on campus**, Carol believes **peer training is still taking place**, but it is **more irregular and less intentional** *"it is not as intentional anymore…now they can just pop into my class and ask me whatever they want…and we're done"*.

Lennie believes even though **there is technology training** at the school *"it is on and off depending on what is happening…we get training on* miEbooks*"*, **it is not sufficient** *"it is not sufficient in the sense of keeping up with the world…no matter how hard you try, technology is just one step ahead, so we always fall behind"*. As Lennie teaches EGD, he also **receives training on specialised technology** *"I got training is using 3D software which I haven't used before"*. Furthermore, Lennie has **joined a community of practice** *"if I've got a nice idea technology wise…we share with each other…show each other how to do it…also with some difficulties"* and provides **peer mentoring** to other teachers in the school *"we started with our own training amongst the teachers"*.

When preparing to **work remotely**, Lennie reports the IT teacher **provided training** on the new technology tools *"our IT teacher sent a lot of videos, instructions and documents to explain exactly how to do things"*; there were **peer training groups** one of which he led *"they asked for volunteers, teachers who are tech-savvy…to divide into smaller teams so as not to overload the IT teacher…I have two members in my team…they come to me first and I can usually help them…the small teams were really clever"* and **extensive training from head office** on **how to work the technology** and **use it more effectively in teaching** *"we had a lot of training from head office…live sessions, videos, links, emails…on exactly what to do and how to do it…also on how to use technology efficiently in our teaching"*. In addition, Lennie reports **learners were also trained** *"we spent a full week where we didn't do school work… made every sure learner was set up…ready to go onto online learning…so they had the skills".*

Now **back on campus**, Lennie reports **optional training** is being provided for those needing assistance *"if you need extra support there is still optional training being provided"* and he is also **training teachers to edit their videos** made when teaching remotely *"I started teaching some of the staff to edit videos…make it more interesting"*.

Maxine believes **technology training** at the school is **not sufficient** as it is **infrequent** and **mainly theoretically based** *"I would like to have more training… teachers to show and share with us how technology works…don't just stand and talk in front of me…I want you to sit next to me and say download the app, this is how you do it, how you connect"*. Furthermore, as there is **no technology induction for new teachers** *"there is not a good induction for new teachers"*, Maxine often feels she is **unaware of how to use the**

technology effectively *"I didn't know that…eventually I had to say how do you do this"* and **does not have the time** to **explore** or **teach herself** *"it's hard to find time to go and learn yourself…the workload is heavy"*.

To prepare teachers to **work remotely**, Maxine **believes the training videos** and **how to documents** *"our IT teacher made a lot of little videos…she typed out documents…if a school doesn't have a person like her, then I don't know how they would cope…I would be lost"*; the **small technical teams** led by her peers *"she took a few staff and had sessions with them…divided the staff into smaller groups…there's a technical teacher with two or three people…it's really worked"*; and **head office training** really **helped** her **learn the skills needed** *"they trained us on* MS Teams*, on more functions of* miEbooks*"*. In addition, Maxine also feels **training from head office** on **how to engage learners more online** is **useful** *"on how to engage kids more online"*.

Since **returning to campus**, Maxine reports there has been **no further training** *"we have had no additional training".*

Magda believes **training at the school** which consists of **mainly theoretical type lectures is sufficient** *"we've got like lectures and training sessions…especially when we get a new system…we don't need more training, we can do it ourselves"*, as she is **able to teach herself** or **ask her more knowledgeable peers** *"we are all so clued up, I can myself…if I don't know I can always the IT department head…she shows me specific ways to access and work with marksheets"*, if needed. Magda also feels if she would like to attend **training course**, the **school would be supportive** *"if there are courses they will send you on that"*.

To **prepare for teaching online**, Magda reports the **extensive training** *"there was a lot of training"* provided through **content created by the IT teacher** *"our IT teacher is magnificent…she made all the documents and puts in you have to do this and this"* and **small teams led by tech-savvy teachers** at the school *"we've got teams, someone who knows a lot...my team leader is such a darling…if I ask her something…she goes onto her computer and explains…we call each other on* MS Teams*, I share my scree and she tells me what to do"*, really **assisted** her.

Shirley believes even though she **loves technology**, she is **happy to teach herself** *"I love technology so I learn…I teach myself…so I don't feel as if I don't know"* and not only has she **attended many courses** on using technology for teaching but feels the **school is also supportive** *"I have been on courses where they talked about technology in the classroom, different apps…we have an open door policy…if we would like to go on a course we can talk to the principal and we can go"*. However, she feels the **training provided by the school is not sufficient** for **newer teachers** or **those** who are **afraid to ask their peers** *"I haven't had any technology training since I joined… but there's a lot of teachers in the school who are afraid of technology…they in the habit of not using it because they don't want to ask".*

When preparing to **work remotely**, Shirley who is considered tech-savvy **headed up one of the small teams** *"we created small team to assist the other teachers"* and feels **content created** by the **IT teacher** is **extremely useful** *"our IT teacher shared with us, if you want to compress a file or whatever, you can use this online tool"*. Shirley also **attended head office training** and **found sessions** on how to engage learners and make online classes more interesting, **informative** *"head office schedule things we can attend…it's on how to keep students engaged or breathe more life into online classes"*.

Support

Carol believes **IT support** at the school is **mainly technical** *"if I am having trouble…there is help"* with a **permanent person** stationed **at the school** who is **extremely helpful** and responds **promptly** *"we've got a permanent person here…he knows* ITSI…miEbooks*…he also does networking, printers…he gets to your class in minutes…really gets the job done"*. While the **support team at head office** assists with bigger technical issues *"there's a whole team at head office…you email or phone them with your issues…if you're having big issues, if you're locked out, they would help"*, Carol believes their **response time** is **often slow** *"they take a while to respond to our requests"*.

When assisting teachers **working remotely**, Carol reports not only did the school provide **technical support for software related issues** *"for software issues, passwords…all stuff...I just need to phone him and he will sort it out",* but also offered **peer support** in the form of **training videos** *"the IT teacher made videos on how to do this, how to do that"*. In addition to standardise across the group of **schools**, **head office** also took a **more active**

support role by holding frequent **technical** and **pedagogic type sessions** *"at this stage head office has taken over…direct academic input comes from them…they do the same session three or four times...on quality over quantity"*.

Lennie believes the **support at the school**, which is **mainly technical**, is **excellent** with a **full-time IT support person on-site** *"we have a physical contact person"* and a **prevailing culture of peer support** *"the people here are willing to help…experienced it from day one…you can walk into anyone's classroom or contact anyone…they either help you if they have time or refer you to someone else they think can help"*, with **head office support** where teachers can log calls for **technically related issues** being **satisfactory** *"you can log an email to head office…it is satisfactory"*. In addition, Lennie finds support through a **community of practice** where teachers from other schools **support each other** *"we made a group of technology teachers from different schools…share resources…when I had a problem with my printer…someone else had the same problem…sent me a video to try help…we communicate back and forth"*.

Lennie reports when **working remotely**, the school's technical support person **continues to provide assistance** when needed *"we have our IT support member…ready to help with any problems"*; there are **small teams** *"the small teams were really clever"* and **head office** is not only providing **technical support** but also offers **pedagogical support** *"we had a lot from head office…showed us some system tricks...posted exactly what to do…supply us programmes to better teaching quality"*.

Maxine believes the **IT support person at the school is excellent** and **really assists** her *"he is good at getting the teachers up and running…he is here all the time…just* WhatsApp *him…if we have problems he will come to you… responds quickly"* Maxine feels while she is able to get **technical assistance from head office** for administrative system issues *'there's a whole support centre…if we have problems with software that we use for the admin…it's stuff the IT support guy doesn't have access to"*, she finds their **delay in response frustrating** *"there is always a bit of a delay…but as a teacher I'm stuck, you know real life is happening in the classroom"*.

When **remote**, Maxine really appreciates the support provided by the **IT teacher** *"she uploaded technical videos, documents…we wouldn't cope without her"* and the **small**

teacher-led teams *"there's a technical teacher with two or three people…it's really worked"*. While **prior to remote teaching**, Maxine believed the **support** at the school was **mainly technical**, now Maxine reports the **support from head office** is also pedagogical *"how to engage kids online…it is helpful"*.

Magda reports **support** at the school, which is **mainly for technically related issues**, consists of an **on-site support person** who is **very responsive** *"the IT guy is the fixer man…he really get quickly to our classes…if there is something wrong, the child cannot get into their tablet or my laptop isn't working";* **her peers** who she feels she can ask for **assistance at any time** *"we can always go and ask"* and **adequate institutional support** *"there is sufficient support from my perspective"*.

When needing to **work from home**, Magda believes the **support from the IT teacher** and the **small teacher led team** *"the guidance received from our IT teacher and her small team as invaluable…my team lead is a darling…she tells me what to do*" and the **head office support on MS Teams** *"they helped us with MS Teams"* has been **invaluable**.

Shirley believes even though the **on-site technical support person** and her **peers** are able to **assist her with any technical issue** *"if there's a problem…the Wi-Fi is down, my cable isn't working…after a few seconds he runs into your class…if it's not the IT guy another teacher will come…everyone helps each other to make it happen in the classroom…that support is more than sufficient"*, **more institutional support is needed** to assist teachers with **exploring pedagogically how to use technology** within the classroom *"they assume teachers will teach themselves…they feel if you want to know then you can find out…but there's teachers who do not know how to use technology in their teaching…there isn't support for that, only if I have a hiccup is there someone there to fix it"*.

While **remote**, Shirley reports in addition to the **technical support person** who **continues to assist** teachers and learners *"when I ask him to assist learners, he responds immediately"*, **she leads one of the small teacher-led technical teams** to support her peers *"we created a technical team of teachers…support those less technical…I help a lot by phoning them on* MS Teams*, sharing the screen and helping them…it's not training but assistance that they get from me"*. Even though Shirley believes **offering support to**

teachers for remote teaching is challenging *"I think doing this online thing is difficult…sometimes they assume everyone knows what is going on"*, she reports **head office** has played a **more active support role** during this time, by sharing relevant information with teachers and offering **sessions to guide teachers in changing their pedagogic approaches** *"there is a lot of support…have a meeting every week…we get information and they share…really want to make sure everyone is on the same level…there is a lot of support"*.

Time

Carol believes whilst she is **familiar with using technology**, she is **open to learning new things** *"as a teacher we are lifelong learners…we can't say at any point in time that we know everything"* and is comfortable to **ask her peers** or **learners** in her class to assist *"we can always ask other teacher to help…we need to realise we are sitting with a bunch of millennials…if we struggle we can ask the kids".* Carol states even though **learning to use technology initially takes time** *"so the first time you do something new it's obviously going to take you time"*, she believes it **saves time in the future** as she **prepares content once** and then simply **enhances it yearly** *"once you have got it…you can start making your things more enhanced…the next year you do other sections…I prep once properly for a lesson"*.

When **remote**, Carol believes **teachers are managing with the new tools** *"I think we are doing great"*, however she cautions the **extra time needed** to make use of the technology **is not sustainable** in the long term *"I don't think we can continue to do this every day for the rest of our lives…it is just not feasible"*.

Now **back on campus**, Carol feels **teaching remotely has forced** her to not only **use her current skills more** but also to **extend them** and **use technology more consistently** *"it forced me to use my skills more, previously I knew I could do it, but it was a nice to have…now I'm actually being challenged to use it consistently"*.

Lennie feels as **technology is constantly changing**, teachers need to **invest time** in learning **how to use it effectively** *"when I started here I never had any experience…I watched a lot of videos...in the evenings I would spend time learning and teaching myself"* as well as to **explore new ways** in order to become familiar *"every single day there is*

something new I can try…this year will look completely different to next year, because technology keeps on adapting" and be **open to growing their technology skills with input from the learners** *"I actually learned a lot from the kids themselves"*. In addition, Lennie believes using technology in class **takes time** and thus finds **after school sessions are preferable** for practical technology use *"time constraints are a big problem…practical things using technology can only happen in small workshops after school where we have let's say three hours to work"*.

To **teach remotely**, Lennie reports while he has had to **dedicate time to learn new skills** as he did not have access to specialised hardware at the school *"I've started teaching myself programming languages"*, he believes **if teachers rethink their pedagogic approach**, they **can lessen time taken to use technology** for remote teaching *"it takes a lot more time than it used to...everything takes longer…but I realised that if I just teach differently I can make my work less…I can make one video per chapter…even the links…you can then lessen the time you spend"*.

Now **back on campus**, while Lennie reports **still spending time learning new skills** as some learners are still at home *"I had to start looking how we can move away from the physical robots to online coding…to reach all learners…it is the first time in my life I have looked at programming languages like Python and Java script"*, he feels the **extra time** needed to **record videos** alongside the **time needed in class**, is simply **not sustainable** *"I still make videos, but it is a lot less as more time is physically spent in class…it just takes too much time"*.

Maxine believes while she is **familiar enough using technology** to **support her teaching** *"so I know how to use my projector,* miEbooks*, how to upload memos"*, she feels she **could be using technology more effectively** *"I think there is a lot more than could be done".* In addition, Maxine reports even though she can **ask her peers for assistance** *"teachers help me...with an app where I can actually work on my iPad"*, she believes she does **not have the time to search for material on her own** *"I don't have the time to go and dig for it myself"* and would therefore **prefer training** so that she can **decide** if using technology in a specific way is **useful for her subject** *"I would like someone to say this is available and this is how you use it…then I can say this is not going to work for my subject"*. Furthermore, Maxine believes she is **unable to use technology extensively** as

integrating it into lessons takes too much time *"to be honest with you there are time constraints…my curriculum is so packed I don't have the luxury of putting on a whole period aside to show them a video".*

When **remote**, Maxine believes not only is **training** and **support from the school** and **head office really assisting** her in becoming **familiar with the new technology tools** *"with the guidance from the IT teacher, the small teams and head office…I now know about these tools…I can start running with it"* but also her **extensive use** has resulted in her **feeling more comfortable** with using technology in her teaching *"I'm more comfortable with what I am doing…I've figured out easier ways to do things…I feel more easy with technology now…it built up a bit of experience"*. However, Maxine believes **teaching online takes longer** and thus teachers need to **find extra time** for preparation, feedback, and extra admin which can be **overwhelming** *"all the preparation for it, the recording…giving feedback…it is hours more work to teach like this…it is taking its toll…it is a nightmare…also the extra admin for the kids sitting at home…it is killing me"*.

Magda believes even though **technology is integrated in her pedagogic practice** *"it is part of my teaching…I don't see it as something extra"* and she **knows how to use technology effectively** *"I am capable of doing what I want"*, she feels she is always able to **ask for assistance from her peers**, if needed *"if I don't know I will find out exactly what to do"*.

When **remote**, Magda **appreciates the training** and **support** provided but also believes she is becoming **relatively familiar** with the new tools as she **experiments on her own** *"I am fine with what is required…I don't feel out of my waters…luckily if you show me something I'm fine with it, I'll be able to do it next time…I can try and test it myself to know if it works and how it works"*. Magda feels besides for the time needed to learn new skills, teaching remotely with technology requires a **lot of extra preparation time** which can be **extremely demanding** *"it is a lot of preparation…beforehand I have to know what I want to say…every minute is hectic…I don't think they realise how tiring this is"*.

Now **back on campus**, Magda feels **more familiar** with the technology and **working online** *"I think I am getting into this"* but is finding the **extra admin exhausting** *"the admin is very exhausting"*.

Shirley believes while she is **familiar with using technology**, able to **teach herself** *"I teach myself"* and can **ask her peers for assistance** if needed *"if I don't know I can ask…there are colleagues here that I can run to and they help"*, she feels **lack of time** to **search for different ways to utilise the technology** is **limiting her use** *"because of lack of time…I don't necessarily Google what's the new app or try something new…I know there are many more things…but I'm not using them"*. Despite the **investment of time** *"it takes a long time"*, Shirley feels **technology really benefits her teaching** *"it really helps teaching, without the technology I think it would be a struggle and may even take longer".*

When **remote**, Shirley feels she has been able to **teach herself new skills** as well as **extend her existing skills** *"I've made myself so comfortable with it…I had a chance to learn more and extend my skills"* and reports **preparing** and **distributing online content** is **taking her less time** *"what would have taken me two or three hours to create one video, now I can do it within half an hour"*, however, she still believes the **time needed is considerable** *"those nights that I go to bed at two or three in the morning…it is really tough…uploading also takes time…have to share the link…post guidance documents…all that takes times…extra time after you have created the content"*.

Being **back on campus**, Shirley reports she **no longer records as many videos** for learners, as she believes the **time** to do this and teach on campus, **would lead to complete exhaustion** *"it would be challenging to get home, set up, create a video, upload and then still go back the next day and teach a full day and then go back and record again…that is burnout for a teacher".*

Appendix E-2: Teachers' accounts of Internal Beliefs at School 1

Pedagogical Beliefs

Carol believes her role is to **actively engage learners** *"they talk about stuff, we do stuff, and then they understand…there is time to sit and just work, sometimes there's nice fun chats and discussions, and sometimes there's a flipped classroom"* by being a **facilitator** and **enabling collaboration** to promote learning *"I've never been nor will be a stand in the front and everyone should listen to kind of teacher…I'm a facilitator of learning…I arrange the class in groups of four…the when I see they are getting iffy or something that I said excited them, I give them a focused thing to talk about, to collaborate on"*.

Carol feels **teaching remotely has shifted her pedagogy** *"I don't think we would have ever gone this way without this…we have seen a different side to education now…we have seen how things can be done differently"*, made **her more adaptable** and has been **advantageous** as it has opened up **many possibilities as to what technology can offer** *"we've learned a lot about adaptability…I think we are better teachers for what we have learned"*, however she believes there is now **a greater need for learner support** as **remote teaching cannot facilitate personal connections** with the learners *"so now I have to physically reach out and check on them…make sure they are okay…in class you have an advantage…they all say it is better to be physically in class…it is the human connection…normally I make eye contact…see if they are okay…with remote teaching you just can't"*.

Lennie believes teaching is **more about actively engaging** learners *"you give them a challenge, then they try it, I maybe give them a bit of advice"* to **impart skills** *"we need to focus on what skills they have for tomorrow…so they don't fall behind".*

Lennie feels even though **remote teaching** and **learning** has made **learners more responsible** for their **own learning** and **catching up** work when absent *"learners now have to take up more responsibility to make sure they keep up their work…there's no more excuses to miss work if they are absent, because the work is uploaded to the online platform, there are online videos or recordings of the lesson"*, teachers **now need to provide more support** *"there is a greater need to support learners…play a more supportive role…especially now as people are distant…because you can forget about the*

individual in the class…for those learners developing you can't leave them on their own". In addition, Lennie feels the COVID-19 pandemic has **made him more accepting of future changes** *"we won't go back to where we were before…we need to be prepared for anything…to jump from one to the other at any point in time"*.

Maxine believes **learners need to be actively involved** in the learning process *"so the kids has to be involved in the whole process…with their page in front of them"* and while she feels **collaboration is beneficial**, the **maturity of the learners** needs to be taken into consideration *"with the senior class they collaborate as well…they can sit and pull their tables together…but my juniors if they get too much of collaborating they lose the plot, they just sit and talk"*.

Maxine believes even though **remote teaching** and **learning** can be beneficial *"there are definitely aspects that have changed…and are good"*, **face-to-face lessons are still preferable** as she feels an online context is **not suited for learners who are not self-motivated** *"I've experienced face to face contact is important…going completely online will not work…there are learners that are more suited to online than others…it's got to do with internal motivation…the diligent learner will watch the video…others don't care"*.

Magda believes the **most important part of teaching is passing on knowledge** *"parents just want to know if their child can do the subject"* and while **collaboration can be beneficial**, **group size needs to be considered** *"as soon as the group is too big…they just talk"*. While Magda reports the need to **teach remotely** has **changed her views of pedagogy** *"it has changed a lot"*, she **did not elaborate** as to what these changes encompass.

Shirley believes she **facilitates learning** *"the students need to figure out some things by themselves…do problem solving on their own…we can't be seen as the sole source of information…we are just facilitators"* and **aims to instill in learners** that **learning is a lifelong process** *"they can never stop learning…I can only teach them something I have mastered and understand…I keep on learning"*.

With the shift to **remote teaching**, Shirley believes not only has **pedagogy shifted to focus more on developing skills**, but **teachers also need to be more adaptable** in the

future to ensure recent **beneficial changes will not be reversed** *"if we go back to what it was we will be taking a billion steps backwards…we need to do more to develop skills…it is our responsibility to follow through…that things will change"*.

Normative Beliefs

Carol believes not only does the **school culture mandate technology use** *"we have to use technology…it's a technological school"* but as the **school is known as a technology school** at the start of the COVID-19 pandemic the school was **approached to advise on** how best to integrate technology *"we had multiple schools come to us, to see how we do lessons because when other schools closed we didn't…we just continued with remote learning"*.

In regard to her **peers' views** on technology, Carol believes even though **at times teachers complain about technology issues**, for the **most part technology is embraced** *"we might moan when we're having a terrible day and the Wi-Fi has stopped…we can't project…it's just human niggles but overall we are likeminded, we embrace it, because if we don't we can't use it effectively"*. However, there are **some teachers who feel** the **learners are using too much technology** and thus should utilise it less at school *"there's some who feel the kids already spend too much time on the device so it's not healthy to also do it at school, but I feel they are going to be on their devices anyway"*. When needing to **teach remotely**, Carol feels **some of her peers are really managing**, and **others are completely overwhelmed** *"I've got peer who are absolutely rocking…thriving…some of feeling completely overwhelmed…they are not so comfortable…it really depends on your situation"*.

Lennie[107] reports the **school** is **very pro-technology** with the **principal** always trying to **provide the latest technology** to **build important skills learners need** *"the principal is very pro-technology…he always tries to get in the newest technology…the kids need to walk out of here and be able to use computers, AI or robots, or at least have some experience in it"*.

[107] Lennie did not comment on School Norms when remote.

In relation to his **peers**, Lennie believes **mainly older teachers** are **fearful of using technology** and now with **remote teaching some teachers are feeling overwhelmed** *"teachers are scared…especially the older teachers who didn't grow up with technology…some are overwhelmed…they weren't so comfortable using technology before"*.

Maxine[108] feels the **school supports technology use** which is evident in the **use of e-textbooks** and the **principal** always trying to **provide additional technology** when requested *"the school is very pro-technology…that's why we're using e-textbooks…they are really trying to give the kids the opportunity to learn to use technology…management try and support…if I find something good and they can, they will look into it"*.

Maxine believes while her **peers** are **generally pro-technology on campus** *"I think we're all very pro-technology"*, she feels **some** of her **peers are really struggling** with using **technology for remote teaching** due to **changes in pedagogy** *"one teacher she is more of an introverted person so making videos is very uncomfortable…even though she usually stands in the front of the class, this is a different thing"* and **data access issues** *"some of my peers are struggling with not having enough data"*.

Magda[109] feels the **school** is **very pro-technology** *"we need to use technology"* and **supportive of teachers** *"if there are courses they will send you on that…they are supportive of us".* Magda believes when **teaching remotely** most are **managing** with the new demands *"no one has moaned…so they are managing…if not they can ask for help".*

Shirley[110] believes even though the **school** is **pro-technology** *"we use a lot of technology, we expect everyone to use it"*, she feels while **some teachers are really positive about using technology** for teaching, **others are scared** and thus are **not making effective use of the available resources** *"some are extremely positive they view it the same as I do…some are scared of using technology…we have even bought visualisers and they haven't even used them yet as they are too scared"*.

[108] Maxine did not comment on School Norms when remote.
[109] Magda did not comment Peer Norms when on campus and School Norms when remote.
[110] Shirley did not comment on School Norms when remote.

Shirley, who is one of the technical teachers leading the support team assisting teachers with using technology for remote teaching, believes **her group of teachers are all managing with the new technology tools** *"we are all on the same track"*.

Knowledge Beliefs

Carol believes knowledge is **acquired from interacting** with **various sources around us** *"there is information all around us…lots and lots…so many sources to get it"*. **Without appropriate knowledge** Carol feels **humans are fearful**, as **knowledge empowers** one to **explore the affordances of technology** *"the more knowledge you have, the more empowered you feel…the more daring you will be with what you do…if you don't have the knowledge you will fear it…you are not going to use it"*. Due to **extensive use** of technology for **remote teaching**, Carol believes teachers have **gained more knowledge** and consequently are **using technology more effectively** *"I think we are using it more effectively now"*.

Lennie believes one acquires knowledge through **experience**, **making mistakes**, **reflection**, and being **mindful of the ever-changing nature of the world** "*by embracing what the world is becoming…where it is going…experiencing the world…making mistakes…thinking critically afterwards about what happened, did you learn from the experience…did you achieve what you wanted"*. Lennie also believes the **constant evolution of technology** means there is **always more knowledge** to be learnt and thus teachers need to be **willing to invest time** in learning about **new ways** and **how best to utilise** technology *"they have to go and figure it out by themselves…one day I won't be there…you need to be willing to be scared and frustrated because it's big"*. Due to **using technology extensively** for **remote teaching**, Lennie maintains he is now **using technology more in his classroom** *"I have more experience and so I use it more now"*.

Maxine believes one has to be **actively involved in order to acquire knowledge** *"you have to be actively involved, you have to go and do it on your own"*, however, she feels learners are often **not willing to put in effort** and **take responsibility** for their own learning *"the younger generation…they don't want you just to spoon feed them, they want to chew and swallow…I don't know how to combat that because then no learning takes place…you have to take responsibility for your own learning"*. Maxine believes not only is **knowledge of how to use** technology important, but one also needs **knowledge as to**

the affordances technology can provide in order to utilise it fully *"obviously if I know more I'm going to be able to use it more…but if I don't even know about it, you are not going to use it at all"*. Even though extensive support and training has been provided by the school on how to use technology for **remote teaching**, Maxine still **feels she lacks knowledge** as to the **best way to utilise the technology** in her teaching *"I know there are probably more and easier ways of doing things, but I just don't know about them…there must be…I would love to know"*.

Magda believes one **acquires knowledge from the world around us** *"through seeing and reflecting on everyday things that happen around you"* and feels prior to utilising technology one has to **possess the knowledge on how to use it** as she **does not like experimenting** while in class *"I must know if it works and how it works…I must have tried and tested and gone through it before class"*. Due to the **support provided** on the new tools for **remote teaching**, Magda reports she has **acquired the knowledge** of how to **make effective use** of the new technology *"when we started using* MS Teams*…I didn't know how but due to the training and support…now I am able to just jump right into it"*.

Shirley feels one acquires knowledge by **being actively involved** *"one can only learn by doing…you need to practice, try something new…do it by yourself and then you have learnt"* and consequently believes teachers who **do not utilise available technology resources**, often **lack "how to" knowledge** *"we bought visualisers, but they haven't even used them yet as they are too scared…they don't know how"*. However, Shirley believes simply knowing **how to use the technology** is not sufficient as one also **needs to know about the affordances** that **technology can provide** in order to make full use of its capabilities *"if you don't know about the full capacity or ability of the app, you are only going to use one part of it…there's a lot of things I don't explore and just resort to what is comfortable".* Due to the **extensive use of technology** for remote teaching, Shirley feels **more comfortable** and reports she is **using technology more** *"we are more comfortable now and so we are using it a lot because it doesn't scare you"*.

Value of ICT Beliefs

Carol believes technology can be used in a **variety of ways** depending on the **teacher's personality** and **subject** *"this is not a cookie cutter approach…you cannot say this is how it should be done by everyone…it's very personality and subject based, but then your*

personality also determines the subject you teach". Carol maintains **technology** can be used to bring **in real world concepts** to **advance learning** *"I feel it advances learning in my subject…by demonstrating real world concepts"*, inform **parents** on **learners' engagement** with resources *"with* ITSI*…parents can see how many resources their kids opened and engaged with…if the kids fail we can say look he only has been in 15%, the class average is 80%"*, make **learning more relevant and exciting** *"I'll say here all three links, go and check the out…they do because they are excited about their learning"*, offer **virtual field trips** and **augmented reality** to assist with understanding *"don't need a travel budget to go field trips anymore…also have an augmented reality app so I literally point to my table and it augments a river…it allows them to see it in the 3D…many of them don't get it until they watch this"* and cater to **different types of learning styles** *"not everyone learns in the same way…the more ways I can show them the same thing, the more I am going to enhance their learning…if you are visual…different approach to some who is more auditory"*.

When **remote**, Carol feels technology enables **recording lessons** for **learners to work at their own pace** *"kids can go and watch the live lessons because it is all recorded"*; provides her with a **more flexible schedule** *"I'm not forced to choose between work and home, I am more flexible now…when I pre-record as long as it is available when learners need it"* and allows **absent learners to catch up work** *"a learner can just login and catch up".* Carol believes an additional benefit of using technology is that **learners** are now being forced to become **more self-motivated** and **responsible** for their own learning *"the kids are stepping up beautifully…the old way of spoon feeding is no longer possible, they have to read through the instructions and follow through…apply life skills…I'm not trying to make them more self-directed, but a lot of those skills are required for the current system"*.

Now **back on campus**, Carol reports she has a **greater appreciation** and **dependence on technology** *"I've always seen technology as something that can enhance my teaching but now it's the main way I teach…our perception and dependence has increased"* but believes technology **can only offer affordances** if **learners take advantage of them** *"only the motivated learners really benefit…they actually go back and watch the videos".*

Lennie believes technology not only **supports pedagogy** by making **teaching activities easier** *"to make whatever we do in class easier…to strengthen you teaching"* but also

improve practices where appropriate *"not to replace old school teaching and learning…for example writing in pen and paper is the best way to remember something…technology is only there to improve on certain things…there is nothing wrong with the old techniques that work"* by **exposing learners to the possibilities of technology** *"my focus is always to expose them to as much technology as I can…so they will be willing to embrace it…to prepare them for a world that will be run by machines"* and providing opportunities to **practice skills** *"they can learn how motors work…with the virtual world on the computer they can programme the robot…they can move the robot and then go back to the physical robot…they can play around without messing up"*.

When **remote**, Lennie feels using technology enables **learners to work at their own pace** *"if I pre-record they can always look at later on"*, **shifts more responsibility** of **catching up work** to the learner *"if you are absent you don't have to miss the work…fall behind…you can see what was done in class"*, **submitting** and **marking work online** to prevent work being lost or forgotten *"now you don't have to lose the work…can be sent via* MS Teams*…less chance of learner forgetting it…when you have an electronic copy"* and **saving time** by **building up a bank of videos** and **recorded lessons** for future use *"you can build a library of resources for yourself…more to reference for the next year…less work to prepare since you have a library of videos ready to reuse"*. Aside from these benefits, Lennie feels it is **harder to stimulate learner interest** and **motivation remotely** *"online teaching was fun for the first few weeks…it was something new, different…attendance started dropping…we had to apply different techniques to keep learners interested"*.

Now **back on campus**, while Lennie believes **without technology schools cannot operate** in a **remote** or **hybrid context** *"without technology we wouldn't have gotten very far…if you didn't have access to technology for online teaching…you lost months and weeks of teaching"*, he feels **face-to-face teaching is sometimes easier** *"there are some aspects where it's just easier to teach the learner something…when they physically in class"*.

Maxine believes using technology improves **learners' understanding** by **contextualising school** content *"it can actually enhance my subject…it can make it real for them"* and affords learners the opportunity to **record**, **review**, and **practice** class content *"the kids*

can use their tablets to take pictures of what I've written on the board…they've got this snap scan thing in their textbook…the authors have done videos explaining the concept, showing it to them…reinforcing what they have been taught".

When **remote**, Maxine feels even though technology enables **recording of videos** so learners to **review content multiple times** *"the videos the learners can always watch again"* which **helps with understanding** *"the videos they can rewind and pause, rewind and pause…it really helps"*, **unless learners are self-disciplined using technology is ineffective** *"the challenge is how do you get them to come along…some just don't have the self-discipline"*.

Now **back on campus**, Maxine reports having a **greater appreciation for technology** *"I think technology is really important"* but once again cautions technology is **only valuable if learners take advantage** of the affordances offered *"it aids teaching a lot but if the kids don't use what's there…you can make videos till they're coming out of my ears, but if they don't watch it…it doesn't help"*.

Magda believes technology can be used to **bring the outside world into the classroom** in order to **assist with teaching concepts** *"the world is wide open and if you have access you can bring it into the classroom…when we did currency we could Google the price of the Zimbabwe dollar…we got a picture of a wheelbarrow of money…they understood what it meant"*.

When **remote** Magda feels while making **recorded videos** enables learners to **review concepts** for **better understanding** *"a lot of times the children don't understand…use the technology to pause and do it again"* and **reinforcement** of content *"if they go back and watch the video"* and teachers to **build up a bank of videos** to provide additional support to **future learners** *"next year I will explain to them and then I can put this video on their* ITSI *group and say it's about equation and refer them to video three"*, she maintains online teaching and learning **can feel very isolating** *"with only using technology…you can get very lonely, for the children to sit at home all the time the motivation will fall away"*.

Now **back on campus**, Magda believes technology is **more valuable** than she had thought beforehand *"I think it is more valuable…it gives the children the assurance that we are there"*.

Shirley believes while technology can be used in a **variety of ways** *"I change the way I teach daily…I don't stick to one method…the kids will become bored and I want to keep it exciting"* to **support** *"to make your life better, it can be used as an aid to help you"* and **enhance education** by making school **content more relevant** *"to connect with them in the world they live…they are part of the technological world…we have to create exciting teaching using technology"* and **exciting** *"it makes the kids excited about their learning…without technology it would be lifeless"*, **improving learners' concentration** *"when I use the visualiser they concentrate better because my back isn't facing them…I can sense immediately if there's a kid struggling and I can anticipate the question and help"*; **advancing understanding by contextualising content** *"it takes something very abstract and brings it into context…if you teach them and it is not in context they are not going to understand at all"* and **enabling differentiation** *"some learners take longer to understand and me explaining once is not always sufficient…if they can watch the video over and over…it really helps"*, she maintains it should **not be used to replace the human side of education** *"one can use technology to help you study, to acquire knowledge…it's endless actually…but it will not be able to take the role of human connection…with the kids, motivating them, that's for us"*.

When **remote**, Shirley feels the use of technology enables **recording live lessons** or **making pre-recorded videos** to assist learners **review content multiple times** and **work at their own pace** *"a student explained to me, if we don't understand we can go through the video again…they can pause and rewind and watch it ten times if they want at their own pace...in their own time"*, dealing **more effectively with absent learners** *"they can go back if they missed work"*, **online submission of work** so she does not have to **carry around learners' books** and can **mark at home** *"now with* MS Teams *they can upload their work…so rather than go through 200 hundred students' stuff, carrying books that are so weighty…I can go through it at home"*. However, Shirley feels it is **hard to get feedback** and **track learner progress** in an online format *"with online sessions it's so difficult to get feedback from them…if you ask if they questions or have any troubles, no one responds…it is so quiet…also difficult to track how they are coping"*.

Now **back on campus**, Shirley believes technology is an **even more integral part** of her pedagogic practice *"I was always very positive about technology but now it is an integral part"*.

Self-Efficacy Beliefs

Carol feels **very confident** using technology in her **teaching** as she believes it makes her **job easier** *"I enjoy using technology…it makes my life easier"*. In her **personal** life, Carol reports she uses technology extensively *"I have everything on my phone"*. When **remote**, Carol reports she is **very confident** using the **new technology tools** *"I'm even more confident using the technology…I'm in a good place"*.

Lennie enjoys using technology in his teaching but believes he is **not as confident as should be**, as **there is so much to learn** *"so I really enjoy using technology…the more you start using it, the more you realise how little you know…a fraction of what is happening in the world…there's just not enough time to go into everything"*. In his **personal life**, Lennie **feels confident** and reports he **uses technology for every aspect** *"I can't think of anywhere where I don't use technology"*. When **remote**, Lennie believes he is **more confident than his peers** with the new technology tools as he has **prior experience** *"I use it more, I am more confident…because I have more experience…for teachers where it was new, they aren't so comfortable"*.

Maxine believes even though she is **not scared of using technology** in her teaching, she would like **more assistance in knowing how the technology works** *"I'm not scared of using technology…I just need to know how it works…so if I get the opportunity and someone tells me this is how it is…I will incorporate if I can"*. Maxine reports she is **open to using technology** and uses it **extensively** in her **personal life** *"I'm completely computer literate…open to using technology"*. When **remote**, Maxine reports she is **confident** using the **new technology tools** due to the **guidance received from the school** and her **ability to gain skills quickly** *"I now know about all these tools…with all the guidance we've received…then minute I'm shown…I can then start running with it"*.

Magda feels even though at first, she found using technology in the classroom challenging, she **now feels confident** and **believes technology is essential** for her teaching *"while it was hard for me in the beginning, very quickly I realised that I wish I had it my whole*

life…if the power goes off and I can't use technology I am lost" but only uses it when she is **completely confident** *"I won't use the technology and say let's see how it goes…it must be something that I know"*. In her **personal life**, Magda **feels confident about using technology** but reports she does so in a **limited way** *"I don't get emails on my phone, no apps…no* Facebook*"*. When **remote**, Magda reports she is **confident** using the **new technology tools** but believes she can still **acquire more skills** *"I think so for what is required right now…I'm fine…but I always think we can learn more"*.

Shirley maintains she **loves technology** and feels **confident** using it in her **teaching** and is comfortable to **teach herself new technology skills**, if necessary *"I love computers…I love technology…if I don't know I can always teach myself…figure out as I go"*. So too in her personal life, Shirley reports she feels **confident using technology** and reports utilising it **extensively** *"in my personal life I use technology a lot…for everything, and gaming"*. When **remote**, Shirley believes she is **more confident** and is **using technology more efficiently** due to her **extensive utilisation** *"something that would have taken me a long time…I've made myself so comfortable…it would have taken me three hours to create one video, now I can do it within half an hour"*.

Appendix E-3: Teachers' accounts of Professional Dispositions at School 1

Carol believes **school** and **everyday knowledge are interlinked** *"they are absolutely intermeshed"* and the relationship between them is crucial as **academic knowledge on its own is meaningless** *"if you never make it practical it is just going to stay words on a page"*. In addition, Carol feels learners **acquire knowledge** with **maturity** *"now as an older person I see maths in a lot of stuff we do…now I get why it's called a trig beacon…my matric teacher told me that but I was whatever…knowledge comes with maturity…then it becomes wisdom"* and in her discipline knowledge can be gained in **either direction** through **interacting with the world** *"one of the kids came the other day and said I felt an earthquake and I was let's check it…a quick lesson…today they are building models to take something flat and academic and make it 3D…there's information all around you…so many sources to get it"*.

In regard to the **regulative** discourse Carol reports while she has **strict boundaries in the class** *"I'm their teacher not their friend…so there are boundaries"*, which have not changed much since the shift in the educational context *"I think it is very similar"*, she is **approachable** and **values mutual trust** between herself and the learners *"it is built on trust…they can trust me and I can trust them…it's not that I am unapproachable"* but still **controls** the classroom context and has **disciplined lessons** *"I've got disciplined classes…it's my class, it's my domain"*.

Lennie believes **school** and **everyday knowledge** is **interlinked** *"school is basically just a mini world"* and learners need to **first acquire school knowledge** which is **organised** and **structured by teachers** to prepare them for the outside world where they can then **experiment**, **reflect** *"they need to be prepared for the world…be able to figure it out for themselves…they need the skills…experiment, make mistakes…think critically about what happened"*, and then **apply school knowledge to everyday contexts** *"what you learn outside is a dangerous place to learn from…school is the best place to learn…then you can apply what you have learnt to the outside…at first information is everywhere, it's chaotic…need to decide how to structure it…you can't just give them information and leave it…they won't learn anything"*.

In regard to the **regulative** discourse, Lennie reports he has established **professional boundaries built on mutual trust** *"I always keep my boundaries professional…they respect my classes…there is a form of respect both ways" and* **controls the classroom context** *"it is my class, it is my home, they are guests in my class"*. However since **teaching remotely** and now in a **hybrid manner**, Lennie feels **boundaries** have **shifted slightly** due to the **learners** being **more comfortable with online, anytime communication** *"they contact me anytime…have become more comfortable with talking online…at the beginning…some wouldn't say anything, now it's a lot easier…I get a lot more feedback and questions"*.

Maxine believes while **school** and **everyday knowledge are interlinked** *"it's all integrated"*, it is essential to **first acquire knowledge in a school context** and then to **apply** this knowledge to the **everyday**, as **academic knowledge on its own is worth nothing** *"it can't just be loose standing pieces of knowledge…I can gain all the knowledge in the world but if I don't know how to link it is worth nothing…academics gives you the foundation and knowledge to go and problem solve yourself…to apply it in the world"*. Maxine feels within her subject **knowledge is acquired vertically**, built on **strong foundations** *"you have to build foundations…if they are wonky they can't build, they can't scaffold"* and **reinforced through continuous practice** and **active engagement** *"practice, practice, practice…sit down and do the problems…here's the theory and now let's do it…you have to be actively involved…go and do a little on your own""*.

In regard to the **regulative** discourse, Maxine believes **strong boundaries** and **control are needed** *"we have boundaries to keep everyone safe…I say this is how we do it is more controlled by me because I have a curriculum to cover"* but feels the younger generation's **general lack of respect** can make this challenging *"I think there is a lack of respect not just towards teachers…respect is not what it used to be"*. When **teaching remotely** while Maxine reports boundaries have not changed *"I've still got the same type of connection…there are still boundaries in my class and discipline"*, she feels the **change in educational context** has resulted in an even **greater lack of discipline** amongst learners *"there is a more slackness towards general rules and discipline…boundaries have really blurred"*.

Magda believes even though **school** and **everyday knowledge are integrated** *"it is all interlinked"*, **school knowledge is only valuable** if it can be **applied to everyday contexts** *"when I teach maths I always tell them no one will ask…is that an acute angle or what is three times eight…it teaches reasoning…so I try and link it"*. Magda reports knowledge within her discipline is **not only acquired through knowledge taught at school** but can also be **attained from learners' everyday knowledge** of the subject *"I'm very open…they don't have to only use my method…they may know easier ones…I can then learn and rewrite the memo"* gained by **interacting with the world** *"through seeing and reflection on everyday things that happen around you"*.

In regard to the **regulative** discourse, Magda believes she has established **firm boundaries** built on **mutual respect** *"strict but loving…I'm not just this ice person standing there…they respect me, and I respect them"* and **controls the classroom context** in a **loving way** *"I control it, it is my palace…I'm firm but very kind"*. Due to the change in the educational context, Magda reports she has been **sharing more with the learners** in order to connect and thus feels **boundaries between her and the learners have shifted** *"now I'm sharing much more about myself and they also getting to know my funny side…I think I am closer to them"*.

Shirley believes **school** and **everyday knowledge should be integrated** *"they should integrate"* as school knowledge is **only valuable if learners can apply knowledge to the outside world, in either direction** *"they only thing they can do is sums…do they really know what they are doing…applying it to everyday, where do I see this in everyday life…teachers need to link the outside and inside…need to access the outside and not just be textbook driven"*. To **acquire knowledge** Shirley feels one needs to **practice** and be willing to **explore new learning opportunities** *"one can only learn by doing…practice, try something new…if I can do it by myself I have learnt"*.

In regard to the **regulative** discourse, Shirley reports even though she has **professional boundaries** with the learners, she believes her role is also to **mentor** and **support** learners *"I'm not their friend…there is a boundary…it is a professional relationship…also to mentor, support and motivate them, to be interested in them, to build them up"* and **shares control of the classroom context** *"we don't live in a generation now that in teaching we have to control the whole time…I learn from the kids as well, when they*

explain…sometimes they do it much better than I would". Due to needing to **teach online**, Shirley feels **boundaries are more relaxed** as **learners now expect her to be available around-the-clock** *"they can contact you at any time and they expect you to respond immediately to their questions"*.

Appendix E-4: Teachers' accounts of Orientation towards Technology at School 1

Carol reports she **doesn't just use technology mindlessly** *"technology is not the be all and end all…it is not the only thing we are doing"* but rather believes technology **supports** *"to make our lives easier…wherever it becomes a distraction or makes you work harder…we can just go old school"*, **enhances** *"it advances learning in my subject…a method to enhance the learning experience"* and **transforms** "*it has transformed my pedagogic practice…I wouldn't be as comfortable doing what I'm doing if it wasn't for technology"* her pedagogic practice. When teaching **remotely** Carol feels **technology** is **supporting** her practices and making her **more structured** *"I'm more structured, it's supporting what I want to do with content and skills"*.

On campus, Carol reports she uses technology to: **prepare, present push and upload learner content** *"with wireless projection…all the* PowerPoints*…whatever resources I use are available to the kids"*, **search for information** in class *"can open the web browser and go to* Google Maps*"*, **access online videos** *"video links…use the two that are most suitable for the projector"*, **conduct assessments** *"do some of my test electronically through* miEbooks*"*; and **provide parents with information** *"parents can see how many resources their kids have actually opened"*. In addition, she uses technology to **transform educational experiences** with **virtual field trips** and **augmented reality** *"can use the VR goggles to take them on a virtual tour of the Grand Canyon…can point to my table and it augments a river"*.

When **remote**, Carol reports using technology to: **pre-record videos** *"*PowerPoint *has a narration facility…record your voice on each slide…can highlight information and talk around it as I would have done in class…export the video"*, **conduct** and **record live lessons** *"record on my computer with a webcam on MS Teams"*, **post lesson guidelines** and **content** *"upload all our resources to their software with their textbooks…also have a* YouTube *channel so I post links"*, provide **online assistance** for learners *"I'm on* MS Teams *in standby…they can say I'm struggling with this and what do you think I should do here"* and enable **online submission of work** *"*MS Teams *for the submission of tasks and stuff"*. For **administrative** tasks, Carol reports using technology to **communicate with learners** *"make a concerted effort to keep in contact with the kids on* WhatsApp*"*, **get support** *"our IT teacher is amazing she sends us lots of videos"*, **attend meetings** and

training *"attend head office training and meetings"*, conduct a **virtual open day** *"we had a virtual open day…every hour we started a virtual your"* and **catch up learners** *"a learner can just log in and catch up"*. When **returning to campus** Carol reports she intends to **continue pre-recording videos** and **recording live lessons** *"would pre-record things such as calculations…live teach but also make a recording…a two pronged approach"*.

Now **back on campus**, Carol reports she is **not making pre-recorded videos** as intended but is using technology to: **record live lessons** *"I'm recording all my lessons…have my data projector, the e-textbook,* PowerPoint *and* MS Teams *running through a webcam"*, enable **learners at home to take part** in lessons *"the others just join in"*; **communicate with learners** *"communication between the students and me has skyrocketed"* and for **catching up absent learners** *"learners can still keep up"*.

Carol believes while **technology is now essential for education** *"to a certain extent technology is now the main way I teach"*, she feels conducting classes **only online** is **not fitting for all learners** "*only the motivated students go back and listen"*, **deprives learners of in-class interaction** *"from the students perspective…given the choice they choose to be in school"*, is **unsuitable** for **parents who do not want to home-school** their children *"plain online learning sounded good on paper…when parents had to do it without the teacher…not really apples that you are comparing"* and **cannot be successful without the appropriate infrastructure** *"you can't do this if you don't have data"*.

Lennie believes technology not only **strengthens his pedagogic practice** and makes his **job easier** *"it is there to improve on certain things…to strengthen your teaching…to make what we do in class easier"* but also enables him to **rethink his pedagogical goals** and **change his practice** *"one can really integrate all subjects together with technology…an integrated task…communicate via the technology…it is really transforming how I was teaching…changed it completely"*. Lennie reports **using technology** during remote teaching has **changed the way he is organising** and **pacing content** for the learners *"it's changing things…like for instance for next year if this works…will give them planning for the whole year…ask them what they want to do first…give them more freedom and power in what they do"*.

On campus Lennie reports he uses technology to **prepare**, **present**, **push** and **upload learner content** *"I project to their screens, they can see in front of them…draw on the document…add notes"*; **search for information** in class *"I tell them let's Google it"*; and **expose learners to the possibilities of technology** *"they can virtually programme…use the laser cutter…3D printers and robots"*.

When **remote**, Lennie uses technology to: **pre-record videos** *"I send videos where I explain content"*, **build up resources** *"building a bank of videos…if a learner has questions I just refer them back to a video I made a month ago"*, **conduct** and **record live lessons** *I've done a few live lessons but I keep it short as not all learners have fast internet"*, **post lesson guidelines and content** *"explain to them how to use the software…to show them where to access free student and education software"*, **set** and **conduct assessments** *"on* MS Teams *there is a built in assignment tool where you can create your own quiz…this is something new I took on"*; provide **online assistance** for learners *"they join* MS Teams *during class time and we spend time seeing how everyone is doing"*; and for **online submission** and **marking of work** *"they send work via* MS Teams*…or* miEbooks*…photos…you have an electronic copy that you can always go back to…can mark"*. For **administrative** tasks, Lennie reports using technology to **communicate with learners** *"I use three channels just to make sure they get the work"*, **get support** *"our IT teacher sends lots of videos and instructions"*, **attend meetings** and **training** *"we have had a few Zoom meetings…lot of training from head office"* and **catch up learners** *"if you're absent you can catch up…see what we did in class"*. When **returning to campus** Lennie **intends** to continue **pre-recording videos** and start **recording live lessons** *"I'll make videos more often…while I'm teaching in class I will record…edit it a bit and upload for them to use"*.

Now **back on campus**, Lennie reports he is **not making pre-recorded videos** *"the videos are a lot less"* but rather is using technology to: **record live lessons** *"recording live lessons…for learners at home"*, enable **learners at home to take part** *"have to balance between physical and online classes"*, conduct **online assessments** *"assessment are still being done online"*, **communicate with learners** *"have become more comfortable with communicating online"* and for **catch up absent learners** *"if they're absent they don't have to miss work because all the work is uploaded to an online platform…there's no excuse"*.

Lennie believes while **technology can greatly assist education** *"especially in this time without technology we wouldn't have got very far as a school"* and can provide **more learners** with **access to better education** *"can have a learner attending your physical school…at the same time there'll be an online classroom…learners at their own homes…will reduce fees and give access to all resources"*, he feels some activities can **only be done** when **both teachers and learners are physically present in the classroom** *"with my robotics…it is circuit building that all needs to be done in class, I can't send it home…we need to do the practical work in class"*.

Maxine believes she uses technology only where it is **suitable** *"I integrate it where it works…can actually enhance my subject…try and make it more real for them"* to **support her pedagogic practice** *"it is more supporting…before it was transparencies and the green board…now it is the whiteboard"*. For example, Maxine **utilises hardcopies** as she feels **e-textbooks often makes her job harder** *"e-textbooks are wonderful, but they just don't work in my subject…have to scroll up and down and up and down…the hardcopy is much easier"*. Furthermore, Maxine reports she is **experimenting more** with the **affordances of technology** due to the demands of **remote teaching** *"focusing more on formative assessment, marking some of their homework…just the normal activities…I'm also doing a little online quiz on* MS Teams*, I'll see how it goes"*.

On campus, Maxine reports she uses technology to **prepare**, **present**, **push** and **upload learner content** *"in class obviously the whiteboard with our projector…use* miEbooks*…upload memos"*; and for learners to **access textbook videos** *"authors have done YouTube videos explaining the concept…to reinforce it"*.

When **remote**, Maxine uses technology to **pre-record videos** *"instead of me standing in class giving a lesson, I pre-record it…explaining the example…discussing the memo of every activity…showing the kids how to do an exercise"*, **conduct** and **record live lessons** *"with my seniors…more live lessons…we always record it and they can watch it again"*, **post lesson guidelines** and **content** *"upload extra resources for the kids…links to videos that I make, lesson guidelines for each week"*, **set** and **conduct assessments**; and for **online marking of work** *"I've started to mark some of the homework online"*. For **administrative** tasks, Maxine reports using technology to **communicate with parents** *"to email the parents with students who didn't attend"*, **get support** "*she uploaded technical*

videos, documents" and **attend meetings** and **training** *"we had to attend meetings and presentations by head office"*. When **returning to campus**, Maxine intends to **record live lessons** *"I want to position my laptop in the class…when I work on the board, the lesson is recorded"*.

Now **back on campus**, Maxine reports she is using technology to **record live lessons** *"I'm teaching live lessons and recording them" a*nd enable **learners at home to take part** *"I'm basically teaching live in the class and the ones at home just have to dial in and listen to me"*.

Maxine believes even though **technology can greatly assist education** *"online learning has definitely taken off big time"*, she feels **face-to-face teaching cannot be replaced** *"traditional face-to-face will always be needed*" as **most learners** in South Africa **do not have access** to **appropriate technology** "*most learners in this country don't have the infrastructure"* and **online education is not suitable for all learners** *"there are kids that cannot cope just talking to a tablet or a laptop"*.

Magda reports she does **not simply use technology for technology's sake** *"we don't just use technology to use technology…if it doesn't make sense then I am not going to do it"* but uses it to **supports her existing pedagogic practice** *"I still teach the same way…it is an aid to help me…it can be the textbook or the board"*. However, she feels technology can sometimes make her **job harder** due to the **nature of the subject** being taught *"for u maths teachers it is too difficult…because we can't type in formulas"*. When **teaching remotely**, Magda still feels **technology is supporting her existing practices** *"it is exactly the same as what I do in class…I'm teaching the same"*.

On campus Magda reports she uses technology to **prepare**, **present**, **push** and **upload learner content** *"if I can't project I am lost"*; **search for information** in the classroom *"we Google the Zimbabwean Dollar and found a picture"*; and to **record** and **upload marks** *"she showed me how to work with the marksheets for recording marks"*.

When **remote**, Magda reports using technology to **pre-record videos** *"I pre-record the whole lesson…with examples and explanations"*, **build up resources** *"the way I have recorded my videos…next year…I can put the video up for them"*, **conduct** and **record**

live lessons *"so if I do a live lesson, I record it…then I've still got a video of that"*, **post lesson guidelines** and **content** *"I post my videos as well as the work they need to do onto ITSI"*; and provide **online assistance** to learners *"during the period my* MS Teams *is open…they can ask me anything"*. For **administrative** tasks, Magda reports using technology to **get support** *"she explains it and sends the video…also call each other on* MS Teams *and then I share my screen…she shows me"*. When **returning to campus** Magda would like to **record her live lessons** *"if I do a lesson, I want to be able to record it"* and use her **desk camera as a visualiser** *"write at my desk and put the desk camera onto the screen"*.

Now **back on campus**, Magda reports using technology to **record live lessons** *"I use my camera…it is then automatically recorded and sent to their* MS Teams *group"* enable **learners at home to take part** *"when I'm teaching the learners at home can see my camera, they can see everything I write"* and **track attendance** *"I can see the kids that attend…if parents come and ask…I can say your kid was in class today, but he didn't even join the meeting"*.

Magda believes while **technology can greatly assist education** *"we can't go on without technology"*, she maintains **face-to-face teaching cannot be replaced** as it deprives learners of the **benefits of in-class interaction** *"it is too hard for the children to remain focused, and they will become very lonely"*.

Shirley believes she utilises technology where **it makes sense** *"wherever I see it fits…I don't just integrate technology"*, to **rethink her educational goals** and **transform her pedagogic practice** *"all I knew was chalk and talk…it is definitely changing…and I'm changing with it…I'm seeing different things happening, the flipped classroom, them teaching themselves, asking questions"*. When **teaching remotely**, Shirley feels **technology aids** and **makes her teaching better** *"we are using technology as an aid…to make everything better"*.

On campus, Shirley reports using technology to **prepare**, **present**, **push** and **upload learner content** *"I have a visualiser in the classroom…use the projector…do a presentation"*, **search for information** in class *"sometimes they will do research on their phones"*, **access online videos** *"share videos"*; conduct **assessments in class** *"create*

digital tests…did a Kahoot…I thought they understood the work…then I saw they didn't and I could explain…a very fun environment that is stress free" and **create her own videos** *"I create videos at home of me speaking and writing…put on* miEbooks *and then they can go through these in their own time"*.

When **remote**, Shirley reports using technology to: **pre-record videos** *"I started recording videos of me explaining certain topics and sums using my visualiser…a PowerPoint where I record my screen then I write…work through the slides"*, **conduct** and **record live lessons** *"I had an interactive session…we all logged in and I could share my screen"*, **post lesson guidelines** and **content** *"I created a* YouTube *channel to upload all the videos…on* ITSI *I post guidelines for each day and links to the videos"*, provide **online assistance** and **guided sessions** *"I write out the sums for them and they can ask questions"* and for **online submission**, **marking**, and **feedback** of work *"I can receive their work…on* MS Teams *can create assignments for them to upload their work…it indicates who has submitted and who didn't…I can give feedback"*. For **administrative** tasks, Shirley reports using technology to: **communicate with learners** *"I can communicate with learners via* WhatsApp*"*, **get support** *"our ICT teacher shared with us…it worked well"* and **attend meetings** and **training** *"we have weekly meetings…get information from them…we can share"*. When returning to campus Shirley **intends to continue to record videos** for learners *"I actually want to create more videos…they really work…I would do the flipped classroom more".*

Now **back on campus**, Shirley reports she is **not making pre-recorded videos** but rather is using technology to: **record live lessons** *"I make recordings of all my lessons"*; enable **learners at home to take part** *"now it is not just the class that sits in front of me, I also have to accommodate the learners at home"* for **online submission** and **marking of work** *"I'm using* MS Teams *so they can submit their work and I can also give feedback online"*, **catch up absent learners** *'if their electricity was off or they missed…can access the lesson in their own time"* and **communication** *"they can contact me at any time"*.

Shirley believes technology is **integral to teaching** *"I feel technology is now an integral part of learning"* and can **transform pedagogic practice** *"we can't be seen as the sole source of information…we are facilitators, we need to go further than the content we teach…technology can calculate the level the child is one and give them exercises…as a*

teacher I can then do problem solving that is more creative". However, she feels **online** teaching and learning **requires a lot of self-motivation** and thus is **not suitable for all learners** *"you have to be self-motivated…to engage with online learning"*.

APPENDIX F DETAILED MICRO AND MESO ANALYSES OF SCHOOL 2

Appendix F-1: Teachers' accounts of External Structures at School 2

Resources

Chantal indicates even though teachers have **access to hardware** *"learners tablets…we have laptops…projectors in each class…the computer lab…uncapped Wi-Fi"* and **software** *"we have* ITSI…D6 *as the communication platform…also for amin purposes…*WhatsApp*"* that are mainly **suitable** and of **good quality** *"it's a very good quality projector…Wi-Fi can be improved…laptops are entry level…for what I am doing it works"*, **lack of hologram** device *"I would like a device to project holographic images…project from a screen…slice a heart in front of them"*, limited **apps on the learners' tablets** *"it's a bit limited…they only allow* ITSI *on the tablets…could do so much more with the tablets…but it's a lot more than other schools have"*, the **unsuitability of *ITSI* for setting assessments** *"you physically have to click on each question…then choose which type of question…it takes a lot of time"*, **limited access to the computer lab** *"I don't go there…takes time and effort…there's also a full time teacher in it as well"*, and the **quality of the teachers' laptop** are concerns *"the camera is a bit blurry…but you don't need high definition to record…it is manageable"*. For **physical arrangements**, while Chantal believes **learners' desk facing forward** create structure, she would also **like more open learning spaces** *"they want structure at the school…to be order…so having one desk per learner is important…for open space learning…there's just not enough space".*

When **remote,** although Chantal feels a **headset is needed for better sound** *"every teacher should have a headset with a microphone"…would have made the sound clearer"*; finds the **laptop's camera blurry** *"the camera is a bit blurry"* and has **issues** with ***ITSI*** *"there were a lot of problems when teaching remotely with* ITSI*"*, she believes her **access is sufficient** as she has the **school issued laptop** and **Google platform** *"we have created G-Suite accounts…all active on* Google Classroom*"*. While Chantal has **uncapped Wi-Fi at home** *"I'm very fortunate to have uncapped Wi-Fi at home"*, she believes **modems** should have **been provided** for teachers **without data access** *"there are educators that have limited data caps or mobile internet…the school should have invested in modems for these educators*. Furthermore, Chantal feels ***ITSI*'s high data usage** is an **issue for learners** *"on* ITSI*…learners have to download every resource…on* Google

Classroom *you just open it on the app…it's better data usage"* and thus has **recommended using the Google platform** *"*Google Classroom *is easily accessible to everyone…data is also less as you don't have to download resources"*.

Now **back on campus**, Chantal reports she is **continuing to make use of *Google Classroom*** *"nothing has changed as we started in June with* Google Classroom*"*.

Phillip[111] believes although **teachers** have **sufficient access to quality resources** *"they bring tablets…you're given a laptop…got projectors…whiteboards…access to Wi-Fi for the teachers…when there is no electricity…we have a backup…they are good quality"*, including the **MathU app**, ***WhatsApp*****,** and **ITSI** *"have the* ITSI *platform…to communicate with the kids…*WhatsApp*…a programme we are launching…*MathU*…similar to Kahn Academy"*, he feels the **lack of Wi-Fi access for learners** *"kids are not able to get onto the internet…restricts access"*, **limited access to the computer lab** *"I used to book the lab…now it's too much time"* and the **unsuitability of *ITSI* for specific subjects** *"for certain subjects, you can set assessments online…like for English…but for others it is very basic and limited especially for subjects like mine and accounting"*, are concerns. For **physical arrangements**, Phillip believes the **current setup is appropriate** with **projectors centrally mounted facing the whiteboard** *"the projector on the ceiling…whiteboards in front…they can see what I am projecting"* and **learners' desks facing forward** *"learners face the teacher"*, however, he feels **extra speakers would be helpful** when playing videos *"we need extra speakers…when playing a video through the projector…kids say they can't hear"*.

When **remote**, besides for **initial data access** concerns which the **school have now addressed** *"when it came to data we had to struggle the first month…lately they have compensated us"* and ***ITSI* issues** *"the system was overwhelmed…it was not able to function properly…the server was overworked…but even now the learners can't download the resources we send"*, Phillip believes his **access is sufficient** as he has the **school issued laptop**; the **Google platform**; and ***WhatsApp*** *"whatever we had is what we are using…using* ITSI *platform…*Google Classroom*…we have* WhatsApp *groups to post work"*. However, Phillip is concerned **learners' lack of access to data** due to **high costs**

[111] Phillip did not comment on Resources when back on campus.

is **hindering remote teaching efforts** *data on their side is quite expensive…challenging for them to get their work online…when I ask why are you not joining us they say we don't have data"*.

Mattie[112] feels besides **lack of access to accounting software** *"the book system we are using is outdated…would love to have* Pascal *or whatever…to show the kids how it works practically"* and **limited access** to the **computer lab** *I don't use it…there is only one"*, **teachers** have **sufficient access** *"I think we've got more than enough with the computers…its' fine"* to **quality hardware** *"learners use their tablets…we all have laptops…projectors…a computer lab"* and **software** *"using* miEbooks…D6 Connect…WhatsApp *and email"* at the school. Mattie feels while **most resources are suitable** to **project content** *"for accounting I can just display my format sheet"*, the **tablet's hardware limitation** of one page at a time makes it **unsuitable for subjects like accounting** *"kids cannot work on the tablet…for me it's completely not working…I print out notes from the textbook and give it the learners"*. In addition, Mattie finds the **physical arrangement** at the school **appropriate** with **projectors centrally mounted facing the whiteboard** *"with the projector above, whiteboard in the front…everyone can see"* and **learners' desks facing forward** *"desk face forward"*, however she feels sometimes **learners at the back are unable to see the board** *"it is difficult for some of the learners at the back to see"*.

When **remote**, besides **issues with *ITSI*** *"we did encounter some problems with* ITSI*…learners did not get all the information they needed…we resorted to other methods"*, Mattie believes her **access is sufficient** as she has the **school issued laptop**; **uncapped Wi-Fi at home**; the **Google platform**; and ***WhatsApp*** *"we have our laptops…I've got uncapped Wi-Fi at home…we are trying out new methods like* Google Classroom…WhatsApp*"*.

Mpho[113] feels **teachers** have **excellent access** *"the technology we have is privileged…it is remarkable really…learners have got tablets…every single teacher has a personal computer…in every class there's a Wi-Fi projector…we have* ITSI*"* to **good quality resources** *"when I came everything was newly installed in my class…the quality of the*

[112] Mattie did not comment on Resources when back on campus.
[113] Mpho did not comment on Resources when back on campus.

technology is great" at the school. However, she believes **limited access to the computer lab** is an issue as only computers in the lab have internet *"if you want internet access…only the computer lab has access…there is only one lab…you have to book it way in advance"*. Mpho finds the **physical arrangement** of the classroom **appropriate** with **projectors centrally mounted facing the whiteboard** *"the projector is right in the centre, allowing everyone to have a good view…there is also sound so you don't need extra speakers"* and **learners' desks facing forward** as she believes it **assist with discipline** and enables her to **deal with technical issues** *"I prefer to have my kids facing the board…it assists with discipline…teacher can monitor technical issues…control what the learners are doing"*.

When **remote,** even though Mpho reports she has access to the **school issued laptop**; the **Google platform** and ***WhatsApp*** *"I've got my laptop…they introduced* Google Classroom*…it is user friendly and really quick…use* WhatsApp*"*, she believes access to **additional hardware** would be **helpful** to **record videos** *"honestly I would have liked a camera to record…with it you can rewind, play it again, rewind, add on and still have your hands to write"*. In addition, she feels teachers' **lack of access to sufficient data** should have been **dealt with more effectively by the school** *"in the beginning it was really upon us…to get Wi-Fi or buy data…I had to cough up a lot of my own money to continue teaching…they then purchased us 2GB of data"* and **outdated software on tablets** *"the kids had old software that needs to be updated…this makes it quite challenging to teach remotely"*, **broken tablets** *"you post work…assuming they receive it…only to find out they don't have access to their tablets as they are broken and damaged"* and **learners' lack of data access** *"there are kids that do not have data…we can't send them work or emails"*, are **concerns**.

Training

Chantal believes **training** at the school is **insufficient** as it is **infrequent** *"training is not sufficient…it is about once a term…it should be once a week"* and consists of **mainly theoretical** and **demonstration based *ITSI* professional development** *"the only technology training we have is for* ITSI*…telling us how to create and push an assessment…they tell you how to use the software"* and should rather assist teachers in **learning how to incorporate technology** into their **subjects** *"there is no training on how*

to incorporate technology into life sciences…that is really needed as it would improve teaching". Furthermore, Chantal feels **more technical training is needed** as many of the teachers at the school are **not computer literate** *"there are a lot of gaps…some educators lack basic computer literacy…still entering marks by hand"* and thus not only **struggle with setting up devices** *"need training on how to set up their own projectors…get a lot of teachers their screen is upside down on the projector…they need to know the shortcuts"* but also are **unable to take advantage of the benefits** *"technology makes the administration part of teaching so much easier"*.

When **remote,** Chantal, who is one of the teachers from the group of schools **tasked with training staff** *"the training is on the six of us…the other educator is very clued up"*, has created numerous **'how to' videos** on **Google Classroom** and other tasks like **screen recording** *"making videos to help educators"* to assist teachers. While Chantal feels the current training is **adequate for most teachers**, she believes it is **insufficient for older teachers** *"some of the older educators…they want me sitting next to them…want to be showed step for step…one educator can call or text me at least 10 times a day…she doesn't know what to do"*.

Now **back on campus**, it appears Chantal is **still active in training teachers** on the new technology tools.

Phillip believes **training** at the school which is **mainly theoretical** and **demonstration based *ITSI* professional development** *"when they improve their product…they will come and say these are things we have introduced, this is how each one works"* is not only **too infrequent** *"we have training every now and then…about once a term…there could be more training"* but should also address **how to incorporate technology** into **specific subjects** *"we have to get to a point where we are shown how to use it in class…specifically for a maths teacher this is how you use…if you're an English teacher…if you are a geography teacher"*.

When **remote**, Phillip believes the most effective training on the new technology tools for him has been **communities of practice** and his **prior use of *Google Classroom*** *"it's a collaborative thing…we collaborate with other schools…I used* Google Classroom

before…so I am learning as I go".

Now **back on campus**, Phillip reports **peer mentoring** on *Google Classroom* is **assisting him** in using the new software more effectively *"when we returned we have had more training on* Google Classroom*"*.

Mattie believes **training** at the school which consists of both **theoretical** *"have training…their textbooks…all the functions…for communication with the learners…how to use the technology…the updates, upgrades…she uses her tablet to show us"* and **practical hands-on** *"you bring your laptop and you sit with them and they go step by step…they say this is what you do…if you struggle they show you exactly…the practical solution"* **professional development**, should be **voluntary due to time constraints** *"training should be voluntary as time is really limited"* and should rather focus on **how to incorporate technology** into teaching **specific subjects** *"give us specific training about accounting and technology…not just* ITSI *training"*.

When **remote**, Mattie believes the **peer mentoring** *"teacher have been appointed from different schools…they take a screen capture and record a video on how to resolve an issue…they show you go there and there in order to do this"* on ***Google Classroom*** is providing her with the **knowledge** to **utilise the tools** *"it's for* Google Classroom*…to expand our skills…we are already comfortable with* WhatsApp*,* ITSI *and* D6*"*.

Now **back on campus**, Mattie feels the **additional training** provided by her **peer** is helping **expand her *Google Classroom* skills** *"since we got back to school, we've had* Google Classroom *training"*.

Mpho believes **training** at the school, which consists **theoretical** and **demonstration based *ITSI* professional development training** *"it covers how to send resources…the textbook"*, is **too frequent** *"it is more than enough…it should not be as frequent"*. In addition, Mpho feels not only should training focus more on **how to incorporate technology** into **specific subjects** *"how to incorporate technology into your lessons…into your subject"*, but training would also be **more relevant** if the school **asked what type of training is needed** *"they decide…we don't give suggestions…would be better... if asked*

us what we need". Mpho also reports **informal peer mentoring** exists within the school *"individual training happens in the corridor…it's not formal and usually on the group"*.
When **remote**, Mpho believes the **peer mentoring** type training on ***Google Classroom*** coupled with **teaching herself**, is providing her with the **knowledge needed** to **utilise the tools** *"the only training we've received is on* Google Classroom*…from a colleague of mine…she is our IT guru…has made it so user friendly for us…showing it on the screen from her laptop…it's enough for us…it is upon us to extend our horizons…to Google, research and train ourselves"*.

Now **back on campus**, Mpho reports **additional peer mentoring** is being given on ***Google Classroom*** *"*Google *is now the platform…we are having training in that…our principal and one of our internal teachers"*.

Support

Chantal[114] believes even though **IT support**, which is **mainly technical** and consists of general **on-site general** *"we have a IT support guy…if you have any issues you can just go to him…drop a* WhatsApp*…used to be here every day…now he's travelling between us and another school"* and **remote *ITSI* support** *"you can contact the* ITSI *guys for support…if something goes wrong…remotely"* is **responsive** and **more than sufficient** as teachers **utilise technology in a limited way** at the school *"they are quite responsive…it would be a waste if there was more support…for what the educators use"*, **school support** is **lacking** due to management's primary focus on **maximising profits** *"they want to be an e-school but their support is lacking…they are trying to maximise profits"*.

When **remote**, Chantal reports although the **IT support person is still providing assistance** *"the technical support is still from the IT guy contracted to us…we have his cell phone number if we have any difficulties…but it is only remote"*, she believes the **main technical** and **school support** being provided by **herself** and **the task team of teachers** from other schools in the group is **adequate** *"it's only us giving support…we are a team of six…working together…from how to use and what to do if something goes wrong…I'm the only point of contact…I believe it is adequate"*.

[114] Chantal did not comment on Support when back on campus.

Phillip[115] believes the **IT support** which is **mainly technical** and consists of **general on-site** *"we have an IT guy…if you're having a problem…maybe the projector is not showing, or it is upside down…there's technical support…every day"* and **remote *ITSI* support** *"they give us* ITSI *support…have them online…they are able to access our accounts and even the learners…send a message on the* WhatsApp *group…they help while they're not here"* is **appropriate** and **responsive** *"they're good…they always helping us"*. In addition, Phillip feels the school really tries to **support teachers utilising technology** by providing **extra apps** to assist **specific subjects** *"they try and bring in a whole lot of technology…with this* MathU *app for instance…the school is really trying to make our life easy"*.

When **remote**, Phillip reports the **primary technical support** on ***Google Classroom*** and other **new technology tools** is being provided by his **peer** and the **task team of teachers** *"we have this person…she will show us what are the things we need to do, she will get us there…we collaborate with other schools"*, while the **principal** and the **operational manager** are offering **useful tactical support** *"our operational manager…is coming up with ideas…trying to forge the way forward…have these* Zoom *meetings…with the principal suggesting things, giving feedback…they are helping us"*.

Mattie[116] reports the **IT support** offered at the school is **mainly technical** *"if there's a technical issue…they will sort the situation"* and consists of a **general on-site** *"there's an individual here…to sort out technical stuff"* and **remote *ITSI*** support *"for* ITSI *we have a group where you can ask questions…they say I am gonna*(sic) *be there this and this day and we can sort out the situation"*. While Mattie believes the ***ITSI* support** is **adequate** and **responsive** *"there's always someone to assist"*, she feels **less on-site technical support is needed** *"I think there's too much"*. In regard to the **school's support** of technology, Mattie believes it is **inadequate** as she feels simply **monitoring teachers' technology use** is not beneficial *"we have feedbacks sessions…they would say this is the number of items you pushed…type of items…why haven't you created an assessment…they monitor us…so we can step us our use of technology"*.

[115] Phillip did not comment on Support when back on campus.
[116] Mattie did not comment on Support when back on campus.

When **remote**, Mattie believes the **primary technical support** on ***Google Classroom*** and other **new technology tools** being provided by her **peers** and the **task team of teachers from other schools** *"there is someone available to try and support us…we have an inter-group of school…teachers have been appointed…if you need assistance"* is **adequate** *"I think we are pretty much set up"*.

Mpho[117] believes the **IT support** offered at the school which is **mainly technical** and consists of **general on-site** *"we rely on the IT support…whether it's your laptop…any technical related issue…he will assist the teachers and also the learners…he's full time on-site"* and **remote *ITSI* support** *"ITSI support is rarely at the school…have a* WhatsApp *group where they can easily assist you"* is **appropriate** and **responsive** *"on the technical side I am happy…the response is quick…two minutes…they respond to my* WhatsApp*"*. In addition, Mpho reports she relies on **some of her peers for support** *"my colleague she has a vast amount of knowledge…she can help me with the tablets and computers"* and feels the **school** supports **using technology** *"the school really encourage us…they really assist us"*.

When **remote**, Mpho reports the **primary technical support** on ***Google Classroom*** and other **new technology tools** is being provided by her **peer** and the **task team of teachers** *"we have someone appointed we can ask…not only our colleague but also from other schools…on how to use this e-platform"*, with the **principal** and **communities of practice** also offering **support** *"I've got this group with our sister school…we share information on how they use this e-learning platform…the principal is regularly checking…are there any challenges, do you need assistance"*. Notwithstanding this support, Mpho believes the **school could offer more financial assistance** for teachers to **purchase data** *"you don't really get much support, I had to cough up a lot of money from own pocket to continue teaching"*.

Time

Chantal[118] believes while she is **familiar with using technology**, there is **more to learn** to make **effective use** of technology in her teaching *"I'm quite familiar…there are still some aspects I can develop…need to get ideas of how to teach with it effectively"*. While

[117] Mpho did not comment on Support when back on campus.
[118] Chantal did not comment on Time when back on campus.

Chantal finds setting **assessments on *ITSI* time consuming** *"it takes more time to develop an assessment on* ITSI*…what used to take me 30 minutes…takes three hours"*, she believes using technology is **feasible** when you are **computer literate** as it **saves marking and preparation time** *"it's feasible…I'm computer literate so I can work faster on a computer than it takes me by hand…it takes more time…but now you don't have to marks…it saves you a weekend of marking…if a test is 30% closed questions, you can save 30% of your time"*.

When **remote**, Chantal feels even though she is **familiar with the technology**, she is **learning more** as time progresses *I'm familiar with using technology…but I'm also learning more as I go"*. However, Chantal believes the **size of the school** which requires teaching across a **number of subjects** and taking **numerous classes** makes the **extra time needed to prepare content**, **overwhelming** *"it takes a lot of time to incorporate…I've tried to cut corners…in a larger school it's entirely feasible…but with us who are a smaller school…you have six to nine subjects to prep…that's a bit daunting…takes a lot of time"*.

Phillip reports even though he is **quite familiar** with technology *"on a scale of one to ten, with five being very proficient…I'm a three"*, he finds it **challenging to incorporate** due to a **lack of opportunities** within his **subject** *"it is a struggle to incorporate technology into your teaching…not because I'm not familiar but because of a lack of opportunities in my subject"* and thus would like to **further explore the affordances** for his subject *"to know how to use it more in maths"*. In addition, Phillip believes using technology is **often impractical** as it **slows him down** *"it actually slows you down"*.

When **remote,** Phillip reports while he is **familiar** with using the **new tools**, the **large amounts of time** needed to **prepare content** *"I think I'm okay…*Zoom *is fine, the* Google Meet *and* Google Classroom*,* ITSI*…it just takes time…we are busy around the clock…preparing content…looking for videos… examples to subsidise the content…the lesson plan…notes to make the instructions clearer"* and the **uncertainty whether he is utilising the tools effectively** *"I'm not sure that I am using the technology effectively"*, are concerns. Furthermore, Phillip believes teaching **numerous classes** makes the time needed to **prepare content** with technology **unrealistic** *"I'm not only focused on one class…it really takes time…it's painful"*.

Now **back on campus**, although Phillip still believes **dedicating the amount of time needed** to teach **multiple classes on campus** while still **catering to learners at home** is **not feasible** in the **long-term** *"it has really been quite stressful…it takes a whole lot of time…you do a lesson twice…have contact time with the learners here…learners sitting at home are waiting for you to send them work, to tell them what to do"*, he feels the current approach is **forcing him to improve** and **extend** his **technology skills**, is motivating **greater technology utilisation** and **exploring of additional affordances** *"it has forced us to familiarise ourselves…improve our technology skills… were not using it as vigorously before…now we really had to optimise the use of it…take it to another level… to learn how to plan lessons online or set assessments…we had to make sure it worked for us"*.

Mattie reports even though she is **familiar** with technology *"I am fine with technology"*, she feels the **large amounts of time needed to digitise content** *"you cannot copy from* miEbooks*…you have to rewrite, retype your own content…transfer everything from the textbook into a technological process"* and **short class periods** where using **e-textbooks waste time** *"it is very time consuming…it is often easier to just stand and refer to the textbook…explain it from there…you don't need to use technology…there's no time to waste in any class period for using technology"* can make technology utilisation **unfeasible**.

When **remote,** Mattie reports although the **tools needed for remote teaching are new** for her, she believes she is **managing** *"*Google Classroom *is quite new to me…the screen capturing…but I can follow their instructions"*, however she feels **older teachers** are finding it **challenging** *"I think there is a greater problem with older teachers…but we are all trying"*. In addition, while Mattie feels **time needed to repurpose existing lesson plans** and **content** *"it is very time consuming…you had your lesson plan for an in-classroom lesson…have to convert everything to an electronic format…with business it is fine as I had the slides but with accounting has to show them how to do it"* coupled with teaching **many subjects and classes** *"we teach many subjects…six different classes, that means preparation on six different levels…it is very time consuming"* can make **utilising technology impractical**, she believes at least the time spent is **benefitting her teaching** *"now instead of just wasting my time on the additional stuff...extracurriculars…invigilating…I am now utilising my time to the benefit of education…where previously I didn't have that time"*.

Now **back on campus**, Mattie feels the current approach gives her **more time** to **engage with learners individually** *"while in the past…time never allowed you to individually give the attention to each student in the classroom period…now with accounting they send me answers every day…so I have an entire day, while in class we only had 40 minutes"*.

Mpho reports even though she is **familiar enough** to use technology for what she needs *"I can say I'm well equipped…I can get around with whatever I need"*, **engaging with technology** and **exploring its affordances consumes time** *"I need time to plan my work…time to be engaged with technology itself…to know how to use it in technology not just push resources"*. In addition, while Mpho believes technology **saves learners time** as **work can be covered at home** and **pictures can be used instead of taking notes** *"for taking down notes, they take pictures…it saves them time…a video not watched in class, they can watch it at home or the* PowerPoint *if not paged through in class, they can watch it at home"*, she feels utilising technology is often **impractical** *"I don't think it's feasible given the time constraints"* as class time is wasted as learners need to **switch between subjects on their tablets** *"when they change classes, if there tablets aren't ready…10 minutes are taken away from my period having to wait for the textbook to load…it's really time consuming"*.

When **remote,** Mpho believes she needs **more time** to become skilled, as she does **not feel comfortable** with the new technology and thus is utilising ***WhatsApp*** as an alternative *"I really am trying but I am struggling…I'm not really comfortable and confident using these tools…I use* WhatsApp *mostly"*. Furthermore, Mpho reports teaching **numerous classes** *"I don't get much time because I've got five classes"*, coupled with **large amounts of time** needed for **administration** and to **repurpose existing content** *"you already had a lesson plan set out…now you have to articulate it and send it to the learners…upload…it takes more time to do it electronically"*, can make using technology **unfeasible**.

Now **back on campus**, Mpho reports not only has she been **forced to improve** and **extend** her **technology skills** *"we were compelled to grasp new ways…had to come on board and train myself"***,** but also her **attitude towards technology is more positive** *"was reluctant…not in favour of technology…had to change…join them or be defeated"*.

Appendix F-2: Teachers' accounts of Internal Beliefs at School 2

Pedagogical Beliefs

Chantal aims to provide **learners with knowledge** *"I have a great passion for delivering knowledge…knowledge is food"* and believes **her role** is to **utilise technology to make education more relevant** *"to create relevance and engagement…technology, this is what the world revolves around…we need to use it to create education that is more sustainable…otherwise you are going to lose them"*.

Although Chantal believes teaching **remotely** and with a **hybrid approach** now includes **more repetition** *"it is more repetitive…you have to repeat the work that they do on their own a lot"* and **learner collaboration** *"we need to change education to focus more on teamwork and collaboration"* and **has shifted her pedagogy** *"my teaching has changed"*, she feels **changes are unsustainable** due to Department of Education **limitations** *"when you are sitting with the department that we have…just going to revert back all the way…for the majority of schools"*. Aside from the benefits of using technology for remote teaching, Chantal feels **face-to-face teaching is better for certain learners** *"I have learnt to distinguish between learners that really need to be at school and those that have the self-discipline to perform at home"*.

Phillip believes his **goal** is to provide **skills** *"I know what it takes to do maths…they need skills from me"* and **ensure learners**, who are young and often irresponsible, **do their work** *"really have to make sure that the learners do their work…they are young and very irresponsible…need to be on their back to make sure the work is being done"*.

Phillip feels **remote** and **hybrid teaching** requires teaching to be **more repetitive** *"have to reteach concepts that were difficult for them…when they were at home"* and **facilitative** *"we have to be more of a facilitator than just a teacher…it's not just about me now"*. In addition, Phillip reports he now **uses more technology** *"I feel like technology is something now that is really required"* as it enables **virtual teaching** and **learning** *"we can now always have learners that remain at home"* and feels recent **pedagogical changes** will be **long lasting** *"I feel like it has changed forever…it will never be the same"*.

Mattie aims to **provide learners with content** while **positively influencing their lives** *"to teach the learners content…to give them work…but my main role is to touch someone's heart…show them true values…it's more than just content"*.

Mattie reports not only has her **pedagogical beliefs changed** due to shifts in the educational context, with the **use of technology** becoming **more central** *"it has changed…we are moving towards a technological revolution"*, but she also now believes technology is enabling her to **teach** and **learn in a virtual environment** *"this home schooling thing…it is going to happen"* and offer **learners more individual attention** *"can now send to them individually…actually analyse and see how much better, or how far they are"*.

Mpho believes her role is to **share and engage with learners** in order to enable them to **grow as individuals** as well as **enhance their skills** *"to share knowledge, to engage…to see another's perspective…see them grow…watching it become a beautiful flower…the level of growth…from where they were and where they are now"*.

Even though Mpho reports her **pedagogical beliefs have changed** *"education as a whole is very different…I think it will never be the same"* and now incorporate **technology as integral to her teaching** *"everything is going to be technologically based…*Google Classroom *has become part of our lives"*, she believes **face-to-face teaching is still preferable** for **certain learners** *"most of our kids struggling are those choosing to do remote learning at home"*.

Normative Beliefs

Chantal believes even though the school **claims to appreciate technology** *"they like the use of technology…that's why they are using tablets"*, they are **not really technology driven** as they only allow learners to use very **limited tablet functionality** *"they are using it too restrictively…we can do so much more with the tablets…for geometry let them play Tetris…use games for education"* and **offer teachers' limited support** *"it is more of lip service…like I mean we are a tech school but we still print newsletters…we are really just using textbooks…they want to be an e-school but support is lacking"*. While Chantal reports **lots of her peers are favourable** towards technology *"I would say let's give it a number…60% believe technology can aid education"*, she believes even though there are

subject constraints *"there are constraints for maths…like how do you test on it"*, many **teachers simply do not want to utilise the devices** *"you get those stubborn teachers, they don't want to use it…even for accounting…you can do it"*.

When **remote**, Chantal reports the school **requires teachers to utilise technology** *"the principal is checking on* ITSI*…Google…have to add the HODs to your class, so they can monitor usage"* and has **developed a general framework** to **assist teachers** with the transition *"it doesn't say you have to have a video on this, or you have to use that…didn't want to tell them they have to…otherwise they become like rebellious teenagers"*. Although the framework is not prescriptive, the school **requires teachers to create their own content** *"they have emphasised you must make the lesson yourself…not just about pushing* YouTube *tutorials or videos…you have to put your own stamp to the material"*. Despite **older teachers finding the new tools challenging**, Chantal believes they are **more excited** about the possibilities of technology *"older teachers are finding the technology more challenging…they are more enthusiastic…have a passion for the field*", than their **younger peers** who are not willing to **ask for assistance** where needed *"younger teachers are not very excited…are reluctant to ask for help…would rather struggle or find a different means…or just remain silent…you only find out they are in trouble when they need to do something"*.

Phillip believes the school's mandate to be **technology-driven** coupled with its **extensive use across the organisation**, **differentiates** it from **other schools** *"we are a technology-driven school…the organisation is using technology almost everywhere…technology is one of the values that makes us different from the rest of the schools"*. For his **peers**, Phillip believes **more training** and **support is needed** to equip the teachers with the **skills needed to integrate it into their teaching** *"we need to get more teachers keen on technology…teachers are not actually using it…they need more support and training…it's one thing to know how to use something but implementation in class, it's something else"*.

When **remote**, Phillip reports while the **school** has **developed a framework** to assist teachers with the transition, it is **not prescriptive** *"they really do not mind…we are using whatever…there are no restrictions, if you are using something that you feel is going to work or help…that's fine"*. In addition Phillip feels his **older peers are not managing** with the **recent technology changes** *"teachers are struggling…the ones that are a little bit*

old…they find it difficult…ask questions like how do I open a Google Classroom*…they've never been exposed to such technology…so how can you expect them to be positive about it"*.

Mattie[119] believes the school simply **uses technology for technology sake** *"their main aim is to use technology…they want you to use it all the time"* and thus **monitors rather than encourages teachers' use** *"they have feedback sessions with us…say this is the number of items you pushed…why haven't you created an assessment…they monitor our use"*. Mattie feels **using technology is a personal preference** and her **peers** should be able to **decide for themselves** whether to integrate technology in their teaching *"it's a personal preference…it confuses some of us…we can decide for ourselves"*.

When **remote**, Mattie reports although the **school has developed a non-prescriptive framework** to assist teachers *"they are pretty open to use whatever suits you"*, the school does **mandate where teachers need to post learner content** *"work needs to be posted on all platforms…*ITSI, D6, Google Classroom *and on* WhatsApp*…it's everywhere"*.

Mpho reports technology use is a **core value at the school** *"we are an e-learning school…we have five core values and technology is incorporated in all of them"* with **teachers' use monitored** *"if you don't use it, it's a big issue…may even be called to the principal to say I've noticed you are not active enough with the technology"*. For her **peers**, Mpho believes **most are favourable** *"I think they do value technology…they embrace it, appreciate it…they are using it in their teaching"*.

When **remote**, Mpho reports the **school requires teachers to utilise technology** and the **principal regularly checks up on teachers' use** *"the principal is the one regularly checking"*. In addition, Mpho reports the **school mandates where teachers post learner content** *"every time I post work…it is on* ITSI, Google Classroom…WhatsApp *group"*. Mpho believes some of her **older peers** are **enjoying the new tools as it makes their lives easier** *"one of our educators in the older generation, in the 60's…she's loving it…makes her life easier"*.

[119] Mattie did not comment on Peer Norms when remote.

Knowledge Beliefs

Chantal believes one **acquires knowledge** from **interacting**, **researching**, **engaging with the world**, and **drawing on existing** and **past experiences** *"it's what you see, read, what you have been taught…those are all knowledge bases…then you do research, go and find out about something you don't know"*. In addition, Chantal feels **knowledge** on **how to use** technology *"there are a lot of educators entering marks by hand…they don't know how to use* Excel*…or even set up their own projector…don't know the shortcuts"* as well as knowledge on **affordances** *"if teachers can see what technology can do…how it benefits them…seeing is believing…that's why a lot of teachers don't use technology because they cannot see what it does for them…the more they know…the more they will use"* are **essential** when utilising technology.

When **remote,** Chantal feels she is **using technology more effectively than her peers**, as she is **more knowledgeable** on **how** the technology works and its **affordances** *"I'm using it a lot more than others…they're basically making a* Power Point*, but they don't know about narrations in the slides…screen recording…so they are using the same technology but I'm using it more effectively because I'm more comfortable"*.

Phillip[120] believes **knowledge** is **acquired** when one **practically engages** with something *"if people put their hands on something…that is how you learn…especially with technology, you have to use the device, have it in front of you, to know how it works"* and that both **knowledge** on **how to use** technology *"there is a correlation between knowing an using…if you are confident on something…you won't be hesitant to display that knowledge in front of the learners or incorporate the technology in the class"* and on **affordances** *"I struggle to incorporate it my lessons…because I don't know about the opportunities"* are **essential** to successfully incorporate technology.

Mattie feels one **acquires knowledge** only when **content is relevant** and through **constant repetition** *"relevance makes us want to learn more…repetition a lot…keeping it interesting…so you want to learn more"*. Furthermore, Mattie feels **knowledge** of technology **affordances** is **essential** *"if I knew more about what I could do…in accounting*

[120] Phillip did not comment on Knowledge Utilisation when remote.

we teach everything in theory…maybe we could use technology, like software for bookkeeping".

When **remote**, Mattie believes if she **had more knowledge of how it works,** she would **utilise technology more** *"obviously if I knew how to…I would use it more"*.

Mpho believes to **acquire knowledge** one needs to be **inquisitive**, **make mistakes** and **learn from them** *"talking, writing, asking, being curious…making mistakes…and the corrections from that"*. In addition, Mpho feels **knowledge** on **how to use** technology **is essential** to successfully incorporate technology *"If I knew more, I would use it more…at home…incorporate it in my classroom more…apply it in class"*.

When **remote**, Mpho reports she is **using alternative tools** as she **does not possess** the **knowledge on how to utilise** the **new technology effectively** *"I use* WhatsApp *as this is the tool that I know…I'm comfortable with it…I don't use Google Classroom regularly…as I don't know it"*.

Value of ICT

Chantal believes technology can be used to **create** and **distribute content** *"pushing resources…just scan and push the resources",* **advance learning** *"for geometry…let them play Tetris so they can get spatial awareness…general knowledge apps"*, bring the **outside world into the classroom** *"using a hologram…don't need to have the physical heart…can slice it in front of them…brings the real world into the classroom"*, **prepare learners for the future** *"create a better future for this generation…opens doors…an advantage to know how to use technology…incorporate it into everyday life…is a big advantage"*. Notwithstanding these benefits, Chantal feels technology should not be used to **replace the human element** *"we still need face to face contact…personal connection and to create relationships"* and only **utilised where it makes sense** *"we need to use it where it makes sense"* to **provide learners with engaging lessons** *"sitting and talking to them…you lose them…their interest is with technology…we have to stick to this"*. For **affordances**, Chantal believes technology can offer **virtual experiences** *"life sciences is a visual subject…can use technology to create an image with sound…do a dissection in class"*; make **content more exciting** and **relevant** *"let them play* Tetris*…it becomes more relevant for the kids…brings more engagement"*; **save time preparing**, **distributing** and

projecting content *"my prep time is less…for pushing resources, where we used to stand and wait for the copier, you can just scan and push…will have graph paper projected on the screen…don't have to redraw each time…do explanations right next to the images"*; **administration** and **marking** *"saves administration time…I immediately enter marks on the* D6 *communicator…export…have a copy if anything happens…makes administration part of teaching a lot simpler"*.

When **remote**, Chantal reports technology not only enables the **academic project to continue** *"can make topic lessons…*Power Point*s with animations…have a question and answer session…create a* Google Meet*…explain live to the students"* and is being used to **stimulate teachers' creativity** *"teachers can come up with new ideas…enhance their creativity"*; **manage resources** *"you can get and push lots of resources…saves time"*; **create content** for **future** learners *"you can make a digital recording…can use it in the future if you have the same subject"*; **communicate** with learners *"use* WhatsApp*…have a* Google Meet*"*; and provide work to **catch up absent learners** *"you make a recording of yourself…put it up online…if a child is ill for a day, they have access to those lessons…do not fall behind"*. However, Chantal believes **learners' inability to purchase data** *"at the end of the month…we can see a lot the kids are not opening any resources…their data is done…that's our biggest challenge"*, **lack of self-motivation** and **engagement** are **hindering** remote efforts *"it is challenging to engage them…motivation is lacking…they need to be self-disciplined…have some who are not featuring at all on the electronic or remote teaching platforms"*.

Now **back on campus**, Chantal reports although she **appreciates** technology **affordances** even more *"I was always a believer in using technology"*, she feels not only can **technology be distracting for some learners** *"it can benefit some learners more than others…certain individuals are distracted by all the bells and whistles"* but also **learners need to be self-motivated** for remote and hybrid approaches to be effective *"they need self-discipline to be able to work from home"*.

Phillip believes even though technology can be used to **create** and **distribute content** *"can push videos, other resources"*; **advance learning by enabling practice** and **review** *"for* MathU*…if I taught a concept in class…the learner can login and do the sums there…if it's wrong, there's a written memo…if he doesn't understand there is a video…it creates a pathway for learners"*, **support** and **simplify current teaching practices** *"I'm able to*

highlight and say…these are some of the key things you need to look at…can project and the learners can see", he feels technology should only be **utilised where it makes sense** and to benefit **learners** *"just because we have technology doesn't mean we have to throw it at them all the time…I use it where it makes sense…where it will benefit the kids"*. For **affordances**, Phillip maintains technology **saves time** in **class** *"you can push videos…when they come to class they have a better idea of how to do this…it can speed up the pace of teaching in class"* and enables **communication** *"I can just send them a message…on the* WhatsApp *group…with the educator console we can communicate easily with the kids"*; **marking** *"*MathU *is able to mark…they take an assessment and immediately they get the scores"* and **administration** *"I can check how the learners are using their e-textbooks*.

When **remote**, Phillip reports technology enables the **academic project to continue** *"prepare lessons…record myself teaching….make them notes…send work to learners…look for videos that are similar to what I have created*", by providing **additional resources** *"I can subsidise with other resources…to make it clearer"*, **checking on learner resource engagement** *"we can track how far the kids are, are they getting the lessons…are they doing the work…those that are not doing the work…who has taken the assessment"*, **reviewing content** for **better understanding** *"if I created a lesson…they would have an opportunity to go back…watch the same video again"* and **communicating** with learners *"created a* WhatsApp *group with the kids"*. However, Phillip believes **learners' inability to purchase data** *"it's not working…you can only reach learners who can connect…only they are benefiting…half the school isn't online…when I ask why are they not joining…they say we don't have data…it's too costly"*, **lack of self-motivation** and **engagement** *"often you can see a learner has joined a class but they hardly interact…hardly ask questions…it's a challenge"*, **unfamiliarity with the new technology tools** *"the kids are battling…they don't know what to do…some of not getting it…they are not prepared for this at all"* and **non-involvement of parents** *"we are relying on the parents…they complain…I have to share my phone with my kids"* are **challenging** remote efforts.

Now **back on campus**, Phillip reports he **appreciates** technology **affordances even more** *"technology is now the way to go"* and feels the changes are **forcing learners to be more self-reliant** *"they're not just relying on me for information…can get information for*

themselves…share with each other", however he maintains **learners** are **not self-motivated** *"it requires a whole lot of responsibility from them…we can send work but if they are not doing it…their side is lacking…it's not working"* and **parents** are still **not actively involved** *"the parents also need to come on board…saying to their kids this is how we do this…sitting with them an doing the work with them"*.

Mattie believes although technology can be used to **provide learners** with **different teaching approaches** *"you can play a summary from someone else's point of view"*; **prepare learners for the future** *"in accounting the book system that we are using is so old and outdated…with technology they can use some of the software programmes for book keeping…for* Pastel*…show them how it works"*; and for **communication** and **administration** *"thank goodness for technology for administration…communication with the learners…for internal communication"*, she feels technology **should only be utilised** where it **suits the learning activity** as her **aim is to teach** *"my main aim is not to use technology, it's actually to teach content to learners...but their main aim is to use technology…but technology is not suited to every task"*. For **affordances**, Mattie feels technology **saves time** for **administration** *"marks can be easily, maintained , and retrieved"*; **communication** *"internal…external…meetings with peers is much easier"*; **content preparation** and **distribution** *all my slides are on technology…I can just push content from my PC to the learners' tablets"*; and **in class teaching** *"with green boards I had to redraw the format for different classes…was time consuming…now I just display it once"*.

When **remote**, Mattie reports technology not only enables the **academic project to continue** *"I send them resources…video they have to watch…voice recordings…give them instructions…they send me pictures of their homework"* but allows: **learners to review material in their own time** *"they can access the lessons anytime, anywhere…they can view them at home"*, **communicate with learners** *"to communicate with the students…use* WhatsApp*…send me their work and questions"*, **catch up absent learners** *"they can access it anytime, anywhere"* and **build content** for **future learners** *"the lessons I'm creating…I can push them to future learners' tablets"*. However, Mattie believes **learners' inability to purchase data** *"data is a huge problem for learners…not everyone has data to look at the stuff you send…so you can't really keep track of what they are doing"* and **lack of self-motivation** and **engagement** *"you don't get an*

immediate response…you don't know if they are with you an if they are getting the information", are **challenging** remote efforts.

Now **back on campus**, Mattie reports she **appreciates** technology **affordances more** *"I value technology more…it's here forever"* and believes technology is enabling **learners to review content for better understanding** *"they can review content, cause a lot of them sit here and say I understand and then go home and say what am I doing, now they can review it"*.

Mpho believes technology can be used to **create** and **distribute content** *"you can push resources to the kids"*, **advance learning** *"kids learn differently…if the child doesn't understand…they can watch* YouTube*"* **support existing teaching** *"for additional resources…enrichment of what I do"*, bring the **outside world into the classroom** *"teaching them how to conduct a speech…they can watch the SONA…see how the president starts his speech"*, **take pictures of the board** *"taking down notes…taking pictures"* and **cover work outside of class** *"videos not watched in class…can watch it at home or the* Power Point *if not paged through in class…they can do it at home"*. However, Mpho cautions one must be **mindful about where technology is used** *"you need to be mindful…is the technology helping the kids engage, pay attention"* as the **aim is not to utilise the tools but to teach** *"some teachers just use it for the sake of using it…what is the value of that"*. For **affordances**, Mpho feels technology **simplifies current pedagogic practices** *"they can use Google or translate it…if they get it better in their home language"*; **saves time** when **communicating** *"with* WhatsApp*…can easily assist"*; and enables **content distribution in** and **outside of class** *"I can send the resources…whether* Power Point*, PDFs or videos…can watch it at home"*.

When **remote**, Mpho reports technology enables the **academic project to continue** *"create lessons…send videos…download from the net…give them activities…email me their essays…can mark instantly",* **communication with learners** *"*WhatsApp *mainly to check on my kids…ask them to respond by raising their virtual hand on the group"*, makes **learners more self-reliant** *"kids don't have to rely on the teachers' knowledge…can check for themselves…encourages them to work amongst themselves"* and for **learners to review content in their own time** *"they can watch it at home in their own space"*. However, Mpho believes **learners' inability to purchase data** *"the kids don't have*

data…they couldn't get the work", **lack of self-motivation** and **engagement** *"it's like you are talking to no one in those groups…there is a poor response and action"* and **parents non-involvement** *"it is a poor response from parents"* **challenge** remote efforts.

Now **back on campus**, Mpho reports although she **appreciates** technology **affordances** even more as it **brings relevance** to **the curriculum** *"now you can actually see the curriculum and what they have and what you teach…what is happening in the world…what technology can give them…so many resources…information"* and is **forcing learners to become more reliant on their own skills** *"self-learning can be implemented"*, she feels it is an issue that **technology makes learners lazy** *"I fell technology makes them lazy…it gives them everything…happens in a click of button"* as she feels **self-motivation is needed** to make **remote and hybrid approaches effective** *"most of our kids struggling are those that are choosing to do remote learning…it is hard for them to be motivated"*.

Self-Efficacy

Chantal feels **very confident** using technology in her teaching, however, she believes **face-to-face is better for disciplining** and **connecting with learners** *"I am confident about using technology…but not for personal interactions between teacher and student….physically I can keep better discipline in the classroom…certain elements need face to face time"*. In her **personal** life, even though Chantal feels **confident when using technology** *"I use technology a lot in my personal life"*, she reports only **using it where it makes sense** *"I use it where it makes sense for me…I still don't trust self-drive cars…I would rather trust my own judgement…it doesn't make sense"*. When **remote**, Chantal reports she is **even more confident** and is **constantly improving her skills** *"I am very confident…learning more every day"*.

Phillip believes he is **confident using the technology** both in his **work** *"I think I'm okay with what I need"* and **personal life** *"in my personal life I am fine with technology…I use it a lot…for almost everything"*. When **remote**, Phillip reports he is **confident with utilising the new tools** *"I think I am very effective…constantly giving feedback…constantly online"*.

Mattie believes she is able to **use technology for what she needs** in both her **work** *"where I can, to what my knowledge allows me, I use the technology"* and **personal life** *"I am confident using technology for communication, social media, banking"*. When **remote**,

Mattie reports **even though the tools are new**, she is able to **utilise them by following instructions** *"the ones I can do are good…but it is all still quite new to me…but it is easy if I follow the instructions"*.

Mpho reports she is **not confident in using technology in her teaching**, as she believes not only has she not **been exposed sufficiently to teaching with devices**, but also **integration in her subject is limited** *"I'm Mrs textbook…I really struggle to teach from a tablet…I was not exposed to it…also it is my subject…the kids need to physically engage on paper…it is better with a hardcopy textbook"*. While Mpho feels **confident** in utilising technology in her **personal life** *"I am very confident in using technology in my personal life"*, she would **prefer not to use technology** at all *"if I could, I would resort to not having a phone at all"*. When **remote**, Mpho is **reluctant to use the new tools** as she feels she is **not confident** *"it is foreign to me…I have struggled and I'm still reluctant to use it…I'm not really technology inclined…if I was granted more time…I think I would be more comfortable"*.

Appendix F-3: Teachers' accounts of Professional Dispositions at School 2

Chantal believes although **school knowledge** is **more structured** and **related to everyday knowledge** *"you get book knowledge and street smart knowledge…they are related…book knowledge is structured…it tell you like this and this"*, one **first needs to acquire everyday knowledge to create new knowledge** *"everyday knowledge creates new knowledge…if everyday knowledge is lacking you don't have the discipline to acquire school knowledge…if you have street smarts or behavioural knowledge…only then are you open to more suggestions and new ideas"*. Within her subject, Chantal feels learners can **acquire knowledge** through **interacting with the world** around them *"watching, reading, accessing resources"*.

For the **regulative** discourse, Chantal reports while she has **strong professional boundaries** *"I am the educator and they are the students"* and **controls the classroom context** *"I am in charge of my classroom, there's a time for learning…for discussion…I control that"*, she believes she is **approachable** *"I've got an open door policy…they can come to me with issues about the subject…personal issues"*. When using a **remote** and **hybrid approach,** Chantal indicates her **boundaries have not changed except** for the **addition of boundaries around response time** *"even though they are more in contact with me…on* WhatsApp *and email…I've maintained my boundaries…they are firm…but I do tell them after 8pm and until 7am there will no response"*.

Phillip believes **school knowledge** is **more structured** and even though **related to everyday knowledge** there are **boundaries** *"there are boundaries…one influences the other…at school we tell you how to do things"*. Therefore, Phillip feels **one first needs to acquire school knowledge** to **provide learners with the necessary skills** *"you can't just do maths…you need school knowledge to guide you"*. Within his subject, Phillip reports **learners acquire knowledge** in a **vertical manner** *"they need a base…the foundation and then they can learn"* with **continuous teacher guidance** *"in maths learners need guidance…when they are doing a sum and they get it wrong, it's easy for them to quit, if they know they can get help quickly they will be able to learn"* and **practice** *"learners need to practice sums…if they get it wrong…do it again"*.

For the **regulative** discourse, Phillip reports he has **firm**, **strict** and **professional boundaries** in place *"I have strong boundaries…I'm somebody who is very strict…a soft approach won't work for them"* and **controls the classroom context** *I am 100% in control of what happens in my class"*. When teaching **remotely** and with a **hybrid approach**, Phillip believes his **boundaries** are **less strict** as he is playing a **more facilitative role** *"I am learning with them now…I am more of a facilitator now"*.

Mattie believes while **school knowledge** is **more structured** *"it is structured"* and **related to everyday knowledge**, there is also a boundary *"they interact, they relate…there is a boundary"***,** and therefore **one first needs to acquire school knowledge** to **provide learners with the necessary knowledge base** *"you need to teach from a base…school knowledge comes first…then we can apply it…take it back again and then advance it"* Within her subjects, Mattie reports **learners acquire knowledge** in a **vertical manner** *"you need to teach from a good base…otherwise learners will not know"* through **continuous repetition** and **practise** *"repetition is the best thing…practising it a whole bunch of times…practising, practising"*.

For the **regulative** discourse, Mattie reports even though she has **strong professional boundaries** in place *"I am not their friend, I am their teacher"* she believes she is **approachable** and **mutual respect** is present *"we have lots of fun together…there's a level of respect which we maintain at all times"*. While Mattie likes to **control the classroom context** *"I don't usually share control"*, she is willing to **share limited control** depending on the **time of the year** and the **class makeup** *"I can share a little…depends on the time of year…first term you obviously in control…from term two they know where to draw the line…also depends on what class it is and who is in the class"*. When teaching **remotely** and with a **hybrid approach**, Mattie believes **boundaries** remain **unchanged** *"they have not changed really…we still respect each other…even though they have my number I have not had a problem"*.

Mpho believes **school knowledge** is **more structured** *"school, knowledge is more structured"* and **related to everyday knowledge**, thus **both types of knowledge** need to be **acquired simultaneously** *"there is knowledge at home and at school… at home you can teach and learn about work, school, technology…all sorts of subjects… one takes it home and then comes back and shares…you need to learn it at the same*

time…incorporate everything into one". Within her subject, Mpho feels **everyday knowledge** is **important** *"knowledge learnt at home is best…it is more practical"* and learners **acquire knowledge** through **interacting with the world** around them *"you have to read, talk the language, write…question a lot…engage"*.

For the **regulative** discourse, Mpho reports she has **strong professional boundaries** *"there are boundaries…I have a role to play, and they've got a role to play…they've got tasks that need to be completed and I'm tasked to teach them"* built on **mutual respect** *"first thing is respect"* and **controls the classroom context**, even when **learners** are **collaborating** *"most of the time I control the classroom…even when they engage with each other…I walk around the class and monitor and maintain discipline"*. When using a **remote** and **hybrid approach,** Mpho **reports** her **boundaries have not changed** *"nothing has really changed"*.

Appendix F-4: Teachers' accounts of Orientation towards Technology at School 2

Chantal believes she uses technology to **support** *"create lessons…scan and push resources…now have a copy of everything…don't have to redraw"* and **transform** *"it is completely different…I don't have to have all the knowledge and information…we stop and Google…if we are curious about something they can satisfy it"* her **pedagogic practice**. When **teaching remotely**, Chantal feels **technology** is not only **supporting** her pedagogic practice *"you can get lots of resources…if a child is ill…can have access to those lessons…use it in the future"*; and **facilitating easier communication** with learners *"*WhatsApp…*Google Meet"*, but is also making her pedagogic practice **more collaborative** *"focusing more on teamwork and collaboration"*.

On campus, Chantal reports she uses technology to: **prepare, present push and upload learner content** *"*Power Points *that I create…project the graph paper on the screen…just scan and push the resource"*; **show videos** *"can just put up a* YouTube *video on the projector"*; **search for information** in class *"if we do not have the information we stop the lesson, we Google it"*; **conduct** and **mark assessments** *"on* ITSI*…building an assessment…if closed-ended questions…the computer marks it"*; and **record marks** *"I immediately enter the marks into the* D6 *communicator"*. In addition, she uses technology to **transform educational experiences** by making **abstract concepts more real** *"a video on…inhalation and exhalation…physically see the motion"*.

When **remote**, Chantal uses technology to: **pre-record lessons** *"I do a recording with me talking…sometimes I'm visible…a* Power Point *with animations"* **find resources** *"I'm using* Teacha*,* Twinkle*…they are resource platforms…can get resources like worksheets,* Power Points*"*; **post lesson guidelines** and **content** *"make a topic lesson and then push the resource"*; provide **online assistance** and **feedback** *"have a question and answer session on* WhatsApp*…if there's a majority problem on one topic then I create a* Google Meet *and we discuss it there"*; and **build a bank of future resources** *"can use it in the future"*. For **administrative** tasks, Chantal reports she is using technology to **communicate with learners** *"*WhatsApp *text…with them"*, provide **teacher support** *"make a tutorial video…share with all the educators"* and **catch up learners** *"making a recording…putting it up online…they have access"*. When she returns to campus, Chantal **intends** to **use**

technology more extensively and **record live lessons** *"we are going to use it continuously…do recordings for all lessons"*.

Now **back on** campus, Chantal indicates she is using technology to **record live lessons** *"I record my lessons in class…when I cover a new topic I do a recording…I do it in class"*; **facilitate remote learners** *"I recorded all my lessons in class and put them on* YouTube *for the learners at home"*, **post** and **store resources online** *"still posting our lessons online…you have a presentation you will put it on…recorded my lessons…put them on* YouTube*"* and **communicate with learners** *"there is more contact with me on* WhatsApp*, email and everything"*.

Even though Chantal believes education will become **more blended** *"I envision they will come in for contact time only…identify where they don't understand…only have contact on that…the rest online"*, **transformed** *"there's a lot more we can learn and change in education, especially in a country like ours that is focusing on teamwork and collaboration...making it more online"* and offer **greater home schooling options** *"can come in for contact time only twice a week"*, she feels **increased technology use is not sustainable** *"we are going to revert back all the way…for the majority of schools they will just go back to doing what they did before"*. Furthermore, she believes **online education is not suitable for all learners** *"there are some students that really need to be at school…they don't perform when they are online…some students benefit more with using the technology…those that are actually motivated, certain individuals are distracted"*.

Phillip believes he uses technology to **support** *"able to highlight…project…push resources"* and **enhance** *"it changes everything…my approach in class…have to be more mindful of how I teach…the kids are not only relying on me for the information, they can go elsewhere"* his **pedagogic practice**. When **teaching remotely**, Phillip reports **technology** is not only **supporting** his **pedagogic practice** *"can track how far the kids are…prepare lessons…send work…look for videos…they can watch the same video again…to make it clearer"*; and **enabling easier communication** with learners *"*WhatsApp *groups with the kids"*, but he also believes his pedagogic practice has become **more facilitative** *"have to move to be more of a facilitator than just teaching"*.

On campus, Phillip reports he uses technology to **prepare, present push and upload learner content** *"can highlight…project…push videos"*, **show videos** *"when I am playing a video"*, **mark** *"*MathU *is able to mark…take an assessment immediately and get the score"*, **check learners' resource activity** *"can also check on how the learners are using their e-textbooks"* and **communicate with learners** *"on* ITSI*…we've got what you call the educator console…to communicate with the kids"*. In addition, he uses technology to **transform educational experiences** by providing **other teaching approaches** *"can watch a video…if they don't understand"* and **personalised learning** *"*MathU*…creates a pathway…if you get it wrong it creates similar questions to the one you got wrong…you have to try that…then you can go back and take the test"*.

When **remote**, Phillip uses technology to **pre-record lessons** *"record myself teaching"*; **find resources** *"go and look for a video…on* YouTube*"*, **post lesson guidelines** and **content** *"make them notes, to make instructions clearer so the learners know what to do…on* Google Drive…D6…on ITSTI*"*; provide **online assistance** and **feedback** *"we are constantly giving feedback…constantly online…some send questions on* WhatsApp*"*; and enable **online submission of work** *"they write out the work I give them…take a picture, post it back to me"*. For **administrative** tasks, Phillip reports he is using technology to **communicate with learners** *"also send voice notes"*; **get support** and **attend meetings** *"have this one person…she shows us what are the things we need to do…have these* Zoom *meetings all the time"*; and **check learners' resource activity** *"check which learners are taking the assessments or which learners are actually checking their books…to track how far the kids are"*. When he returns to campus, Phillip **intends** to **use technology more extensively** *"we will be using it extensively…fully optimise it"* to **record live lessons** *"I can record lessons…ones I am doing in class"* and **teach classes simultaneously** *"split the classes…the other class is next door, they should see me teaching live…projected to the other class"*.

Now **back on campus** Phillip reports he is using technology to **create** and **post resources** *"it will be a voice note…recording…a* YouTube *video…send to them…lesson plans…saying this is the instruction"*; **facilitate remote learners** *"need to push work…particularly to learners at home…they are relying in getting the work online…to be taught online"* and **communicate** *"on* WhatsApp *when they don't understand"*.

Phillip feels **using technology is now essential** *"we'll never have to do things the traditional way…particularly our schools with technology…I feel like technology is something that is now really required"*, and thus he believes in the future education will be **more blended** *"being blended…in the education space"* and **home schooling options** will **increase** *"we can always have learners at home"*. However, he feels **challenges** still exist as **online education is not suitable for all learners** *"it requires a whole lot of responsibility from them…their side is really lacking…they come to school and you realise they have not been doing anything"*, **parents are disinterested** in **assisting their children with school work** *"parents need to also come on board…should be sitting and helping their kids do their work"* and the **technology infrastructure in South Africa is poor** *"the kids that are at a disadvantage are the kids that are not on technology…e-learning…the kids in public schools"*.

Mattie believes **technology is not suitable for all subjects** *"it is not suitable for every subject…for accounting it is extremely difficult"*, and therefore she uses technology to simply **support her existing pedagogic practice** *"all my slides are on technology…can send them videos…don't have to redraw, can just display it once…my teaching hasn't changed…it just helps us reach more kids in certain aspects"*. When **teaching remotely**, Mattie feels **technology** is not only **supporting her pedagogic practice** *"create lessons…push to their tablets…to future learners' tablets"*, **assisting learners' understanding** *"a lot of them used to sit here and say I understand and then go home and say what am I doing…now they can review"* and **facilitating easier communication** with learners *"*WhatsApp*…send pictures of their work and questions"*, but it is also enabling her to provide **learners** with more **individual attention** *"individually…analyse and see how much better they are"*.

On campus, Mattie reports she uses technology to **prepare, present push and upload learner content** *"transfer everything from textbook into the technological process…all my slides…display the format sheet…push content from our PCs to learners' tablets"*, **show videos** *"there's different business environments...so I play a little video"* and **communicate with learners** *"communicate either via* WhatsApp *email…*D6*"*. In addition, she uses technology to **transform educational experiences** by providing learners with **other teaching approaches** *"can play a summary from someone else's point of view"*.

When **remote**, Mattie uses technology to **pre-record** lessons *"lessons I'm creating…show them how do it…with accounting I'm recording my voice"*, **find resources** *"there's videos that they watch and see what the topic is about"*, **post lesson guidelines** and **content** *"online methods to transfer files for the learners…to open up stuff…give them information…tell them this is what needs to be done"*, **build future resources** *"can push to future learners' tablets"*; provide **online assistance** and **feedback** *"they send me their work…am able to help them"* and enable **online submission of work** *"they take pictures…of their homework and everything…then you respond with a voice message…then they send you the corrections"*. For **administrative** tasks, Mattie reports she is utilising technology to **communicate** *"different methods of…*WhatsApp*,* Google Classroom*"*; **catch up absent learners** *"they can access it anytime, anywhere"*; and **get support** *"if you need assistance…you would take a screen capture and record am issue…you go there, go there in order to do this".* When she returns to campus, Mattie **intends** to **use technology** to **pre-record** and **record live lessons** *"I will do my live lesson…record it…I will still create these videos…so they can view them anytime"*.

Now **back on campus**, Mattie reports she is using technology to **record live** *"lesson are conducted in class…sent online"*, **create** and **post resources** *"do all different things…creating videos…post homework on* Google Classroom*…transfer files"* **conduct lessons** and **facilitate remote learners** *"streamed videos while you're speaking…send screen shots of their answers"* and **communicate** *"in contact with* WhatsApp*…still as busy as it was"*.

Mattie believes even though **using technology is now essential** *"we are moving into a technological revolution…this is going to be our new method"*, to be successful **teachers** and **learners** need to be **willing to adjust** *"depends on how willing people are to adapt to these things"*. Furthermore, while Mattie believes education will become **more blended** *"it will be a blended approach"*, **transformed** *"you will be teaching here and your teaching will be displayed in other schools"* and offer **greater home schooling options** *"the home schooling thing…is bound to happen"*, she feels **challenges** still exist as **online education is not suitable for all learners** *"the kids studying at home we can see a huge dip in their marks"* and the **technology infrastructure in South Africa is poor** *"kids need data to do this"*.

Mpho believes **technology** should only be used where it **supports** and **enhances pedagogic practice** *got all sort of learning styles…in class if the child doesn't understand…can switch on* YouTube *or* Google*"*. However, when **teaching remotely** Mpho feels **technology** is not only **supporting** her **pedagogic practice** *"it just supports really…send a video…*Power Points*"*; **assisting learners' understanding** *"can watch at home in their own time"*; and **facilitating easier communication** with learners *"checking on my kids…ask them to respond by raising their hand on the group"* but is also enabling **learners to become more self-reliant** *"the kids don't have to rely on teachers' knowledge"*.

On campus, Mpho reports she uses technology to **prepare, present push and upload learner content** *"send resources…either PDF,* Power Point *or videos…switch on* Google *or* YouTube*"*; **show videos** *"when I am showing a video"*; **search for additional resources** *"for resources one can add"*; and **communicate with learners** *"email…*WhatsApp*"*.

When **remote**, Mpho uses technology to **pre-record lessons** *"I'm making videos…send videos of yourself teaching"*, **find resources** *"presentations that you downloaded from the net or just Word documents"*, **post lesson guidelines** and **content** *"the lesson plan…compile…upload and send it through to the learners…you send* Power Point *presentations"* and enable **online submission** and **feedback of work** *"email me their essays…send them feedback…I mark and send back"*. For **administrative** tasks, Mpho reports she is using technology to **communicate with** and **catch up absent learners** *"on* WhatsApp*…emails…*ITSI…Google Classroom*…they can watch it at home"*, **get support** *"a colleague of mine…she had a session where she trained us…showing it on the screen on her laptop"* and **attend meetings** *"we have* Zoom *meetings"*. When she returns to campus, Mpho **intends** to **use technology to post additional resources** *"to download videos…let them watch it at home"*.

Now **back on campus** Mpho reports she is using technology to **record live lessons** *"I prefer recording myself audio…they are really quick…when you're in class"*; **conduct remote lessons** *"using remote learning, other than contact sessions…also did a* Google Meet *the other day…to have a discussion with them"*; **create** and **post content** *"*Google Classroom *for resources…push resources there"*; **facilitate remote learners** *"post on*

WhatsApp*…for those at home…before the lesson starts…tell them to be on the lookout for the* Google Classroom*…check resources…after you conduct the lesson you need to post everything you taught in that lesson on* Google Classroom*"* and **communicate** *"*WhatsApp *groups…we do in the beginning of your lesson"*.

Mpho believes as **using technology is now essential** *"it has become part of our lives…everything is going to be technologically based…assessments…things are mostly going to be computer based" in* the future technology will **transform education** to be **mostly online** and the demand for **home schooling will be greater** *"we can have virtual learning…mainly online assessments…there is so much information that we can get to a point where teachers can be replaced…we're going to do things remotely…self-learning can be implemented"*. However, she feels **challenges** still exist as **online education is not suitable for all learners** *"most of the kids struggling are those at home…choosing to do remote learning…they are not responsible…sometimes technology makes them lazy"* and **some learners lack technology skills** *"now they have to use technology and you find some don't even know how to use a laptop"*.

APPENDIX G DETAILED MICRO AND MESO ANALYSES OF SCHOOL 3

Appendix G-1: Teachers' accounts of External Structures at School 3

Resources

Ben believes **access to hardware** *"teachers get given laptops…classes have SMART Boards…SMART Kapp…there are computers in the lab…internet…learners have tablet from the government"* and **software** *"we have* Siyavula *for textbooks"* at the school is mainly **suitable** and of **good quality** *"for me it is 100% sufficient…we can do everything that we need…learners new notebooks are good"*. However, he finds the **Wi-Fi slow** *"my laptop…I prefer to use the cable as it is a bit faster than the Wi-Fi"*; would like **access to tablets** *"would like to buy tablets…for teaching"*; and **higher performance devices** *"I think we could improve a little…get bigger machines"*. While Ben reports each classroom is arranged with **SMART Boards** and **SMART Kapps next to each other in front of the class**, with **tablets on learners' desks** *"the arrangement of the SMART Kapp next to the SMART Board is similar in all classes…students have tablets on their desks, facing frontwards"*, he believes **another SMART Board is needed** in the class as **learners at the back struggle to see** *"I would put two SMART Boards in one class, because sometimes you have to bring the learners up close…to see the board"*.

When **remote** although teachers have **access to school issued laptops** and **software**, and **learners** have their **tablets** *"we have laptops…we have software…they have their tablets"*, Ben feels **access to resources is an issue** due to the **insufficient provisions from DoE** *"it depends on the department…it is not good enough"*, specifically in regard to **data for learners** *"they don't have free data on the tablets…that is an issue with regards to access, as learners cannot access the work"* and **teachers** *"it's my own internet that I pay for"*.

Now **back on campus**, Ben reports while the DoE have provided **teachers with data** if needed *"if you mentioned you are struggling they do provide data at home"*, he believes **learners' lack access to data** is **hampering the academic project** *"they don't have data…we can't post online…we tried that during the first lock down and it failed badly"*.

Nombuso believes even though **teachers** and **learners** have **sufficient access to quality hardware** *"we have smartboards…laptops from the DoE…SMART Boards…we also have*

SMART Kapp…computer labs for IT learners…learners have tablets…it is of good quality" and **software** *"have GDE online content for problematic areas…use Siyavula textbooks, have softcopies on the learners' tablets…also have Via Africa textbooks that come with the device"*, **connectivity is an issue** as there is **limited Wi-Fi capacity** at the school *"if you want to conduct an online assessment you can't…not all learners will be able to connect…in a class of 25, only 10 can connect…there are connectivity issues"*. For **physical arrangements**, Nombuso believes the **current setup is appropriate** as the **SMART Board** and **SMART Kapp** are **placed next to each other in the front of the class** *"the arrangement is good…I can use both the SMART Board and SMART Kapp…they're next to each other…if I have a picture on the SMART Board I can do a summary on the SMART Kapp, then capture that and send it to them"*. However, she feels even though **learners' devices are portable** *"learners' tablets are portable, they can move around"*, the **arrangement of desks** makes it **difficult for learners at the back of the class to see the work** *"the visual for the learners at the back is a challenge…they can't really see as it is very small"*.

When **remote**, Nombuso reports **learners' data access is insufficient** *"it is not adequate...it's not equal for everyone…for learners you send work, then there's somebody asking about the work three weeks later because of connectivity issues"*, and believes this is **hampering teaching efforts** and **limits which technology tools teachers can use** *"it would be nice to use other platforms like* Zoom*…have live interaction once in a while, similar to the classroom…we only use* WhatsApp *groups to communicate and give learners work"*.

Now **back on campus**, Nombuso reports while there is an option for **remote learners to collect work** due to **lack of data** *"if the learner doesn't have data….they can come and collect with their memory stick"*, she is still **mainly using *WhatsApp*** *"we still try give the learners at home work on* WhatsApp*"*.

Kgomotso feels while **teachers** and **learners** have **access to quality hardware** *"we have all these gadgets…they are suitable and good quality…every class has a SMART Board…SMART Kapp…laptops for preparation…every learner has a tablet…have computer laboratories"* and **software** *"use textbooks on the notebooks…can login and complete the activity…get feedback"*, she believes **slow Wi-Fi is an issue** *"if the kids are*

connecting…the educators…find the internet will be very slow…the Wi-Fi is the one that has problems". Kgomotso finds the **physical arrangement** at the school **appropriate** *"I think this way is fine"* with **learners' desks facing the SMART Boards located in the front of the class** *"I have a SMART Board just in front and all the learners' tables are arranged to face that side"*.

When **remote**, Kgomotso feels even though she needs to **purchase her own data** *"I use my own data"*, the **school has really tried to provide sufficient access** *"we all have laptops…they could not have given us more than what we have…it came with such short notice"*. However, she maintains **learners' lack of access to data** is **hindering teachers' academic efforts** *"for learners it has not been enough…learners are unable to view the work as they can't afford the data…I can see that the data we use for lessons are too much"*.

Now **back on campus**, Kgomotso reports **resource access**, **quality** and **suitability**, and **physical technology arrangements** are **as they were prior to remote teaching** *"there have been no changes"*.

Training

Ben believes **regular professional development** at the school run by **technology suppliers** *"they get people from the companies to come and do trainings…sometimes quite often, depending on the schedule"*, which is **mainly technical** and **demonstration based** is **sufficient for novice users** *"the how to training is good…there are teachers who are blank when it comes to technology…it is helpful for them…on how do I open this book…access it…avoid this…highlight these things"*. However, Ben feels **more training is needed** on how to make **effective use of technology in the classroom** *"what we have isn't sufficient…it's not something that is only technologically based…I need better ways to make technology effective in my classroom...how do I grab the attention of the learners…how do I balance the classroom while using it…how do you make it effective"*. Furthermore, Ben feels **training should be more peer-based**, given by **teachers who have experience in utilising technology in the classroom** *"it'll be better taking a teacher who has experience with using technology in the classroom to train other teachers, rather than a person who knows what technology can do but has never used it in*

the classroom…never had experience…seen the challenges".

When **remote**, Ben reports **no formal training** has been **offered by the school** *"there's never been anyone who came to train us now"*, rather **teachers research** and **teach themselves about the new technology tools** and **skills needed for remote teaching** *"we just follow different people from different platforms and look into their ideas of how to teach during this time…find out for yourself"*. However, Ben feels the **lack of formal training is not an issue** as the **school's technology focus** has **already prepared teachers** to **utilise technology** for **remote teaching** *"we received training before the Coronavirus came into play…it's something they have been training teachers at our school for, in preparation for things like this"*.

Now **back on campus**, Ben reports a **collaborative approach** is being employed to provide **suggestions** as to what **technology solutions can be used** to facilitate hybrid and remote teaching *"we as the staff came up with suggestions, they were collated, and we took out the best ones and made use of them"*.

Nombuso[121] believes in the **past professional development** at the school was **sufficient** as it was **scheduled regularly** *"in the past the training was good…there was an ICT person, who was regular…twice a week"* and aimed to **upskill new and existing teachers** *"used to train the new teachers…I didn't know anything about technology…as well as the whole staff…set a time for new teachers"* by utilising **demonstration-based** *"literally showed us how to open a SMART note…how to select…how to change the colour of the pen"* and **peer mentoring** approaches "also *had presentations…on how to use the technology…he created a platform where we can learn from each other"*. However, **more recently** Nombuso feels training provided by the school is **not suitable** *"the current training is not sufficient…have to just sit there and listen to someone train you on something you already know…also some staff have skills…there's no platform to demonstrate them to the other staff members"* and believes the **school's current approach** of **asking teachers what training is needed** will be **beneficial** *"this year we had to answer questions, so they won't train on us general stuff…will train us on what we answered…on what we need"*. Furthermore, Nombuso feels training should **not just**

[121] Nombuso did not comment on Training when back on campus.

address technical issues as most teachers at the school are computer literate, but should rather **assist teachers in making effective use of technology in the classroom** *"people know already how to play a video, but they don't know how to use the video in class…so you find teachers that just play the video and walk out…don't pause, interact, circle…use it effectively"*.

When **remote**, Nombuso believes **no additional technology training is needed** as most teachers at the school are already **accustomed to utilising technology in their teaching** *"I wouldn't say in our school teachers need training…it is something that we use every day…to others it is something foreign…it is in our practices…in the back of our minds…technology"*, and if needed she is **able to teach herself** *"I can just figure it out by myself"*.

Kgomotso[122] believes **regular technology training** at the school *"there is ICT training every quarter"* which is run by **external technology providers** *"it is run by external facilitators"*, is **appropriate** *"it is fine"* as it is focuses on **assisting teachers gaining technical skills**, **which they perceive they are lacking** *"they give us a form to check what we are lacking, what we need…ask things like how confident are you using the SMART Board, Word, Excel…what are the loopholes…where do teachers need help"*.

When **remote**, Kgomotso believes the school **did not have sufficient time to train teachers on utilising remote tools** *"they did not give us extra training….because it was such short notice"* and thus teachers simply need to **utilise whatever technology** tools they have **access to** and are **most comfortable** with *"they told us just decide what you are most comfortable with…because if we say use* Zoom *then we would need training and there is no time…it was late…so just use whatever you can*

Support[123]

Ben reports **IT support** at the school consists of **on-site technical staff** *"we have the technician that is here at the school…if something breaks…our technician is here to fix the minor stuff…if your SMART Board is not turning on…you send him a* WhatsApp*"*; the **ICT committee** *"we also have an ICT committee…if you have a problem…don't have the*

[122] Kgomotso did not comment on Training when back on campus.
[123] None of the teachers commented on Support when back on campus.

textbooks or they're not working, you report it to the committee…makes sure everything is running smoothly"; **service providers** *"they come every Monday…take care of problems…do the updates…we can ask them questions…the major stuff…just have to send them a notification so when they come they are prepared for this";* and **limited** and **inconsistent DoE support** *"we have some support from the Department of Education…they also host workshops every now and then…it is not consistent"*.

When **remote**, Ben believes **peer support is being used more frequently** *"try and contact the other teachers who are teaching the same grade as me…ask then to post on the group"* as **no technical support is being offered by the school** *"it's a problem"*.

Nombuso reports the **on-site IT support** offered at the school, which deals **mainly** with **technical issues** *"we have a guy stationed at the lab…for fixing and maintenance…if my SMART Board doesn't switch on, I can contact him to come and he checks and fixes it up"* is **adequate** and **responsive** *"I think it's good…I haven't had an instance where I called someone…and they didn't come…they are responsive"*. However, she feels **institutional support** from the **school could be improved** *"they could advance our training…we know the basics…now they need to support us and take us to the next level"* and **DoE support could be quicker** in addressing issues with **teachers' laptops** and **learners' tablets** *"the laptops and learners' devices take more time"*

When **remote**, Nombuso reports while the **principal** is providing learners with **support for social issues** *"she supports us with information…what we should tell the learners…if she has food parcels…it's more of social support"*, **no IT technical support is being offered** *"at the moment there's no technical support…if your laptop breaks…there's no plan B"*.

Kgomotso believes **IT support** offered at the school, which is **mainly technical** *"if you have a problem with your computer and it's not working…they fix it"* and consists of the **on-site ICT committee** *"we have an ICT committee, these are people who'll assist you if you need help…if they can't they find people who can"*, **lab interns** *"in the lab we also have interns…they come and ask if you have any problems"* and **remote service providers** *"we have service providers, they are the people who ensure we have laptops and tablets each year and that they work, if not they fix them"*, is **adequate** *"I think it's sufficient"*. In addition, Kgomotso **appreciates** the way the **school encourages** and

supports teachers' use of technology *"it is nice…they encourage us…the principal goes around the school and if she picks up something outstanding, she will show it to the rest of us, this is what he's doing with technology…we can all do that"*.

When **remote**, Kgomotso reports even though **no formal IT technical** *"they can't assist…those whose laptops aren't working or are broken are using their personal laptops"* and **tactical support is being provided** by the school *"they do not talk much about how we are going to do this…they just said we must do it"*, she maintains her **peers are offering 'how to' support where needed** *"the teacher that I teach with, if there's anything I can't do, I phone them or the teacher who is teaching IT and CAT…we can also post on the* WhatsApp *group and ask there, any person who can answer, will then answer"*.

Time

Ben feels although he is **very familiar with using technology** *"I am very familiar with technology…I'm using it sufficiently"*, he reports **not using the SMART Kapp** as he believes using the **SMART Board is adequate** *"I haven't given myself time with the SMART Kapp…I have the SMART Board…most of the things that I'd write on the SMART Kapp are just side explanations of what is on the SMART Board"*. In regard to **time needed to use technology**, Ben believes **utilising technology** is **feasible** as it **saves preparation** *"technology actually saves times…prep time…most of the questions are already in the textbook…I copy and paste and then there is the solution"* and **class time** *"if you are writing notes on the board for LO…then for natural science….you need to wipe out the notes and rewrite…with technology you can write the notes once…you just remove them and put it up again"*.

When **remote**, Ben feels even though he is **unfamiliar with some of the new technology tools**, he is able to **teach himself** *"some of the tools I am not familiar with…I know how to figure my way around different applications"*. However, Ben reports he is **only using *WhatsApp*** as **learners do not have data** *"if there was data, I would use them…do live teaching and videos and stuff"* and finds **preparing lessons remotely is time consuming** *"it can take a lot of time to prepare and deliver lessons"*.

Now **back on campus**, Ben reports not only is he now **more familiar with technology**, but he has also **discovered more ways in which technology can enhance his teaching**

"I thought I knew a lot of apps, but I have discovered a lot of things that I did not know….it enhances my lessons a lot".

Nombuso reports she is **familiar** with technology and believes she is **successfully incorporating it into her teaching** *"I think I'm very familiar…I am able to use it effectively in my teaching"*. In addition, she maintains **using technology is feasible** as it provides her with **more teaching time** *"for me it actually closes time…instead of using 45 minutes to write notes, now it can just be explanation…gives more time in class to discuss"*.

When **remote**, Nombuso believes **using technology does not take more time** *"it is the same as when you plan for a normal day in class…it is no different, just now that we are remote"*.

Now **back on campus**, Nombuso maintains **she has not gained new technology skills** as she was **already utilising technology in her teaching** *"I'm using the same skills that I've known, I'm not using anything new…before COVID we would do the work in class and then I would send a note on* Google Classroom*…I'm familiar with those apps and everything…I didn't really upgrade my skills"*, however she does feel **more familiar with additional apps** *"I learned about* MS Teams*…for staff meetings"*.

Kgomotso reports although **initially she was unfamiliar with technology**, she now feels **comfortable** as uses it **extensively** in her teaching *"when I started it was so new to me, but the more I use it, the more I gain confidence…now I feel comfortable with everything"* and is happy to **ask for assistance from learners when needed** *"can ask if I need help"*. In regard to **feasibility**, Kgomotso maintains using technology **saves time** and enables teachers to **complete the syllabus on time** as **notes need not be written out** *"I don't waste time…writing notes, you are able to push the content"*, and **alternative teaching methods can be used** to **enhance understanding** *"if they're saying they don't understand…if you use technology they can go straight to Google and find something…say this is what you are talking about, then you are able to continue quicker…makes it easier to finish the syllabus on time"*.

When **remote**, Kgomotso even though she is **familiar with other technology tools** *"I do know other tools…I'm familiar with other platforms"*, she is **not using them** as **learners**

are unable to purchase data *"I can't use them because they are expensive for learners…if they had data then they could"*. While Kgomotso believes using technology currently **requires a significant investment of time**, she feels in the **future this will lessen** as teachers become **more comfortable** *"right now it is a lot of work for us, a lot of time…it is something we were not prepared for…first two years are going to take a lot of time to prepare content, but in the future we will get used to it…it will be less"*.

Now **back on campus**, Kgomotso maintains remote teaching **necessitates teachers becoming more familiar with technology** *"it is motivating us…COVID is forcing us actually to be more technologically inclined…everyone must do it to reach the kids…you need to upskill, reskill"*.

Appendix G-2: Teachers' accounts of Internal Beliefs at School 3

Pedagogical Beliefs

Ben believes teaching is **not simply about giving over content** *"I'm teaching maths…but it's not all about the maths, they will remember me for something else…it's more than the content"*, but rather it is about **connecting with learners**, **giving support**, and **impacting their lives** *"you have to connect with the learners…then I feel like you can teach…give support, parental support…there's an impact I make on them…it's more of heart thing than a profession"*.

Ben believes teaching **remotely** and with a **hybrid approach** requires **teachers** to **rely more heavily on technology** *"even if the pandemic clears…we are relying more on technology now…more technology centered…the way we used to be in the teaching field, is gone"*; be **open to continual learning** *"you will have to know more stuff…be open minded…accept the new technology….there's a lot of thing you will need to discover"*; and **prepare for future changes** *"we should be preparing for the next time like this"*. Nevertheless, Ben feels the current educational context makes it **harder for** him to **assist learners** as **more time is now needed to provide individual feedback** *"what has become harder is now when they ask questions...on a digital space…it's very difficult to respond to all those questions, it takes a lot of time"*.

Nombuso believes **teachers** should **enable learners to build confidence** and **form opinions** *"create a space for the learner to be confident…voice their own opinions, form beliefs"*, through **creating a safe classroom context** *"the classroom environment needs to be a space where we share views…listen to each other and learn… without being scared they're going to be judged"*.

Now **teaching remotely** and with a **hybrid** approach, Nombuso believes teachers need to **embrace technology** and **be prepared for future changes** *"it has been a wakeup call for a lot of people…the train is moving…we have to look at how we use technology to make educators more accessible…COVID will still be here next year…we have to be prepared and not act as if things didn't happen"* as **technology enables** and **enhances the educational context** *"it can only happen with better and more upgraded technology in our schools…to improve the learning environment"*. Despite needing to incorporate

technology, Nombuso feels **technology should not be used to replace teachers** *"the reality is you can't replace a teacher…you need to holistically develop a child"* but rather a **blended approach should be employed** *"there needs to be a blended approach, where physical and technological approaches are used"*.

Kgomotso aims to **positively impact learners' lives** *"I aim to impact their lives positively…if you see them become becoming an engineer…it is the most important thing, if I was able to change someone's life for the better…when they become successful, that's the most rewarding time in teaching"*, by **providing learners with direction and guidance** *"you need to provide direction to people who are young, who don't know life…you give them guidance"*.

Due to the recent **changes in the educational context**, Kgomotso believes **increased integration of technology in the classroom** will be **long-lasting** as teachers are now **more familiar** with the tools and **aware of potential affordances** *"it won't go back to where it was…now we are closing all these things of technology…even if it goes back to normal…we will still use all these things of technology…everyone is familiar with them…it gives better interaction…because of the advantages in what we are doing"*. However, Kgomotso feels **technology should not be used to replace teachers** as learners still **need guidance** *"learners still feel the need of the educator…that person to guide them…there are a lot of things they still need clarity on…you need to still work with the learners"*, and within a **South African context technology only amplifies inequalities between advantaged** and **disadvantaged learners** *"the challenge with technology in South Africa is it's dividing learners…the affordability, the data expenses, especially when we start using advanced apps…those from disadvantaged backgrounds…they can't afford it…they remain behind…now only if you have money can you study"*.

Normative Beliefs

Ben believes the **school promotes technology use** by **providing teachers** with a **range of hardware**, **software**, and **technical support** *"in order to ensure that we use technology, the management always tries to make everything electronic…we have support"* and also **encourages teachers to utilise technology wherever possible** *"the principal always praises people who use technology…to speak about it in the next briefing to encourage others to do so"*. While Ben believes most of his **peers are favourable**

towards technology *"they are pro-technology"*, he maintains **older teachers** who are **uncomfortable** with technology not only **utilise the tools less**, but also use technology in **more traditional ways** *"those who are not used to technology…the older teachers…they are not comfortable with using technology…they don't use it to the same extent…it's more two dimensional"*.

When **remote**, Ben reports even though the school **encourages teachers to utilise** technology, **no formal support has been provided** and thus teachers are **relying on other teachers**, both **within** and **outside** the school for **guidance** *"there's never been anyone to come…we were given a platform to share ideas…help us succeed during these times…can try contact other teachers…I just follow different people on different platforms and look into their ideas and use them"*. Notwithstanding the lack of school support, Ben believes although **some teachers needed help initially**, **most are now managing** with the **technology** *"at the beginning we did have a few questions about small things…people needed a little help…now they are managing"*.

Nombuso believes the **school** is very **pro-technology** and therefore offers teachers and learners access to a **wide range of resources** *"they are very pro-technology…they prefer us to use the technology…our learners have opportunities…the heart of the school is technology…have lots of technology at the school"*. For her **peers**, Nombuso feels **technology excites most teachers at the school** *"while some people are resistant to technology…with us technology excites us…our mindset to technology is different"*.

When **remote**, Nombuso believes even though the **school encourages technology utilisation**, the school is rather **focusing on social issues** as **most learners** are from **disadvantaged homes** *"at the moment there's no technical support…it's about social support…if she has foo parcels for learners"*. While Nombuso reports her **peers are trying to utilise technology**, she feels some **find it ineffective** as **many learners are not receiving the content** and thus **work** will **need to be repeated** when schools return to campus *"most educators are using* WhatsApp*…but we have a sense that we can do all of this, but at the end of the day we must repeat the work as not everyone is following…it's just to keep them busy"*.

Kgomotso[124] believes the **school** is **pro-technology** and not only **provides teachers with numerous technology tools** to assist them in the classroom, but also **encourages technology integration** *"we have all these gadgets in the classroom…the school provides us with everything that we need…they encourage us in the use of technology"*. For her **peers**, Kgomotso feels while **most of the younger teachers are comfortable using technology** in their teaching, some **older teachers prefer traditional teaching methods** *"we are not the same…the younger teachers…we started teaching with technology…that's the way we found it, that's why we are comfortable with it…we find it more interesting than the traditional way…some of the older teachers believe in the traditional way of doing things"*.

When **remote**, Kgomotso reports while the **school** wants to **utilise technology to continue the academic project**, the **principal is aware of non-attendance** and **lack of engagement** issues *"the principal wants us to use the technology but she is aware of everything…learners not showing up... not engaging…learners who are not available"* and thus she is simply **encouraging teachers to interact with learners** who are **willing** and **available** *"she texts us…asks how are you doing…we tell her we have few learners...she tells us not to give up on those who are willing…work with those that are available"*. Kgomotso reports some of her **peers** believe **technology is ineffective** in a **remote setting** as **learners often make excuses** for **not attending sessions** or **handing in work** *"the few I share my experiences with are not happy…the main concern is that learners don't show up…don't hand in work…they say it is because of lack of data…not sure it is the real reason for lack of engagement"*.

Knowledge Beliefs

Ben believes one **acquires knowledge** through **experience** and **being interested** *"people acquire knowledge through experience and through interest"* and thus maintains when teachers are **disinterested in technology affordances**, they are **unlikely to know how to use technology** *"they don't even want to know…they don't like it…it depends on how interested you are in something…it's got to be a combination"*.

[124] Kgomotso did not comment on Peer Norms when remote.

When **remote,** Ben believes his **current knowledge of new technology tools** can be attributed to **prior experiences** and a **willingness to explore** and **teach himself** *"some of the tools I was not familiar with…I work my way around…just follow different people with different platforms…find out for yourself"*.

Nombuso believes **knowledge** is **acquired** through **reading** and **interacting with other people** *"one needs to interaction with other people…read and study"* and that **knowledge** on **how to use technology** not only **influences the way it is utilised** it in the classroom *"obviously the more you know…it does influence the way you use it"*, but also **motivates teachers to explore possible affordances** *"when you gain confidence using the technology…experiment with different approaches…don't just say I am going to use just that…just videos but also simulations for example"*.

Nombuso believes she **does not need to acquire additional skills** on the **affordances** or **utilisation of the new technology tools**, as she **already possesses this knowledge** *"it is something we use almost every day…it is already in our practices…technology is at the back of our minds all the time…it is not different to what I do in the classroom"* and is able to **self-teach where needed** *"I can just figure it out for myself*

Kgomotso feels **knowledge** is **acquired** through **one's senses**; by **actively doing things**; and **making mistakes** and **learning from them** *"we learn by seeing, by hearing, by reading…by doing things…maybe if they don't go right, you try another way until you find it working…that is how we learn"*. In addition, Kgomotso believes for **teachers to integrate technology** into their classrooms, irrespective of subject being taught, **utilisation knowledge is essential** *"if you don't know how to use technology, obviously you are not going to use it, but if you know how to use it then you are able to incorporate it into whatever subject you are teaching"*.

Kgomotso maintains **without prior utilisation knowledge**, teaching **remotely** with the **technology tools** is **more difficult** *"if you didn't know anything from before, it was going to be much harder…to others it was foreign…with the knowledge it is much better"*.

Value of ICT Beliefs

Ben feels **technology** should be used to **prepare learners for the technological world** *"everything is about technology…we need to give our learners the experience so when they go outside, they are able to be effective…people who go to work without knowing how to use a computer are disadvantaged"*. Ben believes using technology not only **supports teaching** as it is easy to **create** and **distribute content** *"I can prepare more easily…can upload lessons and then learners can access them there"* and **record lessons for learners to review** *"it records my voice and then learners can get those lessons afterwards"*, but also feels it **enhances teaching** and **learning**: as **learners are more engaged with technology** *"it helps me with the learners, most like these technological devices…with technology I think learners are more interested…so it's easier with medium of technology"*; **lessons are more interesting** and **fun** *"it makes the work more interesting…it's also fun, it's not the old kind of work…technology makes everything super interesting"*; teachers are able to **bring the outside world into the classroom** *"brings in the outside world…using simulations…they can visualise the things outside…how they look like"*; and learners can **review recorded lessons multiple times** *"my recorded lessons…learners can get those lessons afterwards, just in case someone is a bit behind, a bit slower…they can listen to them over and over and over again"*. In addition, Ben believes technology facilitates **easier communication** *"I can communicate with my students…I have a* WhatsApp *group where they can contact me"*; **increases productivity** as **preparation** *"saves my prep time…most of the questions…they already in the textbook…I copy and paste with the solutions…only need to do this once"* and **marking time** can be **reduced** *"you can do a class test without even breaking a sweat…can use an application to mark for you…it saves time"*; and **content distribution can happen outside of school** *"you can send work even when you're at home…it makes it easier".*

When **remote**, although Ben believes the **lack of proper planning** and **digital strategy** *"if we had a strategy…we just dived in without setting proper rules, like looking at the advantages and disadvantages, it wouldn't be as difficult as it is now"* and **learners' inability to purchase data** *"the devices don't have free data, so that is still an issue…some learners cannot access the work…if there was data I would enjoy doing live teaching on videos"* is **limiting technology affordances**, he believes ***WhatsApp* partially enables the academic project** as it allows for: **distributing content** *"on* WhatsApp*…write down examples, take pictures, do a voice recording"*, **reviewing**

material *"learners have the ability to go through things over and over again"*; and **providing assistance to learners** *"they ask questions…post on the group and then they help one another"*.

Now **back on campus**, Ben reports although he is **relying more on technology** to **provide content** *it's easy to get the content"*; **create** and **distribute recorded lessons** *"when I'm recording the lessons, it becomes easier, because I just do it once and then send it to all them"* and **shy learners are interacting more** *"there are learners who are shy to ask questions in class, now they are open to asking questions, we interact, they are learning better"*, he believes learners' **inability to purchase data** is still a **major challenge** *"we are not able to post online, they don't have data…we tried that…failed so badly"*.

Nombuso feels technology should be used **where appropriate** to **improve** and **support teaching** *"wherever possible…to make lessons for interesting…make it closer for the learners, more real…to post notes, content"* and **enhance learning** *"for things they can't see…to enhance their understanding"*. Nombuso believes technology can **assist teachers** by: **accommodating different learning styles** *"they are visual learners, they're audio learners, so with the SMART Board we're able to play a 3D video and interact with it"*, **making lessons more exciting and relevant** *"if you do the body system instead of going through the notes…you can show a video with the picture and they see the flow of bodily fluids in front of them…instead of just reading from the notes"* and **enabling abstract concepts to become more real** *"things they can't see…like an atom…if there is a simulation that builds the atom, they can see it…makes it more real"*. Furthermore, Nombuso believes technology can **advance learning** by: **facilitating practice** and **providing immediate feedback** *"there is a platform for practice…it gives learners feedback immediately"*, **explaining concepts through a variety of mediums** *"it enhances learning…learners don't like reading so you can have a three minute video that summaries the notes…it is then much easier for them"* and **enhancing understanding of concepts** *"it enhances their understanding…they now have a picture of what a cell looks like, what an atom is…it is real for them"*. For **pedagogic support** and **productivity**, Nombuso maintains technology **ensures learners do not lose their work** *"I post notes online…even if they lose the notes on the tablet…can still go back online and find them"* and can **save time in class** as technology enables teachers to **distribute content online**

prior to a lesson *"I post notes online…we don't have to write down notes…they come to class with the notes that I sent them"*.

When **remote**, while Nombuso believes technology enables: **creating** and **distributing content** *"I prepare on my laptop, transfer it to my cell phone and then send it to the learners"*, **recording of lessons** *"I record videos if concepts are difficult"*, **communicating** and **assisting learners** *"they understand me by explaining and typing on* WhatsApp*"* and **multiple reviewing of lessons** *"I encourage them to watch…I send a video…watch it more than once"*, she feels **learners' lack of access to data** *"it's not adequate…you find you send work…three weeks later they asking because of connectivity issues…videos don't really work because of the amount of data required"* and **technology at home** *"I told them to watch this channel on DSTV…they play videos on natural science and maths…one of the learners was like I don't have DSTV"* is **severely limiting the technology's ability** to **support the academic project** *"we have a sense that we can do all these things but not everyone is able to follow, to access the work…I think it is just to keep learners busy"*.

Now **back on campus**, Nombuso believes **technology can potentially benefit education** *"we can use technology to improve our learning environment"* by offering **virtual classes** *"the value is they don't have to come physically to school…they can be at home and access wherever they are"* and providing **greater learner access to teachers** *"it could improve in such a way that it will be easier for learner to access the teacher"*, however she feels **technology inequalities across schools** *"there's a lot of inequalities…our learners have the resources, but others don't…it can happen better with more upgraded technology in the schools"* and **learners' lack of data access** *"the challenge is the internet…data…they may not get the work"* are **major concerns**.

Kgomotso believes although technology can be used to **support** and **improve teaching** by: enabling **easier content preparation** and **distribution** *"technology makes it easier…I can connect to the Wi-Fi for any preparation that I am doing…you can push teaching content"*; offering **better in-class utilisation of textbooks** *"I can highlight in the textbook and show the learners"*; providing **more interesting** and **relevant lessons** *"it makes the lessons more interesting"*; and **bringing the outside world into the classroom** *"the advantage of technology is something you talk about things far from the learners…they*

can't even imagine…they've never seen it being done…with technology you can bring such things into the class", she feels technology **should only be utilised where it makes sense** and **suits the learning activity** *"in a practical lesson there's no way they can have technology there, but in the theoretical lessons…that's where it makes sense…this is where I use the technology"*. In addition, Kgomotso believes technology can **enhance learning** by providing learners with opportunities for **practice** and **feedback** *"with the e-smart notebook…they go login and complete the activity…get instant feedback…try again…we can create an exercise to check after teaching"*; exposure to **different teaching mediums** *"if learners say they don't understand…if you use the technology, allow them to use the tablet they can go straight to Google and find something and say this is what you are talking about…it makes it easier for the learners"* and can **improve productivity** by **decreasing wasted class time** *"if you are writing notes you can take 3 days teaching, but using technology…you can finish within an hour or two…you don't have to write notes which waste time…can finish the class on time"* and **enabling distribution of content outside of school** *"you're able to share with them so they get the work and can continue working at home"*.

When **remote**, although Kgomotso believes technology enables her to **create** and **distribute content** *"in the* WhatsApp *group, I create, I prepare a lesson, I share it with them…you are able to push content"*; **prepare content for future lessons** *"you only prepare content and everything you teach the first few years, then after that…you would just reuse some of the stuff"*; provide **learners with individual assistance** *"they take a picture of their exercise book, forward it to me…I send a correction back to the individual learner"*; **communicate** with **learners** *"I have a* WhatsApp *group with all my learners…where I talk to the learners…they respond using audio, video and text"* and **peers** *"we have a* WhatsApp *group to make our lives easy…post to the group…any person who can answer, will answer"*, she feels **learners' inability to purchase data** *"if we are using data it will be too much for learners…we are expecting learners to buy data…some are unable to do so"* and the **challenge of motivating learners when using technology** *"it is really not working because when we go back to school all those kids that are not engaging will be far behind"*, are **major concerns**.

Now **back on campus**, while Kgomotso reports she is **more technology inclined** *"it is forcing us to be technology inclined…because how do you reach your kids…it is matter of*

everyone has to do it now", she feels **hardware issues** *"learners have tablets, but some their tablets are giving them challenges, they are unable to use them"* and **inequalities between learners who can afford data** and **those who cannot** *"it's dividing learners, now if you have money you study, if you don't, then you don't as you can afford it…some kids can't be on the* WhatsApp *when learning is taking place…it is a major challenge"* are **concerns**.

Self-Efficacy Beliefs

Ben feels **very confident** using technology in his **teaching** *"I'm very familiar with technology…I'm using it sufficiently in my teaching…to communicate with my students…post content"* and attributes this to an **appreciation of technology** *"depends on how interested you are in technology"*. Ben reports his **non-use** of certain tools is not due to a lack of self-efficacy, but rather as he is **selective about which technology he utilises** *"I'm picky when it comes to technology that I use…it needs to be safe and user friendly"*. In his **personal** life, even though Ben believes he is **tech-savvy**, he **prefers not using his phone** *"I'm 100% when it comes to technology…but I don't like the phone…my phone I do it out of necessity as I need to communicate"*. When teaching **remotely**, Ben reports he is **still confident** using technology in his teaching *"I'm still very confident"*.

Nombuso believes she is **confident using technology** in her **work as she utilises it continuously** and **extensively** *"I'm confident…at work I exhaust it…in the classroom I always try and use the technology…to use it effectively in teaching"*. In her **personal life**, Nombuso also feels **confident with technology** *"I think I'm confident…outside of work I use my smartphone…what a normal person would use"*. When teaching **remotely**, Nombuso reports she is still **confident utilising technology** as she has the skills required *"I am confident…it is not something I don't know…because it's in our practices already"*.

Kgomotso believes she is **confident using technology** in her **work** due to **continuous use** *"the more I use it, the more confidence I gain, the more comfortable I feel using it at work"*. In her **personal life**, Kgomotso reports she is also **confident utilising technology** and does so extensively *"I am confident using technology in personal life…I don't go to the bank anymore…communication, photos…everything"*.

When teaching **remotely**, Kgomotso believes even though she is **confident using the new technology tools** *"I am confident about using this technology…I do know the other tools…platforms"*, she is **not using the tools** as **learners' cannot afford data** *"I can't use it, not because I don't know, but because they are expensive for learners".*

Appendix G-3: Teachers' accounts of Professional Dispositions at School 3

Ben believes one **first needs to acquire everyday knowledge** *"if I'm going to teach financial maths, first thing I'm going to ask I what they know about a loan in general, not mathematically"* as **school knowledge** is **related to everyday knowledge** and **explains** and **builds on what learners already know in a structured way** *"school is there to explain some of the things they already know…when they come to school they explain why it happens like this…also to bring something new they didn't know about"*. Within his subject, Ben maintains learners **acquire knowledge** through **experiencing** and **applying school knowledge to their everyday lives** *"we learn in school…then we experience…it help learners deal with issues at home…there has to be a context they can relate to…it's about trying to relate it to their everyday lives"*

For the **regulative** discourse, Ben believes even though he is **approachable** and assumes the role of parent and friend for many of the learners, he has **strong boundaries** in place *"I'm their friend, but they know there is a line they don't cross…they can approach me to discuss any issues…there are children who regard me as a parents, but there are clear boundaries…they don't forget that I'm the teacher…they respect that"*. In regard to **control**, Ben maintains while he is **open to suggestions from learners** *"If they feel like they have a topic they have not understood…I can plan a day where I can teach that…I'm flexible"*, ultimately he **controls the classroom context** *"I'm in charge of my classroom…I decide"*. When using a **remote** and **hybrid approach,** Ben feels **boundaries have not changed**, however he believes **learners communicate more informally** as they are **comfortable using digital platforms** to communicate *"it's not disrespect…it's just a manner of the way they talk in* WhatsApp*…it is what they are used to…it is different in person"*.

Nombuso believes **school knowledge** provides **structure** and is **related to everyday knowledge** *"I don't think there is a boundary, I think we just put scientific terms to everyday knowledge…just naming their everyday language…we take everyday knowledge from the outside and just give it structure…outside it is all over the place"*. While Nombuso feels **knowledge is acquired in both directions** *"I will bring school knowledge…link it to everyday knowledge…then link it back to school"* by **interacting** and **engaging** *"from interaction with other people",* she maintains in her discipline **learners need to acquire**

knowledge in a **vertical manner** *"you can't do Grade 10 maths if you haven't done Grade 8 or 9 factorisation"*.

For the **regulative** discourse, Nombuso reports even though she has **strong boundaries** in place and **controls the classroom context** , *"there are boundaries…I control the classroom, how they react to one another, what we do"*, she creates space for **learners to ask questions** and **engage** *"I create a space where they can fully ask…strictly on work issues"*. When teaching **remotely** and with a **hybrid approach**, Nombuso believes **boundaries** have **not changed** and learners **only make contact for school related issues** *"I don't think it has changed…only contact me if they need work…have questions"*.

Kgomotso believes **school** and **everyday knowledge** are **interlinked** *"it's not separate…we need both to be complete"* and can be **acquired in either direction** *"they learn in school…when they're going around they observe and come and say you know I saw them doing 123…that's how it's supposed to be, so they learn from that as well…from experience from outside"*. While Kgomotso believes **learners acquire knowledge** by **practically doing things** and **learning from one's mistakes** *"doing things… then maybe if they don't go right, you try another way until you find…that's how you learn…if you give a chance to do it practically, the information will be there for a long time...they is how they learn"*, she maintains this **differs depending on learning styles** and **subjects** *"in different subjects they learn differently, some because we have different learning styles…for example some are kinaesthetic learners so they learn best when we do practicals"*.

For the **regulative** discourse, Kgomotso reports she has **strong boundaries** in place *"they know I am the teacher, and they are the learners…it means they respect…can't talk to me the way they talk to their peers"* and **controls the classroom context** *"I control what happens in the class…today if I'm saying this is what we are doing, that is what they will do"*. When teaching **remotely** and with a **hybrid approach**, Kgomotso reports **boundaries have become less defined** and **informal** *"now we are more friends…we are closer…they can text anytime and in their texts they write hey my lovely teacher, they can't do that in class"* which she believes is **encouraging shy learners to interact more** *"even those who are shy, they are now able to appreciate you, they're able to talk to you"*.

Appendix G-4: Teachers' accounts of Orientation towards Technology at School 3

Ben believes technology not only **supports** *"it integrates…links to what I am doing…for most of the stuff, it's just a medium change…could be chalk board or paper, this just is easier"* and **enhances** his **existing pedagogic practice** *"it's impossible for it not to change teaching…it's just not the same…I'm really wishing it makes it better"*, but also **can transform teaching** through **online assessment** *"for assessment…it marks it there…you can do class tests without even breaking a sweat…it saves so much time…that's where it's a transformation"*. When **remote**, while Ben feels **technology can potentially transform pedagogic practice** *"there are a wide range of tools that you could use that are very smart and helpful in teaching…do live lessons, record videos"*, he believes **learners' lack of access to data limits possibilities** *"due to cost constraints…some of them can't afford data…we just resort to doing chats on* WhatsApp*"*.

On campus, Ben reports using technology to **prepare**, **present**, and **push learner content** *"it makes the work easier…saves my prep time…I can write on my tablet, then project on the SMART Board…I can prepare…push your teaching…use the whiteboard, write on it…post content"*; **create assessments** *"I use Socrative to post online assessments"*; **post content from home** *"you can send work even when you're at home"*; and **communicate with learners** *"to communicate with my students"*. In addition, Ben indicates he uses technology to **enhance teaching** *"now I am teaching functions…back then it was not so good…it's enhanced…learners understand it better"* by **recording lessons for learners to review** *"I'm recording my lessons, when I'm answering questions…learners can get those lessons afterwards…can listen to them over and over and over again"* and to **transform educational experiences** by **bringing the outside world into the classroom** *"bringing in the outside world…things which are outside…how it looks like"* and **offering virtual experiences** *"it's easier to do some experiments, also if you don't have the resources…you can visualise these things"*. Aside from these benefits, Ben believes **using technology does not automatically result in better teaching** *"good teaching is good teaching irrespective of technology…for poor teacher it gives them a scapegoat"* and **should not replace the essential skills gained when writing with pen and paper** *"I want them to write, it's very important for knowledge retention"*.

When **remote**, while Ben reports he **initially** used technology to **prepare** and **record lessons** and **push content via *Google Classroom*** *"initially I was doing live lessons…pushing resources on* Google Classroom*"* but due to **data access issues** he is now using ***WhatsApp* to post lesson guidelines** and **content** and **provide online assistance** and **feedback** *"due to data constraints…doing group chats on* WhatsApp*…I now take pictures of the example, do a voice note…they ask questions, some direct message me, some post on the group"*. In addition, Ben indicates he is using ***Siyavula* to assess learners' progress** as **no data is required on this platform** *"on* Siyavula *I upload assignments…then it marks itself and it's free data…so I can use it"*. For **administrative** tasks, Ben reports he is using technology to **communicate with learners** *"*WhatsApp *messages…I view them on my laptop"* and **get support** *"I contact the other teachers who are teaching the same grade"*. Even though Ben believes **challenges exist** as **some learners are not suited to online learning** *"those who don't need much explaining…it's advantageous, they explore more…do more work at a high speed, whereas those who work slow, they are disadvantaged"* and **learners' lack of access to data limits the technology he can use** *"there is a wide range of tools…because of the situation with my learners…we don't upload any videos…they just take too much data"*, when he returns to campus, Ben **intends to use technology more effectively** *"I'm going to try and use it better now"* **to record lessons** *"I'm hoping to record more lessons"*.

With **teachers** now **back on** campus and **many learners remining at home**, Ben reports he is using technology to **pre-record lessons** for **learners at home** *"we have to offer videos for each and every lesson that we do…for those who are doing lockdown learning…because you might have someone here today but tomorrow they not"*, **attend meetings** *"for meetings…we set up in our classroom computers…for the meeting we are in the same premises but in different classes"* and **communicate with learners** *"they ask questions on the digital space…send me* WhatsApp *messages"*.

In the **future**, Ben maintains teachers will need to **rely more on technology within education** *"a lot has changed, we are relying more on technology…the way we used to be as teachers is gone…there's going to be a huge shift towards technology"*, however, he feels the **transition will be challenging for teachers without skills** *"if you are not much gifted on technology…it is a huge problem for you…you're gonna need to learn all those things…if you're aware then it reduces the amount of work"*. Furthermore, Ben maintains

the **increased workload may be unsustainable** as **more time** and **effort is required to teach** *"I have moved from doing five classes to seven…I have to do two lessons for the same class…I have to be teaching the lesson during my preparation so that I can record, and then in the classroom it is a repeat of what I have done"* and **answer learner queries** when **using technology** *"it's very difficult to respond to all their questions…it takes time because you'd get 5 students sending me a* WhatsApp *message at the same time"*.

Nombuso reports she uses technology to **support** *"technology makes things easier…it saves time"* and **enhance** *"it makes lessons more interesting…much richer"* her **pedagogic practice**. When **teaching remotely**, Nombuso reports even though her use of **technology is limited due to learners' lack of data access** *"if content is difficult…I could do a video…my videos are too big…there's the issue of data…videos don't really work because of the amount of data that is required"*, she feels **technology is still supporting her teaching** *"it's not different from what I do in the classroom…I prepare electronic notes, the only difference is that I have to now include detailed instructions"* .

On campus, Nombuso reports she uses technology to: **prepare**, **present**, **push**, and **upload learner content** *"I post notes online on* Google Classroom*…I have a picture on the SMART Board, we can capture it and send it online"*; **show videos** *"we're able to play a 3D video and interact"*; and **communicate with learners** *"communicate with the learners"*. In addition, she reports using technology to **record videos for improved explanation** *"I take a video and explain the whole system with the video, instead of just reading the notes"* and **make abstract concepts more real** *"if you do the body system…put up a picture…a video…they can see the bodily fluids moving"*.

When **remote**, even though initially Nombuso was using technology to **record** and **distribute videos** *"if the content is difficult…I recorded videos"* so learners could **review lessons** *"if I sent a video I encouraged them to watch it more than once"*, she believes this approach is **ineffective** due to **data constraints** *"my videos are too big…there's the issue of data…videos don't really work…because of the amount of data that is required"*. Currently, Nombuso reports using technology to **prepare** and **post lesson guidelines** and **content** *"I usually prepare on my laptop…write out the instructions…I type literally everything, what to do first, what to do after that…then prepare summaries…an activity…then I give it to them"* and **assist** and **communicate with learners** *"they*

understand by me explaining and typing on WhatsApp*…use* WhatsApp *because it's more immediate communication"*, however she believes **remote learning is not suitable for all learners** *"it's the same learners that will ask questions, the rest don't ask anything…that's an indication they are not doing the work"*. When she returns to campus, Nombuso **intends** to carry on using ***WhatsApp*** for **communication** and **assistance** but **not for content distribution** *"I will keep the* WhatsApp *group for homework purposes…to give them work…to remind them…provide clarity…but not for content"*.

Now **back on campus**, Nombuso reports she is trying to use ***WhatsApp*** **to distribute content** *"give them work on* WhatsApp*"*, **communicate** and **provide learners with assistance** *"they contact me if they need work…if they have questions"*, however, due to **data access challenges** many learners need to **collect either softcopy or hardcopy packages** *"if the learner doesn't have any data, then they come and collect with their memory stick or paper packages"*. In addition, Nombuso reports using technology to **attend meetings** *"*MS Teams *for staff meetings"*.

While Nombuso believes in the **future education will be more blended** *"I think there will be definitely be a blended approach where physical and technological approaches are used…learners won't have to come physically to school...can be at home and access the work and teacher"*, and technology can be used to **address teacher shortages** *"there is a shortage of teachers…can have the lesson playing on the SMART Board…in three different classes at the same time…teach one class and the learners in other classes view it at the same"*, she maintains **lack of adequate technology infrastructure** in **most South African schools** *"there are lots of inequalities…learners don't have resources…the challenge is also the internet"*, need for **detailed instructions** *"it has to be very precise an straight to the point, because you're not here to explain the instructions…bullet for bullet"* and **difficulty in tracking learners' progress** *"it is challenging to track who's doing work or not"*, are **issues that need to be addressed** if blended education is to be successful.

Kgomotso believes even though **technology supports** *"things are a little bit easier for me…don't have to waste time writing notes…it's easier to finish on time"* and **enhances teaching** *"we have interactive activities…instant feedback…technology is able to bring things they don't know about into the class"*, she feels **technology is not transformative** *"it just adds onto what you are doing…you are still the same teacher"*. When **teaching**

remotely, Kgomotso reports **technology** is only **partially supporting her teaching** due to **learners' data access issues** *"if we are recording it will be too much data for learners… the platform that I'm using doesn't allow me to be as effective as I was going to be in class…at least on* WhatsApp *it's doable"*.

On campus, Kgomotso reports she uses technology to **prepare**, **present**, and **push learner content** *"I use my laptop...connect to the Wi-Fi…for preparation that I'm doing…you don't have to write notes, instead you push teaching explaining the contents…share with the learners work…with the SMART Board, you can write and the learners capture it"*; **show videos** *"are able to show video clips from the internet"* and **search for information** *"we allow them to use the tablet and they then go straight to Google and find something"*. In addition, she reports using technology to **transform educational experiences** by **bringing the outside world into the classroom** *"sometimes you talk about things that are far away these learners…they can't even imagine manufacturing clay bricks…with technology you are able to bring such things into the class"*.

When **remote**, Kgomotso indicates she uses *WhatsApp* and other technologies to: **prepare** and **post lesson guidelines** and **content** *"I prepare my lessons…I share it with them…say this is what we will be discussing tomorrow…these are the objectives…I expect you to complete one, two, three"*; **teach** *"I share with my learners…then we go through the lesson and we discuss"*; and enable **online submission** and **feedback** *"they take a picture of their exercise book, forward it to me, I go through it, I send corrections back to the individual learner"*. For **administrative** tasks, Kgomotso reports she is utilising technology to **communicate with learners** *"I have a* WhatsApp *group for all my learners…we discuss via audio and videos"*; **get support** *"if there's anything I can't do…have a* WhatsApp *group…if you don't mind posting it the group, you will ask there and any person who can answer, will answer"* and **attend meetings** *"I attend Zoom meetings".* When she **returns to campus**, Kgomotso **intends using *WhatsApp*** for **communication** and to **provide feedback to her learners** *"I will continue with the* WhatsApp *groups…we can use it for discussion and everything, but other things need to be done in class…like submitting their exercise books to avoid using more data…then you share the corrections on this platform"*, but not for **online submission of work** due to **learners' data**

constraints *"they do not have enough data, some of these kids they come from backgrounds that are not favourable"*.

Now **back on campus**, Kgomotso reports while teachers use ***WhatsApp*** for **communication** *"now they text you at any time…they message you privately, they're able to talk to you"*, due to **learners' data** and **hardware challenges** *"some of our kids are remaining behind because they can't afford data…some learners have tablets but maybe they are unable to use them"*, the school has decided for **learners remaining at home** rather than **using data** and **learners' tablets** to **distribute content**, **parents should collect the content** either on **memory sticks** or **paper** so the learners can continue working at home *"we must have both hard and soft copy…for the memory sticks we can even include videos because the learners won't be using data…give them notes, the PowerPoint…the parents will come and collect"*.

Kgomotso believes a **major challenge** of using **technology in South African schools** is **teachers are unable to use the myriad of tools available** as **many learners in the country are unable to afford data** *"the challenge with technology in South Africa is the affordability…the data expense…we are from disadvantaged backgrounds, especially when we start using these advanced apps, some of our kids are remaining behind because they can't afford it"*. Therefore, Kgomotso maintains even though teachers are now **using technology more**, she feels it **not transforming pedagogic practices** *"we use it more, but not in different ways…some kids can't even be on* WhatsApp*…if I'm hosting an* MS Teams *meeting, most kids won't be there as the video requires more data"*.

APPENDIX H DETAILED MICRO AND MESO ANALYSES OF SCHOOL 4

Appendix H-1: Teachers' accounts of External Structures at School 4

Resources

Candice indicates even though **most teachers have access to devices** *"only six or seven don't have a school laptop, everyone else should have…others have desktops in their offices"*, **Wi-Fi** *"they have Wi-Fi access during school time"* and **projectors in the classroom** *"there are currently five classes that don't have out of 42 classrooms"*, **quality is an issue** as **many projectors are broken** and **have not been fixed due to lack of funds** *"some have broken down and the SGB did not sign off since last year…the underprivileged schools are given technology rollouts, not us that's supposed to be a rich school…I still don't have one…I'm using a portable one from the lab…that's how bad it is"* and **Wi-Fi only connects to school issued devices** *"it only connects to school issued devices".* Candice reports while **there is a computer lab at the school** with **desktop computers** and **tablets** *"there is a computer lab…with 20 working desktop computers and 40 tablets"*, **only she has access** *"only I have access…it's only for me to teach…other teachers in the school also can't use the lab or the tablets…we don't have security on them"* and she feels the **numbers of devices limits class sizes** *"my CAT class can only be for 20 learners maximum"*. Furthermore, Candice believes the **physical arrangement of the lab is not conducive to teaching theory** and **assisting learners** *"in the labs they sitting in rows…the kids are not concentrating when we are doing theory…also I want to be able to walk around and I can't because the computers are hooked on the side…it's a bit of a problem, especially when I want to help the slower ones"* and would **prefer having a traditional classroom setup within the lab** *"I would love my lab with computers on the side and normal teaching desks in front"*.

When **remote**, while Candice believes **her access is sufficient** *"it is sufficient for me…I have my school laptop and my subject laptop that I'm using at home"* and has been **able to continue teaching** as she had **previously set up email accounts** and ***Google Classroom*** for her learners *"I've setup* Gmail *accounts for the kids years ago…have a* Google Classroom *setup where I'm busy teaching"*, she reports the school **did not provide access to any additional data** *"for data I even had to buy my own"*, **devices**, or **software to assist teachers** *"they didn't give any extra technology…teachers without*

technology…probably didn't teach at all" and **learners continue with the academic project** *"my kids couldn't get into the subject…they didn't have email access, internet access…many kids do not have that privilege"*.

Now **back on campus** Candice reports **access to technology resources has improved**, as the school has **provided teachers with devices** *"the principal asked me to give all the tablets that was allocated to junior teaching…to those who did not have devices"*; **upgraded the Wi-Fi** *"also set up a fibre, Wi-Fi link into the school…it is better so we can go to our classes and physically use the Wi-Fi to teach there"*; and **enrolled the school onto** Google Classroom *"enrolled our school as a* Google Classroom *school…even enrolled all the kids, with new emails"* and ***MS Teams*** *"instead of having staff meetings in person…teachers installed* MS Teams*"*. However, she believes **learners' lack of access to data** and **hardware** really **constrains current teaching efforts** *"many learners don't have data or devices...that's our big issue"*.

Malefa believes **technology access at the school is mostly sufficient** and of **adequate quality** *"it's 80% sufficient and 20% not there…it's adequate for what I want to do"* as there is **Wi-Fi on the campus** *"have internet access here"* and **projectors in the classrooms** *"we also have access to projectors"*, however, she maintains the **need to share laptops among teachers** *"the laptop at the school is only one per department…science has one, maths has got one…how can we use that…so everyone lands up buying their own"* and the **lack of lab access for learners** *"the kids need access to the computer lab…maybe they don't have access at home…not staying close to an internet café…if they had access it would make a big difference"* need to addressed. For **physical arrangements**, while Malefa believes the **current setup is appropriate** with **projectors centrally mounted facing the whiteboard** with **easy connections** to her **laptop** and the **Wi-Fi** *"in my classroom there's a projector…in the middle of the class…projecting to my whiteboard…so I can easily use my laptop and access the Wi-Fi"* and **external speakers for sound** *"there's external speakers so the learners can listen"*, she feels **overcrowding is an issue** due to the **large number of learners in each class** *"I'm worried about the number of learners in the class…the class is so full…we need a bigger class"*.

When **remote** Malefa reports even though she has **access to technology for communication** *"have contact with very few parents…with phone…messages…*Skype*"*, she believes the **academic project has been unable to continue** as the school **is not providing learners with data access** *"the school did not give any extra access to any technology to assist students...they should have done more…could have provided them with data...so you can communicate with them"*. Furthermore, **teachers have no access to learners' contact details** *"we needed access to the information…to contact the parents…to help…but the school did not give us this access"* so they are unable to **assist** and **communicate with learners**.

Now **back on campus**, Malefa reports although **access to technology resources at the school has improved** with **additional hardware being allocated to teachers** *"teachers who did not have laptops, they managed to get them some laptops"*; **upgraded Wi-Fi** *"there was a shortage of coverage of Wi-Fi at the school and they fixed that"*; and the purchasing of ***Google Classroom*** **for teaching** and **administration** *"we even have* Google Classroom*…have a timetable where the teachers and learners meet remotely…can also do register"*, she believes **data access is still an issue for teachers** *"the only time I can go onto* Google Classroom *is when I am at work…because the school did not buy us data"* and **learners** *"the only issue is data…learners don't have that"*.

Patrick feels there is **sufficient access to technology for teachers at the school** *"for most teachers it's very sufficient"* as there is **Wi-Fi on campus** *"there's Wi-Fi in the school compound so teachers can log on"*; **most teachers are given school laptops** *"most, but not all teachers are given school supplied laptops…so they can plug in and go online"* and there are **projectors in the classrooms** *"all classrooms must have projectors"*, however, he feels **learners need access to a dedicated design computer lab** *"in design we need a computer lab…where we can teach with computers and graphics"*. Patrick feels the **physical arrangement** of **technology** and **classrooms** at the school **constrain design learners** *"physical arrangements are quite constraining…will be better if you had a sort of auditorium look and feel…put students in a different mindset when they come to design classes"* and believes a **more creative space is needed** *"we want the design learners to think differently…with computers at the back and a partition in the middle and theory lab on the side"*.

When **remote**, Patrick feels **access to technology resources is lacking** *"I think a seriously more resourced system could really work better"* as **school issued devices cannot access outside networks** *"the school laptop it's only wired to connect to the Wi-Fi at school…we've got networks around here, but it still won't connect"* and therefore he needs to **use his personal laptop** and **cell phone to communicate with learners** *"I have to use my own laptop…to email stuff…then send it on* WhatsApp*"*. Furthermore, Patrick believes **teachers need better access to learners' contact details** *"it's a real challenge…we are not in contact with our learners…we are not allowed to have their cell phone numbers…it's not allowed by the school to be in email contact"* to **enable the remote academic project to continue** *"we need email to keep in touch…communicate in terms of work"*.

Now **back on campus,** Patrick believes the **provision of additional software** such as ***Google Classroom*** *"our school has adopted the Google platform, so we teachers have now got our classrooms online"* and ***MS Teams*** *"registered now on MS Teams…for peer to peer interaction…get announcements…it's like housing a small office online"* is **enabling the academic project**, however **learners' lack of data access is hampering teaching efforts** *"very few learners are able to interact with the teachers…maybe because of the availability of data".*

Thuli believes **access to technology at the school is very basic** *"we do have access to the most basic technology"* as **Wi-Fi range is limited** *"have internet…but not in all places…in some areas it's there and in others you can't connect"* and **many websites are blocked** *"not all websites connect…you can't access* YouTube *to get a history video...even the school related websites where teachers register and get information for free"*. Additionally, Thuli feels the **school could utilise the existing resources more effectively** *"they could do better with what they have because they have the resources"* as **only some teachers have school issued laptops** *"not all teachers get laptops…there is no criteria who gets…I'm not sure why I don't get that benefit…I use my personal laptop"*; there is **no access to software** that could **potentially enhance teaching** and **save time** *"I would like access to different e-learning classrooms…you can use their content and adapt to your own teaching style…you don't have the create everything which saves a lot of time"*; **wireless capability of projectors is not being used** *"have projectors in most classrooms…you connect manually with the cable…can connect via wireless, I have just*

never seen anyone do that" and the **computer lab is inaccessible to most teachers** and **learners** *"the lab is only set up for the computer students and the CAT teacher"*. While Thuli finds the **physical arrangement appropriate** with **teachers' desks next to the projector cable for easy connection** *"teachers have their table next to the door…that's where they put their laptop…where you'll find the cable"*, she feels the **current classroom layout** with **individual learners' desks in rows does not support learner-learner interaction** and therefore would **prefer round tables** *"I feel rows don't allow for interaction…if they were round tables and all sitting around, it would help them interact more with each other"*.

When **remote,** Thuli believes **teachers' non-contact with learners**, which she attributes to: **issues with technology access** *"we don't have contact with the learners, mainly because of the technology we have…to setup a class online…you need technology to do that…you need a nicer camera that the one I have"*, **learners' lack of data access** *"when getting content to students…learners don't have data"*, the **school being unprepared** *"we have the capabilities…but we're not prepared"* and **teacher's inability to access learners' contact details** *"there's no* WhatsApp *group…no email…kids have their own cell phones, so the school has contact details…that's not provided to us"*, is **severely constraining the academic project** *"because I'm not in contact with the learners, I haven't been doing stuff remotely… nothing has been done by the teachers at home...only uploaded before we closed…put content on* D6*…for learners to download"*.

Now **back on campus**, Thuli reports even though the school has **addressed access issues** relating to the **Wi-Fi** *"broadened the Wi-Fi so it includes my classroom"* and **remote teaching software tools** *"they introduced* Google Teams *and* Google Classroom*"*, she is **still using her personal device** *"I'm using my own personal device, I never got any technology to assist me"*. In addition, she believes the **current inequalities in technology access within South Africa** are making **remote** and **online teaching challenging** *"not every student has access to technology…there's a huge differential between advantaged and disadvantaged schools and learners…access and affordability is an issue"*.

Training

Candice reports there is **no regular** and **formal technology training** provided by the school *"there is no formal training"* and while **in the past** she trained **teachers at the beginning of each year** *"in the beginning of each year, I used to teach and show them how to use* Excel*…to do mark sheets…basic formulas"*, she maintains she **no longer has time** *"now I don't have time"* and **feels teachers are not interested in being trained by her** *"teachers don't want to learn from local teachers…they want external people to come in…they are too proud to learn from a level one teacher"*. Even though Candice feels **more training is needed** as many teachers at the school are **utilising the technology ineffectively** *"we need training…because when their projectors are not on, they don't know how to troubleshoot"*, she believes **many teachers are simply not interested** *"there's still staff that don't want to use the technology"*.

When **remote**, even though Candice maintains **no technology training has been offered by the school** *"no one gave nay training from the school…it's totally not sufficient"*, she reports **using established communities of practice to gain technology knowledge** and **create content** *"I am part of a* Facebook *group for CAT and IT teachers of South Africa…I belong to educational groups…got links there for Africa Team Geeks…I soak up all the information from them…use it to create my lessons"*.

Now **back on campus**, Candice reports while there has been **no formal technology training** *"the principal didn't have people come out and train the staff"*, teachers have been provided with **links to resources to train themselves** *"he gave links to the teachers…so we can learn the various things at our own pace"*.

Malefa reports while **in the past demonstration-based** and **practical technology training was offered** by the school *"in the past the school used to organise people…say whoever wants to be taught how to do a spreadsheet…Word…they showed you how"*, she believes **current training is insufficient** *"training is very important…currently there's no training…nothing",* as **is not continuous** *"there needs to be more training…continuous training as technology changes"* and there is **no induction for newer teachers** on **how to use the technology** *"for newer teachers there's nothing…if these teachers don't have a background of how to use a computer, then it's a problem…you're hired but are all alone"*.

Even though Malefa has **self-funded outside courses on using technology** *"I went to a college to learn how to use computers",* she feels **training on technology affordances** for **specific subjects is also needed** *"don't only need training on how to use...also to help me teach in my subject…if I don't know anything about how I can draw a graph, then I will cut and paste and not take advantage of the benefits"*.

When **remote**, Malefa maintains **no technology training is being provided** by the school *"they did not say anything about training…only told us to upload our stuff to* D6*"*.

Now **back on campus**, Malefa reports **once-off technology training** on ***Google Classroom*** **has been provided** *"there was some training once-off…managed to get some guys to come to the school…trained teachers on* Google Classroom*…how to send a test…put a due date…how to mark"*.

Patrick[125] believes **training on how to utilise technology is essential** and can **result in many benefits** for both **teachers** and **learners** *"if you train teachers how to utilise technology…it will benefit learners…teachers can learn how to easily give out information…be more familiar…will use it more …it would benefit a great deal"*, however he reports there is **no formal** or **informal training being offered** by the school *"we have workshops but not on technology"*.

When **remote**, Patrick reports **no formal training** is being given *"there was no training"* and **only online training content** has been sent to teachers *"there is no training, but I received a communication regarding some form of online training content…sent me material in a PDF form"*.

Thuli feels **technology training** at the school is **insufficient** *"there's no technology training…it's inadequate"*, **even for new teachers** *"since I've been here there was no technology training…even orientations for new teachers, they don't train you on the equipment in the classroom"*. Consequently Thuli believes **most teachers are unaware of how the technology works** *"we have projectors…we don't know what functions it has…I think it's capable of connecting via wireless, but I don't know"* or **how to troubleshoot**

[125] Patrick did not comment on training when returning to campus.

when needed *"what should I do when it's blurry and so on"* and only **learn by asking their peers** or **teaching themselves** *"we have to ask other teachers, figure it out for ourselves…learn it yourself"*.

When **remote**, Thuli reports **no technology training is being provided by the school** *"there was no training…the only communication we got from the school was to go home and wait"*.

Now **back on campus**, Thuli reports even though **once-off training was provided** on the **new tools** *"there was a one-time orientation on these software"*, she **does not feel she can fully utilise the technology** *"told us what to do but I'm still not able to fully work it"*.

Support

Candice believes the **IT technical support**, which is **on-site a few times a week** *"we've got technical support, if the computer breaks down…you write it in the book…they are on-site on Tuesdays and Thursdays for two hours…they then go around…we also have interns for technical support from the company who donated the tablets…they here three times a week "*, is **sufficient** *"it is good enough"*. Furthermore Candice reports **she** and a **group of CAT learners** provide **peer support to teachers** at the school *"everyone runs to me…teachers ask my CAT kids… they ask me to help them, so they can also help the teachers when the projectors don't work…the Wi-Fi is down…they can't access anything…they ask me or the kids"*. In regard to **institutional support**, Candice feels the **school does not actively support teachers using technology** *"I don't think they care if we use it…preferably yes, but if you don't they don't care"*.

When **remote**, Candice reports even though she **can use her cellphone** if needed, she believes **technical IT support is lacking** *"if my laptop breaks there is no support…I won't be able to carry on if my computer cannot work…at least I have a cell phone and can still go on to Google Classroom"*. So too, Candice feels **institutional support is not adequate** to **enable teachers to continue with the academic project** *"the principal put on a link and said go to this website and enrol for online classes for free, but when I tried the link didn't work, no one could help, and no one followed up with me"*. Candice indicates she is still **trying assist by posting relevant online classes** *"when I find lessons for free…once a week I put them on the* D6 *communicator…say this is available"*.

Now **back on campus**, Candice reports **she** and her **CAT learners** still **informally help her peers** *"a lot came to come for assistance…I showed them how to do stuff…informally…my CAT students also go and help them"*.

Malefa believes the **IT support**, which is **mainly technical** and consists of **on-site support a twice a week** *"we have an IT guy twice a week…if you're having a problem…maybe the projector is not showing or it is upside down…there's technical support…every day"*, is **sufficient** *"for now I think it's working well"*, however she maintains **support could be more frequent** *"let's say your computer or projector breaks on Friday, you'll only get it fixed on Tuesday…you will have to wait…it should be more frequent"*. In regard to **institutional support**, Malefa feels the **school does not support technology use** *"I don't think they care…the only thing they want is to submit your work, they don't want to know what you used"*, which is apparent as **teachers lack access to quality technology resources** *"we used to have computers…since they broke, they removed them and didn't bring anything* back".

When **remote**, Malefa believes the **institutional support is inadequate** *"I don't think it's fine…they have wasted a huge opportunity…the only communication is when to expect the PPE…for technology to continue teaching we have never had anything"*.

Now **back on campus**, Malefa reports **temporary peer support** is being provided to **assist teachers** with the **new technology tools** *"we have some teachers employed temporarily who have knowledge of computers…if you are stuck somewhere, you can ask those teachers and they help you continue"*.

Patrick[126] reports there is **twice weekly on-site IT technical support** at the school to **assist teachers** *"there's an IT guy at the school on Tuesdays and Thursdays to fix things that break or don't work"*, however he feels **support should be more frequent** as **delayed response times hamper teaching efforts** *"if it breaks on Friday too bad…you will have to wait a couple of days and you're unable to move on"*. While Patrick believes the **principal is open to supporting technology initiatives** *"the principal is very open minded to changes especially because of technology"*, he maintains there is a **lack of**

[126] Patrick did not comment on support when returning to campus.

support as the **school does not provide teachers with** the **necessary technology resources** *"we need a lot of help…we need hardware, software"*.

When **remote**, Patrick reports he is **unaware of any IT technical support being offered** *"I don't know, but I don't think there is any support…I don't think anyone is at the school to help at the moment"*.

Thuli reports there is **no IT technical support** offered at the school to **assist teachers with general technology problems** *"there's no one…you need to figure it out by yourselves…if the projector is not working, if I can't figure it out, I just end up pulling it out and moving on"* as **technical staff** are only **on-site twice a week at specific times** *"you can't just text him to come…he's only here twice a week…here at twelve and gone at one…he has a time period that he's here"* to **deal with setting up** and **looking after computers** *"the technical person…sets up school emails…monitors school issued laptops…desktops, but does not go into the classroom to help you with your projector"*. For **institutional support**, Thuli believes the **school is not really supporting** and **encouraging teachers to utilise technology** *"when I was interviewed it was a big deal, but once you in the system…it's not forced upon you or even encouraged"* as **access to technology resources is limited** *"I'm a floating teacher…I don't have a laptop or a projector in my class…it is difficult for them to say you must use technology, when they don't give it to us"*.

When **remote**, Thuli believes the **school's support of technology is inadequate** *"I don't think what the school has provided has been adequate…since we closed there's hasn't been any resources given, no communication…they just told us go home and wait"*.

Now **back on campus**, Thuli reports although **peer support is being offered** *"there is someone you can ask"*, she prefers to **teach herself** as she finds **videos more helpful** *"I prefer using videos, they are more helpful…as often they don't know what they are doing"*.

Time

Candice feels she is **familiar with current technology** *"I'm confident using technology"*, however as **technology evolves** she **constantly needs to learn new skills** *"I'm not where I can be…CAT is a very changing subject"*. While Candice maintains **using technology in the classroom is feasible** *"it's feasible to use technology in the classroom"*, she reports **planning is essential** to ensure **learners are focused on the task**, **so time is not wasted** *"I have to plan very carefully what I want to do in the specific 40 minute period…if I don't then the kids start playing on social media…it takes time to get them settled…which just wastes time"*.

When **remote**, Candice believes she is **familiar with the new tools** *"I'm familiar"* and **enjoys exploring** and **teaching herself new technology** *"I like teaching myself…to enrich myself…I try to familiarise myself beforehand…with all the training tools that is online"* so she is able to **utilise the tools when needed** *"I'm learning* Google Classroom *more extensively…our school is going into* MS Teams*…I haven't use that before…I need to learn"*.

Malefa believes even though she is able to **utilise current technology to do what is needed** *"for now what I need the technology for in teaching, I can do it"*, she feels **she would be more familiar if there was training** *"if there's something new…the fact that we don't have frequent training, means we don't know what's going on…if there's new developments"*. In addition, Malefa maintains **short class lessons** coupled with the **setup time** needed often make it **unfeasible to utilise technology within school hours** *"technology takes a long time to setup…in class I only have 40 minutes"* and thus she organises **after school lessons** where **time is less constrained** *"I end up doing some extra classes…come here on a Saturday when there's no tome constraints…then I can the technology in the class"*.

When **remote**, while Malefa feels **familiar** with **tools for remote learning** and **communication** *"I'm familiar with tools like* Google *and* Skype*"* , she reports **not having many opportunities to utilise these skills** *"there is nothing…we are not using any tools…communicating with the learners…they've wasted a huge opportunity"*.

Now **back on campus**, Malefa maintains **irrespective of time needed**, teachers need to **utilise technology to continue with the academic project** *"we find ourselves in a*

situation where we don't have a choice…it is something we need to be using to teach the kids…even if it takes time".

Patrick reports his **technology skills are limited** *"I am very average"* and believes **better resource access** and **training are essential** as **technology constantly changes** *"the world is changing…need to adapt to new technology as it evolves…I could be more familiar with better access and training…t's dangerous to be left behind"*. While Patrick acknowledges **class lessons are short** *"class lessons are about 40 minutes"*, he feels **using technology is feasible** as it **actually saves time** *"it's feasible...in 40 minutes you can do a lot…I can show an image...it takes less time than drawing it or printing"*.

When **remote**, Patrick believes **his current technology setup is unfeasible** as it requires **substantial time** and **effort** *"use my own laptop to email stuff…create using my school laptop…Bluetooth it to my phone, send to* WhatsApp*, then email using my home laptop…it's very cumbersome…takes a lot of time"*.

Now **back on campus**, Patrick believes he has become **more familiar with technology** *"of course it has made me more familiar…we're using the digital space even more"*.

Thuli reports even though she is **familiar with using technology in teaching** *"I'm aware of the different systems we can use and create content"*, she **cannot make use of the technology** due to **resource access** and **quality issues** *"it's not that I'm not able to…it's because the technology may not work…there isn't Wi-Fi access…the projector is not working"* which **wastes valuable class time** *"if I can't figure out what to do, I've wasted 15 minutes of the lesson because of that"*. Furthermore, Thuli feels it is **not feasible to use the available technology** as it takes **too much time** to **create** and **display content** *"I have to create everything on my own...we don't have access to the resources…it is a lot of time if I want to display anything on the screen…I never go onto* Google Maps*, it takes too much time…would rather use a book"* and **setup the technology in the classroom** *"an issue for floating teachers…if I wasn't in the class the previous period, I still have to work on connecting the technology…that's another 10 minutes of class time wasted"*.

When **remote**, Thuli believes she is **familiar with the new tools** *"I know how to use* Zoom*,* Google Classroom*"*, however, she reports the **school's content distribution**

strategy does **not require teachers to utilise the technology**, which she maintains has **wasted resources** and **teachers' time** *"it's not really feasible…they had confusion if they are going to give out pamphlets or go online…many teachers made hard copies…I'm pretty sure when we come back those handouts will still be there…really wasted time"*.

Now **back on campus**, Thuli believes even though prior to moving off campus she was **familiar with remote learning technology tools** "*most of the software we are currently using I had a taste before in using them"*, she maintains her **current use is making her even more familiar** *"now cause we are using it more…I am broadening what I know"*.

Appendix H-2: Teachers' accounts of Internal Beliefs at School 4

Pedagogical Beliefs

Candice aims to **use technology** for **learners to gain knowledge** *"it's not just about technology and how to use in the classroom environment…it's about using technology to gain knowledge and make sense of it"* by acting as a **guide** and **mentor to learners** *"I'm their guide…their mentor…to make him or her be a better little person…it's not just about sharing knowledge"*.

When teaching **remotely** and with a **hybrid** approach, while Candice believes **using technology** is **now essential** *"technology is now a driving force…teachers have to make use of it"*, she maintains **teaching is now just about giving over content** *"teaching is more about content, as opposed to a holistic experience"* as it is **impossible to provide learners with the same personal care when using technology** *"the physical and emotional care of the students, the offsite mother…I cannot do that via technology…I cannot give them the hug they need"*.

Malefa feels **passionate about education** *"I love teaching…I love the kids…"* and **aims** to **create the next generation of adults** *"to make them the people you want for the future…to enjoy watching them"* by **understanding**, **interacting**, **instructing**, **disciplining** and **imparting knowledge** *"first you need to know the child's mind…how it works, then you interact with them…discipline them…impart this knowledge…give them something in return"*.

Malefa believes teaching has **changed positively** due to using a **remote** and **hybrid approach** *"teaching has changed forever…it is really important what we are doing now"* as teachers now **need to give over essential technology skills** as well as **content** to **empower learners for the future** *"in the past it was only content based…not it's also technology based…teachers don't have to only impart the content but they also helping learners with the technology…to help them in the future"*.

Patrick view his **role as facilitative** *"you're the facilitator…they are the reason you are here…it's a partnership between you and the learners"* and **aims** to **create a conducive**

learning environment to **benefit learners** *"want to create an environment where they can learn…make the classes interesting and benefit learners"*.

Now teaching with a **remote** and **hybrid approach**, while Patrick believes **teachers must be more adaptable** to future changes and become **solution focused** *"we need to change the way we have been teaching…become more adaptive to what is happening around us…more solution minded, rather than problem focused"*, he feels there **needs to be a balance between traditional** and **remote teaching** and **learning** *"there really needs to be a balance between digital means and traditional interaction…we need both"*.

Thuli aims to **make difference to learners' lives** and **help them achieve their best** *"I believe I can make a difference…ensuring we turn them into the best students"* by **getting learners to understand** through **active engagement** and **communication** *"it's not about me and what I want to understand…I want to involve my students actively in the communication…they can only learn by engaging".*

When **remote** and using a **hybrid approach**, while Thuli feels teaching is now **simply about giving over content** *"I feel like now it's just about content"*, as she is **unable to sense immediately when a learner does not understand** *"I feel we have lost something because when the child is in front of you, you can deduce what is happening…when you teach them through the internet, you can't…it's not immediate"*, she believes **changes are unsustainable** due to **inequalities in South Africa** *"I don't think it will change forever…even if normal classes resume we will have to disregard this as not every student has access"*.

Normative Beliefs

Candice feels the **school does not really believe using technology is important** as **teachers are not required to integrate technology** *"they don't care if we use technology…preferably yes, but if you don't, you don't"* and **broken resources are often not repaired** *"my projector broke last year…I still don't have one…the school's SGB did not sign it off"*. Furthermore, Candice believes **many of her peers are not favourable towards technology** as it **requires them to change existing practices** *'there's a lot of the staff that's against using new things…new ways of doing things"* and **learn new skills**

"they do not want to learn the features...I've been available for years now…to teach staff…there's still staff that do not want to use it".

When **remote**, while Candice feels the **school has done little to promote technology usage** *"teachers without technology access…probably didn't teach at all…there was no training…only a link for online classes which didn't work…no one followed up"*, she feels **many of her peers** are **not using the limited technology available** and **appear disinterested** *"I've seen one teacher adding things on* D6*…one asking me to put things on for her…but there's very few of them…they are not worried about the kids and if they are okay"*.

Malefa maintains the **school does not believe technology is needed for teaching** *"I don't think they care…the only thing they want is you to submit your work…they don't want to know what you have used"*, **administration** *"we had four computers…punch in your password and all your stuff would come there…since they broke, they removed them and didn't bring anything back"* or **learning** *"don't think the school really believes the kids need to use technology in class…they don't have internet access here".* However, she maintains her **peers** are **favourable towards using technology in their teaching** *"they believe you should use technology…they love using it"* as they believe it **educates learners on how to engage with technology** and about the **benefits** *"teaches them how to behave around this technology…so they know what they can do with the technology"*.

When **remote**, Malefa feels the **school does not promote technology use** as there is **no communication on technology initiatives** *"the only thing…to update us on the PPE…we never had any other communication"* and **access to additional resources** *"the school never gave any extra access to technology…I think they should have done more"*. Malefa reports she is **unaware of her peers' technology beliefs** due to **lack of communication** *"we are not communicating that much"*.

Patrick reports even though the **school espouses the importance of technology** *"they do because…they make it clear, a school without a projector…laptop…tablet, is living in the olden days"*, he believes **current resource constraints indicate otherwise** *"we need a lot of help…we need hardware and probably software…it is quite constraining as it is at the moment"*. For his **peers**, Patrick believes **younger teachers are favourable towards**

technology as **older teachers are resistant** to **changing their practices** *"some of them who are younger...are tech-savvy, but those who are older tend to stick to their old ways"*.

When **remote**, Patrick feels the **school does not encourage teachers using technology** as **school issued devices are restricted** *"the school laptop is only wired to connect to the Wi-Fi in the school…can't use it to email learners"* and **training on tools is almost non-existent** *"I received some communication…regarding some sort of training".* Patrick reports being **unaware of his peers' beliefs** due to **lack of technology for communication** *"we don't communicate much because of the limitations"*.

Thuli[127] feels the **school believes using technology is important** *"they think technology is important...they try...when I interviewed here it was a big deal"*, however she maintains the **pace of implementation is an issue** *"don't think we are big on implementing it...they are working on it, but progress is slow"*. For her **peers**, Thuli feels **most are in favour** and **utilise technology where possible** *"I think most of them believe it is important and they do try and utilise it, in most cases"*.

When **remote**, Thuli reports the **school does not promote using technology** to continue the academic project as **all teachers do not have access to hardware** *"I don't have a school laptop...I use my own"* and **software resources** *"we don't upload stuff ourselves...we give it to somebody else...we're not given access to that website"*.

Knowledge Beliefs

Candice believes one **acquires knowledge** from **speaking**, **interacting**, and **searching for information** *"there are various ways, speaking to each other...interaction, looking at social media, the news"*. While Candice maintains **knowledge of affordances motivates teachers to use technology** *"they don't realise that using technology in the classroom makes life easier for them"*, she believes **knowledge** on **how to use** technology *"if you don't know how to use it, you won't feel comfortable...you can't use it properly"* and **troubleshoot** *"how to troubleshoot...if the Wi-Fi is down, they can't access stuff"* is **crucial for effective utilisation**.

[127] Thuli did not comment on Peer Norms when remote.

When **remote,** Candice feels she is **using technology more effectively than her peers**, as she is **more knowledgeable** *"I'm using it more than someone who doesn't really know technology...others are too scared as they don't know"*.

Malefa[128] believes **knowledge** is **acquired** by **actively engaging with people**, **reading**, **organising**, **analysing**, and then **making sense of the information** for oneself *"learning is all about you...there's lots of ways you can learn...from your colleagues...other people out there...reading...then you can analyse...organise...understand what it means for you...is it good for me or not"*. Furthermore, while Malefa maintains **knowing how to use technology is essential** *"you have to know how to use the technology...in order to use the devices"*, she believes teachers also **need to be aware of affordances** *"if we know a lot about what the technology can do...it will guide us on the ways it can benefit us"*.

Patrick[129] believes one **acquires knowledge** through **practice** and by **making mistakes** and **correcting them** *"when you make a mistake, don't erase them, keep on working on them until you get it right...make it stick...practice makes perfect"*. In addition, Patrick feels both **knowledge on how to use technology** *"the more they know about using it, the more they will use it"* and **affordances** are **needed** *"we need to know how technology can benefit learners...make it easier...allow learners to think differently...be more interested"*.

Thuli[130] believes to **acquire knowledge** one needs to be **actively engaging**, **observing others**, and **writing** *"interacting...being active in the thing you want to learn...observing others...writing it out...to recall it"*. Additionally, Thuli feels one **first needs to know how to use the technology** in order to **appreciate affordances** *"if you don't know how to use the technology...you can't think about using technology to keep them interested...because if I'm incapable of using the technology…I won't use it as it consumes time"*.

Value of ICT Beliefs

Candice believes **technology** should be used to **engage learners** *"by engaging the kids' interest...in a topic"* and **evaluate learning progress** *"we can make use of immediate feedback via a little quiz...to see for their own benefit how they are performing...also for me*

[128] Malefa did not comment on Knowledge beliefs when remote.
[129] Patrick did not comment on Knowledge beliefs when remote.
[130] Thuli did not comment on Knowledge beliefs when remote.

to see if the kids have grasped it". In addition, Candice maintains using technology not only **supports teaching**, as it is enables **content creation** *"I can do my presentations"* and makes **teaching easier** *"using technology in the classroom makes life easier for them...it's easier to teach them the facts"*, but it also **enhances teaching** as **lessons can be more interesting** *"if you have a little video on whatever the topic is and then you discuss the topic...it's less boring"* and **teachers can self-reflect on their pedagogic practices** *"I can get feedback to see if I am on par as a teacher...am I not too fast...too slow...or my process of teaching and learning"*. According to Candice, technology also facilitates **communication** *"if they have data they can email their work"* and **increases teachers' productivity** as **preparation** and **marking can be done at home** *"I can prepare at home and then bring them to school...I can do my marking at home".*

When **remote**, while Candice believes technology can **support** and **enhance teaching** and **learning** by: enabling the **academic project to continue through online classes** and **assistance** *"for kids to be at home and be able to focus on their school work...for me to give live classes...help them, ask what is the problem...are you ok with the content"*; providing **access to additional information** and **resources** *"I can use all those things that's online...teacher.com, study ops...the government one...Africa Team Geeks"*; and empowering **learners to review content in their own time** *"they can go through it on their own time...review it"*, she maintains **benefits can only be realised if learners have access to data** *"if they are able to access it...needs to be for free*. In addition, Candice believes technology can assist with **staff communication** *"can be part of* WhatsApp *groups"* and for **learners** *"can use* Google *for chatting...*Gmail *accounts to speak to them"*.

Now **back on campus**, while Candice believes technology enables **teaching to continue even when learners are at home** *"so we can physically teach...even those who are not in class"* and **staff to attend meetings** *"on* MS Teams*...everyday like a normal staff meeting"*, she is concerned **technology may only benefit advantaged learners** *"my biggest worry is now for those who cannot afford it...the divide between the rich and poor...is definitely emphasised"*. In addition, Candice feels she now **needs to know exactly how to use technology** for it **benefit herself** and the **learners** *"have to be sure that I know in detail how technology will help me and help me to help the kids".*

Malefa believes **technology** should be used to **prepare learners for the technological future** *"the kids need to be taught how to work with these devices...so they know what they can do with the technology...we are living in a technological world here they need to know"*. Malefa feels technology not only **supports teaching** as she can **present** and **project content in class** *"I can project on the whiteboard"*, but also **enhances teaching** by enabling teachers to: **search for information** *"I can access anything, If I want to Google I can just go online"*; **expose learners to other teaching methods** *"if there's a teacher in the UK teaching number lines...they can compare his method to my method and see which is better for them"*; and **use videos to stimulate learner engagement** *"maybe I love how a teacher introduces a topic...can put the teacher up there... the learners can watch and listen, then they will ask questions...be engaged"*. Malefa also believes technology **enhances learning** as **learners can practice skills by finding additional resources** *"they can get different question papers from other schools...practice...compare with our school if there are any gaps"* and **submission of work** is **easier** and **more readable** *"they can submit their assessments on a usb...easier for me and also easier to read as opposed to reading their handwriting"*.

When **remote**, although Malefa believes **learners' data access issues** *"many learners don't have access to data...they can't communicate"* and **contact details not being available to teachers** *"the school could have let us have access to the learners' details, so we can contact them or their parents...I only have four parents communicating with...I was in contact with them before"* **limit technology affordances**, she believes technology can enable **distributing content** *"upload all the work...the content"*; **recording of lessons** *"lessons can be recorded"*; **assisting** and **communicating with learners** *"they can ask questions...through these devices...talking through the phone...messages"* and **reviewing of content** *"every time the learner is studying...doesn't understand the section, they can just go back to the recording and listen again"*. Furthermore, Malefa feels using technology allows **learners more access to teachers**, as **time is less constrained** *"they are not pressurised by the classroom environment...they have more time...unlike when I had only one period in class"*.

Now **back on campus**, Malefa reports she **appreciates the affordances more** *"I didn't know I could really be online with the kids...it's really amazing to know that you can do so many things with the technology"* as **technology can be used** to **continue teaching** and

provide assistance *"I can see them, they can see me...they can ask me questions"*; **distribute content** *"I can send them homework"*; **record lessons** *"I can also record a lesson"*; **accommodate absent learners** *"even if a child is sick...she can still attend the lessons and learn when she's at home"* and **improve learners understanding through reviewing content** *"if they don't understand, they can just go back to the lesson and listen and understand"*. However, she believes **benefits of technology may not be realised** due to **resource inequalities between advantaged** and **disadvantaged learners** *'there's inequalities...if you don't have the resources, then it's not going to help you...it will actually be a loss for learners that don't have"*.

Patrick believes technology should be used to **inspire**, **interest**, and **open the world to learners** *"with technology learners will be more interested to come to school and absorb because they are inspired...it opens up the world to the learners"* as he feels technology can **enhance learning** by **promoting creative thinking** *"it allows them to think differently...can show them several images...makes them think creatively...come up with all kinds of ideas"* and **teaching** as **additional information can be provided to learners** *"there are websites I can use...for good research purposes...to give the learners academically certified information...go online and get something"* and **videos can be shown to assist understanding** *"I can show them videos...help them understand"*. In addition, Patrick maintains technology can be used to **support teaching** as it **saves time** *"it saves you time"* and **enables teachers to project content** *"I can show students an image on a projector"*.

When **remote**, Patrick believes even though technology can **support teaching** and enable **administration activities** and includes: **giving live** and **recorded classes** *"we could actually have a video linkage to the learners...or record a simple video explaining to learners"*, **distributing content** *"send them a brief for the term"* and **communication between staff** *"can send to my HOD"*, he feels **infrastructure challenges** *"it's very cumbersome...working on my school laptop...Bluetooth then to my phone...sending to* WhatsApp*...emailing to learners using my home computer...there is a challenge for learners with connectivity"*, **inability to contact learners** *"it's a real challenge...actually we are not in contact with our learners...not allowed to have their cell phone numbers"* and **lack of learner engagement specifically in his discipline** *"it's not possible to have engagement...we are teaching a practical discipline...it needs contact"*, are **barriers**.

Now **back on campus**, while Patrick believes technology can enable **giving over** and **distributing content** *"classes can be online...with a PDF or* Word *document"*; **making abstract concepts more real** *"with technology it is so easy to bring things to life...make them more real"*; **providing additional information** *"can give them additional documents that I find online"*; **communicating between staff** *"*MS Teams *is a helpful platform for peer to peer interaction...enables feedback, announcements to be given...can also happen on* Google Classroom*"* and **with learners** *"we can communicate with them...asking questions and receiving responses"*, he maintains **South African learners' unequal access to resources** *"the digital divide is a reality in South Africa...very few learners are able to interact...because of the availability of data and devices...some learners can submit their work...others have fallen behind"* and **his subject's need for in-person lessons** *"part of the curriculum we are not really going to explore...as we are digital now"*, need to be **considered**.

Thuli believes technology should be used to **enable learners to interact** and **take charge of their own learning** *"for interactive programmes where they can clock and find out for themselves...there's nothing better than that"*. Thuli feels technology not only **supports teaching** by **projecting content** *"for presentations in the classroom"*, but also **enhances teaching** and **learning** through: **showing videos** *"a video brings out emotion more than words...so they can visualise what happened"*, **making abstract concepts more real** *"they don't have to imagine...it makes it more real for the students"* and **improving learners' understanding** *"kids will ask how is this flat surface created...if you tell them they are like what is that...if they see it, they understand better...able to give a clearer description of what it is"*. In addition, Thuli believes technology assists with **administrative tasks** like **setting assessments** *"assessment setting"* and **capturing marks** *"I can use it for capturing marks"*.

When **remote**, although Thuli feels technology can **support teaching** by enabling **distribution of content** *"we can upload content for learners...put it online"*, she believes: **current lack of access to technology resources** for **staff** *"nothing has been done by staff at home...they don't have technology...don't have access to* D6*"* and **learners** *"they don't have data themselves"*; **unavailability of learners' contact details** *"we don't have contact with the learners...the school has these details...but that's not provided to us"*; and **inability to monitor learner engagement** and **progress** *"there's no way for me to*

monitor what or how the kids are doing", **restricts the possible benefits technology can bring** to the **educational context**.

Now **back on campus**, Thuli feels technology can really assist with: **giving live** or **pre-recording lessons** *"can do live classes...I can record lesson"*, **communicating** with and **assisting learners** *"we can talk directly...they can ask questions...it's more of one on one interaction"* and **staff interactions** *"to have out staff briefings"*, however, she worries about **learners' lack of access to data** *"just over half the class can attend...because of access and affordability issues"* and **loss of personal connection with the learners** *"I feel like we have lost something...when you have to teach over the internet"*.

Self-Efficacy Beliefs[131]

Candice feels **very confident** using technology in her **teaching** *"I am 100% comfortable using technology in teaching"* and believes one needs to **constantly explore** and be **open to teaching oneself about emerging technologies to be proficient** *"one has to explore and teach yourself constantly about technologies for teaching"*. In her **personal** life, even though Candice feels **confident when using technology** *"I'm okay with using technology in my personal life"*, she maintains she only **uses it where appropriate** *"I'm not only living for technology…only use it for major things"*.

Malefa believes she is **confident using the technology** in her **work** *"I'm confident using technology to teach"*, however she feels the **school should provide training** to **assist teachers gain technology skills** *"there can be more training…to help teachers know more"*. In her **personal** life, Malefa feels **confident** and reports **using technology extensively** *"I'm confident…use my tablet...my phone…Googling…order food…Uber"*.

Patrick believes he is **confident using technology for teaching** *"I feel confident using technology in the classroom"* but feels **better access to resources** and **training is needed to improve his technology skills** *"there needs to be better access and training"*. In his **personal life** Patrick feels **confident** using technology *"I am confident in my personal life"*, however he reports he is **not using it extensively** *"I don't use it for Uber…or online shopping"*.

[131] Teachers at School 4 did not comment on Self-Efficacy Beliefs when remote.

Thuli feels **confident using technology in her work** *"I'm equipped…my skills are adequate enough"* and is constantly **trying to improve her skills** *"I've been brushing up my skills"*, but believes **limited access to quality resources restricts her in growing technology skills** *"I'm always trying to use technology…often it doesn't work, or I don't have access"*. In her **personal life**, Thuli feels **very confident** *"I'm very confident in my personal life"* and **uses technology extensively** *"I use it for just about everything"*.

Appendix H-3: Teachers' accounts of Professional Dispositions at School 4

Candice believes one **first needs everyday knowledge** to **acquire school knowledge** *"need outside knowledge to start of a topic...then whatever gaps there are, I can fill in or we can fill in together"* and then **applies it to everyday life** *"they transfer that knowledge then to everyday life"*, however she feels **everyday** and **school knowledge is integrated** *"in my subject there are no boundaries"*. Within her subject, Candice maintains learners **acquire knowledge by applying skills learnt across different disciplines** *"for example with spreadsheets...tell the kids you use this in accounting...in maths...for word processing...you will write a physics report, an essay...I bring in all the subjects"*.

For the **regulative** discourse, Candice maintains she does not have **strong boundaries in place** as she **aims to guide** and **mentor learners** based on **mutual respect** *"I'm there to be their mentor and then their guide...there's a respect for each other as they walk into the door"*, however she believes **controlling the classroom context is essential** *"I try and control what happens in my class...don't want the kids playing on their social media"* otherwise **learners often misbehave** *"I'm tired of dealing with 40 plus jimmies in my class everyday"*. When using a **remote** and **hybrid approach,** Candice feels **boundaries have not changed** *"I don't think the boundaries have changed"*.

Malefa believes although **school** and **everyday knowledge** is linked *"there's a bridge between them"*, there are **boundaries** *"whatever I've learned from home, it's not like the same thing I've learned in school"* which **learners find hard to cross** *"especially in maths...you talk about going to buy something and then you get change...the moment you put the same question in class, they get it wrong...crossing the boundary is very difficult"*. Furthermore, Malefa maintains one **first needs to acquire school knowledge** to **apply it to everyday contexts** *"you teach them content...then you go out of that content and apply it...if we are talking about financial maths...first learn this and then talk about current accounts...so they can make that connection"*. Within her subject, Malefa reports **learners acquire knowledge** in a **vertical manner** *"we build knowledge vertically in maths...first you have to know arithmetic...then you go up"* through **understanding abstract concepts** and **applying them** *"have to learn the abstract terms...apply them...practically"*.

For the **regulative** discourse, Malefa reports even though she has **firm professional boundaries** in place *"they need to know that there's a teacher and they are the learners"* and **controls the classroom context** *"I run the class...control what is happening"*, she maintains **learners still need to contribute during lessons** *"I don't have to restrict them from even talking...they need to have some kinds of discussions"*. When teaching **remotely** and with a **hybrid approach**, Malefa believes **boundaries** have **almost fallen away** *"I think there's no boundary anymore...the freedom the kids have while online is really different to what was in the classroom"*, as **communication is more individual** *"you can be contact with the learner one on one"* and **learners contact her at any time**, **even about non-school related content** *they can ask me anything and at any time"*.

Patrick believes while **school** and **everyday knowledge** are **connected** *"there are connections...meaning between them"*, **school knowledge is essential for learners to make sense of the world** *"they need to learn what is considered knowledge...they learn that at school...if they don't learn it here, I don't know where they'll learn it from...that is why teaching is so important"*. Within his subject, Patrick believes **learners acquire knowledge** through **continual practise** *"a learners needs to do an illustration 1000 times...become a perfectionist...become better at it"* and **applying concepts** *"by applying concepts they have learnt...so ideas can become possible"*.

For the **regulative** discourse, even though Patrick reports he **prefers a facilitator role** *"don't like these teacher–student boundaries...like a facilitator role"* and **encourages learners to share control of the class** as he believes this **enables learners to help their peers** *"want to give them a platform to speak to their fellow learners about things the teacher doesn't know...once they realise they teacher helped them discover this, they become more powerful and can actually help their peers"*, he believes he has **professional boundaries in place** *"there needs to be a discipline aspect...this is the norm when you are in class"*. When teaching **remotely** and with a **hybrid approach**, while Patrick believes **formal boundaries are still needed** *"still have to maintain that formal relationship"*, he reports they have **become less formal** *"they're becoming less formal...learners are more playful...we have to bring them back that this is a class...a space to actually learn"*.

Thuli believes **school** and **everyday are interrelated** and **inform each other** *"I feel like they help each other...what they read at home or in the news comes into direct context with what they learn at school...for example we're learning about the black death...we have coronavirus, it's the same thing"*. To **acquire knowledge** in **history**, Thuli feels learners need to apply **communication skills**, **read**, **analyse**, **synthesise content** to form opinions *"the most important thing is not content...it's the skills...communication...verbalise and written skills...read...synthesise, analyse...give your own understanding"*, while in **geography** she believes learners need to **interact with the content** *"they need to interact with the content in geography"*.

For the **regulative** discourse, Thuli reports she has **strict boundaries** and **firmly controls the classroom context** with **junior grades** as **classes are larger** *"with the younger grades...they are larger...I have firmer boundaries with them...try and keep control...whoever tries to control my classroom is out"*, however in the more **senior grades** Thuli believes **shared control** and **less strict boundaries** are appropriate *"with the grade 10s the classes are a bit smaller...here the boundaries are less strict...I share control"*. When using a **remote** and **hybrid approach**, Thuli believes **boundaries have blurred** and are **less formal** *"boundaries are blurred...they feel they can now talk directly to me"* as **learners contact her after hours** *"they contact me after school hours"* on **non-related school issues** *"on a personal level...they forget this is actually a teaching aid"*.

Appendix H-4: Teachers' accounts of Orientation towards Technology at School 4

Candice believes while technology **supports** *"where it makes sense...to support teaching...empower learners"* and **transforms** *"it has transformed my ways...can do experiments...check homework...mark...give new concepts...make it animated...engage the kids...empower your little person"* her **pedagogic** practice, she maintains it should **not be used to disengage from the world** *"not to disengage from the world"*. When **remote**, Candice feels **technology** is still playing a **supporting role** *"don't think it is changing what there was...it's always how we wanted to teach"*.

On campus, Candice reports technology **supports** her teaching by enabling her to: **prepare, present**, and **distribute learner content** *"do my presentations, prepare at home...bring to school and present them...give them activities"*, **show videos** *"a little video on whatever the topic is"*, **communicate with learners** *"they can email me"*, **mark assessments** *"my personal subject laptop I use at home to mark assessments*", **record marks** *"to do the marksheets...on the school admin system"* and **manage the computer lab's resources** *"I manage the classroom network".* In addition, she believes she uses technology to **transform educational experiences** by **empowering learners** *"they can practice at home on their own...a group of learners train the teachers"* and **making lessons more engaging** *"have my explanation animated on the board...engages the kids"*.

When **remote** Candice reports using technology to: **give live lessons** *"I'm taking live lessons online"*; **share online teaching website content** *'they watch it via my screen into their screens...put free lesson on the* D6 *communicator for parents to use"*; **post content** and **tasks** *"I give them links, videos, tasks";* **find resources** *"all those sites online...teacher.com...Brain Line...I soak up all the information"*; provide **online assistance** and **feedback** *"we chatting...how do you feel, what is the problem, are you okay with the content"*. For **administrative** tasks, Candice reports she is using technology to **communicate with learners** *"I've set up* Gmail *accounts...speak to them regularly"*; WhatsApp *text…with them"* and **some teachers** *"on the SMT* WhatsApp *group"*. When she **returns to campus**, Candice believes she will **continue using technology** in the **same way** and to the **same extent** as **she is currently** *"precisely the way I'm doing now...not going to use it more because I was already using it a lot in the past"*.

Now **back on** campus, Candice reports using technology to **give live lessons to remote learners** *"with* Google Classroom*...electronically we can teach those who are not in class"*; provide **online assistance** *"they still come to me with issues...to assist them...even if it's online"*; **communicate with learners** *"I'm sharing with the kids, communicating with them"*; and **attend staff meetings** *"on* MS Teams*...sharing whatever wants to be shared on the normal staff meeting"*. In addition as the **school has now purchased *Google Classroom***, Candice mentions she is now **using more features**, like social media, to **engage learners** *"we've now got the full academic version of* Google Classroom*...there's all new features...like the social media bitmojis...they create a* Word *document...take a video clip of it...make a GIF and send it to me...via the social media"*.

Even though Candice maintains in the future technology will be **used more in education** to **empower learners** *"technology is going to be more present within education forever...to empower themselves more"*, she believes a **hybrid approach** will only **amplify current inequalities between advantaged** and **disadvantaged schools** and **learners** within South Africa *"those who have technology will benefit but those that don't have, I'm worried about them...they will fall even further behind"*.

Malefa[132] maintains technology, which is simply a **medium change** *"in the past you used a typewriter...now you just print"* should be used **where it makes sense** *"where it's going to help me...not just because I want to use technology"* to **support pedagogic practice** *"it hasn't changed me as a teacher...but I'm essential still teaching the same way"*. When **remote**, Malefa believes **technology** is still being used to **support** her **pedagogic practice** *"send documents...communicate...help learners"*.

On campus, Malefa reports using technology to **present learner content** *"I use the projector with my laptop"*, **show videos** *"so a video...learners can listen"* and **search for information** *"find stuff online...I'm always trying to find out what's the latest developments...to compare what we are teaching here"*.

When **remote**, Malefa reports using technology to **send content** *"send them documents"*; offer **online assistance** *"if they come across something difficult...they ask and I explain*

[132] Malefa did not comment on intended future technology use.

how I've been doing it"; and **communicate** *"have some contact with the parents"* with a **handful of parents** and **learners** *"it's a very small percentage...less than 10%"*, as **teachers have not been given access to resources** *"they never gave us any extra access to technology to assist students during the time"* or **learners' details** *"the school did not give us any access to the learners"*.

Now **back on campus**, Malefa reports using technology to **pre-record lessons** *"record a lesson"* conduct **live lesson for remote learners** *"they can see me, and I can see them...on Google Classroom...teachers and learners meet"*; **post content** *"send them the lessons or homework"*; provide **online assistance** *"they can ask questions"*; and **communicate** *"we communicate with the learners"*.

While Malefa feels technology needs to be **more integrated into existing pedagogic practices** *"we have to integrate technology more into what we're doing"* and can potentially **support a hybrid educational approach** *"at some stage...it will not even be important for kids to attend school, if I can be online with them...whatever lesson I'm teaching I can still go online to helping those kids that are at home"*, she believes this **may not be sustainable** as **many learners** in South Africa **do not have access to the required resources** *"if you don't have resources, then it's not going to change at all, it will be a loss for learners that don't have"*.

Patrick[133] believes **technology** should only be **used where it makes sense** *"where it makes sense as opposed to just for the sake of technology"* to **support existing pedagogic practices** *"it's a good support for teaching...it doesn't really change it a lot...just makes things easier and faster"*. When **remote**, Patrick feels t**echnology** is still being used to **support** his **pedagogic practice** *"send notes...engage with questions"*.

On campus, Patrick reports using technology to **present** and **distribute content** *"use it to project images...send them a brief"*; **show videos** *"show them videos"*; **enable learners to research** *'learners do research on my laptop"*; and **communicate with learners** *"I communicate with them"*.

[133] Patrick did not comment on intended future technology use.

When **remote**, Patrick reports using technology to **create** and **distribute content** *"I create a* PowerPoint *or notes using my school laptop...a brief...send it to* WhatsApp*...email it to my learners using my home laptop"* and provide **online assistance** *"the brief might not be clear...engage with a learner who asked a question...I responded to the class"*. For **administrative** tasks, Patrick reports using technology for **communication** with **very few learners** *"only got one response...I would say less than 5% get back to me"*, as he maintains **learners' have data access issues** *"my learners are not having internet...lack data"* and their **contact details are unavailable to teachers** *"getting email was a real challenge...we are not allowed to have their contact details...got some email addresses from the learners"*.

Now **back on campus**, Patrick reports using technology to **conduct live lessons** *"mostly using* Google Classroom *for explaining...teaching"*, **post content** and **online resources** *"post a PDF or* Word *document for them to follow...lined up links or digital documents they can use"*, **search for resources** *"digital documents I've been able to find online"*, offer **online learner assistance** and **communication** *"on the platform asking questions and receiving responses...I'm ready to communicate with them"* and **attend meetings** and **interact with peers** *"we are not meeting face to face...with* MS Teams *and* Google *we are still able to meet, get announcements...interaction with other teachers"*.

Patrick believes even though technology **needs to be used more extensively** to **cater to current** and **future learners** *"we need to be more open to learners being in contact with the technology...they already know technology...understand it...love it"*, he feels there needs to be **balance between online** and **traditional teaching** *"it's likely that education might have to balance the two, online learning as well as our traditional teaching methods"*, as **learners need in-person contact time with teachers** *"complete reliance on the digital medium is not very productive...learners need that kind of contact with teachers...you can't get that online"* and **enormous inequalities exist** among **advantaged** and **disadvantaged learners** in South Africa *"very few learners are able to interact with teachers using video because of availability of data and devices...the digital divide is a reality in South Africa"*.

Thuli[134] believes **technology** only **supports** her **pedagogic practice** *"it supports rather than transforms"* as **basic teaching methods** and certain **skills** are **still needed** *"you can't move away from basic teaching methods...doesn't mean you can abandon normal teaching...also if they're not writing it out with their own hand...it's not possible for them to remember...also have to read...can't just click all the time"*.

On campus, Thuli reports using technology to **prepare** and **present content** *"to prepare content...for presentations in the classroom, display on the screen...to teach"*; **show videos** *"put in videos"*; **capture marks** *"I capture marks on* Excel*"*; and **set assessments** *"use it for assessment setting"*.

When **remote**, Thuli reports due to **lack of access to learners' contact details** *"contact details...that's not provided to us"* and **resources** *"we don't have contact with the learners...because of the technology that we have"*, she **only used technology prior to moving off campus** to **upload content** *'just before we closed...put exercises, previous exam papers on* D6 *for the learners to download"*,

Now **back on campus** Thuli reports using technology to **pre-record** and **upload lessons** *I'm using the video feature...to record lesson and upload"*, conduct **live remote lessons** *"I have conducted one live class"*, provide **online assistance** *"students post questions underneath my videos...I then can answer these"* and attend **staff meetings** *"we're using Microsoft to have our staff briefings"*.

While Thuli believes teachers now **need to utilise technology more** *"need to be more IT inclined"* and **foresees education being more blended** *'to be more blended"*, she maintains **current inequalities** amongst **South African learners** and **schools** makes this type of **approach unsustainable** *"in South Africa...I feel like we will be disadvantaging most of our students...because of access issues and affordability...there is a huge differential between advantaged and disadvantaged schools and learners"*.

[134] Thuli did not comment on level and manner of adoption when remote, and intended future technology use.