ABBREVIATIONS AND ACRONYMS

ACOT:	Apple Classrooms of Tomorrow project
ANA:	Annual National Assessment (systemic evaluation)
ATC21S:	Assessment and Teaching of Twenty-first Century Skills project
CK:	Content Knowledge
DoE:	Department of Education
DBE:	Department of Basic Education
DHET:	Department of Higher Education and Training
DWCPD:	Department of Women, Children and People with Disabilities
ECD:	Early Childhood Development
ECE:	Early Childhood Education
ETS:	Educational Testing Services
EU SPSP FP:	The European Union's Sector Policy Support Programme "Strengthening Foundation Phase Teacher Education"
FP:	Foundation Phase
ICT:	Information and Communications Technology
ICT-CFT:	ICT-Competency Framework for Teachers (UNESCO)
NCCA:	National Council for Curriculum and Assessment
NEPAD:	New Partnership for Africa's Development
PCK:	Pedagogical Content Knowledge
PK:	Pedagogical Knowledge
OECD:	Organisation for Economic Cooperation and Development
SAIDE:	South African Institute for Distance Education
TbTL:	Technology-based Teaching and Learning
TCK:	Technological Content Knowledge
TELI:	Technology Enhanced Learning Initiatives
TK:	Technological Knowledge
TPK:	Technological Pedagogical Knowledge
TPACK:	Technological Pedagogical Content Knowledge
UNCRC:	United Nations Convention on the Rights of the Child
UNESCO:	United Nations Educational, Scientific and Cultural Organisation
WCECCE:	World Conference on Early Childhood Care and Education

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CHAPTER ONE:
INTRODUCTION AND ORIENTATION TO THE STUDY

Any sufficiently advanced technology is indistinguishable from magic.

- Arthur. C. Clarke

1.1 INTRODUCTION

Education in South Africa has been transformed as a result of a wide ranging series of legislation and policy introduced since 1994. In particular, the former Department of Education stipulates learning outcomes for the 21st century which recognise that learners use information in particular contexts (Department of Education [DOE], 2001; Law & Chow, 2008b in Leendertz, Blignaut, Niewoudt, Els & Ellis, 2013:1). According to Maaga (2009:1), the early childhood phase (birth to 9 years of age) is the most crucial phase for every person. The Foundation Phase of formal education incorporates these years and ensures that quality early learning provides children with the best possible start in life. A firm learning foundation in the Foundation Phase presupposes attention to as well as understanding of the cohort in which the new young learners find themselves.

Furthermore, Weiler (2004:46) suggests that, “it may be that academe, and indeed the entire world, is currently in the middle of a massive and wide-ranging shift in the way knowledge is disseminated and learned.” Prensky (2001a) states that neurobiology and social psychology have proved that various kinds of technological stimulation actually alter brain structures and affect the way people think. More recently, the same author stated that “technology, rather, is an extension of our brains; it's a new way of thinking. It's the solution we humans have created to deal with our difficult new context of variability, uncertainty, complexity, and ambiguity” (Prensky, 2013a:22). In line with Prensky, the generation theory (Strauss & Howe, 1991; 1997) explains how the era in which a person is born affects their view of the world and predicts behaviour and expectations. When persons are born in differing eras, their worldviews and characteristics differ leading to a so-called generation

gap. To this end, Codrington and Grant-Marshall (2011:18) argue that the generation gap is most evident in organisations where there is a large age gap and a difference in attitude between individuals providing lessons and those receiving them, such as in schools. Since the children of today are being socialised in a vastly different way, this study aims at providing insight into technology-based teaching and learning for the present day generation of Foundation Phase learners, from a South African educational research perspective.

The youth of today, as opposed to previous generations, have knowledge readily available largely due to the recent technological boom. "Technology is a huge driver of change" which has granted young children to be born into a 'connected' world of internet, social media, instant messaging and 'always on' digital equipment (Codrington & Grant-Marshall, 2011:86). With this in mind it has become increasingly important to question how these changes influence these learners and especially the way in which technology influences their learning and the teaching thereof. The topic of technology-based teaching and learning (TbTL) in the Foundation Phase was explored through a qualitative study in order to identify specific characteristics of these learners, as well as how technology influences teaching and learning.

The following sections of this chapter consist of the rationale of the study, the clarification of key concepts and follow with research questions. Thereafter, I orientate the reader to the theoretical framework of the study. The remaining section consists of an explanation of the research methodology and ethical considerations. This chapter concludes with an outline of the thesis.

1.2 RATIONALE

The role of technology in learning has great importance today as the world is being transformed by digital technologies at an expeditious rate (Mishra, Koehler & Henriksen, 2011:23). Devereux (1933:1) posits:

> *Today the world of the learner is almost unbounded. He [sic] must acquire facts relating to a bewildering variety of places and things; he must acquire*

> *appreciation of far-reaching interrelationships. The curriculum and methods of teaching must undergo a continuous appraisal. New subject matter and new devices for instruction are being scrutinized for their potential contributions to the learning process.*

Throughout history, technology generates the promise of a revolutionary society, and a revolutionary change in education by virtue of technological advances. The future promises more of the same technological progression according to Mishra *et al.* (2011:23). Furthermore, Codrington and Grant-Marshall (2011:xiii) attest that it has never before been as important to understand the way individuals view the world as now. In other words, how does this cohort of Foundation Phase learners make sense of their world and how do they fit in or stand out from others in terms of the way in which they learn and are taught?

Secondly, I am a mother of two young children, as well as a lecturer in Early Childhood Education (ECE). From a personal perspective, I have a vested interest in exploring TbTL in the Foundation Phase since both my home life and career path involve the way in which these young children learn. The insight gained from this study contributed to my own understanding, as well as provided recommendations that can be applied to teaching and learning in the Foundation Phase.

This study explored the use of TbTL in the Foundation Phase through teachers', learners' and district officials' experiences thereof, specifically the aspects that influenced young children's learning and their respective teacher's teaching. Subsequently, the significance of this study was that the data gathered and the literature surveyed proved valuable in producing a framework for TbTL in the Foundation Phase in order to understand these role players in context (see Figure 5.13).

1.3 CONCEPT CLARIFICATION

For the purpose of this study, the following key concepts are explained: technology-based teaching and learning (TbTL), digital literacy, Foundation Phase learners,

technological profile and Technological Pedagogical and Content Knowledge (TPACK).

1.3.1 Technology-based teaching and learning (TbTL)

Technology, specifically electronic technology, is transforming the way that people work, live and play (Kruger, 2014). The world is interconnected and globalised and learning has become ubiquitous. With the emergence of increasingly robust connectivity infrastructure and cheaper computers, school systems around the world are developing the ability to provide learning opportunities to students "anytime, anywhere" (Hawkins, 2010). A number of terms are employed when discussing technology in education; a common term is information and communication technology (ICT). Crawford (1997) defines ICT as an international network in which the contribution of knowledge and ideas are shared in order to connect people by using communication such as cell phones and computers. With regard to this study, technology-based teaching and learning will imply the use of technological tools such as the internet, devices, applications, social networking and the likes that both teachers and learners use for teaching and learning respectively. Furthermore, technology as a tool is the basis for teaching and learning in the Foundation Phase but other influences such as pedagogy and content are included as key elements of this term in the study.

1.3.2 Foundation Phase learners

In South Africa, the Foundation Phase caters for children from 5 to 9 years (Grades R-3 of schooling) (Department of Education, 2001). Bush and Codrington (2012: xviii) coined this generation as "the Age of Possibility"; Codrington and Grant-Marshall (2011) refer to them as the *Next Gen;* and Fiorina (in Bush & Codrington, 2012) describe them as the *dot com boom*. Regardless of the name, this cohort of learners is shaped by the internet, technology, the recession, and social media. Literature often refers to Early Childhood Education (ECE) or Early Childhood Development (ECD) as programmes from birth to 9 years old. Since this term includes Foundation Phase learners, they will be used interchangeably. For the purpose of this study the older children of this cohort (9 years) will be referred to as Foundation Phase learners in Grade 3.

1.3.3 Digital literacy

The ability to find, evaluate, create and share information using electronic devices and the internet is becoming increasingly important as a 21st century skill. The skills are often defined as flexible problem solving, communication and collaboration (Binkley, Erstad, Herman, Raizen, Ripley, Miller-Ricci & Rumble, 2012), intrapersonal skills of self-management, time-management, self-regulation and adaptability (Koenig, 2011:2) and process orientated skills like teamwork and flexibility (Noss, 2012:3). According to Brooks-Young (2007:10), "mastering these skills is the first step toward learning how to make effective use of technology as a tool for teaching and learning." In an attempt to define digital literacy, Belshaw (2012:31) posits that, although ambiguous, digital literacy is simply a set of basic skills in a digital world. In this study, the term digital literacy therefore, refers to the capabilities that an individual possesses in order to teach and/or learn in a digital age.

1.3.4 Technological profile

This 21st century learner has never lived without the internet and has been "born into a digital world, proficient with and dependent on technology, making it a critical part of how they interact, play, and learn" (Grail Research Report, 2011:3). In this study, the technological profile of learners will refer to the representation or type of South African Foundation Phase learner in light of their interaction with technology for learning.

1.3.5 Technological pedagogical and content knowledge (TPACK)

Shulman (1986) bore the idea of *Pedagogical Content Knowledge* (PCK). Using PCK as a point of departure, Koehler and Mishra (2005) highlight the importance of *Technological Pedagogical and Content Knowledge* (TPACK) for understanding effective teaching with technology. Moreover, this framework considers teacher knowledge regarding technology as significant, yet not isolated nor unrelated from the contexts of their teaching. Koehler and Mishra (2009:60) state that the interaction of three bodies of knowledge, namely content, pedagogy and technology, comprise the TPACK framework. TPACK in this study refers to the theoretical framework

which is also at the core of the conceptual framework (see Figure 3.3) since it represents technology integration in the Foundation Phase.

1.4 RESEARCH QUESTIONS

1.4.1 Primary question

How do teachers and learners experience technology-based teaching and learning in selected Foundation Phase classes?

1.4.2 Secondary questions

- What is the 'technological profile' of Foundation Phase learners?
- How can technology benefit teaching and learning in South Africa in the Foundation Phase?
- What recommendations can be made to ensure technology-based teaching and learning in the Foundation Phase is successful?

1.5 THEORETICAL FRAMEWORK

The meaning of theory in any scientific field is to provide a framework within which to explain relationships among the phenomena being studied and to provide insights, thereby leading to the discovery of new relationships (Tudge, Mokrava, Hatfield & Karuik, 2001:3). According to Hitchcock and Hughes in Cohen, Manion and Morrison (2005:13) "theories therefore aim to both propose and analyse sets of relations existing between a number of variables when certain regularities and continuities can be demonstrated via empirical inquiry." The definition of a theory can often be bound in its components which according to Wacker (1998:363) are namely: "1) the definitions of terms; 2) a setting where theory applies; 3) a set of relationships of variables; and 4) specific predictions." In this vein, the TPACK framework was applied to this study in order to establish the conceptual framework for technology-

based teaching and learning in the Foundation Phase (see Figure 3.3) as well as to explain confirmation or non-confirmation of the empirical data regarding technology for teaching and learning. Finally the interaction between and among technological pedagogical content knowledge predicted, by means of a framework, the way forward for technology-based teaching and learning in South African Foundation Phase education. The conceptualisation of Mishra and Koehler's (2006) TPACK framework as indicated in Figure 1.1 served as the lens through which I conducted my exploration, paying particular attention to technology-based teaching and learning in the Foundation Phase.

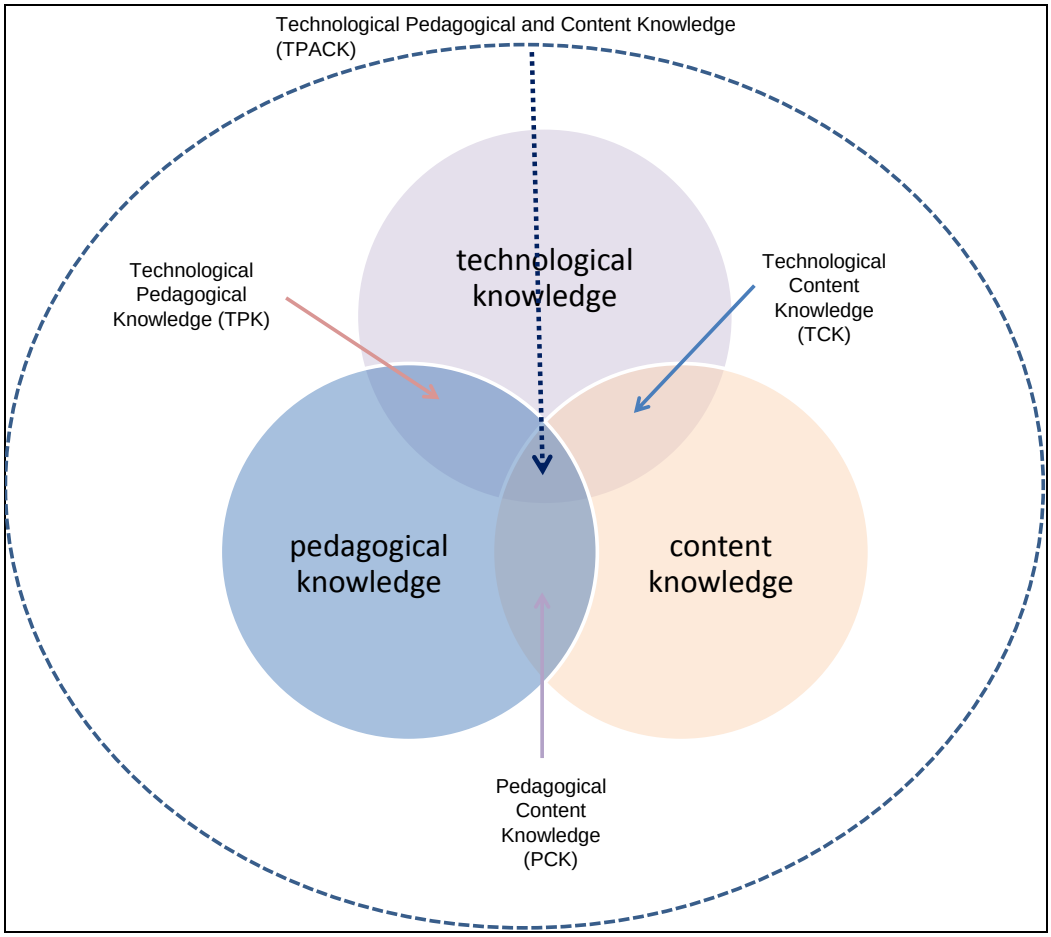


Figure 1.1: Conceptualisation of TPACK framework (Reproduced by permission of the publisher, © 2012 by tpack.org)

Shulman (1986) introduced the notion of pedagogical content knowledge (PCK) which went beyond knowledge of subject matter only and included knowledge about

how particular content can be taught. Within the context of a technological environment, Koehler and Mishra (2005) recreated Shulman's idea of PCK to represent the concept of technological pedagogical and content knowledge (TPACK). Hence, there are three primary constituents for teaching with technology - content, pedagogy and technology - and the interaction between these bodies of knowledge are essential to the framework (Koehler & Mishra, 2009). At the centre of the framework is the interaction of all three bodies of knowledge known as technological pedagogical content and knowledge. TPACK essentially consists of seven knowledge areas, which are briefly discussed below and in further detail in Chapter 3:

1.5.1 Technological Knowledge (TK) refers to an understanding of the various technologies that exist (Schmidt, Baran, Thompson, Mishra, Koehler & Shin, 2009:125). TK includes standard technologies and more advanced technologies as well as the way in which to use the technological tools and resources (Koehler & Mishra, 2009; Mishra, Koehler & Henriksen, 2011).

1.5.2 Content Knowledge (CK) may be defined as the knowledge of the subject matter according to Mishra *et al.* (2011:23). Shulman (1986) elaborates further to state that CK includes knowledge of theories and concepts, conceptual frameworks as well as knowledge relating to acquired ways of establishing knowledge.

1.5.3 Pedagogical Knowledge (PK) encompasses knowledge about the practices and processes of teaching and learning and includes lesson planning, classroom management and assessment methods (Koehler & Mishra, 2009; Mishra *et al.*, 2011).

1.5.4 Pedagogical Content Knowledge (PCK) is knowledge about how to adequately integrate pedagogy and content to better teaching practice in a specific content area (Shulman, 1986; Schmidt *et al.*, 2009). PCK embodies knowledge of common misconceptions and likely preconceptions students bring with them to the classroom according to Archambault and Crippen (2009).

1.5.5 Technological Content Knowledge (TCK) refers to technology usage that can alter the way that learners practise concepts in a certain content area (Schmidt *et al.*, 2009). Koehler and Mishra (2009:65) postulate that "understanding the impact of technology on the practices and knowledge of a given discipline is critical to developing appropriate technological tools for educational purposes."

1.5.6 Technological Pedagogical Knowledge (TPK) refers to the affordances and constraints of technology as an enabler of different teaching approaches (Mishra & Koehler, 2006). Leendertz *et al.* (2013) suggest that technology should be connected to pedagogy to add value to teaching and learning and therefore, cannot be regarded as context-free.

1.5.7 Technological Pedagogical Content and Knowledge (TPACK) refers to the knowledge and understanding of the interplay between CK, PK and TK when using technology for teaching and learning (Schmidt *et al*., 2009). It includes an understanding of the complexity of relationships between students, teachers, content, practices and technologies (Archambault & Crippen, 2009).

Niess (2005:510) states that "TPACK, however, is the integration of the development of knowledge of subject matter with the development of technology and of knowledge of teaching and learning. And it is this integration of the different domains that supports teachers in teaching their subject matter with technology." Likewise, the TPACK framework was a useful organizational structure for defining what it is that teachers need to know to integrate technology effectively (Archambault & Crippen, 2009). To understand the context of learners currently in Foundation Phase, the TPACK framework was used since "the interaction of these bodies of knowledge, both theoretically and in practice, produces the types of flexible knowledge needed to successfully integrate technology use into teaching" and learning (Koehler & Mishra, 2009:60; Koehler, Mishra & Cain, 2013:13).

1.6 RESEARCH METHODOLOGY

The research methodology consists of the research design and research method. The research design of this study is outlined by a brief discussion of the interpretivist paradigm, qualitative approach, and case study research type while the data collection and analysis procedures are briefly elucidated in the research method section.

1.6.1 Research design

The research design consists of the research paradigm, research approach and research type as specified below in Figure 1.2.

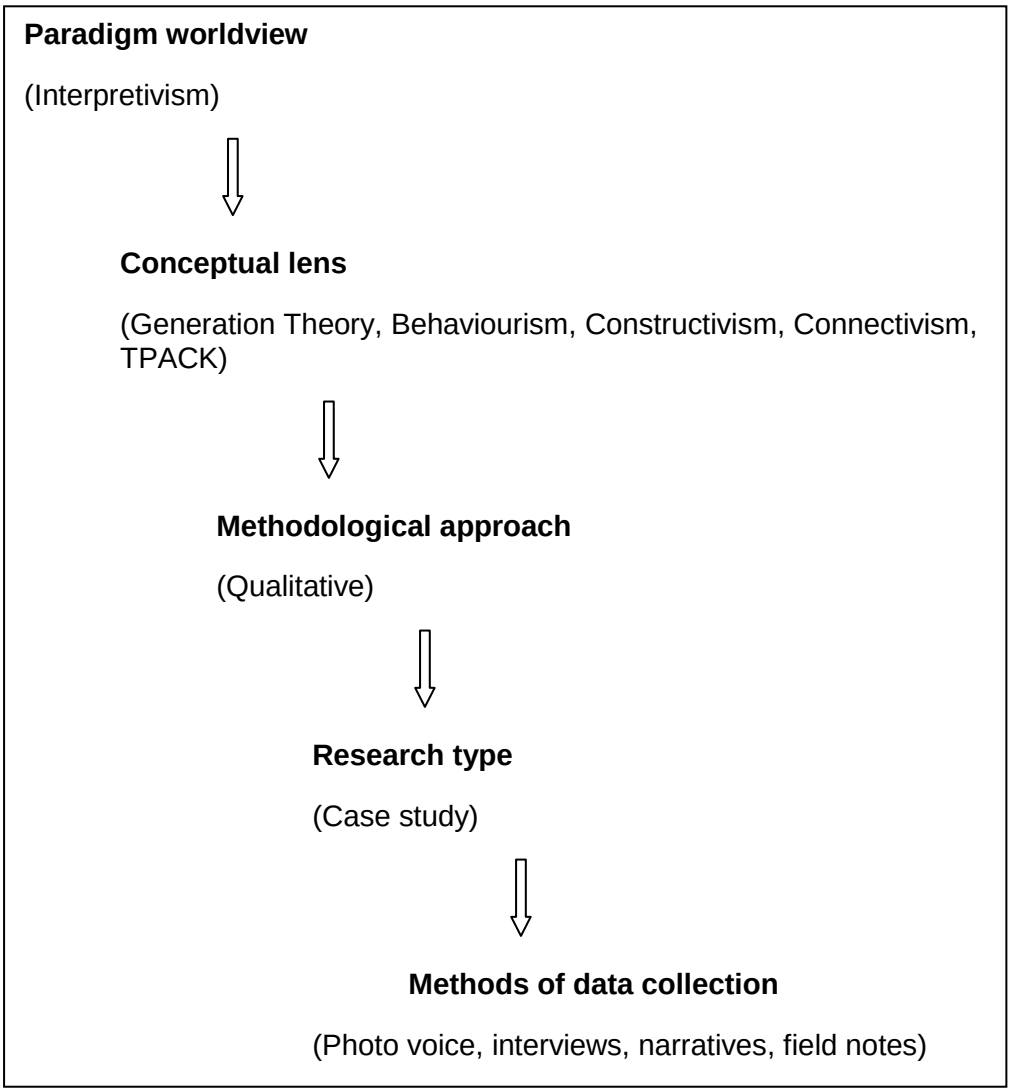


Figure 1.2: Four levels for developing a research study (Adapted from Crotty (1998) in Creswell and Plano Clark (2011)

1.6.1.1 Research paradigm

Congruence between the epistemological assumptions, theoretical assumptions and methodology provided an overarching framework of guiding principles which assisted me to garner meaning from my investigation.

Philosophical assumptions in research consist of a basic set of beliefs or assumptions that guide investigations (Guba & Lincoln, 2005). The ontology of the interpretivist worldview is such that it "acknowledges an interactive relationship between the researcher and participants as well as between participants and their own experiences and how they have constructed reality based on those experiences" (Nieuwenhuis, 2007:55). The epistemology based on the interpretative paradigm endeavours to "understand the subjective world of human experience" (Cohen *et al*., 2005:23).

In this vein, I began data collection in classrooms and set out to understand the Grade 3 teachers' and learners' environment since "the social world consists of and is constructed through meanings" (Livesey, 2006:4). My prime motivation was to take a social view by examining learners' everyday interactions in their natural environment of their classroom. Within the interpretivist paradigm, "the uniqueness of a particular situation (context) is important to understand and interpret the meanings constructed" (Nieuwenhuis, 2007:59). Furthermore, Nieuwenhuis (2007) explains that within this paradigm, human behaviour is affected by knowledge of the social world, which emphasises a two-way relationship between theory and research. Finally, concerning the methodology of the study, I linked the theoretical with the empirical by means of a qualitative case study approach to conduct and interpret a multifaceted study. With regard to this study, I also explored the use of TbTL based on the assumption that it will be useful to understand teachers' and learners' experiences of the latter.

1.6.1.2 Research approach

The methodological approach of this study was qualitative since this approach is aligned with the research question and nature of the study (Maree, 2007:35). Nieuwenhuis (2007:79) maintains that a qualitative approach endeavours to make sense of a set of circumstances that surround a particular situation accomplished through a real-life, naturalistic approach. Qualitative research uses a naturalistic approach that seeks to understand phenomena in context-specific settings, such as Grade 3 learners and their respective teachers, as well as the general Foundation Phase population in South African schools, which presents a "real world setting [where] the researcher does not attempt to manipulate the phenomenon of interest" (Patton, 2002:39). Creswell (2007:37) defines qualitative research as a process of research that emerges from a philosophical standpoint to a theoretical lens and then to the methods associated with studying human phenomena. Furthermore, Richardson and St. Pierre, (2005:3) posit that qualitative research includes a set of analytical and concrete practices such as interviews, conversations, field notes, photographs and researcher's memos. Such is the case in this study as qualitative data collection involved photographs taken by the participants, narratives, interviews, opinion pieces and ongoing field notes (see 4.4.2).

1.6.1.3 Research type

I chose to make use of case study research for the purpose of acquiring a deeper understanding of the experiences and descriptions of TbTL in the Foundation Phase (see 4.4.3). Within the interpretivist paradigm, this case study aims at a multifaceted understanding of participants' relations and interactions in teaching and learning situations in order to make sense of TbTL. According to Hitchcock and Hughes in Cohen, *et al*. (2005:183), a case study has several distinctions such as the focus on participants while seeking to "understand their perceptions of events" and the "blend of the description of events with the analysis of them." Cohen *et al.* (2005:181) define a case as "the study of an instance in action" where the instance is bounded by a system. This case study concentrated on one instance which was the unit of analysis, namely TbTL and was bound in the Foundation Phase at three different research sites.

The purpose of case study research is to capture “a thick description” (Kuper & Kuper, 2004:92) while considering the social context (Yin, 2011:4) of the phenomenon and individuals under study. The qualitative case study research type allowed me to use various sources and approaches to collect data as well as allowed me to substantiate the phenomenon of TbTL with existing knowledge and practice.

1.6.2 Research methods

The research methods consist of the sample of participants and research site, data collection methods and data analysis strategies.

1.6.2.1 Selection of participants and research site

The primary research sites were two chosen schools in Gauteng due to the fact that the environment was identified as data rich, which implies that the schools are technologically inclined. I made use of the facilities at the schools to gather data, for the practical reason that they provided the most accessible venues for teachers and learners that are familiar with this location. Accordingly, Creswell and Plano-Clark (2011:172) state that in order “to address a research question or hypothesis, the research engages in a sampling procedure that involves determining the location or site for the research, the participants who will provide data in the study and how they will be sampled, the number of participants needed to answer the research questions, and the recruitment procedures for participants.”

Since there was a need to target a particular group for the qualitative data collection of this study, the method of sampling was purposive. Within the above mentioned research sites, I chose “the nearest individuals to serve as participants” (Cohen *et al*., 2005:102) in a heterogeneous sample of Foundation Phase learners and their respective teachers, and district officials. This method of sampling is used in special situations where the sampling is done with a specific purpose in mind (Maree 2007:178), as is the case in which a certain profile of teachers, learners and district officials was necessary. I purposively selected five Grade 3 learners from each of the two particular schools, as well as their class teachers to participate in the research. The reason for choosing the 10 above-mentioned learners was to reflect the exit year of the Foundation Phase as these children are the older of the Foundation

Phase learners under study. Participants were selected according to the criteria outlined in Chapter 4 (see 4.4.1). In the same vein, I selected two district officials from the same district as Case 2 to take part in the study in order to ascertain official perspectives with regard to TbTL in the Foundation Phase.

1.6.2.2 Data collection methods

I made use of qualitative data methods in order to collect and saturate data. Tashakkori and Teddlie (2003:298) state that "a method of data collection is simply a technique that is used to collect empirical research data." In order to add to the ability of interpreting the data, I used the photovoice technique, narratives, interviews, opinion pieces and field notes and an expert verification to probe deeper into understanding the Foundation Phase learners and teachers, as well as to understand the landscape of the Foundation Phase population with regard to TbTL. The specific techniques that I employed are outlined below and further in Chapter 4 (see 4.4.2.1 – 4.4.2.5).

i. Photovoice method

The photovoice method involved cameras being issued to participants who are prompted to take pictures of people or things that are closely connected to the research topic. One of the crucial strengths of the "photovoice" method (also known as "reflexive photography") is to emphasise personal experiences in particular, as well as to gain participants' maximum involvement in the research study (Olivier, Wood & De Lange, 2009). I therefore decided to use this method, especially to ensure participation from the young learners, but also from their teachers. With regard to the skepticism of involving young children in this technique, Strack, Magill and McDonagh (2004) note that similar to Freire's (1973) line drawings which "served to personalize issues for discussion, the youth's own photos created a great sense of pride and ownership that contributed to their exchange of views."

In order to implement this method, I made use of a step-by-step guide to facilitating a photovoice project, as compiled by Olivier *et al.* (2009). I also foresaw the photovoice procedure as useful because this was case study research, and the practicality of

completing the steps to analyse data collected could be obtained with ease with young children and their teachers. The steps which are further explained in Chapter 4 (see 4.4.2.1) were incorporated into three sessions (see Table 1.1)

ii. Narratives

The use of the narrative in this study was important since it allowed for a more comprehensive understanding of the learner participants' perspective of TbTL through the collection and analysis of text which was based on photographs that were taken during photovoice. Andrews, Squire and Tamboukou (2008:5) describe this method as "individual, internal representations of phenomena and the events, thoughts and feelings to which narrative gives external expression." In this study, narrative refers to "the term assigned to any text or discourse" (Creswell, Hansen, Plano-Clark, & Morales, 2007:240).

I made use of this mode of inquiry during the third session (wrap-up) of the second phase of data collection by asking the same learners who participated in photovoice to write a story in response to their chosen photograph. Since Foundation Phase learners cannot write at length, they were required to submit narratives of half a page and a discussion thereof was also held. During the latter discussion and analysis, I applied functional analysis to establish emerging themes and categories, which is looking at what the narrative is "doing" and what is being told (Maree, 2007).

iii. Semi-structured interviews

A semi-structured interview is often used in qualitative research to corroborate data emerging from other data sources (Nieuwenhuis, 2007). In this study, semi-structured interviews (see 4.4.2.3) were conducted with same teachers that participated in the photovoice phase of the study in Case 1 and Case 2. Semi-structured interviews were also conducted with the two district officials in Case 3. I conducted the interviews during the second phase of data collection. In a semi-structured interview the interviewer asks all participants the same series of pre-established questions (Denzin & Lincoln, 2000:649). This type of interview "defined the line of inquiry" (Nieuwenhuis, 2007:87) by asking participants a set of predetermined questions while still being sensitive to the participants' responses in

order to probe and define further investigations. A voice recorder was used during the process of the interviews and the notes were transcribed for data analysis.

iv. Field notes

Nieuwenhuis (2007:83) posits that qualitative observation is the structured process of recording patterns of behaviour without actually communicating with the participants. This type of data collection technique allowed me to gather field notes by conducting an observation as a non-participant or 'outsider' at the research site of the two schools (Creswell, 2007). Similarly, Creswell (2007:134) advocates that the researcher should record field notes by means of an observational protocol which can include descriptive, as well as reflective notes. I defined a purpose and focus for my observation based on my research questions and made use of both anecdotal records and structured observation recordings (Nieuwenhuis, 2007).

v. Opinion piece

In this study, district officials were requested to write an opinion piece based on their perspectives of TbTL and in light of their vantage point in the Foundation Phase. I used an open-ended questionnaire technique since "site specific case study is required… to capture the specificity of a particular situation" (Cohen *et al*., 2005:247). Two question items were included which allowed the participants to write their responses freely (see 4.4.2.5). The opinion piece was requested from the participants after conducting an interview with them to ascertain what is currently reflective of TbTL in the Foundation Phase and to explore the benefits and barriers of the landscape in the Foundation Phase with regard to TbTL. This method was useful to probe deeper into understanding the technological landscape for TbTL in the Foundation Phase and to provide guidelines and suggestions thereof to the relevant stakeholders.

vi. Systematizing expert interview

After data were collected using the indicated methods, it was analysed. At this point, I held a discussion with an expert in educational technology who has "special expert knowledge which is related to a special professional field" (Bogner, Littig and Menz, 2009:11). The discussion was based on the themes and categories that emerged from the empirical data (see Table 5.7) in order to verify the latter. Van Audenhove (2007:12) maintains that a systematizing interview is particularly useful when there is a focus on "aggregation" of different points of views. To this end, the interview with the expert in this study was concerned with the verification of the themes and categories which came forth from numerous participants' responses.

Table 1.1: Projection of data collection

<table>
<tr><th colspan="5">PROJECTION OF DATA COLLECTION</th></tr>
<tr><th>PHASE</th><th colspan="2">DATA COLLECTION STRATEGY</th><th colspan="2">OBJECTIVE</th></tr>
<tr><td rowspan="3">PHASE 1</td><td rowspan="2">Administration</td><td>1. Ethical clearance</td><td colspan="2">• Permission to conduct research</td></tr>
<tr><td>2. Contact participants</td><td colspan="2">• Establish relationship with schools and district</td></tr>
<tr><td colspan="2">3. Correspondence with participants and parents</td><td colspan="2">• Explain nature and intent of study</td></tr>
<tr><td rowspan="4">PHASE 2
Facilitate Photovoice</td><td colspan="2">i. Photovoice Technique (teachers and learners)</td><td>1. Orientation</td><td rowspan="4">Field notes</td></tr>
<tr><td colspan="2">• Discussions
• Preliminary field notes</td><td>2. Exhibition</td></tr>
<tr><td colspan="2">ii. Narratives (learners)
iii. Interviews (teachers)
iv. Interview (District officials)
v. Opinion piece (District officials)</td><td>3. Wrap-up</td></tr>
<tr><td colspan="2"></td><td></td></tr>
<tr><td>PHASE 3</td><td colspan="2">Analysis</td><td colspan="2">• Analyse data
• Interpret data
vi. Expert verification</td></tr>
</table>

1.6.3 Data analysis strategies

Although most studies in the interpretive paradigm prefer inductive data analysis, this study made use of a combination of deductive and inductive methods. I mainly used deductive techniques to analyse the data based on literature and the conceptual framework of the study. However, since this study was conducted in the natural setting, it was insinuated that "realities are in essence compete aspects (wholes) that cannot be understood in isolation from their contexts" (Lincoln & Guba, 1985 in Maree and Van der Westhuizen, 2007:37). McMillan and Schumacher (2001:463) posit that there is no one 'right' way to analyse since data can be analysed in multiple ways. In line with this view and explained further in Chapter 4 (see 4.4.3), I used both inductive and deductive analysis in Creswell's (2012:237) six steps which are frequently used in analysing qualitative data, as well as data analysis for a case study research type (Creswell, 2007:156-157).

The methods used to document data during the data collection stages comprised of extensive field notes, audio recordings, narratives, opinion pieces and verbatim transcriptions. Data managing took place throughout all phases of the data collection. Thereafter, data from the photovoice technique, narratives, opinion pieces, interviews and field notes were coded and reorganised into topic clusters. Upon further analysis, the data were sorted into categories with the guidance of the research questions and conceptual framework of this study. Finally, themes emerged from participants' understanding of TbTL in the Foundation Phase. I then analysed the critical points and linked these themes explicitly to the larger theoretical and practical issues (See 4.4.3, 5.2, 5.3, 5.4 and 5.5).

1.7 ETHICAL CONSIDERATIONS

Mertens (1998:23) maintains that ethical guidelines are needed to guard against the obvious and less obvious atrocities of research. According to Elias and Theron (2012), the ethical principles of beneficence and non-maleficence, fidelity and responsibility, integrity, justice and respect for people's rights and dignity were applied in this study. With regard to the aforementioned principles, firstly, the

participants were guaranteed safety in participation and were not placed at risk or harm of any kind. Participation was voluntary and participants were able to withdraw from the study at any time. The participants in the study were safeguarded from harm as they were not exposed to any acts of deception or betrayal in the research process or in its published outcomes (University of Pretoria, 2009).

Secondly, it is the researcher's responsibility to maintain professional standards of conduct in her role and behaviour throughout the research process (Elias & Theron, 2012). In this case, participants were fully informed regarding the process and intention of the study and informed consent from parents, principals and the Department of Education, as well as consent or assent from each participant was acquired beforehand. No inducements were offered to the Grade 3 learners and their teachers or district officials who took part in this study. Similarly, the confidentiality, anonymity and privacy of participants were protected at all times. The collection of data remained anonymous and confidential and participants' names and identities were not linked to the findings (McMillan & Schumacher, 2001:366). Moreover, since teacher and learner participants could photograph themselves or family members during the photovoice method, I ensured that the faces of individuals, who wished to remain unknown, would be blurred out. I applied for ethical clearance from the University of Pretoria (see Appendix K). This enabled me to observe all the ethical codes of conduct and procedures as stipulated.

1.8 OUTLINE OF STUDY

1.8.1 Chapter 1: Introduction and Orientation to the study

In the first chapter of this study the orientation and background of the research as well as clarification of key concepts and an introduction of the literature surveyed, the theoretical framework and the research methodology are provided.

1.8.2 Chapter 2: Technology-based teaching and learning vis-à-vis Early Childhood Education: A literature review

Chapter 2 of this study delivers an in-depth description of the contextual literature that is important in this study. The purpose of this chapter is to orientate the reader in Early Childhood Education and its importance as well as to account for the various aspects involved in and around technology-based teaching and learning.

1.8.3 Chapter 3: A conceptual framework for Technology-based Teaching and Learning in the Foundation Phase

This chapter provides a framework based on a number of theories and conceptual underpinnings that are relevant to technology-based teaching and learning in the Foundation Phase.

1.8.4 Chapter 4: Research methodology

Chapter 4 includes the research methodology of this study. It provides the research design and research methods while addressing trustworthiness and taking ethical considerations that are pertinent to the empirical nature of the study into account.

1.8.5 Chapter 5: Data analysis and interpretation

This chapter offers an analysis of the data that was obtained from the photovoice method, narratives, semi-structured interviews, opinion pieces, field notes and expert interview. The data were presented in three cases as a result from data provided by each participant. The subsequent themes and categories were then expertly verified. Data interpretation was done according to the main elements of the conceptual framework, the themes of the data and the research which essentially provide meaning to the phenomenon of TbTL in the Foundation Phase.

1.8.6 Chapter 6: Summary, conclusions and recommendations

This chapter completes the study with a summary of key findings from literature and empirical data. Research conclusions answer the research questions and recommendations for successful TbTL in the Foundation Phase are suggested. It

concludes by reflecting on limitations of the study as well as suggesting possibilities for future research endeavours within the discipline.

1.9 CONCLUDING REMARKS

Chapter 1 provided the introduction and rationale as well as presenting the research questions of this study. The pertinent concepts related to the phenomenon of TbTL are clarified and a brief introduction to the literature surveyed is also given. This chapter also accounts for a short outline of the research methodology, addressing trustworthiness and the ethical criteria that were considered (see Chapter 4 for a more detailed account of the above mentioned). Lastly, an overview of the chapters of this study is supplied. The following chapter presents a detailed description of the various areas of literature, such as early childhood education, the importance thereof and its place in South Africa, TbTL, 21st century skills, digital literacy and the benefits and barriers of TbTL, which place this study in context.

CHAPTER TWO: TECHNOLOGY-BASED TEACHING AND LEARNING VIS-À-VIS EARLY CHILDHOOD EDUCATION – A LITERATURE STUDY

New technology is common, new thinking is rare.

- Sir Peter. Blake

2.1 INTRODUCTION

The aim of this study was to explore TbTL in the Foundation Phase. Particularly, the results obtained from data as well as literature surveyed served to provide a framework for TbTL in the Foundation Phase. Therefore, the role of the subsequent literature review is to provide background information about the context of Early Childhood Education (ECE), as well as highlight pertinent skills required to teach and learn in the 21st century. Leendertz, Blignaut, Nieuwoudt, Els and Ellis (2013) explain that South African education has to change regularly to meet the requirements set out by the Department of Education, including the development of learning outcomes for the 21st century. However, in the Foundation Phase, key challenges need to be addressed, in addition to developing 21st century learners. Meier (2013) highlights that the 2010 Annual National Assessment systemic evaluation (ANA) results indicate that a large percentage of South African children are not achieving basic literacy and numeracy skills which further portrays a gross educational inequality. Moreover, the Department of Education (2007) found that grade repetitions were the highest in Grade 1 as a result of school entrants' learning abilities being inadequate as well as learning programmes that are inappropriate. With the above-mentioned in mind, it becomes increasingly important to explore alternative approaches to teaching and learning in the current era.

In addition, Weiler (2004:46) suggests, “it may be that academe, and indeed the entire world, is currently in the middle of a massive and wide-ranging shift in the way knowledge is disseminated and learned.” Thus, an aim of this study is to explore the essential elements of a framework for TbTL in the Foundation Phase, specifically the aspects that influence young children’s learning and their respective teacher’s teaching.

The purpose of this chapter is to provide an overview of literature surveyed on teaching and learning with technology in the Foundation Phase. The chapter begins with the contextualisation of the study against the backdrop of the local ECE environment. Furthermore, digital literacy and 21st century learning are discussed as they encompass the learners and teachers involved, as well as a specific set of skills that are necessary for individuals to become digitally literate. The new technologies that are multifarious do not come without challenges, especially in education within the South African context. Therefore, I provide a synopsis of the benefits and barriers to TbTL. Finally, this contextual analysis will explain both international and local TbTL in ECE.

2.2 EARLY CHILDHOOD EDUCATION

In order to situate both the reader and the participants, this study will depart from the importance of ECE and its context in South Africa. Literature often refers to ECE or Early Childhood Development (ECD) as programmes from birth to 9 years old. Since the terms ECE and ECD include Foundation Phase learners, they are used interchangeably in the following discussion depending on the appearance in the literature source referred to (see 1.4.3 for a more detailed clarification of the terms). The following subsections account for the importance of ECE, as well as the provision for ECE in South Africa.

2.2.1 The importance of Early Childhood Education

Especially in recent years, the domain of ECE has received increased attention. Pearson and Degotardi (2009) conclude that ECE has the potential to support change and improve lives on a global scale. “Globally, urbanisation, changing economic circumstances, migration and adjustments to family structure have resulted in greater acknowledgement of formal early childhood care and education” (Pearson & Degotardi, 2009:99). Similarly, Garcia, Virata and Dunkelberg (2008: 29) claim that “the future of Africa lies with the well-being of its children and youth.” Furthermore, this organization recognises that socio-economic transformation and growth lies in a vested interest in children.

The dawn of democracy in South Africa, emphasised early childhood development (ECD) as a significant area for reform and development (Shaik & Ebrahim, 2015). To this end, the Pan-African Forum for Children (2001) states that “today’s investment in children is tomorrow’s peace, stability, security, democracy, and sustainable development.” ECD is the underpinning of human development whereby an emphasis on ECE and its children enables rebuilding in Africa by virtue of viable human development, economic growth and social change (Aidoo, 2008).

International interest in early childhood provisioning and reaching positive outcomes for children has been inspired by the 1989 ratification of the United Nations Convention on the Rights of the Child (UNCRC) and universal provision of formal early childhood service (UNESCO, 2004). The latter organisation regards the early years as crucial in terms of later development and learning. Education enables children and the nation "… by equipping them with values and basic skills that allow them to critically reflect and make informed decisions about issues and courses of action" (Kaga, 2008:54). ECE has the potential to transform and improve the lives of communities on a global scale by providing children with fundamental skills for learning and for life.

Another issue regarding ECE is that learners have to be prepared for their future responsibilities as citizens of a democratic society (Schoeman, 2005). A nation's future relies on its young children since the circumstances and experiences that "happen to children in their first days, months and years of life affect their development, the development of our society and the development of our world" (Bernard van Leer Foundation, 2004:3). Schoeman (2005) also declares that many institutions help to develop citizens' knowledge and skills to shape their civic character and commitments, for example family, religious institutions, the media, and community groups which all exert important influences. In her study, Schoeman (2005:275) additionally ascribes a specific responsibility to ECE programmes whilst maintaining that they bear a special and historic responsibility for the development of civic competency and responsibility. Aidoo (2008) agrees when asserting that countries need to develop ECE policies that will guide strategic decision-making and resource allocation (Aidoo, 2008).

It is proven that quality early childhood care and education enhance children's growth and development in life, as well as safeguard that children develop crucial skills to meet the demands of childhood and subsequent adulthood. However, the quality of childcare and education is subject to *inter alia* the question of "whether the provision of ECD in South Africa is opening windows of opportunity for young children, and if so, whether such windows are being opened to be utilised to best advantage" (Meier, 2013:3).

2.2.2 Early Childhood Education provision in South Africa

In South Africa, ECD is explained as "… a comprehensive approach to policies and programmes for children from birth to nine years with active participation of practitioners, their parents and other caregivers" (Education White Paper 5 on Early Childhood Development, 2001:7). Furthermore, Williams and Samuels (2001:5) describe ECD as "the provision of physical, emotional, social, spiritual and moral development for children aged between zero and nine years". Therefore, children's development and the corresponding spectrum of elements which influence ECD form the basis for understanding this intricate term.

ECE in South Africa encompasses "an ideological and political struggle towards the creation of a society founded on human rights, which acknowledges the centrality of childhood in human and social development and children as individuals and citizens" (Williams & Samuels, 2001:5). The Department of Women, Children and People with Disabilities (DWCPD, 2013:73) states:

> *…education policies and programmes in the aftermath of apartheid focused on remedying the historical exclusion and under-resourcing of education for the majority of children in South Africa. However, while this increased access to education, the quality of educational inputs and outcomes did not receive the same degree of attention, and as a result South Africa has faced critical challenges*.

According to Meier (2013), the policy directive for the provision for ECD in South Africa paints a picture whereby sufficient groundwork for young children which meet international benchmarks has been undertaken, but under further examination, this picture is inaccurate. In the light of this, one should consider the context and conditions that are often far from conducive to development of South African children in the efforts to elevate their current status. Meier (2013:15) further posits that evidence on the implementation and quality of ECD which reflects a disparaging situation of fragmentation between policy and practice, lack of unified vision among sectors, goals and accountability, and disparity in service delivery to poor communities. Yet, Dr Zola Skweyiya, former Minister of Social Development, (in Maaga, 2009:1) verbalises government's commitment to improving ECE when stating: "In the human life cycle the early childhood phase from birth to nine years is considered the most important phase for every human being. Giving children the best start in life means ensuring them good health, proper nutrition and early learning".

The government has established many policies, programmes, laws and initiatives in an attempt to enhance the quality of life for young children. According to Meier (2013:7):

> *The South African government's commitments to children flow from South Africa's ratification of international child rights conventions, such as the United*

Nations Convention on the Rights of the Child (1990) and the African Charter on the Rights and Welfare of the Child (1999). Children's rights to ECD provision are also implied through a number of other constitutional rights such as the South African Constitution, the Children's Act, white papers and ECD policies.

The South African government has therefore responded to the less conducive conditions such as access to ECE, disadvantaged members and low qualifications of staff, in its endeavour to provide universal access to Grade R by 2012 (South African Institute for Distance Education, 2012). According to the 2014 State of the Nation address (South African Government, 2014) by President Zuma, the number of children attending Grade R had more than doubled, from about 300 000 to more than 700 000 between 2003 and 2011, and a Draft Policy Framework towards Universal Access to Grade R has been gazetted in order to make Grade R compulsory in South Africa.

The Diagnostic Review of Early Childhood Development (ECD) was carried out in 2012 under the National Evaluation Plan which established the groundwork for developing an ECD policy and programme (Berry, Biersteker, Dawes, Lake & Smith, 2013). Acknowledging the divided field of ECD, the Diagnostic Review of Early Childhood Development documents many risks faced by children and indicates that current services are not able to promote their optimal development (Richter, Biersteker, Burns, Desmond, Feza, Harrison, Martin, Salojee & Slemming, 2012). Likewise, the South African Department of Social Development (2013) has completed the Integrated Programme of Action for Early Childhood Development – Moving Ahead (2013 – 2018) which provides a programme for quality services to young children. South African Institute for Distance Education (2012) also reports that nine projects including 16 South African universities in collaboration with The European Union's Sector Policy Support Programme "Strengthening Foundation Phase Teacher Education" (EU SPSP FP), under the Department of Higher Education and Training (DHET), aims to provide better Foundation Phase teachers through strengthening the capacity of the higher education system.

ECE provisioning is a longstanding issue in South Africa. In a previous nationwide audit of ECE provisioning in South Africa, Williams and Samuels (2001:7) point out that a criterion that government should meet is that of providing policies that intend to improve the conditions under which young children grow, live and essentially develop. More recently, Meier (2013:3) claims that the period of ECD, as delineated by policy, is composed of services that advance or sustain the development of young children. These services include supplying infrastructure such as water and sanitation, registration of birth, health, cost effective and secure day care, structured programmes for children to learn, and formal schooling preparation (Richter *et al*., 2012:3).

In order to make provisions for ECE as mentioned in the preceding section, the public attention that ECE has received has been noted by the government which aims to improve the quality of life for young children through various policies, programmes and initiatives. Clearly, there is global, as well as national recognition of the importance of ECD for each child and society as a whole. Similarly, it is evident that providing ECD services to children has innumerable benefits. Williams and Samuels (2001) state that such benefits include: better school performance, a higher rate of primary school enrolment, decreased repetition and drop-out rates, lessened costs for remedial welfare and medical services, lower crime rate amongst juveniles and enhanced social and economic capacity. Unequivocally, these benefits of the investment in ECD surpass the advancement of other forms of human capital investment. In acknowledgement of the importance and benefit of ECD, I subsequently inquire into the type of learning that is necessary for these young children in the current century.

2.3 TECHNOLOGY-BASED TEACHING AND LEARNING

According to Kruger (2014), technology, specifically electronic technology, is transforming the way that people work, live and play. Bearing this in mind, the following section reviews literature regarding the skills required of citizenry in the 21st century and proceeds to discern the term, with all the elements of digital literacy. It

also examines 21st century teaching and learning paying attention to both the benefits and the barriers involved in TbTL.

2.3.1 21st century skills

This section departs from the array of definitions of/for 21st century skills in existing literature by delineating the elements that constitute them. Firstly, during 2009, both the Assessment and Teaching of Twenty-first Century Skills project (ATC21S), a multi-year, multinational, public private partnership project, developed a series of white papers to conceptualise changes and define the parameters of 21st century education (Griffin, Care & McGaw, 2012:6). The specific skill needs from the above-mentioned project were classified into the following categories according to Griffin *et al.* (2012):

- *Ways of thinking* incorporated problem-solving, critical thinking, creativity and innovation, metacognition development as well as learning to learn.
- *Ways of working* embodied collaboration, teamwork and communication.
- *Tools for working* constituted information and ICT literacy.
- *Living in the world* included elements of social and personal responsibility, components of life and career development, as well as a shifting priority on local and global citizenship.

Furthermore, *ways of learning* and *ways of teaching* were also mediated for assessment strategies that focus on specific 21st century skills that should be taken into account in 21st century education.

Secondly, according to the National Research Council (2008) in the United States (US), 21st century skills were first classified under five categories: adaptability, complex communication skills, non-routine problem-solving skills, self-management/self-development; and systems thinking. The said five categories of skills were subsumed in three broad collections, namely: cognitive skills, interpersonal skills and intrapersonal skills (National Research Council, 2011). The skill categories are defined below (National Research Council, 2011):

- Cognitive skills: involve critical thinking, non-routine problem solving, as well as systems thinking.
- Interpersonal skills: include communication on a complex level, teamwork and social skills, as well as sensitivity to culture and diversity.
- Intrapersonal skills: comprise of the self (self-management, self-regulation and self-development), as well as time management, adaptability and executive functioning.

The first cluster of skills involves the solving of complex problems where the person solving the problem uses special skills to find a solution to the problem. Levy and Murnane (2004) state that acquiring a solution includes metacognition and conceptual knowledge in order to reflect on the process and include multiple strategies in problem solving if necessary. Non-routine problem solving further fosters creative and innovative solutions to use prior knowledge and possibilities that are not always clear-cut (Houston, 2007). Systems thinking is also part of the cluster of cognitive skills, which constitutes decision making and abstract reasoning (Peterson, Mumford, Borman, Jeanneret, & Fleishman, 1999). This type of thinking is further concerned with the understanding of a system as a whole and taking the 'big picture' perspective on how things work (Houston, 2007).

Interpersonal skills fall into the second cluster of 21st century skills that were identified. This subset of skills includes all skills that are necessary when relating to other individuals. Furthermore, the National Research Council (2011) describes interpersonal skills as a form of 'social intelligence', specifically perception and cognition including attention and decoding in a social context. Complex communications as well as social skills fall into the category of interpersonal skills. Levy and Murname (2004) state that a person who is skilled in communicating has the ability to define in words, sounds or images and key pieces of a complex idea to create a mutual understanding. Furthermore complex communication skills are those including interpretation and processing of verbal and non-verbal information in order to send and receive messages.

The National Research Council (2011) defines the third cluster of skills as talents or abilities that are inherent within the individual and assist them in problem solving. One such intrapersonal skill is adaptability which is the capability to confront changing circumstances, situations, tasks and technologies. Similarly Houston (2007) maintains that adaptability also constitutes adaptation to varying communication preferences, cultures, environments and personalities. Self-development, which is the ability to work individually, virtually or remotely while monitoring and motivating oneself, is another aspect of interpersonal skills.

Furthermore, The Partnership for 21st Century Learning (n.d) developed a framework for 21st century learning in 2007 which includes learner outcomes such as 4C's (critical thinking, communication, collaboration and creativity); life and career skills; key subjects; and information, media and technology skills. The framework also accounts for various support systems such as standards and assessments, curriculum and instruction, professional development and learning environments. All of the components of this framework are interconnected in the process of 21st century teaching and learning.

Siraj-Blatchford and Siraj-Blatchford (2006) recognize four key areas of TbTL to support 21st century skills, specifically in ECE. These skill areas are briefly outlined below:

1. *Communication and collaboration*

   By nature, young children problem solve collaboratively, as well as construct, draw or record, use screen-based applications and experiment effortlessly with technology.

2. *Creativity*

   Creativity is supported when children are endorsed to look at novel ideas playfully, to know that a choice is always available, to make connections between ideas, to compare these ideas and to account for an array of opinions (Edwards & Hiller, 1993). Technology, such as a competent application supports children in being creative.

3. *Socio-dramatic play*

   Innovations and improvisations of both existing hardware and software use child's play to reproduce shop environments, family situations and so forth.

4. *Learning to learn*

   Papert (1980) indicates that technology helps young children to think about thinking. Moreover, Kalaš (2010:29) posits that technology that establishes metacognition is the same as that which is beneficial to communication, collaboration, creativity and socio-dramatic play in children.

Recent research reviewed (Griffin *et al*., 2012; National Research Council, 2008, 2011; Siraj-Blatchford & Siraj-Blatchford, 2006) highlight that although different names are given to a set of skills that are necessary in the 21st century, the underlying elements are mostly uniform. Skills such as communication, creativity, collaboration, critical thinking, problem solving and self-development underpin the competences that are required to function effectively in schools in this day and age.

2.3.2 Digital literacy

At the core of 21st century skills, lies the term digital literacy. Paul Gilster (1997) published the original *Digital Literacy*, which has become a progressively discussed and debated work. According to Ferrari, Punie and Redecker (2012:79), the aforesaid concept is a "multi-faceted moving target" as academic literature, policy documents, teaching and learning, and entrance systems all have differing ways of explicating it. Belshaw (2012) in particular debated the term, digital literacy in his thesis, entitled: *What is digital literacy?* In this study, the term digital literacy therefore, refers to the capabilities that an individual possesses in order to teach and/or learn in a digital age (see 1.4.2).

Belshaw (2012:18) is of the opinion that "problems around digital literacies are not dry, academic problems but real-world, everyday issues affecting individuals, organisations and communities worldwide." According to the National Council for Curriculum and Assessment (NCCA) (2004), three reasons are often referred to for

advocating the use of technology in education which provides learning opportunities in line with development of 21st century skills. Firstly, students' motivation and achievement increments are often the product of using technology in teaching and learning. Secondly, recognition is made to the permeation of technology in our daily lives and the society in which we live. Lastly, as a result of the above mentioned, it is contended that the levels of low digital literacy should be addressed so as to allow individuals to be functional in the knowledge society. It is therefore, important to understand digital literacy in order to enhance the level thereof when using TbTL.

Kepell (2010) explains the development of literacy in the digital era as such:

> *Previous traditional connotations of literacy focused on text-based reading and the ability of the reader to comprehend, interpret and evaluate the text for understanding and communication. With the advent of more complex media through the internet, three-dimensional environments, mobile technology and the need to socially connect across national borders, literacy in the 21st century needs to be re-conceptualized.*

Rudimentarily, Kalaš (2010:119) defines the term digital literacy as knowledge, skills and understanding necessary for appropriate, safe and productive usage of digital technologies for learning and discovering. However, in the digital age, literacy is complex with many facets which implies that individuals will depend on numerous skills in order to interact and communicate in this age. In order to function literately, individuals need to adapt their mind set and accept multi-literacy as a new language that involves novel thought processes, novel media and novel technologies. With regard to education specifically, the adaptation to multi-literacy in teaching and learning is vital for individuals to move away from being consumers to being creators and designers.

Belshaw (2012) suggests that there are eight essential elements of digital literacy, namely: cultural, cognitive, constructive, communicative, confident, creative, critical and civic, which are mentioned and briefly discussed in relation to this study.

- Cultural

The cultural aspect of digital literacy can be understood as the assorted range of digital contexts that an individual encounters. Within the Foundation Phase, for example, the learners may experience different applications and devices which have their unique protocol in terms of operation. Furthermore, “the nature of literacy in a culture is repeatedly redefined as the result of technological changes” (Hannon, 2000:22-23). It is, therefore, most beneficial to surround individuals with a wide range of digital technologies as the cultural aspect is best realised through an immersion into a range of digital environments (Belshaw, 2012:207).

- Cognitive

Similar to the cultural aspect of digital literacy, individuals require numerous forms of developing their thoughts and relating in digital spaces in order to help them develop the *cognitive* element of digital literacies (Belshaw, 2012:208). As Johnson (2008:42) explains, it is not about “the ability to use a set of technical tools; rather, it is the ability to use a set of cognitive tools.”

- Constructive

The constructive constituent of digital literacy is concerned with creating something original in the digital world. An integral element of the constructive aspect of digital literacy understands how and for what purposes content can be appropriated, reused and remixed (Belshaw, 2012:210).

- Communicative

The communicative aspect of digital literacy is closely aligned to the constructivist aspect, which in turn, is related to the cultural aspect. Unequivocally, literacy involves communication which in turn involves reading and writing. Belshaw (2012:209) states that the communicative aspect of digital literacy, in essence, is the nuts and bolts of how to communicate in digital networked environments. Furthermore, “a systematic awareness of how digital media are constructed and of the unique 'rhetorics' of interactive communication” (Buckingham, 2007:155) make up the communicative component of digital literacy.

- Confident

Belshaw (2012) explains that the confident aspect of digital literacy includes a confidence based on the understanding that in contrast to our physical environment, the digital environment can be more forgiving with regard to experimentation. The premise that digital technology is liable to change captures the confident aspect of digital literacy.

- Creative

The creative facet of digital literacy relates to doing new things in new ways. Conlon and Simpson (2013:149) posit that the current culture in which the curriculum is prescriptive, practices are routine and target-setting is tight, should be replaced with the teachers who are willing to take risks and adopt technology creatively.

- Critical

The critical constituent of digital literacy is closely aligned with the communicative aspect. Reflecting critically on various literacy practices in various sign systems which “therefore involves the reflection upon literacy practices in various semiotic domains” within the digital environment constitutes the critical aspect of digital literacy (Belshaw, 2012:213).

- Civic

Participation, social justice and civic responsibility encapsulate the civic aspect of digital literacy, which therefore, relates it to the aspect of confidence. Moreover, resulting from new technologies and tools as a result of literacy practices to support the development of organisations, relationships and fundamentally, the state is found in the civic component of digital literacy.

Although there is not one accepted definition or delineation of digital literacy, the above-mentioned aims to simplify and account for the knowledge and skills that are required in order to function as digitally literate. Digitally literacy can therefore be regarded as the knowledge and skills that can and should be used to communicate, construct and create confidently and reflectively in digital environments in a variety of contexts.

2.3.3 21st century teaching and learning

As mentioned previously in this chapter, technology is ubiquitous in existing society and this impacts on the way individuals work, live and play. For instance, technology is used on a personal level to share ideas, communicate with friends and family, make purchases, apply for jobs and search for information. Professionally, technology is also prevalent as it is used to create new ideas, services and products, collaborate globally and market and manage businesses. While technology has made a substantial impact to mainstream and business life, "most educational systems operate much as they did at the beginning of the twentieth century" (Binkley *et al*. 2012:v).

Griffin, Care and McGaw (2012) argue that many countries are moving from an industrial-based to information-based economy and that education systems must respond to this change. During the industrial age, there was a strong focus on the development, distribution and consumption of products and employment was classified accordingly, whereas the focus has shifted to classifying employment in terms of the development, distribution and consumption of information in today's age. Educational outcomes therefore need to be adapted to meet the demands of new ways of work, thinking, learning and living. Moreover, Laurillard, Oliver, Wasson and Hoppe (2009:2) posit that what and how students learn has been impacted by the role that education has in preparing individuals for work. In order to align the 21st century skills to young childhood, Resnick (2009) explains that young children "construct stories and castles through play and artwork together, they establish and cultivate their abilities to collaborate and think creatively, exactly the skills that are needed for accomplishment in the 21st century."

The NCCA (2004:8) in Ireland advocates that in the knowledge society, the growing sophistication in the use of technology will endure and expand so that technological literacy will become a necessary functional element to our work, personal and social lives. Mdlongwa (2012:6) claims that within South Africa, the use of technology will provide its people with an advantage to cope and compete in the 21st century labour market, as well as to potentially offer answers to some of the developmental

challenges faced. I depart from this viewpoint in clarifying and explaining the skills needed in ECE education in the 21st century.

In the light of the prevalent development in the use of digital technologies for learning, government, teachers and experts in subject disciplines are in a quandary. Belshaw (2012:19) therefore asks the following questions: What are the new skills called that are professedly necessary to function optimally in society today? How can these new skills be taught? Who is in the best position to transfer these skills?

Noss (2012:4) posits that commanding features of the workplace should not be the only factor that controls policy or practice. It is agreed that technology does influence existing culture, as well as the culture being influenced by it. Therefore, it is crucial that one is cognisant of such influence in order to know how to respond to technology. For example, technology has mostly pertained to institutions until now, but one has arrived at a stage where technology has shifted from the institution to the home, the pocket and the street – technology has become personal (Noss, 2012:4). It therefore, leads to the question of how children in the 21st century learn. Furthermore, the question is posed: how should 21st century children be taught?

Laurillard (2008b:12) postulates that the range of teaching methods was consequentially established from the prerequisites of education and also from the means at disposal. Teaching methods have evolved from small group to large group practices, from cave walls to paper and from enlightenment to the classroom. Yet the teaching and learning theories that have accompanied education over the centuries are largely concerned with 'tell-practice-test' (Laurillard, 2008b:12). It appears that the manner in which theories on education are formed does not align with the development of technologies.

For instance, education theories on what it takes to learn effectively have evolved strongly since the 19th century. Dewey's 'experiential learning' emphasised theory relating to learning (Dewey, 1938). Thereafter, during the 20th century numerous captions were given to educational theories, such as: constructivism, social constructivism; inquiry-based education; meta-cognition; situated learning; reflection; and collaborative learning (Entwistle, 1991; Harel & Papert, 1991; Jonassen, 1994;

Lave & Wenger, 1991; Papert & Harel, 1991; Vygotsky, 1962) which all bestowed learning as a verb - an active process. During the middle of the 20th century, the computer surfaced and subsequently, a variety of digital technologies. Thus, educational learning theories with distinguishing features in accordance with the various types of experiences that technology offers, such as inquiry, discovery, problem solving and collaboration, have emerged.

It is easily understood from the aforesaid that due to the rapid advance in technology, practical teaching and learning implications also need to be investigated. “It is about changes to the curriculum, teaching styles, organisation and support systems within schools” (Barton & Armstrong, 2003). Laurillard (2008b) claims that technology is most beneficial when it has to meet a challenge instead of being employed as a solution to a problem. The importance therefore is to emphasize that teaching practice and the implications that technology has for learning should be viewed from the stance of meeting aspiring educational aims and not vice versa (Department for Education and Skills, 2005).

It is thus necessary to consider the teaching approach, as well as the type of technology that is most beneficial to young learners. “To participate and take advantage, citizens must be digitally literate – equipped with the skills to benefit from and participate in the Information Society. This includes both the ability to use new ICT tools and the media literacy skills to handle the flood of images, text and audio-visual content that constantly pour across the global networks” (Europe's Information Society Thematic Portal, 2007 in Belshaw, 2012:21). Laurillard (2008b:14) highlights further that the responsibility and function of the teacher is not necessarily synonymous with that of the learner:

> *The teacher has the opportunity to learn about their learners’ points of view and their practice, but the teacher’s knowledge is privileged over that of the learner. As a consequence, it is their job to ensure an intelligible learning experience - they must adapt the practice environment to the capabilities of their learners, provide the appropriate goals and feedback, and reflect and learn from that process, as much as the learners learn.*

2.3.4 Benefits of technology-based teaching and learning

Numerous advantages of the use of technology in schools have been researched (Bialobrzeska & Cohen, 2005; Isaacs, 2007; Laurillard *et al*. 2009; Tinio, 2003; Mdlongwa, 2012). Tinio (2003) posits that "these tools have been touted as potentially powerful enabling tools for educational change and reform". Similarly, in the African context, the e-Learning Africa Report (2012:47) claims that stakeholders "hold high expectations about the ability of new technologies to scaffold progressive change at both institutional and system- wide levels." Furthermore, The World Bank (1998) maintains that technology has the power to promote knowledge gain and provide developing countries favourable circumstances to improve education, policy and business. Laurillard *et al.* (2009:290) argue strongly for incorporating new digital technologies into schools and other educational institutions to transform pedagogy. Accordingly, the NCCA (2004:8) assumes that the possible advantages of using TbTL are heralded as the reason to increase their use in schools.

These advantages alluded to above include boosts in student motivation, advancement in student achievement, growth in higher order thinking and problem solving abilities of students, as well as progression to work collaboratively (NCCA, 2004). Some research projects provided mixed results when examining the effects that technology has on teaching and learning, but under specific conditions, for specific purposes a positive effect is apparent. One such study (Brooks-Young, 2007) which is an ICT intervention on the evaluation of the Apple Classrooms of Tomorrow project (ACOT), noted that technology enables students to exhibit technological, inquiry, collaborative, and problem-solving skills much more than peers in a traditional school programme.

Both Mdlongwa (2011) and the e-Learning Africa report (2012) mention common benefits of using TbTL if implemented properly. The above mentioned literature notes that technology in schools enhances motivation, increases collaboration and enables learners to be globally connected to information. Furthermore, technology allows learners to actively participate thereby producing knowledge for themselves which is of benefit to their independence, responsibility and self-esteem.

Mdlongwa (2011) notes the increasing use of TbTL assisted administrative tasks such as record keeping, routine tasks and communication between teachers and learners. He also mentions particular benefits of integrating TbTL. Firstly learners who are exposed to technology are at an advantage due to the fact that the future industry is technologically rich. Secondly, it allows learners to become the creators of their own knowledge and as a result "cultivate a culture of personal information management, independent learning and working without supervision, communication skills, teamwork and research skills, which are highly valued in today's global workforce" (Mdlongwa, 2012). Thirdly, integrating technology is also beneficial to the advancement of teaching as technology enables teachers to better manage and administer, as well as communicate their work (See also Bialobrzeska & Cohen, 2005).

The Action Plan to 2019 created by the Department of Basic Education (DBE, 2015), articulates and expands on priorities outlined in the most recent National Development Plan (2012) in order to ensure quality schooling for all South Africans. To promote focus within the system, five of the 27 goals dealt with in the action plan remain priority goals which deal with Grade R, teacher development, learning materials, school management and support by district offices. All of the aforesaid priority goals can be supported and improved with technology. Specifically, Goal 16 which refers to teacher development states "improve… computer literacy of teachers throughout their entire careers" (DBE, 2015:1). In relation to this study, further pertinent end goals (2030) which take heed of the impact that technology has on teaching and learning, anticipate the following by 2030 (Department of Basic Education, 2015):

- *Much learning happens through the use of computers and, from Grade 3 onwards, all learners are computer literate.*
- *Teachers who received the training they require are continuously improving their capabilities and are confident in their profession.*
- *Computers in the school are an important medium through which learners and teachers access information.*

On paper, the indicated goals support the integration of technology in schools in order to provide numerous benefits. Despite the benefits of TbTL in the Foundation Phase in South Africa that have been mentioned, the challenges cannot be ignored as the DBE (2015:15) highlights:

> *...many have pointed to weaknesses in the system when it comes to the adoption of new technologies to improve the administration of the schooling system and the teaching and learning process. This is an inherently difficult area, not just in South Africa. Yet we need to do better if we are to avoid a widening of the gap between South Africa and other countries, even other middle income countries.*

The above mentioned statement underscores a digital divide in the South African education system when it comes to TbTL. The following section will discuss some of the barriers to TbTL.

2.3.5 Barriers to technology-based teaching and learning

The discussion thus far highlights the necessary skills for coping with the demands of the 21st century. However, it is not merely a case of acquiring certain skills. One of the grounds for using TbTL is to lessen the digital divide. According to the NCCA (2011:10), the digital divide alludes to "the gap in achievement between those who have access to technology in the home, and those who do not." Kalaš (2010:118) further comments by defining the digital divide as the gap in the skills needed to take part as a digital citizen, as well as in the physical means to technological resources. Selwyn (2004:351) conceptualised the digital divide in terms of two categories, namely, unequal opportunities to access and use different forms of technology, and further disparities of outcome emanating from direct or indirect engagement with these technologies.

International research on the digital divide conducted by Rainie (2013), Director of the Pew Research Center's Internet Project, highlighted that factors such as age, household income, community type and educational attainment contributed to the

non-use of technology. Taking into account the need to bridge the gap, certain programmes have been initiated. For instance, a programme, *Closing the digital divide: ICT in deprived areas* has been established in the United Kingdom to provide computers to schools in need, supported by the Wired Up Communities project (NCCA, 2004). Furthermore, the digital divide is influenced by parental and community support in using TbTL (NCCA, 2004); limited literacy, numeracy, and problem solving skills (ETS, 2001, OECD, 2001); inequality between the uses of technology in school and outside of the school.

According to Prensky (2001b:1), "it is now clear that as a result of this ubiquitous environment and the sheer volume of their interaction with it, today's students think and process information fundamentally differently from their predecessors." Teachers who are currently teaching this group of Foundation Phase learners hail from an era which differs from that of their learners. Furthermore, each generation has a particular view of the world, with similar underlying value systems, due to the fact that they share situations, events and experiences that are correlative (Codrington & Grant-Marshall, 2004:3). Prensky (2005) classifies individuals born into digital technology as 'digital natives', while older adults like their parents or teachers are known as 'digital immigrants.' Additionally, digital immigrants may create barriers to digital natives' advancement by holding onto their perspectives from pre-digital change.

However, more recently, the terms of digital natives and digital immigrants have been contested. Prensky (2013b:1) responded to the misinterpretation of these terms which implied that everyone born before a certain time knows nothing about technology by stating that:

> *The Digital Natives / Digital Immigrants metaphor is NOT about what people know, or can do, with technology. Everyone has to learn in one way or another. It's more about culture and attitudes.*

This implies that a possible generation gap could exist which could impede TbTL being successful if the different generations do not learn from each other.

With the possibility that information and communication technologies have to reduce prevalent obstacles in various contexts, the former Department of Education (2004:8) argues that "education systems have an obligation to deliver on public expectations of quality education for economic growth and social development." That being said, noted improvement and the strengthening of excellence in education ought to provide for an increase in equity and access which are often debilitated by circumstances such as capacity-related limitations, financial restrictions and spatial challenges. Additionally, Crawford (1997) claims that one of the fundamental obstacles in implementing technology in schools is the financial cost of purchasing the hardware and software to set it up. Within the South African education milieu, Howie, Muller and Patterson (2005) claim that government is not in the financial position to equip schools in all education departments with computers and the necessary infrastructure to support TbTL. Regarding South Africa, Isaacs (2007:5) notes that despite having the most developed telephone system on the continent, the infrastructure is not distributed evenly and is poorly linked. Although the previous two references are outdated, a more recent source, the National Integrated ICT Policy Green Paper (2013:9) posits that information infrastructure is still disparate – especially between rural and urban areas in South Africa.

Laurillard *et al.* (2009:290) emphasize that the education system cannot be altered or remodelled from the outside, but rather it needs to revise itself. Outwardly, computers, tablets and connection to the internet are being administered to many schools on an international scale, yet the resulting curriculum and teachers' professional skills continue unchanged. The benefits of using TbTL have been noted, however, the symbiosis between these and educational practice as a whole is somewhat aimless (Conole, White, Oliver & Conole, 2006). Laurillard (2008a; 2008b) proposes a number of probabilities as to why there has been little educational change with the rapid advancement of technology as discussed below:

Firstly, it is postulated that the drivers of the educational system need to change in order for the practice of its associates to follow suit. In other words, there needs to be a considerable change in the appreciation of what technology brings to the table in terms of the elaborate system of curriculum, assessment, professional development and advancement, financial growth and quality criteria, since

associates are assessed by and work towards these conditions. Howie *et al.* (2005) agree with the above mentioned within South Africa where government does not make TbTL a priority since other necessities appear more urgent. Secondly, the rate of technology change is quick. Laurillard (2005) argues that it took a number of years to develop our education systems with the advancement of old technologies such as publishing, broadcasting, the telephone, the printing press and so on. Yet the pace at which digital technologies are continually changing has not allowed us the time to make the same such changes to the current education system.

Thirdly, the strong leadership of those in the education system is crucial to the successful change and implementation of teaching and learning with technology. Too often, "the education system is run by leaders who are not comfortable with either the detail or the implications of the technology potential, and those who are, are not powerful enough within the system" (Laurillard, 2008a). Lastly, the slow rate of change in education systems is largely due to the "hierarchical command-control systems, rather than devolved power adaptive systems" (Laurillard, 2008b:15). The above mentioned serves to illustrate that teachers are not allowed the means, nor the control to progress in TbTL.

In a South African comparative study (Mdlongwa, 2011) on ICT and enhanced learning, challenges were noted by both teachers and learners when integrating TbTL. Mdlongwa (2012:4) found that learners wanted to have technology accepted and more valued; language skills were 'corrupted' by SMS and social media use; there was a lack of resources especially with regard to amount and access to internet; there was a shortage of qualified teachers to use the technology effectively; and there was restricted access to the technology. A further problem in using TbTL in the South African educational environment is the language barrier: most teachers and learners are English second language speakers whereas English is used for 80% of software and the internet (Tinio, 2003).

Dolence and Norris (1995:2) posit that all individuals are, in different ways and means, affected by the rapid increase in technology and "only those who realign their practices most effectively to the information age ... will reap ... benefits. Those who do not will be ... diminished by ... competitors". One of the key questions surrounding

the challenges of ubiquitous technology therefore is “who has access to what forms of technology and when and how it is used?” (Walker, Huddlestone & Pullen, 2010:10). Tinio (2003) comments that failure to meet the challenge of bridging the digital divide would contribute to the gap in knowledge between those who are exposed to technology and those who are not expanding which will further contribute to inequities in the social and economic sectors of the country. Ndlovu and Lawrence (2012:2) claim that the PanAf Research Agenda (2008-2011) revealed findings that the South African ICT policy is being actualised ineffectively especially in instances where economic and social prejudice is the root of the digital divide. However, the Department of Communication (2013) claims that the approach towards ICT is under review so as not to unintentionally further the digital divide where access to technologies, infrastructure and quality communication are only an exception, instead a right for all.

The literature surveyed elucidated the term digital literacy so as to better understand what is required from young children who are to be wholly literate in a digital era. Specific skills that are necessary for individuals, specifically young children, to function effectively, as well as various implications that these skills have on teaching and learning in the 21st century were explained. Finally, both the strengths and weaknesses of TbTL were reviewed so that a comprehensive overview could be achieved before looking at the situation of TbTL in South Africa ECE in the following section.

2.4 TECHNOLOGY-BASED TEACHING AND LEARNING IN EARLY CHILDHOOD EDUCATION

One of the main objectives of this study is to better understand TbTL specifically in the Foundation Phase with the idea that it can support teaching and learning. The notion of capitalising on TbTL in the Foundation Phase in order to achieve educational aims, whenever appropriate, is the driving force behind this research. In the subsequent section, TbTL in ECE is firstly considered in a global context and then viewed in light of happenings in South African schools. Finally, the section will conclude with a synopsis of South African policy with regard to technology in ECE.

2.4.1 Technology-based teaching and learning in Early Childhood Education across the globe

In the early 1900's, a French educator, Célestin Freinet (1896–1966) combined characteristic and contemporary pedagogy with existing technology of the time to develop an example that would be acknowledged in modern TbTL in ECE (Kalaš, 2010:20). This implies that TbTL is not something that is novel or derived from industry but instead necessary in the impending educational milieu. In the middle of the 20th century Kobler and Moore (1966) invented the talking typewriter for three year olds to read and write. The importance of the invention was subordinate to the guiding principles and theoretical underpinning of the invention which can be replicated to produce numerous new inventions. Similarly, Kalaš (2010) explains that during a time where personal computers were non-existent, Feurzeig and Papert (1967) considered that children should have access to computers so that unique learning can take place which in later years produced Logo programming[1] for children. Yet again, in the 1980's Rachel Cohen (1988; 1994) investigated using new technologies to acquire language at an early age by using voice synthesisers with three to six year olds.

Currently, educational policies by many governments around the world include technology in education. In the US, the ambition of raising the contribution that technology can make to education is stated in the No Child Left Behind Act of 2001 (US Department of Education, 2009). Similarly, the emphasis on a one-to-one student to computer ratio for every student from Grade 9 onwards has been expressed in Australia (Australian Labor Party, 2007). On an international level, the Early Learning in the Knowledge Society conference (2003) dedicated itself to ICT competencies of ECE teachers (Siraj-Blatchford & Siraj Blatchford, 2006:69).

[1] According to Kalaš (2010:119) Logo is a programming language created in 1967 for educational use by Daniel G. Bobrow, Wally Feurzeig, Seymour Papert and Cynthia Solomon. It stems from the Greek word, *logos*, which means word, as it differs from other programmes in as much as it does not use numbers. Logo was designed as a tool for learning by exploring big ideas and gave young children an opportunity to programme.

More recently, a number of nations (US, United Kingdom, France, Italy, China, and India) and UNESCO established large projects which aimed to delineate the use of ICT by teachers which resulted in The UNESCO ICT-Competency Framework for Teachers (ICT-CFT) in 2008 (UNESCO, 2011a:4). All the above mentioned projects contain a common thread that access to technology and the accompanying skill development is crucial for education and the resultant growth in each nation. In 2010, UNESCO commissioned an analytical survey to appreciate the potential of ICT in ECE across 17 different ECE centres in nine different countries. Although not policy, the study yielded valuable information regarding early childhood experiences, and more specifically the significance TbTL has in the lives of young children. Kalaš (2010:19) discloses that although many aspects have changed since the date of the study due to emerging technologies and innovative practice, the following broad conclusions can be made for young children, parents and teachers:

- New technologies have a noticeable influence on young children;
- Young children have a distinctive approach to new technology;
- Parents are often uninformed as to the benefits as well as dangers of content provided through technology;
- Parents differ in their capacity to provide support and applicable encounters in using technology for children;
- Teachers often lack the know-how as well as confidence to implement technology;
- Teachers and parents seldom communicate about children's encounters with technology; and
- Providing for experiences with technology in ECE settings is inadequate.

Balanskat (2012) provides a report of the impact of technology in 209 866 primary schools, which included education from the age of 4 – 11 years, in 30 different countries. Although the information is slightly fragmented due to data being unavailable due to restrictions by government and local municipalities, it yields a number of commonalities among the European countries under study. Firstly, although language and mathematics, followed by science form the central part of the curriculum, "digital competence is formally in the curriculum (in various forms) in 22 of the 30 countries" (Balanskat, 2012:12). Secondly, the general trend amongst the

schools surveyed was that technology could have the greatest impact for reform in the areas that dealt with administration and management concerns, training for teachers, improving achievement of learners, as well as collaboration and communication. Thirdly, the above mentioned report highlighted that in the approach to including ICT in policy, only eight countries have policies for ICT in primary schools, which implies that such schools may be eliminating ICT opportunities.

The attention to ECE is growing worldwide as it is becoming noticed as an essential aspect of human development (Aidoo, 2008; Are, 2007; Bowes, Watson & Pearson, 2008, in Pearson & Degotardi, 2009; Pan-African Forum for Children, 2001). The first World Conference on Early Childhood Care and Education (WCECCE) reasoned about research that clearly indicates how ECE is the backbone of lifelong learning and accommodates an improvement of health, education, employability and overall quality of life (UNESCO, 2011b). The global incidence of TbTL in ECE is recognised in efforts to increase access to technology for both teaching and learning as well as to improve the development of the nation, with ECE being the most suitable vantage for effective change.

2.4.2 Technology-based teaching and learning in Early Childhood Education in South Africa

In 2004, the South African Department of Education released White Paper 7 (DoE, 2004) on e-Education as a response to the rapidly changing technological environment in education. Similarly, in the US, the National Education Technology Plan (US Department of Education, 2010:8) calls for technology “to enable 24/7 and lifelong learning.” Burnett (2014:15) agrees with the above mentioned policies and plans by stating that “such ambitious statements, however, need to be tempered by ecological understandings of educational practice which explore what happens when different policies, preferences and priorities intersect.”

Isaacs (2007:8) explains that the development of policy on ICTs in education started in 1995 already as Technology Enhanced Learning Initiatives (TELI) originated. Subsequently, the e-Education White Paper in 2004 was supported by a preceding Strategy for Information and Communication Technology in Education in 2001 which

was delivered by both the National Department of Education and the Department of Communication (SAIDE, 2005). The intention of the above-mentioned policy was for all school-going learners to become efficient in using ICT by 2013. In order for this intention to be actualised, it was anticipated that e-schools were to be established. Isaacs (2007:8) explains such schools possess: learners who make use of ICT to improve learning; teachers who are both able and capable of using ICT to improve teaching and learning; leaders who are adequate in planning, administering and managing using ICT; security to ICT that enables curriculum enhancement; and infrastructure to connect ICT.

According to Isaacs (2007) technologies are accepted as national government strategies to improve and sustain economic growth, social development and market employability. Furthermore, the South African government is using technology as a point of departure to reconcile inequities of the past while enhancing teaching and learning (Ndlovu & Lawrence, 2012). Subsequent to government response, numerous initiatives have commenced that indicate the South African government's responsibility for building a successful information society.

Isaacs (2007:5) further posits that the present policy for ICT in education which includes a wide national social, economic and development plan has been unfolding since 1996. It constitutes the following:

- consideration by government of the economic potential, social enhancement and international standing that ICT plays;
- the link between the New Partnership for Africa's Development (NEPAD) and its devoted e-schooling project;
- reconstruction at all levels in education and skills development; and
- a policy that is committed to the adaptation of teaching and learning by using ICT's.

In addition to the above mentioned educational policy, the Department of Communication (2013) released a green paper on ICT policy in South Africa in order to provide an insight into the growth in the country since 1994, as well as to illustrate the current conditions and changes within the ICT sector and to query how the

country can become more efficient in the global market. Furthermore, the same green paper aims to provide answers that will ultimately, "provide a seamless information infrastructure that by 2030 will underpin a dynamic and connected vibrant information society and a knowledge economy that is more inclusive, equitable and prosperous" (Department of Communication, 2013:3).

Although the above mentioned policy initiatives are not exclusive to ECE, it serves to portray that the general education sector in South Africa is paying attention to TbTL. It also further draws attention to the importance of this study to develop a framework for TbTL in the Foundation Phase in order to customise and create a specific set of criteria that is applicable to this important phase of schooling.

Williams and Samuels (2001) postulate that there are still substantial inequities as a result of the history of South Africa, which need to be addressed in ECE. In a survey of ICT in Education in Africa (Isaacs, 2007), it was noted that despite the growth and development of TbTL on a daily basis, obstacles still need to be reduced. In line with the above mentioned, the Action Plan to 2019 (Department of Basic Education, 2015:18) noted that although there was an improvement of TbTL in schools since 2011, it is worrying that "our knowledge of the fairly fragmented yet substantial e-education landscape as it currently exists remains limited."

In addition, Mdlongwa (2012:2) claims that over recent years, South African schools have relied on traditional teaching methods without much change and they face a number of challenges. Such challenges include: the advancement of learning through the most favourable use of technology, the absence of a comprehensive policy on TbTL across all educational domains, the on-going demand for leadership and co-ordination of TbTL campaigns as well as the obligation to prove the worth of investing in TbTL for better possibilities in the altering labour market. Mdlongwa (2012) also posits that national department authorities are attempting to use TbTL with the intent to improve education and primarily better the competency and performance of both teaching and learning. Furthermore, one major disadvantage for schools in South African is up-to-date statistics for researchers instead of data that is five to six years old due to the problematic profile of compiling statistics (Mdlongwa, 2012).

Numerous South African initiatives provided by legislature and policy have commenced in an effort to support TbTL. Table 2.1 provides a synopsis of local projects that support the integration of TbTL as a prelude to TbTL in South African ECE policy.

Table 2.1: Local Technology-based Teaching and Learning initiatives (text adapted from Isaacs, 2007; Department of Communication, 2014; Mdlongwa, 2012)

Local TbTL initiatives			
Title of project	**Description**	**Partners**	**Geographic range**
Dinaledi	Fosters advancement in math and science performance	Private sector & NGO partners	South Africa
Telkom schools	Access to ICT's, training and content in schools	Telkom Foundation	South Africa
Ungana Afrika	ICT skill support among NGO's	Ungana Africa	South and Southern Africa
Digital Links	Refurbishes and deploys PC's to schools and offers training	Digital Links UK	South Africa Some African countries
NEPAD e-Schools	Project in 6 schools	eAfrica commission, National Department of Education, Cisco, Microsoft, Oracle	South Africa
NetDay	Sources, refurbishes and supplies PC's to schools and offers training	SchoolNet South Africa	South Africa Some African countries
Southern African Institute for Distance Education (SAIDE)	Research on ICT's in education in Southern Africa	Commonwealth of learning, UNESCO, Open University	South Africa Africa
Meraka institute	Formal application of innovative ICTs to support teaching and learning in schools and informal hands-on exposure for children aged three to 18 to science and technology	CSIR	South Africa
Ulwazi Project	Broadband e-Learning pilot project	Motorola Foundation, Meraka Institute, Department of Communications Omega Digital Technologies, SchoolNet South Africa, St Alban's college	Pretoria

Local TbTL initiatives			
Title of project	**Description**	**Partners**	**Geographic range**
SA connect	Broadband policy and strategy	iKamva National e-skills Institute, National Broadband Advisory Council (NBAC)	South Africa
Teach to the future	Teacher development programme	INTEL	South Africa
SCOPE	11 teacher development modules for schools	Finnish development support programme, SchoolNet SA, SAIDE	South Africa
SchoolNet SA	Online, mentor-based programmes that foster in service training to teachers		South Africa
E-schools network	Non-profit, self-funded organisation providing communication solutions, training support and project management	Belfast Unemployment Resource Centre	Western Cape, South Africa
Gauteng online	Technology access (design, build and run computer labs) programme in schools in the Gauteng province.	Gauteng Department of Education, ICT companies in South Africa	Gauteng, South Africa
Kanya project	Dedicated provincial government programme to address the shortage of teacher capacity and the need to deliver curriculum to schools through the innovative use of ICTs.	Provincial government of Western Cape, corporate sponsors	

The above mentioned table illustrates the void in projects conducted in the ECE sector. For example, statistics from the e-Learning Africa report (2012) highlight that 43% of the respondents in this study concentrate on higher education as opposed to only 1% in ECE. The purpose of section 2.4.2 is to not only indicate the importance of the actual projects that have taken place, but also to stress the essential benefit that technology has on teaching and learning in ECE despite the shortfalls.

2.5 CONCLUDING REMARKS

Technology is altering the way in which people live, work and play and therefore has an impact on the outcomes for education. More specifically, the investment in ECE as a form of human capital investment through sound policies, programmes and initiative has far reaching benefits. It was therefore highlighted that the learners in this era require significant kinds of knowledge and skills in order to meet the demands of the 21st century in order to effectively communicate, construct and create confidently and reflectively in digital environments in a variety of contexts. Furthermore, it was noted that both teaching and learning need to evolve and affiliate with technology to be favourable to meet a challenge instead of being employed as a solution to a problem. At the same time, TbTL should be employed to meet aspiring educational aims and not vice versa. The review of literature highlighted advantages of transformation, learner development and teacher development as well as the opposing systemic barriers, generational barriers, professional barriers and teaching and learning barriers in TbTL. In addition, this chapter emphasized international and national TbTL, or lack thereof, with particular reference to ECE. Finally, the information reviewed serves as a contextual framework for this study and the conceptual elements pertinent to TbTL in the Foundation are discussed in the next chapter.

CHAPTER THREE:
A CONCEPTUAL FRAMEWORK FOR TECHNOLOGY-BASED TEACHING AND LEARNING IN THE FOUNDATION PHASE

The important thing is what those who live with, or work with and for young children in our present times and settings say and do. The important thing is that the new pioneers, those working in early childhood settings and elsewhere in the pursuit to make the best provision for young children, take these ideas (from the past) into the future and make them their own. There is no better tribute to those who have gone than to remould, revisit and revise their ideas for a new today.

- Nutbrown, Clough & Selbie (2008:181)

3.1 INTRODUCTION

In the previous chapter literature was reviewed that highlighted the context of ECE in South Africa, as well as providing elucidations of digital literacy and 21st century skills. The literature surveyed also emphasized the benefits and shortfalls of using TbTL and concluded with an overview of TbTL in ECE. The aim of this chapter is to provide insight into conceptual perspectives that are relevant to this study. I specifically define this chapter as a conceptual framework as it consists of a number of theories that are relevant to TbTL in the Foundation Phase. Firstly, it provides insight into the generational theory since doing so places the participants of the study into a particular cohort and assists in classifying their common attributes. Secondly, it considers teaching and learning theories that are both pertinent to the Foundation Phase, as well as to technology, namely: behaviourism, constructivism and connectivism. Lastly, the chapter investigates the application framework, TPACK in order to explain the relationship between technology, pedagogy and content for TbTL in the Foundation Phase.

3.2 GENERATION THEORY

Archaic societies from the Sumerians to the Mycenaeans to the Mayans, philosophers such as Plato, Polybius, Toynbee and Schlesinger and the Hebrew Bible point towards the generation to explain how and why recurring archetypes occur (Strauss & Howe, 1997:14-15). A generation "is the aggregate of all people born over roughly the span of a phase of life who share a common location in history and, hence, a common collective persona" (Strauss & Howe, 1997:16). Codrington and Grant-Marshall (2011:12) define a generation as "a group of people with a set of shared experiences that exhibit a shared worldview, and continue to exhibit the characteristics of that worldview until they grow up through life." Furthermore, these authors explained that "as time and events began accelerating, the concept of generation identity has become more important to describe each new generation" (Codrington & Grant-Marshall, 2011:14).

The relationship between the generation archetypes and eras is outlined and discussed further below:

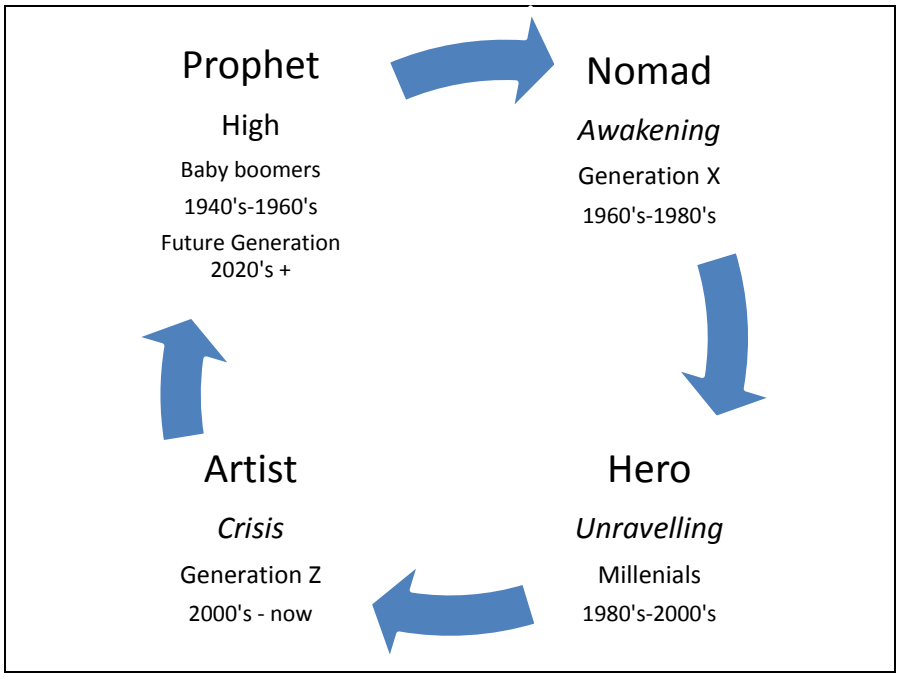


Figure 3.1: Generation archetype cycle (adapted from Strauss & Howe, 1997)

Furthermore, Strauss and Howe (1991:35) explain a generation cycle as consisting of consecutive 20 year cohorts, namely: Idealist, Reactive, Civic and Adaptive. The characteristics of each cohort occur in a four stage process of history spanning roughly 80 years. The generation archetypes were since renamed in *The Fourth Turning* by Strauss & Howe (1997), where Idealist became Prophet, Reactive became Nomad, Civic became Hero and Adaptive became Artist. In order to inquire about what will happen next in terms of generation traits and eras, one has to link current generations with the repeated sequence of the four generation archetypes. Strauss and Howe (1997:19) explain that each archetype is recognised by the turning of their birth, with a Prophet generation being born during a *high* era, a nomad generation being boring during an *awakening*, a hero generation being born during an *unravelling* and an artist generation being born during a period of *crisis*. As a new turning commences, each generation moves into a new period of its existence.

To understand the above mentioned cohorts as well as their characteristics at each stage of their lifespan, a brief explanation from Strauss and Howe (1997:84) follows. The Prophet generation is described as accepting of societal order and being born near the end of a *crisis*. Strauss and Howe (1997:101) explain that the first turning is a *high* that takes place following a crisis era in which institutions take precedence over individualism. Due to the catastrophic years prior to their birth, Prophets grow up as pampered children, with a strong pursuit of morals and principles during middle age, and as the cycle completes, steer another *crisis* as senior citizens. The following cohort, the Nomad generation, are born during a period of social standards and spiritual agendas that confront the existent recognised order. In contrast to the Prophet generation, the Nomads develop as under-protected children and somewhat divided during an *awakening* period. According to Strauss and Howe (1997:102) the attack of institutions for the sake of individuality and spiritual independence characterises this era. This generation are sensible leaders during middle age and become flexible mature adults in a post-*Crisis* era. After an *awakening* and during an *unravelling* period, the Hero generation are born into individualism. Institutions are fragile and doubted, although independence is strong and burgeoning during this Third Turning which is in in several ways contrary to a *high* (Strauss & Howe, 1997:103). Heroes grow up sheltered but emerge as positive partners during the

crisis of their youth and develop into dynamic and expectant young adults. They are cited as "powerful elders attacked by another *awakening*" (Strauss & Howe, 1997:84). The final cohort in the generation cycle is the Artist generation – the generation that Foundation Phase learners of this study were born into. This generation is born during a *crisis* which occurs after an Unravelling - a period where harmony and martyrdom caused by threatening social and political intricacy are part of the social order. Society is demolished and restored to awaken authority and community purpose. The Artist child is overprotected by parents from the Crisis era and develops into traditional and obedient roles as youth. As middle agers, this cohort emerges with a course of action in line with the Awakening of the time and then age into mindful individuals, post-awakening.

3.2.1 Generations explained

"It is through this linkage of biological aging and shared experience, reproduced across turnings and generations, that history acquires personal relevance" (Strauss & Howe, 1997:15). Strauss and Howe posit that "turnings come in cycles of four. Each cycle spans the length of a long human life, roughly eighty to one hundred years, and a unit of time the ancients called the saeculum. Together, the turnings of the saeculum comprise history's seasonal rhythm of growth, maturation, entropy and destruction" (Strauss & Howe, 1997:3).

The late 1980s were a time of radical transformation in terms of historical events that changed the world (Bush & Codrington, 2012). Such events started when terrorism reached the Western world, symbolised by the explosion of the Pan Am Flight 103 over Lockerbie in Scotland. Conversely, individual power reached the East as a series of demonstrations took place in Tiananmen Square in China in 1989. Moreover, the divide between the east and west collapsed as the Berlin Wall came down on 9 November 1989, bringing capitalism and democracy to the communist world. Thereafter, the Romanian communist dictator, Nicolae Ceaușescu, was executed. As Russia was undergoing political and economic reform, Eastern Europe also began to rehabilitate. Finally, these sequential events consummated on 11 February 1990 in South Africa as Nelson Mandela was freed from 27 years of imprisonment. The purpose of explaining these developments is because "we, and

our children, will live the rest of our lives with the consequences of this global transformation" (Bush & Codrington, 2012:xvii)

Everyone has values, expectations and an attitude that is based on what life was like when they grew up. Moreover, and rudimentarily, "the idea behind generation theory is not to pour everyone into a mould; rather your age, your generation is an attitude" (Codrington & Grant-Marshall, 2011:3). The generation theory assists to characterise a cohort of people who are born during a particular period of the same 20 years.

Strauss and Howe (1991) identified 18 generations through four centuries of history with each generation sharing one of four 'peer personalities' which repeat in a specific order. In order to expand upon the generations Table 3.1 is used to introduce each generation. The table indicates the saeculum, which is the historical cycle, approximately the length of human life (± 80 years in length). It also illustrates the turning within each saeculum, which is the changing mood throughout phases of life (±20 years in length). The name of each generation with the corresponding birth years and archetype is displayed.

Table 3.1: Introduction to generations (Text from Strauss & Howe, 1991)

Saeculum	Turning	Generation	Birth Years	Archetype
Late medieval	Retreat from France 1435 – 1459	Arthurian generation	1433 – 1460	Hero
	Wars of the Roses 1459 – 1487	Humanist generation	1461 – 1482	Artist
Reformation	Tudor Renaissance 1487 – 1517	Reformation generation	1483 – 1511	Prophet
	Protestant Reformation 1517 – 1542	Reprisal generation	1512 – 1540	Nomad
	Intolerance & Martyrdom 1542 – 1569	Elizabethan generation	1541 – 1565	Hero
	Armada Crisis 1569 – 1594	Parliamentary generation	1566 – 1587	Artist
New World	Merrie England 1594 – 1621	Puritan generation	1588 – 1617	Prophet
	Puritan Awakening 1621 – 1649	Cavalier generation	1618 – 1647	Nomad
	Reaction and Restoration 1649 – 1675	Glorious generation	1648 – 1673	Hero
	Glorious Revolution 1675 – 1704	Enlightenment generation	1674 – 1700	Artist
Revolutionary	Augustan Age of Empire 1704 – 1727	Awakening generation	1701 – 1723	Prophet
	Great Awakening 1727 – 1746	Liberty generation	1724 – 1741	Nomad
	French and Indian Wars 1746 – 1773	Republican generation	1742 – 1766	Hero
	American Revolution 1773 – 1794	Compromise generation	1767 – 1791	Artist
Civil War	Era of Good Feelings 1794 – 1822	Transcendental generation	1792 – 1821	Prophet
	Transcendental Awakening 1822 – 1844	Gilded generation	1822 – 1842	Nomad
	Mexican War & Sectionalism 1844 – 1860	NONE		NONE
	Civil War 1860 – 1865	Progressive generation	1843 – 1859	Artist
Great Power	Reconstruction & Gilded Era 1865 – 1886	Missionary generation	1860 – 1882	Prophet
	Third Great Awakening 1886 – 1908	Lost generation	1883 – 1900	Nomad
	WWI & Prohibition 1908 – 1929	G.I. generation	1901 – 1924	Hero
	Great Depression & WWII 1929 – 1946	Silent generation	1925 – 1942	Artist
Millennial	American High 1946 – 1964	Boom generation	1943 – 1960	Prophet
	Consciousness Revolution 1964 – 1984	Generation X	1961 – 1981	Nomad
	Culture Wars 1984 – 2005	Millennial	1982 – 2000	Hero
	Millennial Crisis	Generation Z	2000 – today	Artist

The importance of the above mentioned is to elucidate the cyclical nature of the generation theory, as well as its application to this study in terms of exploring the similarities of previous artist generations with Generation Z as well as the differences between generations that influence them.

3.2.2 Generation Z

For the focus of this study, Generation Z is the name given to the group of people who are born after the Millennial generation (see Figure 3.1) and within the Millennial Saeculum. Exact dates differ among authors and countries but the approximate beginning of the latest South African generation is the year 2000, as indicated by Codrington and Grant-Marshall (2011). This particular group (also referred to as the Homeland Generation, Baby Bloomers, NextGen, iFacebook Generation, Generation XD, Digital natives) that shares experiences, stages and events, is the most recent generation who are in their early formative years (Williams & Page, 2010:10). This generation has never lived without the internet and have been "born into a digital world, proficient with and dependent on technology, making it a critical part of how they interact, play, and learn" (Grail Research Report, 2011:3). In accordance, Posnick-Goodwin (2010:8) summarises Generation Z as follows:

> *They'd rather text than talk. They prefer to communicate online — often with friends they have never met. They don't spend much time outdoors unless adults organize activities for them. They can't imagine life without cell phones. They have never known a world without technology or terrorism or Columbine. They prefer computers to books and want instant results. They are growing up in an economic depression and are under tremendous pressure to succeed. Mostly they are growing up fast, and exhibiting behaviour far beyond their years.*

The world is currently in the fourth turning (the unit of time that is comprised of four cycles spanning an individual's life), the seventh cycle of modern time. According to Codrington and Grant-Marshall (2011:13), "in the twentieth century, further industrialisation, a shift to an information economy, and the present transition to an emotion/relationship economy have continued to create change." Bush and

Codrington (2012:9) maintain that there is a "need to make sense of all this change in order not only to assist their children to survive and thrive in an uncertain future, but also to help one through the chaos and change that will characterise life in the 21st century." Furthermore, Carli Fiorina, Hewlett Packard's CEO quoted that the dot-com boom is "an era in which technology will literally transform every aspect of business, every aspect of life and every aspect of society" (in Bush & Codrington, 2012:14).

The current generation is growing up in a world that has been influenced by numerous events. "Born after Nelson Mandela's release, after the end of communism and the breakdown of the Berlin Wall, after the release of Windows, and growing up with laptops, mobile phones and social networking, this is a confident generation of children optimistically looking ahead into the 21st century" (Bush & Codrington, 2012:28). Furthermore, Codrington and Grant-Marshall (2011:5) are of the opinion that Generation Z is part of a delicate world where their surroundings, the management of resources and the world is somewhat unstable and therefore their childhood is unpredictable. With regard to the above mentioned, Bush and Codrington (2012:38) advocate that:

> *… we need both to compete with it and find ways of balancing the noise (technology) and clutter (consumerism) in their lives to ensure that not only do they survive, but also thrive in the world of the 21st century. These are the children who will have to solve the problems that are not yet problems, with technologies that don't yet exist.*

3.2.3 Generation differences

According to Prensky (2001b:1), "It is now clear that as a result of this ubiquitous environment and the sheer volume of their interaction with it, today's students think and process information fundamentally differently from their predecessors." Teachers who are currently teaching generation Z hail from generations Baby Boomers, X and Y. As mentioned previously, each generation has a particular view of the world, with similar underlying value systems, due to the fact that they share situations, events and experiences that are correlative (Codrington & Grant-Marshall,

2004:3). For the purpose of this study, Table 3.2 briefly exemplifies the characteristics as well as the differences of the present-day generations.

Table 3.2: Characteristics of present-day generations (Text adapted from Bush & Codrington, 2012; Codrington & Grant-Marshall, 2004; Strauss & Howe, 1997; Roberts, 2011; Howe, 2014; Phelps & Graham, 2013)

	Boomers 1940's – 1960's	**Xers 1960's – 1980's**	**Millennials 1980's – 2000's**	**Generation Z 2000's – to date**
Motto	If you have it, flash it	Liberation before education What's in it for me? (Karp, in Smola & Sutton, 2002)	Work to live	Instant gratification
Key events	Lived through the birth of apartheid in SA under the National Party	AKA MTV generation	Lived through the end of apartheid and the first democratic elections	Barack Obama's presidency, the financial meltdown of 2008
Famous person(s)	Steve Jobs Bill Gates Elvis Presley Leon Schuster	David Beckham Charlize Theron Mark Shuttleworth	Kim Kardashiam Justin Bieber Brian Habana	Brooklyn Beckham
World events	Hippie movement	AIDS named	Princess Diana died 9/11	Death of Nelson Mandela
Inventions	Ballpoint pen, microwave oven, Tupperware, computer (ENIAC), transistor, bell telephone, bar codes, colour TV, microchip, disposable nappies, oral contraceptive, velcro	Pacemaker, computer mouse, ATM, VCR, CAT scan, Prozac, email, smart card, personal computer, CD's, artificial heart	Walkman, DNA fingerprinting, video games, mobile phones, solar energy, laptop computer, Viagra, animal cloning technology, PDA's, DVD's, digital cameras and memory sticks, HTML webpages (www), Google	Broadband, space tourism, smartphones, apps, social media, PVR, alternative energy Genetic engineering, artificial body parts, Cloud computing, electronic paper, E-readers, 3-D printing
South African	ANC led by Chief Luthuli	Soweto riots Nelson Mandela released	1994 elections	Death of Nelson Mandela
Characteristics	Competitive, flashy, leaders, optimistic, entitled	Individualistic, pragmatic	Confident, diverse, independent, tolerant, honest	Independent, self-directed

	Boomers 1940's – 1960's	Xers 1960's – 1980's	Millennials 1980's – 2000's	Generation Z 2000's – to date
Attitude to education	It is my right to attend school and attend university.	I'll listen, but I will teach myself.	There is more to school than boring memorising.	
Preferred teaching and learning styles	Transmission teaching Learners are passive Teachers in control Memorization and repetition Individual learning		Constructivist/Connectivist paradigm Active learners Teachers are facilitators, co-creators Discovery learning Collaborative learning (see 6.5.3)	
Present Day	Uphold rules that they were intent on breaking in their youth (Codrington & Grant-Marshall (2004:41)	Anti the corporate culture and part of dot.com technology boom (Roberts, 2011)	Ethical consumers who want to change the world (Codrington, 2008)	

It is significant to mention that the table above is incomplete due to the fact that there is a void in or speculation of information in the highlighted cells. The primary reason for this lack of evidence is that Generation Z is only 16 years old and therefore there has not been much scientific research conducted on this generation group. This study provided some insight into the missing data (see 6.5.3). To this end, and since the study focusses on teaching and learning with technology in the current era, it is relevant to understand common teaching and learning theories that have dominated teaching and learning in the Foundation Phase to date. It is also meaningful to include an existent learning theory that has emerged as a result of a new found branch of knowledge that stems from the creation and use of technologies.

3.3 TEACHING AND LEARNING THEORIES

This section departs from conventional learning theories in existing literature by examining the broad learning theories which are used in instructional contexts as frameworks for thinking and making sense of teaching and learning. Prominent learning theories were established when learning was not influenced by technology, yet recently technology has transformed how we live and especially how we learn. It therefore becomes increasingly important that learning theories address the fundamental social context when describing learning principles and processes

(Siemens, 2005). “Learning theories … equip us with understanding on how learners create new knowledge, build on existing knowledge and apply knowledge to new contexts” (Howell, 2012:21). It is therefore important to discuss pertinent theoretical slants supporting the use of technology, whether existing before yet fit to technology-based teaching and learning; or novel. For the purpose of this study, behaviourism, constructivism and connectivism as outlined in the figure below, will be reviewed since the general category of these schools of thought is applicable to teaching and learning with technology.

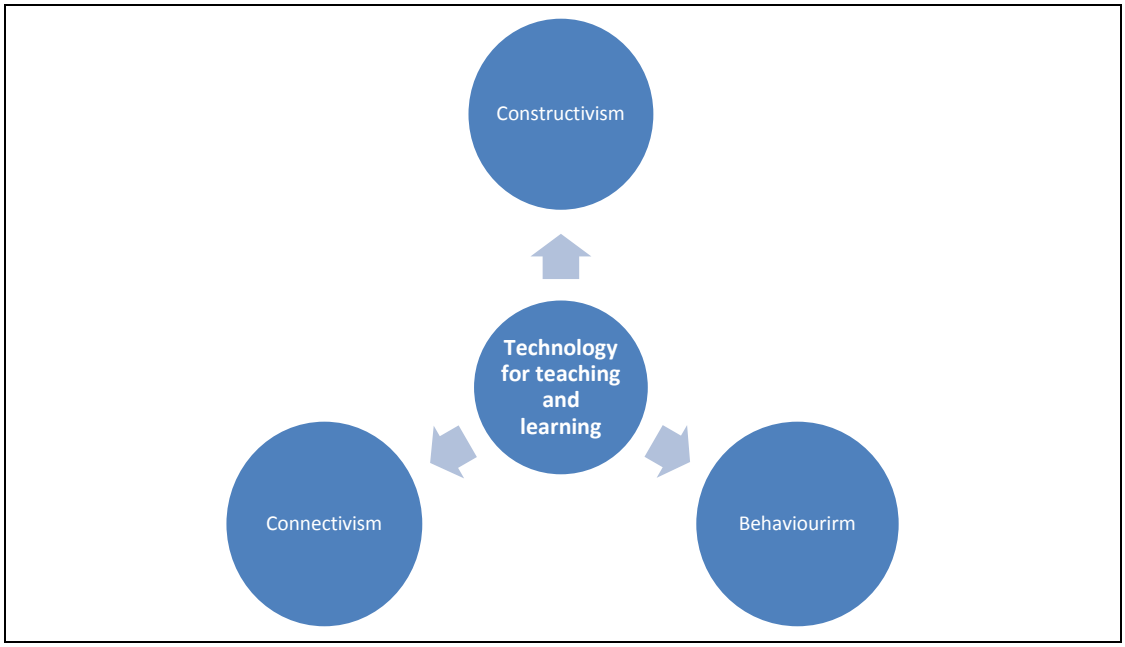


Figure 3.2: Learning theories relevant to TbTL (adapted from Howell, 2012)

3.3.1 Importance of learning theories in education

Essentially, only three learning theories, in a very broad sense have been discussed for the purpose of this study. According to Taylor and MacKenney (2008:248) in their comprehensive overview of learning theories and teaching practices, “no one learning theory is comprehensive enough to cover all aspects of human learning and behaviour.” A single learning theory has an influence on understanding learning to some extent, yet in entirety Taylor and MacKenney (2008:249) synopsize the value of educational theories under the following three points:

1. Educational theories provide researched enlightenment on learning processes that can be utilized and understood in practice.
2. Advancement and additions to teaching and learning strategies generally have a theoretical underpinning which helps teachers to establish which aspects of the curriculum seek further inquiry.
3. Facilitating learning and constructing environments for learning can be based on important aspects of educational learning theories.

Pritchard (2008) claims that in recent years, important advances have been made into teaching practice by two opposing strands of the psychology of learning, namely behaviourism and constructivism. In very broad terms, behaviourism pertains to what is actually happening, mostly behaviour, while constructivism stems from the notion that understanding and hence knowledge is created by individuals through various mental processes. Behaviourists are of the opinion that learning theory relies on evident behaviours that are strengthened with rewards and constructivists argue that learning is more involved than merely a stimulus-response action (Taylor & MacKenney, 2008). I subsequently address the above mentioned existing learning theories, behaviourism, constructivism and connectivism by specifically highlighting the role of technology in each one.

3.3.2 Behaviourism

According to Pritchard (2008:5), behaviourism has been used to describe intricate learning circumstances and is grounded in the central idea that a response occurs from a certain stimulus. Furthermore, as a learning theory, behaviourism concentrates on behaviours that are discernible and rarely includes mental activity. Learning occurs when a new behaviour is acquired and behaviourists name this type of learning conditioning (Pritchard, 2008:5). Ivan Pavlov (1849 – 1936) was the founder of behaviourism in Russia, but Burhus Skinner and Edward Thorndike played a large part in developing the theory further (Pound, 2011).

Two different types of conditioning are described and demonstrated as viable explanations of the way in which animals and humans alike can be ‘taught’ to do

certain things. Firstly, Pavlov's version of the behaviourist theory was highlighted by the reference to classical conditioning in which development and learning were mainly due to nurture after he experimented with dogs. These dogs learnt to connect a bell with food after noticing that if a bell was rung when food appeared that the dogs eventually started salivating even without the arrival of food due to a conditioned response. Pritchard (2008) explains that this type of conditioning is the behaviour that occurs due to a certain stimulus being supported. The other type of conditioning in the behaviourist learning theory is known as operant conditioning and occurs when the behaviour resulting from a stimulus is rewarded. Skinner's theory suggested that conditioning takes place when rewards follow accomplishments based on his initial work he conducted with rats (Pound, 2011). The rats had to press a lever in order to be fed, but Skinner changed the number of times the level had to be pressed to maintain the rats' interest. Operant conditioning can strengthen certain behaviours through rewards, but similarly, disparage negative responses.

The role of technology in association with the behaviourist learning theory can also be linked to Skinner's boxes or teaching machines that he invented. Pound (2011) explains that these boxes set various tasks or raised certain questions which rewarded children if they got the correct answer. Firstly, operant conditioning can be noticed in certain computer programmes whereby learners receive positive reactions based on correct answers and negative feedback for incorrect ones (Taylor & MacKenney, 2008:35). Secondly, Kohn (1993) proposes that Skinner's teaching machines steered the way to programmed learning. Yet another stance taken by behaviourists is Thorndike's theory of 'Law of Effect' which "suggests that any behaviour which has a positive consequence will be repeated" (Pound, 2011:92). Pound (2011) posits that this type of repetition enhances problem solving and problem solving is a key 21st century skill that plays a crucial role in TbTL in the Foundation Phase (see 2.3.1).

Finally, as a by-product of behaviourism, the social learning theory emerged. Albert Bandura (1925 -), not negating the stimulus and response elements of learning, put forward that learning through reinforcement takes place when an individual imitates or models themselves on others. Pound (2011:99) proposes that the social learning

theory is the "bridge between behaviourism and constructivism", which will be discussed in the following section.

3.3.3 Constructivism

Jean Piaget (1952) is largely responsible for the constructivist learning theory. Constructivism is grounded in the understanding that individuals construct their own knowledge of the world by experience and reflection. Piaget's constructivist theory contributes a firm foundation for understanding the way in which children do and think during different developmental levels.

Meier (2013) discusses Piaget's theory of cognitive development which proposes that children progress through four different stages of mental development: the sensorimotor stage (birth to 2 years), preoperational stage (2 – 7 years), concrete operational stage (7 – 11 years) and the formal operational stage (12 years onward). Children construct new knowledge by comprehending the world around them and then encountering conflict between what they know already with new explorations from their environment (Onchwari, Onchwari & Keengwe, 2008:270). It is through Piaget's four stages of cognitive development that children develop and make sense of their world.

According to Kalaš (2010) the teacher plays an important role as they should ensure that they understand the child's pre-knowledge, and then provide guidance to the appropriate activity to address and build upon that knowledge. Moreover, according to Piaget, children possess their own views of the world (which are different from those of adults), as well as these views being very articulate and powerful (Ackermann, 2001).

Yet another powerful influence in the constructivist school of thought is Lev Vygotsky's sociocultural theory (1978) which postulates a sociocultural approach to cognitive development. This implies that learning is strongly reliant on a skilful adult or peer. Meier (2013:5) cites that this type of learning is referred to as cooperative or collaborative dialogue. Central to this view "is the notion that learning is social with more competent others supporting learning in culturally specific ways" (Anderson,

Anderson & Thauberger, 2008:96). A further distinguishing feature of Vygotsky's approach is the Zone of Proximal Development which acknowledges the distance between what the child can accomplish alone and what he or she can achieve with the help of an adult or more capable peer (Pound, 2011). To this end, learners partake in various joint activities that afford the opportunity of "synthesizing several influences into the learner's novel modes of understanding and participation" (John-Steiner & Mahn, 1996:192). By internalizing the effects of working together, the novice acquires useful strategies and crucial knowledge.

Vygotsky's theory is underpinned by the notion that learning is influenced by the culture of the individual and facilitated by language and other systems. Likewise, this learning is not internalized directly, but through the use of psychological tools. With regard to the role of technology in Vygotsky's sociocultural learning theory it is necessary to understand that Vygotsky determined psychological tools and their intricate systems, such as language, writing, numeration and various other signs from technical tools (Vygotsky, 1930). According to John-Steiner and Mahn (1996:193), "other tools, increasingly recognized in sociocultural discourse - the paint brush, the computer, calendars, and symbol systems - are central to the appropriation of knowledge through representational activity by the developing individual". Kalaš (2010:28) asserts that technological tools "are 'technical' tools in the Vygotsky sense as tools to change external objects, at the same time they can be integrated with psychological tools."

Problem solving, inquiry, active engagement and collaboration with others characterises learning activities in constructivist settings. "Rather than a dispenser of knowledge, the teacher is a guide, facilitator, and co-explorer who encourage learners to question, challenge, and formulate their own ideas, opinions, and conclusions" (Weegar & Pacis, 2012:6). Moreover, how people use knowledge and the specific type of skills that emerged from the afore-mentioned theories relate closely to the fundamental skills that learners require in order to function on effectively in the 21st century which serves to elucidate the next learning theory, connectivism.

3.3.4 Connectivism

Finally, this study adds to the dominant view of learning theories by discussing a more recent learning theory which emerged in light of technological developments. Siemens (2005) argues that connectivism is the more contemporary and more suitable learning theory since the pace of change is so rapid in today's world that extended expertise requires continuous learning (and unlearning) of the vast amounts of knowledge over a lifetime which can no longer be contained within the mind of a single individual, and instead is now better stored and processed through technology. In addition, "technology rather, is an extension of our brains; it's a new way of thinking" (Prensky, 2013a:22). Connectivism is similar to the activity theory of Vygotsky since it is concerned with knowledge as part of a system which is retrieved through people partaking in activities. Connectivism as a learning theory "sees learning as a process of creating connections and developing a network which allows for a 'know-where' (the understanding of where to find the knowledge when it is needed) to supplement the ones of 'know-how' and 'know-what' that make the cornerstones of many theories of learning" (Howell, 2012:28). This notion is also known as the extended mind (Prensky, 2013a, Clark & Chalmers, 1998).

An extract for Clark and Chalmers (1998:11) adds to the concept of the extended mind which includes the idea that the storage of knowledge is not contained to just the mind of an individual:

> *Thus consider the use of pen and paper to perform long multiplication (McClelland et al 1986, Clark 1989), the use of physical re-arrangements of letter tiles to prompt word recall in Scrabble (Kirsh 1995), the use of instruments such as the nautical slide rule (Hutchins 1995), and the general paraphernalia of language, books, diagrams, and culture … Moreover, it may be that the biological brain has in fact evolved and matured in ways which factor in the reliable presence of a manipulable external environment.*

Table 3.3: Contrasting constructivist, behaviourist and connectivist teaching in the Foundation Phase (Text adapted from Phelps & Graham, 2013:130; Pound, 2011; Weegar & Pacis, 2012)

	Constructivist	Behaviourist	Connectivist
Teacher roles	• Guide and facilitator of students • Generate own knowledge • Collaborative resource and assistant as learners explore	• Direct instruction • Positive reinforcement • Actively teach learners in constructed environment • Give learners bite size chunks of information	• Distinction between teacher and learner broken down • Everyone learns and collaborates together • Individual learning as well as networks of people learning
Learner roles	• Constructing knowledge (making meaning) • Collaborative learning • Play and exploration • Accommodation, assimilation, equilibrium[2]	• Product of the environment in which they grow up • Stimulus-response	
Curriculum characteristics	• Project-based for higher and lower level skills simultaneously	• Learning stems from connections created from a stimuli-response relationship • Memorized bits of information	• Learning is nonlinear • Emphasis on informal learning through communities of practice • Personal networks
Learning goals	• Identified from where student began to ability to work independently and with others • Process and outcomes matched to learners level (Piaget) • Learners' potential (Vygotsky)	• Outcomes are explicit, behavioural, and observable	• Learning is lifelong (continual process) • Learning, work and recreation are ambiguous
Types of activities	• Investigative (projects) • Hands-on exploration • Product development	• Educational software • Computer assisted instruction (drill and practice)	• Emphasis on exposing learners to networks • Technology-based

[2] Accommodation, assimilation and equilibrium are key processes in constructing knowledge (Pound, 2011:106).

Accommodation: new knowledge or experience is integrated with existing knowledge

Assimilation: new knowledge or experience is reconciled with existing knowledge in order to establish equilibrium.

Equilibrium: The idea is accommodated to fit into knowledge schemes.

	Constructivist	Behaviourist	Connectivist
Assessment strategies	• Observation informs understanding • Performance tests and products (portfolios) • Rubrics and checklists • Measures may differ between students	• Written or oral tests • Individual mastery of entities, activities, and processes.	• Emphasis on capacity to enquire (rather than what is known) • Form connections between sources of information and how to apply them to problem solve

A behaviourist pays attention to what is to be learned and the stimulus of the environment upon that learning, while a constructivist is more concerned with understanding how the learner is trying to create meaning (Bush, 2006). On the other hand, connectivism places importance on the ability to find out (rather than what is known). Blending of the two theories, behaviourism and constructivism since they can be used in combination with educational technologies seems to be a preferred approach to TbTL (Weegar & Pacis, 2012:17). Mishra, Koehler and Henrikson (2011) argue that in order for teaching and learning to be transformative in the 21st century it needs to be transdisciplinary and to this end, connectivism is especially conducive to using digital technology. This study aims to explore TbTL in the Foundation Phase and therefore, an exploration of the TPACK framework will be discussed below.

3.4 TPACK FRAMEWORK

In recent years TPACK, a conceptual technological pedagogical content knowledge framework, originated in educational research (see Figure 1.1). The model was founded on the grounds that for many years, educational technology has endeavoured to expose its theoretical underpinnings (McDougall & Jones, 2006; Roblyer, 2005; Roblyer & Knezek, 2003). Certain explanations for the struggle to ground educational research in theoretical roots involve the accelerated pace of technological change (Roblyer & Knezek, 2003), as well as a lack of strong methodological designs and a convergence on practical matters instead of theoretical ones (McDougall & Jones, 2006; Roblyer, 2005).

In Graham's (2011) analysis of the theoretical considerations for understanding TPACK, several shortcomings of the framework are identified. These weaknesses are briefly discussed according to 'what' elements should be regarded when accounting for the TPACK framework, examining 'how' the constructs in the framework are related, and lastly, explaining 'why' the relationships are worthy of consideration in the larger frame of reference (Whetten, 1989). Firstly, TPACK identifies seven specific elements that constitute the framework which are based on a previous framework – Shulman's PCK, which can generate a lack of theoretical clarity (Graham, 2011:1955). Graham (2011) finds that another challenge is the necessity to cultivate exact definitions of the elements within the framework.

The second issue of investigating how the elements of the TPACK are related displays a dual perspective or stance of the framework according to Gess-Newsome (2002). On one hand, the 'integrative' perspective describes pedagogical content knowledge as "the combination or mixture of different types of knowledge", whereas the 'transformative' perspective acknowledges pedagogical content knowledge as a "new synthesized form of knowledge that cannot be explained by the sum of its parts" (Graham, 2011:1956). Angeli and Valanides (2009:157) clarify this issue by explaining that it is not apparent whether TPCK is "a distinct form of knowledge or whether growth in TPCK simply means growth in any of the related constructs."

However, Graham criticises this elementary viewpoint by stating that construct value which is the theoretical value of all elements in the framework as well as the prescriptive value, needs to be ascertained. Firstly, the construct value is concerned with how the elements of TPACK essentially correlate with other generally used elements such as technology integration (Graham, 2011). Secondly, a valuable theoretical model should not merely describe the phenomenon but should "facilitate one's ability to develop interventions that will predictably influence the phenomenon" (Graham, 2011:1959). Archambault and Barnett (2010:1660) chastise the current TPACK framework on the grounds that it is confined in its capability to predict or reveal outcomes or new knowledge therefore limiting its impact on the field of educational technology.

Although limitations of the TPACK framework have been delineated, a number of reasons as to why it works, especially in the digital era, is summarised by Mishra and Koehler (2006:1044) as follows.

> *One of the most frequent criticisms of educational technology is that it is driven more by the imperatives of the technology than by sound pedagogical reasons. The TPCK framework, we argue, has given us a language to talk about the connections that are present (or absent) in conceptualizations of educational technology. In addition, our framework places this component, the relationship between content and technology, within a broader context of using technology for pedagogy.*

For the purpose of this study, the TPACK framework was included based on the potential it has to provide a foundation for future research in TbTL, as well as to allow for theoretical guidance for how teachers and learners in the Foundation Phase might approach technology in specific ways. The success of using TbTL is not determined by the presence or lack of one element, but instead it is influenced by a number of interconnected constituents (Nyambane & Nzuki, 2014). Pink (2005:3) indicates:

> *Today, the defining skills of the previous era—the "left brain" capabilities that powered the Information Age—are necessary but no longer sufficient. And the capabilities we once disdained or thought frivolous—the "right brain" qualities of inventiveness, empathy, joyfulness, and meaning—increasingly will determine who flourishes and who flounders.*

Schmidt *et al*. (2009) posit that the notion of Technological Pedagogical and Content Knowledge (TPACK) framework has been discerned in education software design originally but also in explanations of the relationships between technology, content and pedagogy, as well as through different characterizations, such as integration literacy, ICT-related pedagogical content knowledge and electronic pedagogical content knowledge. Technological Pedagogical Content Knowledge (TPCK) was introduced to the educational research field as a theoretical framework for understanding teacher knowledge required for effective technology integration (Mishra & Koehler, 2006).

The TPACK theoretical framework (see Figure 1.1), as renamed by Thompson and Mishra (2007-2008), is used in this study to firstly, identify the learners' and teachers' views about the content taught in a technology rich environment. Furthermore, the TPACK framework investigated the pedagogy which guides teaching and lesson design in the Foundation Phase, as well as explored the technology selected to facilitate learners' learning and teachers' teaching. The particular kinds of knowledge that teachers require to effectively teach with technology have been identified by Mishra and Koehler (2006:1025) as a complex interaction among three bodies of knowledge: content, pedagogy, and technology. The following section elucidates and elaborates on each type of knowledge.

The construct that involves the interrelation between three basic components of knowledge, namely technology, pedagogy and content, intersects with a basic premise of applying suitable teaching content to congruous pedagogical methods and technology (Koehler & Mishra, 2008; Mishra & Koehler, 2006). There are seven components in the TPACK framework which stem from the addition of technology to include relations between Shulman's (1986) original PCK. These components are namely: technological knowledge; pedagogical knowledge; content knowledge; pedagogical content knowledge; technological content knowledge; technological pedagogical knowledge; and technological pedagogical content knowledge which are briefly outlined below. Thereafter, a more in depth look into the special kinds of knowledge, skills, and understanding of the three major components (technological knowledge, pedagogical knowledge and content knowledge) will be discussed in relation to this study.

1. *Technological knowledge (TK):* Technological knowledge is concerned with knowledge about numerous technologies spanning from the pencil and paper of low-tech technologies to the interactive whiteboards, the internet and software programmes of digital technology.

2. *Content knowledge (CK):* Content knowledge is the "knowledge about actual subject matter that is to be learned or taught" (Mishra & Koehler, 2006:1026). The content of what they are going to teach and especially how

the knowledge is unique to its own content area should be known by teacher, such as Grade 3 mathematics.

3. *Pedagogical knowledge (PK):* Pedagogical knowledge alludes to the strategies and techniques of teaching and also involves knowledge about lesson planning, assessment, teaching methods, learner learning and classroom management.

4. *Pedagogical content knowledge (PCK):* Pedagogical content knowledge refers to the content knowledge that deals with the teaching process (Shulman, 1986). Howell (2012) explains that is the manner in which a subject is made understandable to learners. Pedagogical content knowledge is different for various content areas, as it blends both content and pedagogy with the goal being to develop better teaching practices in the content areas.

5. *Technological content knowledge (TCK):* Technological content knowledge is assigned to the knowledge of "how technology can create new representations for specific content" (Schmidt *et al.* 2009:125). This implies that teachers recognise that using an explicit technology can alter the way that learners grasp concepts in that specific content area.

6. *Technological pedagogical knowledge (TPK):* Technological pedagogical knowledge exemplifies knowledge through which numerous technologies can be applied in teaching, and moreover to an insight that by using such technologies, the way in which teachers teach and learners learn may change.

7. *Technological pedagogical content knowledge (TPACK):* Technological pedagogical content knowledge is associated with the knowledge that teachers need in order for technology and teaching in any given content area to merge. Shmidt *et al.* (2009:125) postulate that this level of knowledge allows teachers to "have an intuitive understanding of the complex interplay between the three basic components of knowledge (CK, PK, TK) by teaching content using appropriate pedagogical methods and technologies."

3.4.1 Technological knowledge

Webber (2003) claims that one of the most urgent issues is the impact of technology on education. Dias and Atkinson (2001) state that merging technology into education in order to have a positive impact on teaching and learning has been in a state of development for the past 20 years. Technology should not only be regarded as a singular digital tool but rather as an instrument that is used to shape skills while supporting educational outcomes that are necessary in the knowledge society. Kozma (2005) indicates that when technology is used effectively it has the potential to reinforce pedagogical, curricular and assessment transformation while reinforcing the progression of knowledge creation. Using TbTL establishes an environment that is dynamic while at the same time reconstructing learning and teaching (Volman & Van Eck, 2001). Technology is therefore "not just regarded as a tool, which can be added to or used as a replacement of existing teaching methods, but an important instrument to support new ways of teaching and learning" (Nyambane & Nzuki, 2014:2).

Technological knowledge allows teachers to comprehend information technology, determine appropriate technology, use technology most favourably in practice to ensure learning, and adjust to the transformations in technology (Mishra *et al*. 2011). Within the context of the TPACK framework, "the two important elements of teaching and learning which are content and pedagogy must be joined when technology is used" (Nyambane & Nzuki, 2014:3). In line with this study, Williams and Page (2010) explain that integrating technology can be attributed to using any tool to assist teaching and learning.

"The future promises more of the same, given the ever-increasing pace of technological innovation" (Mishra *et al.* 2011:23). The level of integration and success at which technology is assimilated is discouraging which Hew and Brush, (2007) as well as Mishra and Koehler (2006) attribute teacher knowledge as one of the key barriers. Furthermore, Harris, Mishra and Koehler (2009) posit that teacher knowledge should extend beyond technical features of technology to include technology's extent and limitations for reproducing content as well as teaching methods.

3.4.2 Content knowledge

Mishra *et al.* (2011) highlight an important question to ask is "what today's students need to know" which alludes to the 'C' in the TPACK framework. Furthermore, this framework serves as a means to assist teachers in determining how to achieve educational outcomes within what contemporary students need to know. Gardner (2006, 2007) postulates that content or disciplinary knowledge is the most important development of mankind and that the teaching thereof is the most fundamental aim of schooling. "Disciplinary knowledge in the traditional sense is shifting beneath our feet" (Mishra *et al.* 2011:23). It therefore suffices that as the discipline is continually altering, the type of content knowledge that our learners are required to cultivate is changing too.

Thirteen cognitive thinking tools, originally proposed by Root-Bernstein (1996, 1999) were adapted by Mishra *et al*. (2011) to seven key trans-disciplinary thinking tools. Pink (2005) asserts that these thinking tools provide the foundation for the type of curricula that is fundamental for today's learners. In addition, "teaching and learning with technology exist in a dynamic transactional relationship between the three components in our framework; a change in any one of the factors has to be 'compensated' by changes in the other two" (Mishra & Koehler, 2006:1029). The thinking tools are namely: perceiving, patterning, abstracting, embodied thinking, modelling, deep play and synthesizing. These seven tools relate to content knowledge, but without omitting technological and pedagogical knowledge, have the ability to transform teaching and learning as briefly discussed below:

3.4.2.1 Perceiving

Mishra *et al.* (2011:25) explain the cognitive tool of perceiving as a "two-layered process" consisting of both observing and imaging. For example, in the Foundation Phase, observing would entail concrete, hands-on experiences as the first step to making sense of anything that a learner encounters. Thereafter, a higher level of thinking is necessary as the external stimuli become absent and a learner needs to rely of the ability to recall what was observed. In the Foundation Phase and in accordance with Piaget's theory of conservation, "the child now understands that

when there is transformation something must be conserved because by reversing the transformation you can come back to the point of departure" (Piaget, 1964: 179). Linking technology to the needs of pedagogy and content, an activity for Foundation children could be for children to take photographs of geometric shapes in their environment to improve the skill of perceiving through observing and imaging.

3.4.2.2 Patterning

Patterning involves an analytical process of recognising patterns, as well as a creative process of forming new patterns (Mishra *et al.* 2011). The TPACK framework can be used to demonstrate the opportunities of how technology, pedagogy and content can be integrated into Foundation Phase activities to enhance learners' patterning skills. One such example would be combining art and mathematics where learners creatively find and build patterns using a computer software programme such as Inkscape[3].

3.4.2.3 Abstracting

Mishra *et al.* (2011) define abstracting in terms of focussing on one characteristic of a concept or development in order to interpret the meaning of an idea or analyse by means of comparing. In relation to the Foundation Phase, an example of abstracting would be using popular children's literature in the form of an application, which is an uncommon area of expertise in mathematics, to elucidate specific mathematic concepts. This clearly indicates how combining the content and pedagogical factors to technology, in this case an app, that a common goal to transform teaching and learning through abstracting is achieved.

[3] Inkscape is an open source vector graphics program.

3.4.2.4 Embodied thinking

Embodied thinking consists of two skills which are interdependent, namely: kinaesthetic thinking and empathizing (Mishra *et al.* 2011:13). Firstly, kinaesthetic thinking involves using the body – muscle sensations, movements, balance and feeling - for thought. Secondly, empathizing entails identifying or experiencing another's feelings. Using kinaesthetic learning in the Foundation Phase, as the Fleming VARK model (Fleming & Mills, 1992) suggests is one of the most recognised models of how children learn through the modality of their bodies. An example of using embodied thinking in the Foundation Phase would be using the Nintendo Wii to allow children to investigate patterns and symmetry of their bodies through music and movement. The example of embodied thinking above transforms learning "from static to tactile" and merges technology, pedagogy and content (Mishra *et al*. 2011:14).

3.4.2.5 Modelling

Modelling implies presenting a thing in real or theoretical terms with the intention of learning its essence, structure or intention (Mishra *et al.* 2011). More specifically modelling includes dimensional thinking which is thinking in terms of space and time. Mishra *et al.* (2011:15) explain that "dimensional thinking, paired with abstraction and analogies, help create models of things or processes that explain the real world." Using Google Earth in the classroom is one way in which young children explore modelling through the idea of mapping two-dimensionally and then developing three dimensional visualisation skills. From the perspective of TPACK, fusing technology, content and pedagogy is one way to transform teaching and learning.

3.4.2.6 Deep play

Play can be regarded as making use of mind, body, knowledge and abilities "for the pure enjoyment of using them" (Mishra *et al.* 2011:15). The difference between simple, ordinary play and deep play lies in the distinction that deep play is open-ended and transforms thinking about both the player and the object being played with in order to establish new ways of being. Foundation Phase learners can engage

in deep play through many of the available devices on the market, such as Nintendo Wii or an interactive whiteboard. The examples of using play given above, although elementary, may lead to transformational thinking as long as technology, pedagogy and content are blended.

3.4.2.7 Synthesizing

Synthesizing as a cognitive tool brings all the above mentioned tools, discussed above, together. According to Mishra *et al*. (2011:16) it "entails bringing multiple ways of knowing together in order to synthesize knowledge." In this instance, when Foundation Phase learners synthesize the six previously mentioned tools, reinforcement of deeper connections between content and future learning occurs. It therefore is concluded that the seven ways of thinking are interdependent and that "these six tools work together to develop a synthesis greater than the sum of its parts" (Mishra *et al.* 2011:17).

3.4.3 Pedagogical knowledge

In a literature review of factors that influence technology integration in education, Nyambane and Nzuki (2014) highlight different categories that have been used by teachers and researchers. Although not all of the categories are exclusive to pedagogical knowledge, a number of the pertinent ones will be discussed below in relation to this study. These factors include teacher level factors such as teachers' attitudes, ICT competence, computer self-efficacy, teaching experience and teacher workload, as well as school level factors such as professional development, accessibility, technical and leadership support (Nyambane & Nzuki, 2014). A discussion of teacher level factors ensues in the next sections.

3.4.3.1 Teachers' attitudes

A number of authors have cited teachers' attitudes as an area that influences successful use of TbTL (Hew & Brush, 2007; Keengwe & Onchwari, 2008). Specifically, British Educational Communications and Technology Agency (Becta) (2004) posits that teachers' attitudes and understanding of how these technologies

can assist students' learning and be advantageous to teaching influences teacher attitudes towards the use of technologies. In a study from the Netherlands, Drent and Meelissen (2008) found numerous factors such as a positive attitude toward technology, a pedagogical approach that is student centred and personal entrepreneurship of the teacher that assists the use of technology among teachers. In a similar vein, a study from Singapore (Teo, 2008) found that four factors, namely, affect, perceived usefulness, perceived control and behavioural intention to use the computer influenced teachers' attitudes.

3.4.3.2 ICT competence

Teachers' lack of knowledge and skills in using various technologies is one of the barriers to using technology according to Pelgrum and Law (2003). Moreover, technology integration in the United States was positively impacted on by high levels of attitude, skill and knowledge as well as level of access (Christensen & Knezek, 2001). Furthermore, in an Italian study researching confidence and competence of using technology in teaching in primary schools, Peralta and Costa (2007) established that technical competences, as well as pedagogical and didactic competences were important elements for effective technology use.

3.4.3.3 Computer self-efficacy

Nyambane and Nzuki (2014) claim that teachers' confidence in their own ability to use technology in teaching and learning relied upon clarity of computer use and perceived self-efficacy. Moreover, an Italian study highlighted that teachers' technical competence was an element in increasing the overall confidence of using TbTL, whereas teachers from Greece revealed that pedagogical and personal factors were partly responsible for their confidence in technology use (Peralta & Costa, 2007). On the other hand, Balanskat (2012) found that a fear of failure and a lack of knowledge in technology were reasons for teachers' low confidence levels and therefore the reluctance of using technology.

3.4.3.4 Teaching experience

The motive to use technology, as well as the actual use thereof is largely influenced by experience with technology according to Nyambane and Nzuki (2014). The US National Centre for Education Statistics (cited in Nyambane & Nzuki, 2014) established that newly qualified teachers are more experienced in using technology. Contrastingly Russel, Bebell, O' Dwyer and O' Connor (2003) claim that new teachers were more skilled than older ones, yet did not use technology in their teaching for two main reasons. Firstly, new teachers seemed to concentrate on how to use technology effectively in teaching, instead of how to incorporate it into teaching and secondly, these teachers were preoccupied with school curriculum and management in their early years of teaching.

3.4.3.5 Teacher workload

Lack of time is a shortfall of integrating technology into teaching and learning (Nymabane & Nzuki, 2014). Time spent on accessing the internet, preparing lessons, training and subsequently exploring and practicing with technology and technical problems are all cited as aspects that require more of the time that teachers do not possess (Becta, 2004). Similarly, Sicilia (2005) claims that the lack of time reported by teachers to plan lessons with technology and to research different sites and software, are some of the key challenges to technology integration.

A discussion of school level factors follows in the ensuing sections.

3.4.3.6 Professional development

Nyambane and Nzuki (2014) claim that too often, the emphasis of teaching about technology instead of teaching with technology is the focus of technology programmes. Yet Venezky (2004) claims that professional development time is not always accounted for despite it having the greatest impact on the attitudes and implementation of technology in schools. It is suggested that a contributing factor to sound technology in education programmes is professional development of teachers (Nyambane & Nzuki, 2014). Technology training programmes aid teachers' skills in

computer use (Franklin, 2007) and influence teachers' attitudes towards using TbTL (Keengwe & Onchwari, 2008). Sandholtz and Reiley (2004) believe that it is not merely technology skills that determine successful use of technology but rather pedagogically oriented programmes that assist teachers to apply such knowledge and skills. Teachers who successfully combine new teaching practices that are learned in professional development programmes with technology have the ability to influence learners' achievements (Lawless & Pellegrino, 2007).

3.4.3.7 Accessibility

Integration of TbTL is largely reliant on accessibility of technological resources such as hardware and software. Being able to obtain technological resources is a means for teachers to successfully implement pedagogical practices in TbTL (Yildrim, 2007). Furthermore, should the availability of resources be hampered, teachers' motivation towards technology is negatively affected (Osborne & Hennessy, 2003). Four of the top ten challenges to implementing technology in schools were attributed to accessibility according to Pelgrum (2001). These were namely: an inadequate number of computers; insufficient amount of software copies, poor synchronous internet access; and lacking peripherals. Therefore, Plomp, Anderson, Law and Quale (2009) conclude that access to technological tools is a prerequisite for favourable technology use in teaching and learning.

3.4.3.8 Technical support

It can be assumed that insufficient technological support in schools will lead to insufficient maintenance of technological tools and therefore contribute to a technological failure (Becta, 2004). Yilmaz (2011) regards technical support, especially relating to maintenance and repair, as imperative to maintaining the hardware and software that exists in schools. Moreover, Nyambane and Nzuki (2014) claim that teachers also require pedagogical assistance in order to successfully integrate the chosen technological tool into a lesson.

3.4.3.9 Leadership support

Schiller (2003) has highlighted research that supports the crucial role that school leadership has on implementing change, contributing to aims and objectives of education and professional development when using technology to bring about pedagogical reform. Wong and Li (2008) investigated the integration of technology in eight schools in Hong Kong and Singapore and established that a leader with strong collaboration skills was highly effective in transforming technology integration. Yuen, Law and Wong (2003) believe that the school principal is a key agent of change while Nyambane and Nzuki (2014) claim that the leaders in schools should possess strong role modelling examples by making use of technology in their everyday lives.

3.5 SYNOPSIS

Various factors from teacher level and school level that affect the integration of technology in education have been discussed. In the Foundation Phase probably more than any other phase, teachers are challenged by the intricacies as well as assuring the certainty of learning (Kalaš, 2010). Kalaš (2010:27) cites the New Zealand Council for Educational Research's (2004) contribution to how technology can complement the Foundation Phase learning environment:

> *The value ICT can add to young children's learning environments depends on the choices practitioners make about which tools to select, and when and how to use these; and their understandings about how these tools can support children's learning, development, and play. ... They also need to be familiar with contemporary theories about learning and development, and recognize how these can be linked to the use of ICT*.

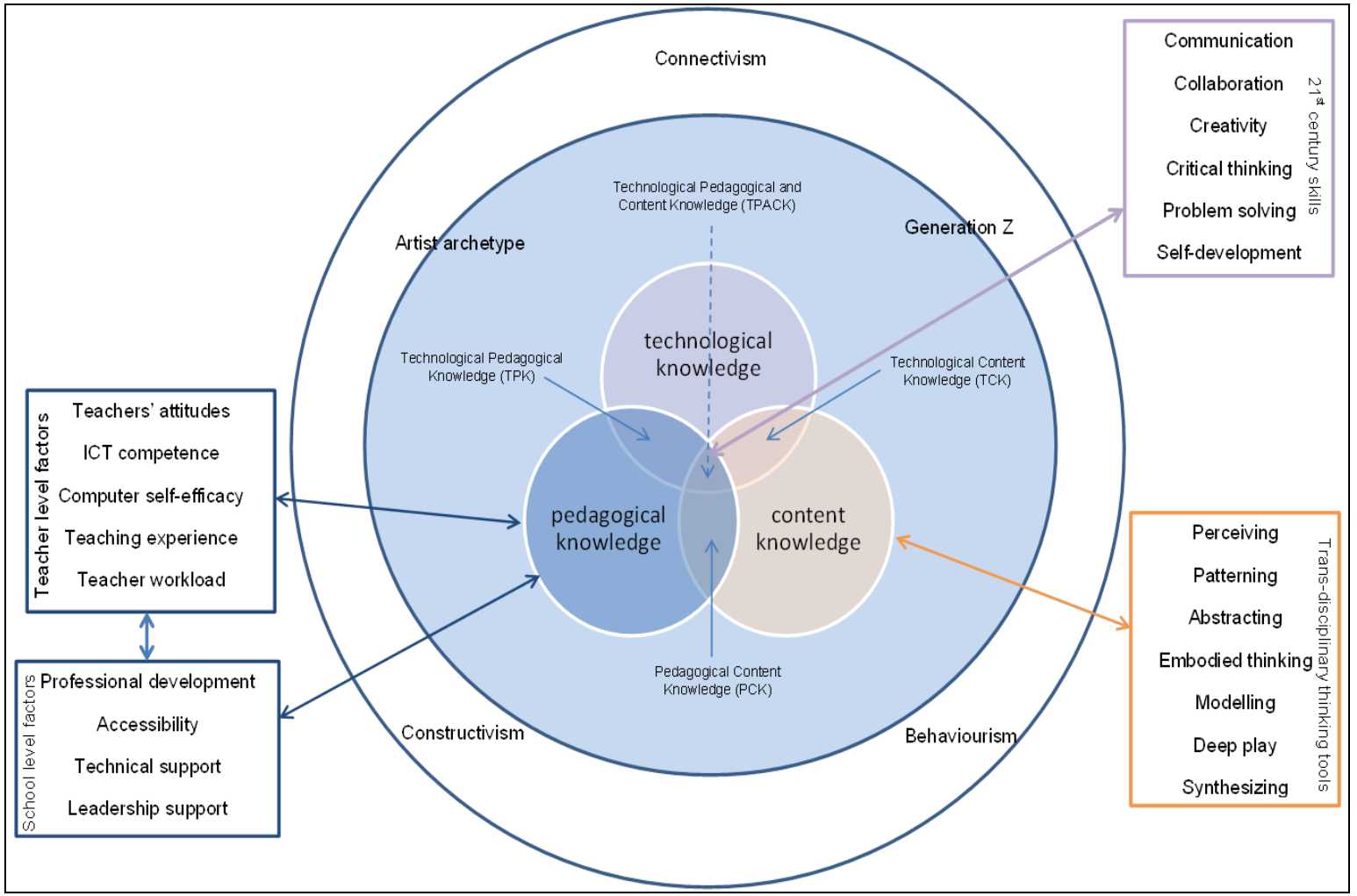


Figure 3.3: Conceptual framework diagram

The above mentioned conceptual framework of this study (see Figure 3.3) serves to synopsize the preceding discussion in this chapter which is based on various conceptual and theoretical underpinnings. The three learning theories, namely behaviourism, constructivism and connectivism, which have a pertinent connection and applicability to TbTL, underpin this framework. The generation theory and specifically the fact that learners of this study are classified according the Artist archetype and are known as Generation Z influence both teaching and learning in the Foundation Phase. Finally, at the heart of the conceptual framework of this study is the TPACK framework. The three primary elements of technology, pedagogy and content, as well as the interrelatedness between these elements ground the conceptual framework of this study.

3.6 CONCLUDING REMARKS

This chapter provided a synopsis of the literature surveyed on numerous theories that are relevant to TbTL in the Foundation Phase. It departed from an explanation of the generational theory which accounts for a cohort of individuals that are born in the same 20 year cycle and that share experiences and a common outlook. The reason for including this theory into the conceptual framework was to draw from previous archetypes and broadly characterise learners and teachers. The learning theories relevant to both the Foundation Phase and TbTL were unpacked in order to provide insight into the learning processes and learning environments within the Foundation Phase based on a theoretical underpinning. Lastly an in-depth account of the TPACK framework and all its interconnected elements was included in order to expose how educational technology can be grounded in theory to shed light on how and what teaching and learning occurs in a technology-rich environment in the Foundation Phase. Literature that is pertinent to this study has been provided and the following chapter will discuss the methodology that was followed.

CHAPTER FOUR:
RESEARCH METHODOLOGY

How you see the world is largely a function of where you view it from, what you look at, what lens you use to help you see, what tools you use to clarify your image, what you reflect on and how you report your world to others.

- Anderson (2004:3)

4.1 INTRODUCTION

The literature review and delineating conceptual elements relating to technology for teaching and learning in the Foundation Phase as presented in the previous two chapters serve as a framework for the research methodology. Moreover, this chapter serves to indicate the approach that was employed to answer the research questions of this study. In this chapter, I discuss the research methodology that I utilized to investigate the topic under study. This chapter therefore explains the research design which includes the research paradigm, approach and type. I then discuss the research methods which consist of the sampling method and participants, the data collection techniques and strategies for analysing the data, as well as the ethical considerations that directed this qualitative study. The main aim of this chapter is to highlight the methodology used in the exploration and development of a framework for technology for teaching and learning in the Foundation Phase. Table 4.1 provides the research methodology that was implemented in this study.

Table 4.1: Research methodology

Research paradigm	
	Interpretivism
Research approach	
	Qualitative
Research type	
	Multiple descriptive case study
Research methods	
Data collection techniques	
Photovoice: Photograph(s)	
Narratives: Original written accounts	
Semi-structured interviews: Verbatim written transcriptions of questions and answers	
Opinion pieces: Original written perspectives	
Field notes: memos	
Expert interview: verification of data (themes and categories)	
Participants	
Selection of participants	Purposive sampling
School A:	1 Grade 3 teacher 5 Grade 3 learners
School B:	1 Grade 3 teacher 5 Grade 3 learners
1 expert in technology	
District officials:	2 Foundation Phase officials
Data analysis and interpretation	
Qualitative thematic analysis	
Trustworthiness	
Credibility, transferability, dependability, confirmability	
Ethical considerations	
Informed consent, anonymity and confidentiality, deception and privacy, role of the research	

4.2 EMPIRICAL RESEARCH QUESTIONS

Jansen (2007:3) explains that a research question provides the research with directions to the relevant literary resources and with a focus for data collection. The main research question, as mentioned in Chapter 1 (See 1.3.1), “How do teachers’ and learners’ experience technology-based teaching and learning in the Foundation

Phase?" underpins this study. In searching for the answer to this question, specifically in terms of empirical data collection during the photovoice method, questions were asked as prompts to guide the participants. The pertinent empirical research questions that follow serve to explain and describe the experiences that teachers and learners have with technology in the Foundation Phase and provide a framework for successful technology for teaching and learning:

- How do learners learn?
- How do teachers teach?
- What technology, pedagogy, content knowledge is apparent (before/after) teaching?
- What is the technological profile of a learner in Grade 3?

4.3 RESEARCH DESIGN

The research design of this study departs with a discussion of the research paradigm which is the interpretivist paradigm. Thereafter, the qualitative approach to the research as well as the case research type will be explained. Finally, the data collection and data analysis procedures are discussed, as well as the trustworthiness and ethical considerations.

4.3.1 Research paradigm

A paradigm is an aspect of reality from a set of views or philosophies which brings into being a specific view of the world and it addresses essential positions such as the "beliefs about the nature of reality (ontology), the relationship between knower and known (epistemology) and assumptions about methodologies" according to Nieuwenhuis (2007:47). Groenewald (2004) claims that a researcher's epistemology is fundamentally the theory of knowledge which assists in how the phenomena will be described. In this study, my epistemological standpoint originates from the view that people involved in using technology for teaching and learning hold data and for that reason, I collected data from these participants – teachers and learners in a technology rich environment.

Lincoln and Guba (1985:15) explain that a paradigm denotes that which we think about, but cannot provide proof for. According to Cohen, *et al*. (2005:137), the interpretivist paradigm of this research study maintains that humans actively construct their own meanings of situations and that meaning arises from social situations which are subjected to interpretive processes. The above mentioned implies that a paradigm acts as the lens through which one makes sense of reality. In this regard, my study aspires to investigate technology for teaching and learning of teachers and their respective Grade 3 learners in the technology-rich context of their school.

Terre Blanche, Durrheim and Painter (2006:275-276) claim that the interpretative paradigm, which I opted to work from, provides the perfect conceptual domain to deal with in-depth investigation and *verstehen* of participants' life worlds, as experienced on a day-to-day basis. This implies that my research attempted to understand and relate to the everyday experiences with technology which influenced the participants' experiences and descriptions of teaching and learning in the Foundation Phase. This paradigm essentially corresponds with my interest in "… the concern for the individual …" (Clasquin-Johnson, 2011:78).

Taking the above mentioned into account, I worked from an interpretive paradigm to make sense of the reality which focussed on teachers' and learners' subjective perceptions and experiences rather than objective, numerical and scientific data. In accordance with Cohen *et al*. (2005) making sense of the particular world of human experience formed the basis of this study. Since the study is subjective in its paradigmatic approach as Cohen and Crabtree (2006:1) state that "… a reality that cannot be separate from our knowledge of it (no separation of subject and object), the interpretive paradigm posits that researchers' values are inherent in all phases of the research process and that truth is negotiated through dialogue."

Moreover, this perspective enabled and guided me to work according to a certain framework of a particular research methodology and make sense of the data collected from the participants, as well as assist me in interpreting the exchange of ideas that occurred. Regarding the methodological stance of this study, within the interpretivist paradigm, knowledge is always relative and therefore, the best way to

study behaviour is to portray it from the viewpoint of those involved (Livesay, 2006:3). Opting to use the photovoice technique, interviews, narratives and field notes (as discussed further on) supported me in gaining insight into the lived experiences of the phenomenon, technology for teaching and learning (Giles, 2007:6).

4.3.2 Research approach

Qualitative research is a research approach which is concerned with an insight into the processes and the social and cultural contexts which underlie various behavioural patterns, and it is mainly concerned with exploring the "why" questions of research (Nieuwenhuis, 2007:51).

From the 1970's qualitative research methods were contrasted with scientific quantitative methods which brought about the differentiation between the objective positivist approach that deals with general laws against the subjective constructivist approach which is more involved with the uniqueness of a certain situation. With reference to the interpretivist paradigm as discussed above, I took a qualitative research approach to this study as my research aimed to gain a deep understanding of Foundation Phase teachers' and learners' descriptions and experiences of technology for teaching and learning in the context of the primary school in which they find themselves. Qualitative research supports a "…real world setting [where] the researcher does not attempt to manipulate the phenomenon of interest." (Patton, 2002:39), which was the case in the qualitative approach that I employed to understand phenomena in context-specific settings, for example teachers and learners at a particular technology-rich primary school.

According to Holloway and Wheeler (1996) the qualitative approach to research usually examines individuals or systems by observing participants in their natural surroundings (*in situ*) and interacting with them to find their meanings and interpretations of a particular phenomenon. In order for a phenomenon to be described in terms of the meaning it holds for participants, qualitative research focuses on describing and understanding phenomena within their naturally occurring context with the intentions of developing an understanding of the meaning(s) imparted by the participants – a "seeing through the eyes of the participants"

(Nieuwenhuis, 2007:51). By making use of photographs, as well as written and verbal responses, the meaning participants ascribe to their descriptions and experiences of technology is elucidated.

4.3.3 Research type

This research employed a case study research design. Yin (in Nieuwenhuis, 2007:75) defines the case study research type as an empirical inquiry that investigates a contemporary phenomenon within its real-life context when the boundaries between phenomenon and context are not clearly evident and in which multiple sources of evidence are used. Furthermore, case studies "…strive to portray 'what it is like' to be in a particular situation, the close-up reality and 'thick description' of participants' lived experiences of, thoughts about and feelings for, a situation" (Cohen *et al*. 2005:182).

This design is particularly appropriate for my study as elements of a framework for technology for teaching and learning in the Foundation Phase could only be hypothesised and are not yet known. Moreover, this study can be classified as a descriptive case study which provides a thorough description of the phenomenon in context according to Yin (2003a). This descriptive case study explains the sequence of interpersonal events from the participants' accounts of technology in the Foundation Phase while discovering the key aspects of technology for teaching and learning.

Specifically, I define this study as a multiple case study. Yin (2003b) describes a multiple case study as a design in which the researcher reproduces the processes for each case and practices the logic of replication. Creswell (2007:74) labels a multiple case study as one issue being chosen in which the researcher selects multiple cases to illustrate that issue. Additionally, a case can be defined as an in-depth exploration of a bounded system based on extensive data collection – 'bounded' meaning that the case is isolated for research in terms of time, place or some physical boundaries according to Creswell (2012:465). This case study focussed on one unit of analysis, namely TbTL in the Foundation Phase at two different settings. Each setting was a technology-rich school in which five Grade 3 learners and their teacher were the

participants. Rule and John (2011:19) postulate that the phenomenon has to be formulated as a case. This implies that each case included the phenomenon of technology for teaching and learning and was bounded by its specific research site.

Blatter (2008:71) posits that case studies have a powerful comparative aspect regarding 'depth' of analysis in terms of "empirical completeness and natural wholeness or as conceptual richness and theoretical consistency." Similarly the strength of a case study lies in its descriptive goals and various gauges for representing a theoretical concept (Blatter, 2008). The particular reasons for choosing case study as a research type are also discussed in Rule and John (2011:7 – 8) and summarised for the purpose of this study in Table 4.2.

Table 4.2: Strengths of a case study

Strength	Reason for choice
Depth	Allowed me to examine technology for teaching and learning in the Foundation Phase in depth, focussing on complex relations within the case.
Flexibility	Allowed me to choose from a variety of research methods for both data collection and data analysis.
Manageability	Allowed me to delineate a particular unit to study, i.e. TbTL in the Foundation Phase.

This research type is appropriate since my aim was to discern and pursue an understanding of the issues that are intrinsic to the case itself (Schwandt, 2007:28). The case study allowed me to answer "how" and "why" questions offering a multi-perspective analysis in which the researcher considers not only the voice and perspective of participants in a situation, but also the views of other relevant groups of actors as well as the interaction between them (Nieuwenhuis, 2007:75). Woodside (2010:1) identifies a primary purpose of case study research as acquiring an extensive understanding of a series of actions namely, participants' self-perceptions (an ''emic view'' of what's happening and ''why I did what I did'') of their own thinking processes, intentions, and contextual influences. In this study, case study research focusses specifically on describing the individuals (learners and teachers) in relation to technology.

The above mentioned explanation of a case study is pertinent to answering my research question on how teachers teach and how learners learn with technology in the Foundation Phase, since answering it requires an in-depth understanding of the phenomenon of technology. Similarly, each setting illustrates a study of five Grade 3 learners and their respective teachers in a bounded system (i.e. TbTL in the Foundation Phase).

4.4 RESEARCH METHODS

4.4.1 Research site and participant selection

De Vos (1998:191) explains sampling as a subset of measurements drawn from a population in which the researcher is interested. In line with the qualitative research approach and case study research type of this study, purposeful sampling is used in order to identify both participants and sites with the focus on people and places that can best help to understand our central phenomenon (Creswell, 2012:205). In addition selectivity is built into this type of sampling method which enabled me to target a particular group in the full knowledge that it does not represent the wider population; it simply represents itself (Cohen *et al*. 2005). Patton (2002:169) claims that the particular method and strength of purposeful sampling is situated in cases that are information-rich and from which one can learn a great deal.

The research sites in Case 1 and Case 2 were chosen based on the fact that the environment was identified as data rich in terms of technology for teaching and learning. I chose two private primary schools primarily because of their use of technology and the availability of technological resources. Creswell and Plano-Clark (2011:172) advocate that in order "to address a research question or hypothesis, the research engages in a sampling procedure that involves determining the location or site for the research." I therefore made use of the facilities at the schools to gather data, for the practical reason that they provide the most accessible venues for teachers and learners that were familiar with this location. In addition, the selection of the specific district for Case 3 was twofold. Firstly, it is the same district in which Case 2 is situated and secondly, the education specialists were identified to yield

valuable information to describe the experiences and official perspectives with regard to TbTL in the Foundation phase. The research sites also gave me further insight into the exact environment where technology is used for teaching and learning as I was able to observe the environments and various technological tools that were being used.

In order to come to findings that are transferable to other settings, I selected representative participants as the sample. Purposive sampling was used to select a Grade 3 teacher and five Grade 3 learners at each of the two research sites which were technology-rich schools. Similarly, I purposively selected the two district officials for Case 3 in light of their experience and vantage point of TbTL in the Foundation Phase. An expert in the field of technology and research was also purposively selected to comment on the data that emerged from the research. The parameters within which the participants were selected were:

- Participants (learners and teachers must come from two schools that are technology-rich.
- Participants must be using technology in their class.
- Participants (teachers) must be a class teacher of the learner participant.
- Participant (expert) must have knowledge and expertise in technology for teaching and learning.
- Participants (district officials) must be Foundation Phase specialists.

The nature of purposive sampling is to select participants on the basis of knowledge of a population, its elements, and the purpose of the study according to Babbie (2004:183). Therefore, I chose the specific sample underpinned by the experience that participants "…possess a similar trait based on membership in a subgroup." (Creswell, 2012:209). Likewise, Creswell (2012:125) maintains that these participants could communicate their lived experiences, were all located at the same site and had all experienced the phenomenon being explored, namely technology for teaching and learning in the Foundation Phase.

All of the participants were invited to participate in the study and all 15 participants were available for the duration of the study. The motivation behind using a small sample in this research was to deal extensively with the complexity of the information provided by the participants (Creswell, 2012:209). In the following chapter I tabulate further information on the participants' from each case in terms of their role, gender, grade and age (see Table 5.1).

4.4.2 Data collection methods

Qualitative methods, such as those employed in this study, "…ensure an adequate dialogue between the researchers and those with whom they interact in order to collaboratively construct a meaningful reality" (Cohen & Crabtree, 2006:3) became apparent in the research process. Acknowledging the qualitative nature of the research, the researcher poses broad, extensive questions to participants and allows them to share their views for the most part, free from the researcher's perspective according to Creswell (2012:212). In light of this, I applied photovoice, narratives, individual interviews, opinion pieces and field notes as data collection techniques in order to gain insight into technology for teaching and learning by Grade 3 teachers and learners in order to guide my study and find answers to my research questions. Table 4.3 provides an outline of the various data collection techniques, the type thereof and the advantages and limitation of each one. Each of the data collection techniques are subsequently discussed in more detail.

Table 4.3: Summary of qualitative data collection (Adapted from Creswell, 2009:178-180)

Data collection technique	Type	Advantages	Limitations
Audio-visual material Photovoice	Photographs	• Unobtrusive method of data collection • Creative and attention captured visually • Opportunity to 'see' participants' reality	• May be difficult to interpret
Documents Narratives	Personal documents – narrative story	• Unobtrusive method of data collection • Allowed me to obtain words of participants which are thoughtful	• Not all participants were equally articulate • Documents may not be authentic or accurate (i.e., parents assisted children)
Opinion pieces	Personal documents – written perspectives	• Unobtrusive method of data collection • Allowed me to obtain words of participants which are thoughtful	• Not all participants were equally perceptive
Field notes	Written and transcribed field notes	• Written evidence	• Researcher subjectivity
Interviews	Semi-structured, face-to-face (in person) interview	• Participants provided historical information • Enabled me to control line of questioning and prompts	• My presence may bias responses • Not all participants were equally articulate
	Systematizing expert interview (Interviewer as co-expert)	• Participant has exclusive expert knowledge • High level of discussion and information generation	• Remains within framework of field (Van Audenhove, 2007:14)

4.4.2.1 Photovoice

I decided to make use of the "photovoice" method (Olivier *et al*. 2009), which is also known as "reflexive photography" as one method of data collection. From a theoretical standpoint, reflexive photography has its roots in the theory of *symbolic interactionism* which is a sociological perspective that places emphasis on micro-scale social interaction (Schulze, 2007). Three key assumptions form the foundation of *symbolic interactionism* according to Blumer (1969) who was the first to use the term:

1. Humans act toward things on the basis of meanings they ascribe to those things.
2. The meanings of such things are derived from, or arise out of, the social interaction that one has with others and society.
3. These meanings are handled in, and modified through, an interpretive process used by the person in dealing with the things he/she encounters.

The three key assumptions of symbolic interactionism can be explained as follows in the framework of this study:

1. Grade 3 teachers and learners photographed certain symbols or things that they identified with technology for teaching and learning based on a personal connotation and meaning that they associated with those specific objects.
2. The reason for abovementioned symbols or things derived from the connection that the teacher and learners had with various individuals or the community.
3. The same explanations stemmed from the meaning that each individual teacher and learner ascribed to the photographs (symbols).

Symbolic interactionist researchers essentially investigate the meanings which individuals ascribe to symbols and things through, and as a consequence of, their social interactions (Kamper & Steyn, 2011:285). For example, the Grade 3 teachers and learners are invariably involved in social interaction with other people, symbols and things, as well as their actions - all of which are seen and considered to be symbolic objects.

Banks (2001) posits that rich descriptions of the meaning attached to symbols are usually obtained through reflexive photography which gives participants the chance to in fact "zoom in" on these symbols (such as a photograph of an iPad or cellphone portraying their experience of technology for teaching and learning). The circumstance to execute photovoice establishes a level of participant involvement, dedication and commitment to the research project that is favourable, as well as a useful approach to secure the meanings assigned to the photograph (Kamper & Steyn, 2011).

One of the primary reasons for selecting this method was for its capacity in acquiring optimal commitment in participants' involvement in a research study (Olivier *et al*., 2009). The method involved that participants were issued with cameras and then prompted to take pictures of people or things which have an intimate connotation with the research topic. More specifically, Grade 3 learners and their teacher were asked to take photographs that depicted their description and experiences of how they learn and how they teach respectively with technology**.** Paulo Freire used visual ethnography ("coded situations", depicted by sketches or photographs), which is similar to photovoice, to assist communities to consider their own situations critically (Kamper & Steyn, 2011:286).

This method of data collection has been favourably applied with children to expose their understanding as they contribute to research in a significant way (Ail-Khan & Siry, 2014:197). Similarly, Kamper and Steyn (2011:286) agree that a "chain reaction" which causes people to remember, reflect and (to) gain new perspectives" is enhanced through photographs.

While implementing this method, I made use of a step by step guide to facilitating a photovoice project, as compiled by Olivier *et al.* (2009). The steps were incorporated into three sessions as follows:

- Session 1: Orientation

I purposefully selected five Grade 3 learners and their respective teacher from each school identified in a purposive sample and requested them to participate in the

research. I explained and motivated that the research project will be based on the characteristics of Grade 3 learners and how this impacts the way in which learning and teaching takes place in the Foundation Phase. I then emphasised to the teachers and learners their critical role as participants. The photovoice method was introduced to the participants, and I emphasised that visual investigation is a powerful mode of learning and creative work. I then issued the learners and teachers respectively with the following prompt for taking the pictures. *Take pictures that show me how you learn* and *take pictures that show me how you teach*. The reason that the prompt did not include any mention of technology was intentional. Prior to collecting data, I implemented a pilot of the photovoice technique with a few learners (in another Grade 3 class) at the first research site. It was found that using the initial prompt, *Take pictures that show me how you learn with technology,* was too prescriptive and yielded photos that contained only digital technologies. I thus, broadened the prompt accordingly.

The participants were requested to take a maximum of 10 photographs for three days, of anything or anyone that they associate with the prompt at hand. The session ended with a practical exercise whereby a disposable camera was given to each participant at school A and at school B. Time (1 week) was given to take the pictures, and arrangements were made to collect the cameras from school A and school B respectively. Following each collection of the cameras from the school, I developed the films and printed the photographs.

- Session 2: Exhibition

The second session, which took place at school A and at school B on different occasions, involved the group of participants exhibiting their pictures (participant by participant) in a boardroom at each school. The discussions with learners that followed focussed on their reasons for selecting certain photographs to express the way in which they learn, whereas discussion with the teachers focussed on their interpretation of the photo according to the way in which they teach. More specifically, the discussions and selected photographs were used as a starting point to elicit in-depth responses by way of a more detailed account of how the learners learn and how the teachers teach. Each participant was asked to pick the one or two

pictures that best depicted their learning or teaching, be it positive or negative. The learners were requested to write a narrative of about one paragraph about the selected pictures and were asked to submit the narratives within one week.

- Session 3: Wrap-up

In the final session of the photovoice technique I arranged to meet with the participants again at school A and at school B where the learners were given the opportunity to present their narratives to me. I also used the above mentioned dates and opportunities to conduct the semi-structured interviews with the respective teachers. The participants were given the assurance that they would be allowed to scrutinise the data of the photovoice method, should they wish to do so. In the case of learners, it was mentioned in the informed consent to parents that, should they wish, they were allowed to examine the data.

4.4.2.2 Narratives

In the context of this study, the first set of narratives was developed from the written paragraph that each of the 10 Grade 3 learners provided in response to the photograph which represented their descriptions of how they learn. Although a narrative in terms of the above mentioned descriptions alludes to a lengthy account of an individual's story, the participants were too young to be able to write more and it was therefore confined to only a paragraph. According to Gomez (1997:195), "…narrative inquiry is a methodological approach of understanding people's representations of the world, their actions in it, through the stories they tell." The word "narrative" is usually linked with terms such as "tale" or "story" and every person has his or her own personal story (Nieuwenhuis, 2007:102). "Narrative researchers aim to understand why people think and act as they do in the situated contexts in which they live and labour." (Gomez, 1997:195). Corresponding with Creswell (2012:507), this specific data collection technique was employed to highlight the learners' and district officials' personal and social experiences from the story and the subsequent themes that emerged from it.

I held the participants' stories as fundamental to explain responses that were necessary to answer my research questions since "the idea of the voice of the situated contributor is central to narrative…" (Walker, 2005:131). Narrative inquiry is elucidated in the following (Walker, 2005:132):

> *The point then is that qualitative narrative inquiry can generate fruitful insights not only in relation to the lives being investigated, but also about the wider context in which that life is lived. At the same time the stories told will be mediated by the time and conditions of their telling; they are not realist copies but a version of experience. They are above all socially located, so that telling one story is also telling the story of many lives, and telling the story of the individual in relation to these other lives*.

This research study was designed accordingly and I collected and analysed the participants' narratives in the wider context of their social experiences.

4.4.2.3 Semi-structured interviews

I opted to conduct interviews in this study in order to collect data and gain insight into the behaviours, experiences, ideas, perceptions, views and opinions (Nieuwenhuis, 2007:87) of Grade 3 teachers who use technology for teaching and district officials who have a bird's eye view of the technological landscape in the Foundation Phase. A qualitative interview is the method of asking one or more participants general, open-ended questions while keeping evidence of their answers according to Creswell (2012:217). In this study, I used semi-structured interviews with a Grade 3 teacher from each of the two schools where I conducted research as well as with the two Foundation Phase district officials. The interviews with the teacher participants took place in their respective classrooms at a time and date that was suitable to each individual participant (Wholey, Hatry & Newcomer, 2004:35). I opted to conduct one interview with the two district officials simultaneously at a central meeting point at a suitable time on a suitable date. De Vos (1998:299) endorses the fact that pre-formulated questions are carefully arranged and put to all the interviewees in a fairly similar sequence during a semi-structured interview. Denzin and Lincoln (2000:649) are of the opinion that the researcher asks all participants the same series of pre-established questions.

As the interviewer, I asked specific questions to the participants thus allowing some measure of control over the information received (Creswell, 2012:218) as well as giving the teacher participants the opportunity to best voice or describe their experiences of using technology for teaching and allowing the district officials to describe the current educational landscape with regard to TbTL. Although pre-established questions were set out in the interview protocol (see Appendix H and Appendix I), I also asked probing questions during these interviews as this allowed me to converse more freely with the participants, and also to investigate any controversy that arose during the interview process itself (Clasquin-Johnson, 2011:87).

In all the interviews that I conducted, permission was obtained from the participants beforehand to use a voice recorder to record the interview and to take notes (See Appendix B and Appendix F). I concluded the interviews by acknowledging appreciation for their involvement, guaranteeing them the confidentiality of responses, and by communicating to them that the results of the study will be made available to them (Creswell, 2012). I transcribed the interviews shortly after they had taken place.

4.4.2.4 Field notes

Over and above the photovoice method, narratives, interviews and opinion pieces, I made field notes at every visit to the research sites. Cohen *et al.* (2005:146) posit that observations are recorded field notes and include a level of description such as a written description and explanation of the events and behaviours of the participants. Field notes can either be written *in situ* or away from the site which are the notes made in the field (Cohen *et al.* 2005:146). I made use mainly of notes made away from the field as I was busy with the techniques of other methods of data collection whilst at the site. I did however minute certain activities at the research site, in a semi-structured way, based on acquiring answers to my research questions (Creswell, 2009:180). Schwandt (2015) describes field notes as evidence to yield meaning and an understanding of the culture, social situation, or phenomenon being studied. The field notes taken in this study served to complement interview and narrative data on the phenomenon of TbTL in the Foundation Phase.

4.4.2.5 Opinion piece

Participants from the district were asked to write an opinion piece based on their perspectives and experiences of TbTL in the wider Foundation Phase population. Although not a widely recognised qualitative data collection method, it is referred to as an opinion piece because it provides the participants' views and experiences of TbTL from their specific vantage point of servicing a large portion of the Foundation Phase. The opinion piece in this study followed an open-ended questionnaire structure to which two open-ended questions namely: "who has access to what forms of technology and when and how is it used" and "based on the pros and cons of the educational landscape with regard to TbTL, what recommendations can be made?" were posed to the two district officials after conducting a semi-structured interview with them. The value of using open-ended questions in this manner allowed participants to provide honest and detailed explanations of their experiences of TbTL in the Foundation Phase while at the same time, the data generated assisted in answering the research questions (Cohen *et al*. 2005:261).

4.4.2.6 Systematizing expert interview

Once data were collected and analysed from the photovoice, narratives, interviews, opinion pieces and field notes, I found it necessary to conduct an expert interview. According to Littig (2013) the expert interview is a special method since the definition of experts and expert-knowledge requires methodological consideration. To this end, Van Audenhove (2007:5) defines an expert as a person with "high insight in aggregated and/or specific knowledge." In this study, the expert has a thorough understanding of technology and technology-related knowledge. Although methodological literature on this data collection method is scarce, Van Audenhove (2007) outlines the different types of expert interviews, interview techniques and procedures. I opted to make use of a systematizing expert interview which is focussed on the uniqueness of expert knowledge which in this case, the participants gained in practice and through research in the field of educational technology. Gumbo (2016) defines the field of educational technology as a specialised field in which technological tools are used to provide support in teaching.

Littig (2013) postulates that if the emphasis of research is on the analysis of a specific configuration of knowledge, then conducting an expert interview is a credible choice due to the practical values of expert knowledge for others. In this study the expert is regarded as a "crystallization point" for practical insider knowledge and hence, acted as a representation of the wider circle of role players in the field technology in education (Bogner, Littig & Menz, 2009:2). The reason for including an expert interview in this study was for quality assurance of the data analysis. To this end the expert critically reviewed the data that had been collected and analysed to a point in order to detect any fatal criticisms or omissions in the themes of the research.

I initially approached the participant by explaining what the aims, significance and purpose of the research were and providing a brief background of my own affiliation. Once the participant consented to be involved in the study, I supplied a brief outline of the research, particularly the final table of data analysis (see Table 5.7). This table was used as basis of discussion in order to connect the data analysed from teachers and learners to implications of TbTL in the Foundation Phase. My role as interviewer in this type of interview was that of confederate (Van Audenhove, 2007:18) which was based on an informal style of dialogue and communicating experiences between me and the participant. I obtained consent from the participant beforehand to use a voice recorder and to take notes during the discussion. I also assured the participant that the responses would be confidential and that the results of the study would be made available to her. The discussion was transcribed soon after it had taken place.

4.4.3 Data analysis

I opted to analyse the data on the grounds that there is not only one common approach to qualitative data analysis. According to Creswell (2012:238) "… there is no single, accepted approach to analysing qualitative data, although several guidelines exist for this eclectic and interpretive process." Nieuwenhuis (2007:99) posits that data analysis in qualitative research attempts to form meaning of the phenomenon under study based on analysis of participants' descriptions and experiences of the same phenomenon. Data analysis of this study merged Creswell's (2012:237) six steps frequently used in analysing qualitative data, as well as data

analysis for a case study research type (Creswell, 2007:156-157) which is outlined below:

1. Firstly, I began data managing (Creswell, 2007:156). I arranged the data that had to be analysed by grouping it into types such as photographs, interviews, narratives, opinion pieces and field notes). Thereafter, the audio recordings from the two teacher interviews were transcribed into text data. In line with Creswell (2007), this also involved steps which included reading and memoing in which initial codes were derived as well as describing the case and their context.
2. Further exploration of the data was done by means of coding, which is also known as classifying (Creswell, 2007). This was done by reorganising the data according to each of the participants. I also read the narratives, opinion pieces and transcripts of the interviews whilst making notes to record my first impressions thereof. Thereafter I pigeonholed and sectioned the text to form descriptions and topic clusters so as to make sense of the data (Creswell, 2007; 2012).
3. At this point, I used codes to develop a more general picture of the data, descriptions and subcategories. Creswell's (2012:236) question, "What in the responses of the participants' provide answers to my research questions?" guided my review of the narratives, visuals, text and transcripts.
4. The findings were represented through in-depth descriptions of the cases (Creswell, 2007). More specifically, narratives, visuals and opinion pieces of the sorted responses about participants' descriptions and understanding of technology for teaching and learning were put into categories and thereafter into themes (see Table 5.5).
5. Another step in the data analysis procedure was interpreting the data (Creswell, 2007). I reflected on the bearing of the findings together with the literature that might appraise the findings in order to interpret the data. This was done by summarising the themes and reflecting on the similarities and/or differences between my findings and those reported by others in the literature (see 6.3 and 6.4).
6. Lastly I used various strategies to confirm the truthfulness of the findings. Different data were triangulated to strengthen the accuracy. Similarly, I

referred to my supervisor and the expert participant to ascertain whether I accurately inferred and represented the participants' (Grade 3 learners and their respective teachers and district officials) descriptions and understanding of technology for teaching and learning in the Foundation Phase.

I paid careful attention that my data analysis should be documented carefully and methodically while being rigorous, disciplined and organized during this particular stage of the study (Schwandt, 2007:7). With reference to interpreting a case study, Rule and John (2011:75) state that data analysis allows one to formulate thick descriptions, establish themes, produce explanations of thought stemming from the case, and finally to theorise the case. Specifically, case study data analysis, according to Stake (1995), requires a comprehensive description of the case that develops in which the researcher fine points features such as the order of events, activities or case. The following table of data analysis in a case study is related to this study:

Table 4.4: Data analysis and representation for case study (Adapted from Creswell, 2007:156-157)

Data analysis and representation	**Case study procedure**
Data managing	Created and organised files for data
Reading, memoing	Read through text, took notes, formed initial codes
Describing (See 5.2.1, 5.3.1 and 5.4.1)	Described the cases and contexts (technology-rich school and wider Foundation Phase)
Classifying (See table 5.7)	Developed topic clusters, categories and established themes
Interpreting (See 5.7)	Directly interpreted data Developed naturalistic generalisations
Representing (See 5.2, 5.3 and 5.4)	Presented in-depth 'picture' of the cases

Creswell (2007:75) maintains that when analysing the data forthcoming from a multiple case study, the researcher first offers a detailed account of each case and themes within the case, known as "within-case analysis" and thereafter a thematic analysis across all cases is provided called "cross-case analysis." My data analysis

began by organising and preparing the data by filing each set of typed, scanned or transcribed data electronically according to each participant, as well as each setting. Thereafter, I broke down the sets of data (photographs, field notes, narratives and transcriptions) by categorising and coding the individual segments and establishing a pattern for the whole by relating the codes to one another (Schwandt, 2007:7).

According to Rule and John (2011:77), sound qualitative research acknowledges that some codes are pre-conceived based on literature and the development of a conceptual framework (deductive analysis) while still allowing other codes to be made known inductively through the data. I opted to deductively and inductively analyse each set of data according to each participant to highlight the various codes derived from participants' photographs, narratives, individual semi-structured interviews, field notes and systematizing expert interview.

In order to progress from the raw data to a thematic analysis (Rule & John, 2011), I grouped codes according to similarities and differences into topic clusters, subcategories and categories and searched for further patterns to generate themes in the end. (See Chapter 5 for an in-depth analysis of data). Finally, the cases were theorised through a dialogical relation between theory and case (Rule & John, 2011:91). In other words, I used theory (see Chapter 3) to initially define the case of technology for teaching and learning in the Foundation Phase yet the case allowed me to develop new theoretical stances. It was in the concluding interpretive stage that I reported on the meaning of the case derived from learning about the issue of the cases (Creswell, 2007) (See 5.6).

4.4.4 Role of the researcher

In qualitative research, the paradigm, ontology, epistemology, research methodology and data analysis, includes "the personal biography of the researcher, who speaks from a particular class, gender, racial, cultural, and ethnic community perspective" (Denzin & Lincoln, 2000:18). In qualitative research, data are facilitated from a human as the instrument, instead of through devices, questionnaires or the like. To this end, Wellington (2000:41-43) claims that the status or beliefs in qualitative research that are usually accepted must be challenged by the primary research

agent. Researcher subjectivity is something that cannot be dismissed in the data gathering and analysis during qualitative research when the researcher is the "research instrument" (Nieuwenhuis, 2007).

McMillan and Schumacher (2011) further explain that the researcher should attempt to be a thoughtful participant, who minutes phenomena faithfully, while still inquiring into questions, following intuitions and probing deeper into the analysis of the phenomena. In order to fulfil the role of the qualitative researcher in this study, I assessed my own background, perceptions, assumptions, feelings and role regarding the research process. I arranged and structured interviews and the photovoice technique, facilitated the collection of narrative data and opinion pieces data, as well as crystallised data. All the necessary resources such as equipment (e.g., camera and voice recorder) and writing tools (stationery for narratives) were supplied to the participants in order to guarantee that no external factors influenced their undertaking in the study. I clearly understood my role as a researcher throughout description, analysis and interpretation of empirical data and tried to convey the most transparent and understandable account of teachers' and learners' experiences of TbTL in the Foundation Phase.

4.5 ADDRESSING TRUSTWORTHINESS

Many perspectives exist for the definition, descriptions and procedures regarding the importance of validation in qualitative research. When Nieuwenhuis (2007:80) mentions research validity and reliability, he usually refers to research that is credible and trustworthy. I will address the concept of trustworthiness in this qualitative study which is concerned with establishing credibility, transferability, dependability and confirmability (Lincoln & Guba, 1985; Schwandt, 2007). To actualise the above mentioned terms, Creswell (2007:204) recommends "techniques such as prolonged engagement in the field and the triangulation of data of sources, methods, and investigators to establish credibility." My framework for thinking about the trustworthiness was to apply accepted strategies to document the "accuracy" of this study (Creswell, 2007:207).

Whittemore, Chase, and Mandie (2001) have organized the strategies to ensure trustworthiness into various forms that apply to consideration of research design, as well as generation, analysis, and presentation of data. Creswell (2007:208) outlines some of the above mentioned strategies that are most applicable to qualitative research which are discussed in relation to this study below. Further strategies to ensure trustworthiness are outlined in Table 4.5.

Firstly, lengthy engagement and continuous observation in the field meant that I had to make "decisions about what is salient to the study, relevant to the purpose of the study, and of interest for focus" (Creswell, 2007:209). Secondly, triangulation should make use of multiple and different sources, methods, investigators, and theories to provide corroborating evidence (Lincoln & Guba, 1985; Patton, 2002). One such accepted strategy to increase the trustworthiness of this study, was the use of multiple methods of data collection (Nieuwenhuis, 2007). To this end, I collected data through photographs, narratives, transcriptions of interviews, written opinion pieces and field notes and remained as objective as possible throughout the process of doing so. Data collected and analysed to this point was verified by an expert in the field of educational technology to further enhance the trustworthiness which was evident in the third approach, member checking. The latter requires that the credibility of the findings and interpretations are verified (Lincoln & Guba, 1985). In the expert verification, thorough member checking of the data analysis took place to further ensure the credibility and trustworthiness of this study. Fourthly, I provided a detailed account of the participants and the research setting in order to provide a rich, thick description of the data and enhance the transferability of the study.

In addition, the trustworthiness of research studies consists of four criteria (Lincoln & Guba, 1985; Schwandt, 2007:299), namely that the data should be credible, transferable, dependable and confirmable. Firstly, the conditions for credibility encompass the accuracy with which the researcher has recorded the phenomenon under study (Shenton, 2004). Merriam (in Shenton, 2004:64) questions "how congruent are the findings with reality?" to establish credibility. Second, Shenton (2004) explains that a rich description of the phenomenon under study and ample background data to establish context of study will allow for comparisons to be made and thus achieve transferability. Thirdly, if the work were repeated in the same

context with the same methods and with the same participants, similar results would be obtained, results would be dependable according to Shenton (2004:71). Finally, Trochim (2006) explains the concept of confirmability as the degree to which the results could be confirmed or corroborated by others. Confirmability is the qualitative researcher's cognisance of objectivity (Shenton, 2004:72). Table 4.5 highlights the four criteria that were applied to establish trustworthiness in this study (Poggenpoel, Nolte, Dörfling, Greef, Gross, Muller, Nel & Roos, 1994:131 – 136 in Ellis, 2012).

Table 4.5: The application of the four criteria to establish trustworthiness
(Adapted from: Poggenpoel *et al*., 1994:131 – 136 in Ellis, 2012).

Strategy	Criteria	Applicability
Credibility	Prolonged engagement	I familiarised myself with the potential participants, prior to data collection, by contacting them and discussing the aims of the study.
	Reflexivity	Field notes were taken to clarify any personal bias in order to best voice participants' experiences. I assessed my own background, perceptions, assumptions, feelings and role regarding the research process.
	Triangulation	I used multiple data collection methods, namely photovoice, narratives, individual and expert interviews, written opinion pieces and field notes to gather data and produce a "…rich and comprehensive picture…" (Creswell, 2012: 536).
	Member checking	Photographs, narratives, interviews and opinion pieces were scrutinised by the expert participant and I used a tape recorder to further consult the data from the interviews. All of these data collection processes were triangulated with the available literature.
	Participants' review	I requested that expert participant confirm that the comprehensive descriptions were fair and representative.
	Peer examination	My supervisors reviewed the comprehensive descriptions of all the data collected.
Transferability	Sample	A purposive sample was used which provides a rich description of the participants and setting under study (see 4.4.1).

Strategy	Criteria	Applicability
	Dense description	A complete account of the methodology was provided as well as verbatim accounts of data in Chapter 5.
Dependability	Audit trail	Participants were given the option to review the report on the narrative of the themes which validated data.
	Methodology triangulation	Data collection itself, the chosen methods, data analysis and literature were used to strengthen evidence and validate findings identified during the data analysis process.
	Peer examination	My supervisors reviewed a comprehensive description of all the data analysed.
	Evaluation	A consensus discussion of the comprehensive descriptions of the data were held with my supervisors and the expert participant.
Confirmability	Audit	My supervisors reviewed the comprehensive descriptions of the data gathered.

The above mentioned strategies refer to triangulation which can be defined as "… the process of corroborating evidence from different individuals, types of data, or methods of data collection in descriptions and themes in qualitative research" (Creswell, 2012:259). Yet, the notion of triangulation is based on an exact, measurable fixed point that can be triangulated instead of the description of multiple perspectives and different realities that form the nature of qualitative research. To this end, the strategy that addresses trustworthiness, crystallisation, yields a more intricate understanding of the phenomenon under study. This is a more modern standpoint which draws on the symbolic image of a crystal to which Richardson (in Richardson & St. Pierre, 2005:934) describes:

> *I propose that the central imaginary for "validation" for postmodern texts is not the triangle-a rigid, fixed, two dimensional object. Rather the central imaginary is the crystal, which combines symmetry and substance with an infinite variety of shapes, substances, transmutations, multidimensionalities, and angles of approach. Crystals grow, change, and are altered, but they are not morphous. Crystals are prisms that reflect externalities and refract within themselves, creating different colors, patterns, and arrays casting off in different directions. What we see depends on our angle of response-not triangulation but rather crystallization.*

Simply put, Nieuwenhuis (2007:81) claims that trustworthiness is addressed through a "… constant search for convergence among multiple and different sources of information." In this study, the multiple data which were analysed to form my own understanding of the phenomenon of TbTL were described as findings which crystallised from this very data.

4.6 ETHICAL CONSIDERATIONS

Ethics can be defined as "a matter of principled sensitivity to the rights of others" (Cavan, 1997 in Cohen *et al*. 2005:56). Furthermore, social scientists have a responsibility to their profession in their search for knowledge, but also to the participants they rely on for data. Creswell (2009:177) maintains that the role of the researcher includes attaining access to the research site as well as handling any of the ethical issues that might arise. Therefore, it was crucial, as the primary research instrument during both data collection and data analysis, to adhere strictly to ethical measures.

Flick (2009:36) states that ethical issues can be encountered at each stage of the research process and it was therefore imperative to apply ethical measures to avoid harming the participants. In this study informed consent and assent, anonymity and confidentiality, safeguarding of participants' privacy and ethical rights, as well as ensuring that no deception took place were ethical guidelines that were adhered to (Laerd, 2011). I applied for and obtained ethical approval (see Appendix K) from the Ethics Committee at the University of Pretoria which involved a rigorous process of ethical scrutiny. Aspects of informed consent, anonymity and confidentiality, and deception and privacy were covered in the application as discussed below:

4.6.1 Informed consent

Prior to data collection, I sent a letter of invitation to the principals of the schools that were selected as research sites to request informed consent to conduct this study (see Appendix A). The reason for this was that informed consent establishes the grounds of ethical procedures (Cohen *et al*. 2005:50). I therefore also sent letters of

invitation and informed consent to teachers (See Appendix B) and parents of learners (See Appendix C) and letters of assent to the learners of the study (See Appendix D). The same process was followed to gain involvement and consent from the expert participant (See Appendix E). I also acquired permission from the Department of Education and consent from the district officials themselves (See Appendix F and G). In order to gain authorisation from all of the above-mentioned participants I (a) explained the purpose of the study, (b) explained that participation is voluntary, and (c) assured them that they may withdraw from the study at any time (Clasquin-Johnson, 2011). I also explained the nature and possible effects of the study and ensured that the participants felt safe and comfortable to withdraw from the study at any time should the need arise. Throughout the study, no incentives or rewards were used.

4.6.2 Anonymity and confidentiality

I ensured that anonymity and confidentiality were maintained and that results and findings could be requested. Research should be free from any form of deception, threat or discriminating incentive or influence according to Berg (2001:56). I kept the participants' personal information confidential (Cohen *et al.*, 2005:62) and did not reveal participants' identities or the research sites in the dissemination of the data. Lastly, all the data from this study will be preserved according to the university's policy.

4.6.3 Deception and privacy

Privacy is reflected from three different angles as outlined in Cohen *et al*. (2005:61). These perspectives are 1) the sensitivity of the information that is being shared, 2) the setting being observed, and 3) the dissemination of information. Data in this study was not sensitive in nature but I was particularly mindful when referencing participants and the research sites (Berg, 2001:58). In order to minimise intrusion with the normal activities of the participants (Creswell, 2003:65), I collected data at the schools that the participants were from to ensure familiarity and accessibility. Furthermore, participants' privacy was protected by informing them that their identities would not be disclosed in the dissemination of data. I also guaranteed

participants' privacy by agreeing to blur out faces of persons who wanted to remain anonymous should photographs of participants or their family members have emerged during the photovoice method.

4.7 CONCLUDING REMARKS

The aim of this chapter was to give a detailed discussion of the methodology I utilized to investigate and analyse the topic under study. A qualitative approach was employed to explore the descriptions, from the standpoint of teachers and learners, of technology for teaching and learning in the Foundation Phase. The research methodology that was selected suited the nature of the research and allowed me to gain understanding of the phenomenon under study. In order to complement the literature review, data were collected by means of the photo-voice method, narratives, and individual interviews. The planned methodology was effective as the data gathered provided thick descriptions and a trustworthy account of the case study due to multiple source and methods of data collection. To this end, my research plan was carried out systematically and thoroughly in order to reflect the descriptions and understandings of the phenomenon, technology for teaching and learning in the Foundation Phase. Subsequently the collected data were analysed in relation to each individual participant's contribution to reveal various categories and themes that will be discussed in Chapter 5.

CHAPTER FIVE:
DATA ANALYSIS AND INTERPRETATION

Research is to see what everybody else has seen, and to think what nobody else has thought.

- Albert Szent-Gyorgyi

5.1 INTRODUCTION

The previous chapter provided a description of the research methodology that was used to do the fieldwork of this study. In this chapter I present the analysed data which explored the participants' descriptions and experiences of technology for teaching and learning in the Foundation Phase. During the photovoice technique as described in Chapter 4 (see 4.4.2.1), participants had to take photographs that depicted and described their experiences of technology for teaching and learning. Kamper and Steyn (2012) posit that this method allows participants to produce rich depictions of the meanings given to the photographs. The photovoice method conducted with all participants, along with learners' narratives (see 4.4.2.2), teachers' interviews (see 4.4.2.3) and field notes (see 4.4.2.4) successfully captured the descriptions and experiences of technology for teaching and learning. Furthermore, Case 3 included data to portray the technological landscape for teaching and learning in the Foundation Phase regarding the South African Foundation Phase population. The analysis of a semi-structured interview and the subsequent opinion pieces from the district officials is provided to account for TbTL in the Foundation Phase in South Africa.

Once this was complete and the data thereof was analysed, the discussion with an expert in the field of technology and research will be given in order to provide verification of the data that emerged from the research. This chapter concludes with the data interpretation which was done according to the main themes of the study, namely, *technological tools, 21st century skills, TbTL* and *mind the gaps.*

The aim of this chapter is to present and discuss the data according to each case and participant (see Tables 5.2 and 5.3). I discuss each case separately, yet similarly by providing a brief picture of each case as well as the profile of each participant according to their background information. In Case 1 and Case 2, after careful consideration of the literature reviewed, as well as the context of the study, I give a topic for every photograph that depicted the participant's understanding of technology for teaching and learning in the Foundation Phase. I then explain what the photographs represented with the support of the analysis of the participants' interview and narrative data. I further discuss the teacher interview data and conclude each section with a summary of the data analysis of each case. Thereafter, I discuss the data analysed in Case 3 from the district officials to present the current status of TbTL in the Foundation Phase population in South Africa. I present the data from both participants in the form of foci that transpired in the interview which are substantiated by their opinion pieces. Finally, I provide an account of the discussion with an expert participant in the form of a narrative.

The data that was collected by means of photographs, narratives, interviews, opinion pieces and field notes provided insight into the descriptions and understanding of technology for teaching and learning in the Foundation Phase from each participant. I detailed points of view that were extracted from the learners' narratives and the teachers' and district officials' interviews. The exact words or phrases that participants used are given when referencing the data. It should be noted that the erroneous spelling used by learner participants in their written narratives has not been altered in order to present authentic, rich data. Since the research sites of Case 1 and Case 2 were two technology-rich schools, themes overlapped in accordance with the technological trends of the time (See 5.2, 5.3 and 5.5).

The learners and teachers of two technology-rich Grade 3 classes were chosen (see 4.4.1) so as to gain a better description and understanding of technology for teaching and learning in the Foundation Phase. The district officials were selected based on their knowledge and experiences of TbTL in the wider Foundation Phase population. Likewise, the expert participant was chosen for her knowledge and experience in technology in education, as well as research in the field. In order to protect the anonymity and confidentiality of the participants, their names are not disclosed and

they are referred to as participant 1 or 2 (teacher participants), A – J (learner participants) and the expert participant will be referred to as that. The district officials are referred to as participants D1 and D2. In accordance with Nieuwenhuis (2007:105), the data that was collected was organised and identified by fictitious names so that it could be contextualised. Table 5.1 provides a brief account of the biographical data of each participant.

Table 5.1: Background data of participants

Case	Participant	Role	Grade	Age
Case 1: School A	Participant 1	Teacher	3	44 years
	Participant A	Learner	3	9 years
	Participant B	Learner	3	8 years
	Participant C	Learner	3	9 years
	Participant D	Learner	3	9 years
	Participant E	Learner	3	9 years
Case 2: School B	Participant 2	Teacher	3	38 years
	Participant F	Learner	3	9 years
	Participant G	Learner	3	8 years
	Participant H	Learner	3	9 years
	Participant I	Learner	3	9 years
	Participant J	Learner	3	9 years
Case 3: District	Participant D1	District official	Foundation Phase specialist	44 years
	Participant D2	District official		47 years

In order to provide information and reference the data in the discussions that follow, I chose various codes for the participants, as well as for the data type. Table 5.2 provides the codes of each participant with the teacher and district official participants using numbers and the learner participants using letters. Similarly Table 5.3 provides the codes for the various types of data.

Table 5.2: Coding of Participants

Participant	Code
Participant 1	P1
Participant A	PA
Participant B	PB
Participant C	PC
Participant D	PD
Participant E	PE
Participant 2	P2
Participant F	PF
Participant G	PG
Participant H	PH
Participant I	PI
Participant J	PJ
Expert Participant	EA
Participant D1	PD1
Participant D2	PD2

Table 5.3: Coding of data type

Data Type	Code
Narrative	NA
Semi-structured interview	SSI
Opinion piece	OP
Field notes	FN
Discussions of technological profile	TP
Expert verification	EV
Line number of narrative/interview	1 - ...

5.2 DATA ANALYSIS: CASE 1

Analysis of Case 1 includes background information on each participant, a discussion of photovoice and narrative data which is followed by a discussion of interview data. This section ends with a summary of data for Case 1.

5.2.1 Background information

Case 1 consists of six participants from a private preparatory school. The school's website mentions that it prides itself of keeping up to date with latest methodologies and programmes which include the latest technology. (To preserve anonymity, the website will not be disclosed as a reference). The technological environment of case 1 has mobile Apple Laptops that learners are able to use throughout the wireless campus to research relevant topics of discussion. Observation of the Foundation Phase school premises showed that there is a computer room (lab) for the children which has been in place for a number of years, as well as a teacher's workroom and an iPad lab per grade for the use in class. The interview with the teacher also conveyed that an iPad initiative was started by the former principal of the school who then gained financial and legal permission from the executives to implement the use of this technological tool. Upon observation of the physical environment, it is evident that technology is a tool that is used for learning.

Case 1 participants were five Grade 3 learners (Participant A-E) and their teacher (Participant 1). A brief description of each participant (see also Tables 5.1 and 5.2) is provided below to add to the background information of this case.

- Participant 1 is a 44 year old female teacher with 21 years of local and international teaching experience. She holds qualifications of a 4 year Junior and Pre-primary diploma as well as a 2 year Further Diploma in remedial education.
- Participant A is a Grade 3 girl who is 9 years old. She uses technology every day either at school in the form of an iPad, interactive whiteboard or computer, as well as at home as she owns a Nintendo DS, camera and tablet.
- Participant B is an 8 year old boy in Grade 3. This participant owns an iPod, iPhone and a computer at home and uses technological tools such as an iPad and interactive whiteboard at school.

- Participant C is a Grade 3 learner who is 9 years old. She uses technology every day in the form of the television, iPad, iPod and radio that she owns at home.
- Participant D is a 9 year old boy who makes use of technology *every day* (TP) in the form of a television, phone and Play Station 4 at home, whilst using the technological tools available to him at school such as iPads, computers and interactive whiteboards.
- Participant E is a 9 year old girl that views technology as *something that you have to plug in or turn on or off* (PE: TP). At home, she mainly uses an iPad, phone, computer, television, DSTV and printer as her technological tools whereas she uses an iPad, computer or interactive whiteboard every day at school.

5.2.2 Photovoice and narrative data

As mentioned in 4.4.2.1, I used various steps to approach data collection during the photovoice technique. It must be mentioned here, that the data generated from the exhibition session was based on the selected photographs from each participant with a corresponding discussion thereof. Although unique to the photographs selected, this discussion followed a general protocol (See Appendix J) of inquiring into each participant's definition of technology, the type and instances of technology as well as the strengths and/or weaknesses of using technology. Thereafter, participants responded further to their choice of photograph(s) by completing a short narrative of half a page, due to their age, on the chosen picture(s). I subsequently discuss each participant's photograph(s), starting with teacher participant (Participant 1) and then each learner participant (Participant A-E) with references to the findings from the discussions (TP) as well as field notes taken (FN) and narratives (NA).

5.2.2.1 Participant 1

Photograph 5.1: Participant 1's understanding of technology for teaching, titled "21st century skills"

Findings:

Participant 1 took a number of photographs of her learners engaging in technology-based learning as a result of her technology-based teaching. I specifically titled the selection of photographs "21st century skills" as it clearly shows signs of communication, collaboration and creativity amongst other skills. This participant makes mention of creativity in terms of her teaching:

> *I'm a very creative teacher and creativity has always been my drive in my teaching (P1: SSI: 37-38).*

As it is evident in the numerous photographs, this participant makes use of technology wherever possible to benefit teaching and learning and developing 21st century learners. She is willing to implement whatever she is challenged with, as she states:

> *Whatever technology brings us… Of course as long as it* (technology) *can be integrated I think it is to the children's benefit. Because we cannot, one cannot*

stay behind because the children are learning at an early age they're learning things that we don't learn, and we are mature. So we've got to keep abreast and I think if there's something new out there, yes I want it, I want to try it and I want to find out what's out there (P1: SSI: 157-161)

Further analysis of the data collected from the semi-structured interview with Participant 1 is discussed in more detail in 5.2.3.

5.2.2.2 Participant A

Photograph 5.2: Participant A's understanding of technology for learning, titled "Borderless world"

Findings:

Participant A's photographs included one of a world globe that she uses often to learn about different countries by using a stylus to tap the country in order to retrieve information about the chosen destination.

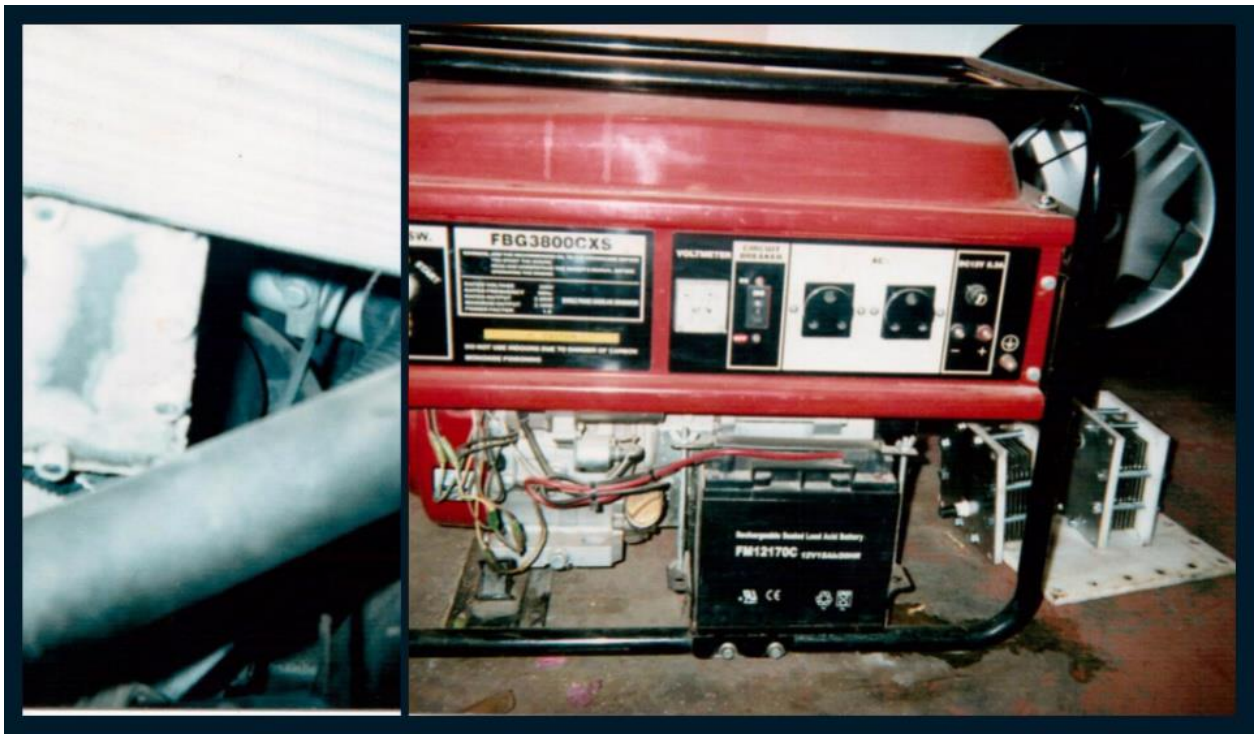
I love learning about the world because… I play with all the time. I play on it with my brother. My dad tests me on the countries a lot (PA: NA: 8-11).

I chose to title her photographs "Borderless world" since she mentioned in the discussions during the photovoice steps that by learning about different countries and being able to use different devices with the internet, that she can reach anyone,

anywhere, anytime. Furthermore, when asked to define technology, Participant A said that it was *mainly electronic equipment that is used to make life easier… it makes things easier and makes things faster* (PA: TP).

Although this participant only chose the photograph of the world globe, I decided to include another one of her photographs of a laptop to illustrate her understanding of technology for learning. Through various field notes, she explained that she has a number of software programmes that are installed on her laptop that help her practice various academic skills, such as mental maths and spelling and she also uses the internet often to *find out stuff, like for school projects* (FN).

5.2.2.3 Participant B



Photograph 5.3: Participant B's understanding of technology for learning, *titled* "Generator generation"

Findings:

Over and above the electronic media that Participant B photographed when given the prompt "how do you learn?" he chose two photographs of generators. I chose to title

these photographs “Generator generation” in light of the generation theory discussed in Chapters 1 and 3 (see 1.5.1 and 3.2) since learners born in this era differ from previous generations especially with the continuous advancement of technology. In Chapter 4 (see 4.4.2.1) symbolic interactionism, the theoretical stance of photovoice, explained that people behave toward things on the basis of meanings they attribute to those things. In his narrative, this participant described the significance of both generators that helped him learn in the following way:

> *… a hydrogen generator unit. With this technology I have learnt that water can be turned into gas using electricity. This makes a car more powerful, saves fuel and is better for oar planet (PB: NA: 2-7).*

During the discussions and affirmed in his narrative, this participant explained that although the technology has the ability to do everything for us, it is important to understand how it works because it streamlines the use of it.

> *Inside the machine there are 8 outer magnets and 8 inner magnets with copper wire around them. The engine turns the inner magnets and it makes electricity (PB: NA: 10-14). Because I know how it works, I can fix it if there is a problem (FN).*

Participant B cited during discussion that technology *is anything made by people to make our lives easier (PB: TP)* and *the strengths of technology are to help us learn and do things quicker (PB: TP).* This participant recognises that technology may have a downside in the sense that *it sometimes makes us lazy (PB: TP).* He explains further, *it’s like instead of playing or doing something we watch TV or go on the computer* (FN).

5.2.2.4 Participant C

Photograph 5.4: Participant C's understanding of technology for learning, *titled*: "e-Tools"

Findings:

Participant C chose a photograph of an iPad and desktop computer to illustrate how she learns. The reason for the titling her photographs "e-Tools" was generated from the discussion with her whereby she mentioned that there were so many 'tools' she photographed – all of them being electronic. The technological tools she finally decided on had many functions that assist her learning as she explained in her narrative:

> (These are the) *technological tools that I use the most to learn with… An iPad. I mostly use this because I can load a dictionary on it… A Youtube app can also help to learn… You can get books on the Kindle and books can teach you a lot of lessons and not only lesson but things that you did not know (PC: NA: 1-6).*

She also included the use of the calculator and games on the iPad. The use of the internet on her desktop also featured where she explained that you can search for anything you require answers to. Her narrative explains:

> (It) *allows you to search things for example like what tool is used to measure temperature the answer I will get is a thermometer but that is just an example of a way you could use (PC: NA:12-15).*

In discussions with her it was revealed that this participant's definition of technology was that it is the a*pplication of scientific knowledge for practical purposes* and the benefits of technology are *that it makes our lives easier and easier to understand (TP).* On the other hand, the downfall of using technology is that is *distracts our brains from consentration, can also blinded us (TP).*

5.2.2.5 Participant D

Photograph 5.5: Participant D's understanding of technology for learning, *titled* "Hardware"

Findings:

This participant's photograph of a PlayStation 4 and laptop which best describe how he learns is titled "Hardware" because for the simple reason that they are electronic devices. In the discussion of his chosen photographs, Participant D defined technology as *something you learn from* (TP). In both his narrative and further

discussion, he mentioned the fact that the hardware he uses assisted him with his academic work:

> *I can watch educational movies (PD: NA: 7). It helps me to understand something, like when I don't know about something, um, I can check the video to see what it is (FN).*

Participant D also feels that it is important and beneficial to understand the hardware of the various technologies as it makes the use thereof easier. He stated in his narrative:

> *Connecting up the PS4 to the TV is quite difficult and I get my grandpa to help me so that when I need to do it one day I know (PD: NA: 5-7). Knowing how to use my PS4 helps me to understand how computers work (PD: NA: 9-11).*

Moreover, this participant believes that it is important to keep up to date with emerging technology as an indication of his status and competency – not necessarily for academic learning.

> *I have the PlayStation4 which is the top of PlayStation technology of the moment (PE: NA: 1-3). It helps me to know things, like cool tricks that my other friends don't know. They have PS3's (FN).*

Finally, discussions revealed that the advantage of using technology for this participant is that it *helps to improve our knowledge* (TP). However, *you'll get addicted to it* (TP) was mentioned as a downfall of using technology.

5.2.2.6 Participant E

Photograph 5.6: Participant E's understanding of technology for learning, *titled* "Digital devices"

Findings:

The photographs that Participant E selected to illustrate how she learns are an iPad and a smartphone. Similarly to Participant C and Participant D, the photograph's title "Digital devices" refers to electronic resources she uses. Her discussion of the photographs exposed the negative side of technology being that y*ou sometimes do not play outside because you playing on a device* (PE: TP). However, for her, the benefit of using technology is that it eliminates borders, regarding communication, as y*ou can contact with people outside the country* (PE: TP). In line with discussion and also alike to Participant A's view of technology making the world 'borderless', her narrative substantiates that she uses her tablet to contact friends and learn about different people and places, as she states,

> *I learn with my iPad. I learn the different maps (PE: NA: 2-3). It is easy to get information on (PE: NA :9-10). You can contact people overseas and your friends easily (PE: NA: 13). We send emails and our projects to children from another school (FN).*

Similarly to technology eradicating borders, this participant feels that technology is very efficient as you can often use it to get something without having to physically go to the place.

> *You can read books and get them quickly not having to go to a book shop (PE: NA: 20-21)*

Participant E also cited in her narrative that technology gives her a sense of organisation and control over both the device and the digital content as she mentions that:

> *It is safe as it has a password (PE: NA: 14-15). It has an alarm and reminder app to help you (PE: NA: 16-17). You get folders so your apps are organised. You can control most of the stuff… (PE: NA: 21-23).*

It was evident from the photovoice data that photographic images taken by the participants were all technological tools of some sort. The use of an image as a starting point to gain optimal participation in the study from each participant, as well as to elicit responses based on each participant's photograph was successful in contributing to the experiences of technology-based teaching and learning in the Foundation Phase. The following section will provide an analysis of the data that was obtained in the interview with the teacher in Case 1.

5.2.3 Interview data

Case 1's data collection concluded with a semi-structured interview (see 4.4.2.3) with the teacher (Participant 1) of the five learner participants. Questions in the interview schedule were broadly categorised around enquiry into this participant's technological, content and pedagogical knowledge which were derived from the TPACK framework (see 1.6 and 3.4). Further categories of questions included the technological environment, the content that was taught and the tools used for teaching (see Appendix H). Data analysis of the interview with reference to the discussions held during photovoice and relevant field notes follows.

With regard to using technology in the Foundation Phase, Participant 1 believes that *it has its place* (P1: SSI: 21-22) but that *there should be a balance* (P1: SSI: 18) in

terms of teaching approaches. She further comments that *technology for me, enhances your teaching, you do not base your teaching on it* (P1: SSI: 19).

Participant 1 tries to integrate technology through various teaching approaches in order to meet the needs of the learners she teaches:

> *(I) find ways of teaching it in a different way, because children learn different ways and if you adjust your methods of teaching, hopefully you can reach more children… children can't always identify the way they learn, the teacher's there to help them to identify how it happens (P1: SSI :39-41).*

Moreover, this participant believes that the successful integration of technology for teaching and learning is largely dependent on the teacher, as stated:

> *I think it really depends on the teacher how you integrate it (P1: SSI: 86-87). It's more your creativity and your goal, as I said of your lessons, of what you, do you wish to attain at the end of the lesson (P1: SSI: 90-91).*

The benefit of technology, when used appropriately, exceeds the limitations thereof by *capturing children's interests quickly and acquiring 21st century skills* (P1: TP). Another advantage of using technology for teaching in the Foundation Phase is that it serves as a motivating factor, as participant 1 states:

> *…children, your weaker children specifically, it is a very high way of motivating the children and giving them, boosting their self-esteem, because suddenly they find that if they might not be able to do the sum in the book, with a good old fashioned piece of paper and pencil, they might feel they achieve it on an iPad (P1: SSI: 45-48).*
>
> *So you boost those children's self-esteem, who really might not be able to achieve in the academic, in the normal academic work that is required of them (P1: SSI: 52-53).*

With regard to skills, Participant 1 feels that communication and collaboration, an important 21st century skill, is enhanced through the use of technology. Since she works with young children, parental involvement is fundamentally important and the use of technology to communicate with parents is beneficial.

> *Well, we communicate with the parents through the D6 Communicator, which you can download on your iPad, iPhone, Android, whatever device you have. So your communication is 24/7 - your newsletters, your sport fixtures, everything is via that specific D6 Communicator… (P1: SSI: 55-57).*

The environment of this school lends itself to using technological tools without unusual glitches, but Participant 1 feels that although this is the case, the content still has to be selected carefully. She feels that *it's really troubleshooting and a lot of hours of research (P1: SSI: 124-125)* that is necessary on the part of the teacher in order to access appropriate teaching and learning (digital) material. Her approach to selecting digital content is mentioned below:

> *So for me it depends on what is available and how applicable it is (P1: SSI: 121). … the content must be on the children's level, although I try it and I play with it first. It must be user friendly (P1: SSI: 129-130). If you don't use it you don't know what's going on (P1: SSI: 135).*

On the other hand, a disadvantage, although limited to this participant's technological environment, is that having one-to-one devices is far more valuable to teaching and learning than shared technological tools. Participant 1 mentions that if there were anything she could adapt in the environment, it would be that each child has their own device to work with.

> *I would love that each child has an iPad (P1: SSI: 104). Some of my projects I work for weeks on end. So that's the challenge if you don't have an iPad per child on a consistent basis (P1: SSI: 110-111).*

From a personal standpoint, this participant feels that South Africa is lagging behind when it comes to knowledge and skills needed in order to implement technology for teaching and learning:

> *… there's some good ideas locally as well, but they are far ahead with regards to IPad integration. We are very far behind (P1: SSI: 182-183).*

Finally, the only major limitation of technology as described by this participant is that children's physical conditions can deteriorate due to a more sedentary lifestyle caused by the overuse of technology. She mentions:

Due to the fact that it provides instant gratification e.g. games, they (children) *often expect that in the normal school environment and we have to teach them to persevere without necessarily receiving a reward* (P1: TP).

5.2.4 Summary of data analysis: Case 1

A combination of Creswell's (2012) six steps frequently used in analysing qualitative data, as well as data analysis for a case study research type (Creswell, 2007) are discussed in detail in Chapter 4 (see 4.4.3) and guided the data analysis. The summary of data analysis was arrived at by means of qualitative analysis of participants' experiences of technology for teaching and learning in order to form meaning of the phenomenon TbTL. After memoing and coding of the participants' photographs, narratives and individual semi-structured interviews was done, four topic clusters, *digital versus traditional technology*, *4C's: creativity, collaboration, communication and critical thinking*, *benefits of TbTL* and *barriers to TbTL* emerged as indicated in Table 5.4. The below mentioned table will serve as the basis for the compilation of a summative table of the themes and categories in this study (see Table 5.7).

Table 5.4: Data analysis of Case 1

CASE 1 SUMMARY OF DATA ANALYSIS						
Topic clusters	**TOPICS**					
	Participant 1	**Participant A**	**Participant B**	**Participant C**	**Participant D**	**Participant E**
Digital vs traditional technology	Computers, iPads, interactive whiteboard Cellular phone	Computers, iPads, interactive whiteboard Nintendo DS, camera and tablet	Computers, iPads, interactive whiteboard iPod, iPhone	Computers, iPads, interactive whiteboard iPod, radio, television	Computers, iPads, interactive whiteboard PS4, television, phone	Computers, interactive whiteboard iPad, phone, computer, television, DSTV, printer
4 C's: creativity, collaboration, communication & critical thinking	Creativity, communication, motivation, self-management, ICT literacy, Adaptability	Problem solving, play, creativity, sensitivity to diversity	Systems thinking, metacognition, time management	Creativity, collaboration, research	Systems thinking, play, adaptability	Communication, collaboration, time management
Benefits of TbTL	Captures attentions Skills learned	Simplifies life Time saver	Time saver Competency	Simplifies life Knowledge	Knowledge Status Competency	Borderless world Efficient Organisation Control
Barriers to TbTL	Infrastructure Sedentary children Instant gratification SA lagging Learning problems	Eye strain	Lazy	Lack of concentration	Addiction	No physical play

5.3 DATA ANALYSIS: CASE 2

As with Case 1, analysis of case 2 includes background information on each participant. Thereafter a discussion of photovoice and narrative data, which is followed by a discussion of interview data are given. This section concludes with a summary of data for Case 1.

5.3.1 Background information

Case 2 also consists of one teacher participant and five learner participants from an all-girls private school. Field notes from discussions with the teacher provides information that the school offers all round education to over 800 girls from Gr 0 to matric. The technological environment at the school has progressed to now include interactive whiteboards and a computer in every classroom as well as the use of an iPad per learner in the older grades which is in the process of being implemented in the Foundation Phase. It is apparent from discussions with the participants that technological content includes email etiquette and internet safety while one of the pedagogical approaches is that of the “flipped classroom” whereby videos are posted before lessons so homework is done before and not after teaching.

Background information on each participant follows to further describe this particular case (see Table 5.1 and 5.2). The teacher participant is described according to her qualifications while the learner participants are described according to their grade and age, as well as the technological tools that they use at home and at school.

- Participant 2 is a 38 year old female teacher with a 4 year Higher Diploma in Education qualification and 16 years of teaching experience.
- Participant F is a female in Grade 3 who is 9 years old. She owns a tablet as a technological tool that she uses at home and she works with an interactive whiteboard and computer at school.
- Participant G is in Grade 3 and she is 8 years old. Personally, she owns a computer and iPad which she uses at home to help her learn.

- Participant H owns a computer, TV, phone, iPad. She is 9 years old and in Grade 3.

- Participant I is in Grade 3 and she is 9 years old. Of all the participants, this one is probably the least technological literate since her parents do not permit the use of technology, which therefore, creates generation gap and makes her very "technologically immature". She does however use a computer and interactive whiteboard at school.

- Participant J is 9 years old and in Grade 3. At home, the technological tools she owns are a calculator, iPad, TV, Wii and XBox and like the all the other participants in this case, she uses a computer, iPad and an interactive whiteboard at school.

5.3.2 Photovoice and narratives

As mentioned in 4.4.2.1, the photovoice method was carried out through certain steps. A discussion of each participant's photograph, starting with the teacher participant (Participant 2) and followed by the five learner participants (Participant F-J) as well as the findings from the discussions (TP), field notes (FN) and the narratives (NA) follow.

5.3.2.1 Participant 2

Photograph 5.7: Participant 2's understanding of technology for teaching, *titled "Technological tools"*

Findings:

The photographs that Participant 2 captured depicted a number of different tools that are used in technology-based teaching such as the interactive whiteboard and the desktop computer in her classroom. Hence, the choice of the photograph's title is "Technological tools". It was evident that technological tools used are of importance to this participant as she makes mention of numerous tools that are used in the technological environment of case 1, namely: Smartboards (P2: SSI: 8), computers (P2: SSI: 9), iPads and iPad Minis (P2: SSI: 36) and Smart document camera (P2: SSI: 56) as well as the mention of various software. Similarly to the teacher participant in Case 1, this participant agrees that you have to be creative in the use of technology to enhance teaching and learning:

> *You just need to take a chance and use it and try (P2: SSI: 170).*

Further analysis of data from the semi-structured interview with Participant 2 is discussed in 5.3.3.

5.3.2.2 Participant F

Photograph 5.8: Participant F's understanding of technology for learning, *titled* "Natural vs manmade"

Findings:

Participant F chose a desktop as the photograph to best illustrate how she learns. However, when discussing the reason for the choice of the photograph she also brought up various other photographs that she captured, such as the non-electronic materials like a dictionary and pencil. I therefore included these photographs and titled the picture "Natural vs manmade" as a metaphor for what learners are used to encountering traditionally in schools versus what they now encounter with the rise of technology. This participant understands technology as *something that helps you learn (PF: TP).* She specifically mentioned that technology does not have to be electronic and the pencil, for example is also a tool that enhances learning (FN). She is an advocate of using such tools for the reason that:

> *Without technology, we would not be able to live like the way we're living today (PF: TP).*

In light of the above mentioned, it was obvious that this participant makes *use* of *technology every day (PF: TP)* and also does not see any negative side to it by stating that:

> *There is nothing wrong with technology (PF: TP*).

With regard to electronic tools, Participant F mentioned that the computer and certain software is the most commonly used technology for her academic work.

> *The computer helps me to find out something for a school project and we play mathletics to help us with our maths* (PF: NA: 2-6).

5.3.2.3 Participant G

Photograph 5.9: Participant G's understanding of technology for learning, *titled*: "Internet savvy"

Findings:

Participant G photographed, amongst other things, a desktop computer. I included two other photographs of a mathematics problem, as well as writing both on a small chalkboard. During discussions of her photograph, she mentioned that in the same manner that she would do a sum in writing, her computer with the relevant software

is used. She also mentioned that photographs of people are not allowed and so she wrote out that *my mom and teacher help me' – especially when it comes to research and the internet (PG: NA)* I therefore chose to title her photograph "Internet savvy" due to the following information from discussions and her narrative.

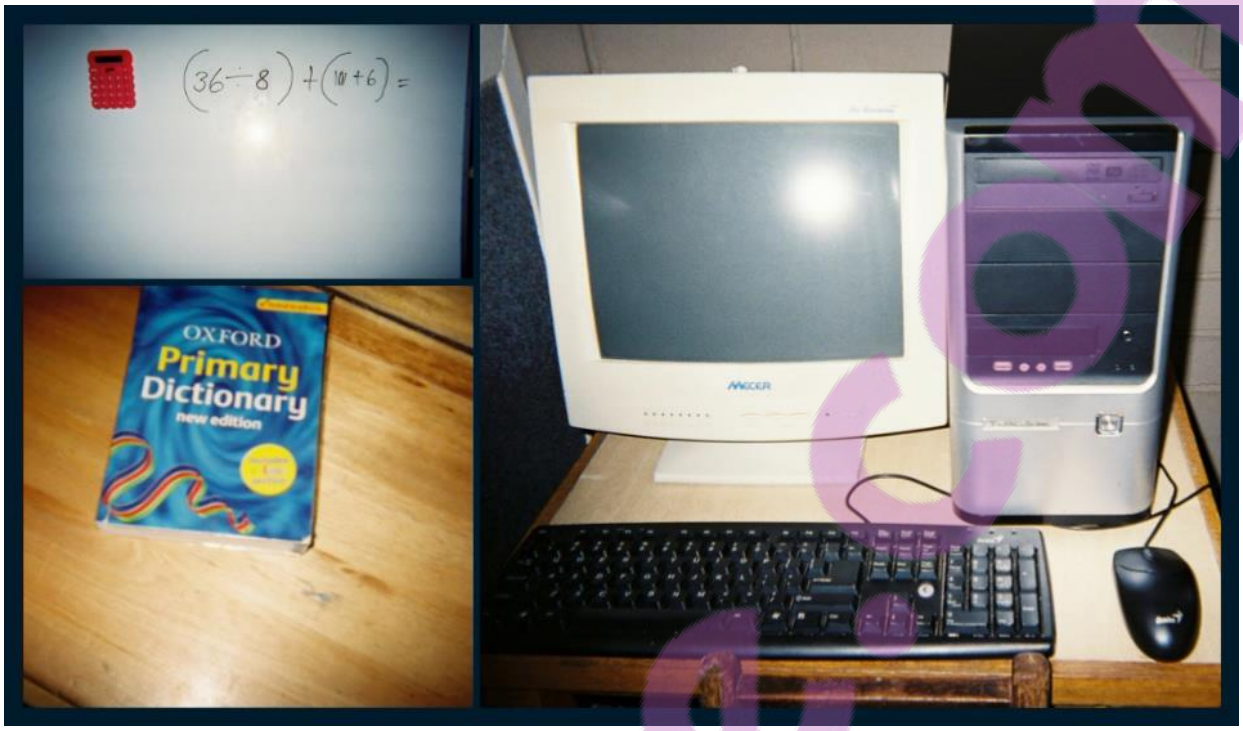
This participant describes technology as something that helps you learn and it is fun to play with (PG: TP). She uses technology *at least once a day (PG: TP)* as she believes that it assists her *to find out anything you want to… (PG: TP).* Specifically, she takes advantage of a cellular telephone and computer to use the internet when doing her school work.

> *I use an iPhone for the internet (PG: NA: 2-3). I use the internet to lookup school work (PG: NA: 7-8).*

Participant G also regards various software meaningful to her learning since she cites various programmes that assist her with her academic subjects. She also mentioned that these programmes are fun and allow her to *work by myself* (FN).

> *A computer teaches me my maths and helps me with my reading (PG: NA: 4-6). My maths on the computer in mathletics and my reading on the computer is readers are leaders (PG: NA: 8-10).*

5.3.2.4 Participant H



Photograph 5.10: Participant H's understanding of technology for learning, *titled* "Practical PC"

Findings:

Participant H (like Participants F and G) chose a photograph of a desktop computer to best describe how she learns. The photograph above includes a traditional whiteboard and a dictionary as it was elucidated in the discussion with this participant that technology is not only electronic. She took photographs of other tools that assist her with learning and the title of her photograph was thus, "Practical PC."

Additionally, Participant H's data revealed that she used *technology every day (PH: TP)* mainly for practical reasons in her everyday life as she states:

> *Without technology, we would not be on time for school because we would not know the time (PH: TP). We would not be able to drive or find directions and my mom and dad would not be able to work without their computers (FN).*

This participant likes the independence that technology provides her with and makes use of various technological tools and specific software to assist her when she learns.

Most of the time I do my homework by myself (FN). My calculator helps me learn my sums. My computer helps me with maths and English (PH: NA: 1-3). I use my computer to do mathletics (PH: NA: 5).

5.3.2.5 Participant I

Photograph 5.11: Participant I's understanding of technology for learning, *titled,* "Pencil and paper"

Findings:

Participant I was the only participant not to include any photographs of technology. Similar to the previous participant, she revealed during the discussion that her chosen photograph, that of a book and pencil, is also technology since they were invented. I titled her photograph "Pencil and paper" in light of the technology preceding the digital era and also included the images of charts and a book that she photographed.

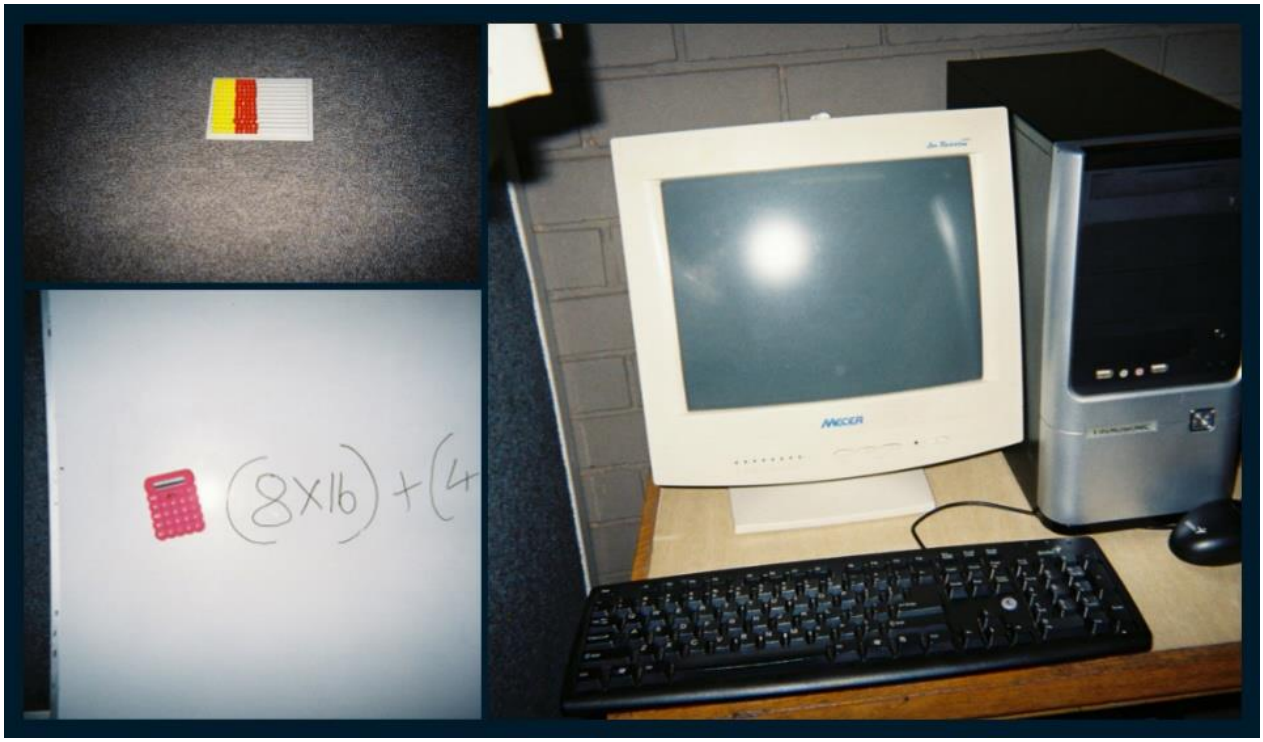
Participant I describes technology as *everything is technology – like everything we make (PI: TP).* This participant is not allowed to use technological tools at home due to restriction from her parents as she indicated in the discussion following her chosen photograph that she is not allowed to use any digital technology unless it is for schoolwork and it is supervised. Therefore, she does not elaborate much on the use

of technological tools to help her learn but instead mentions tools such as books and writing materials.

> *Books helps me with English because my mom says if I read I will be fantastic in my English (PI: NA: 4-6). Whiteboard helps me work out sums (PI: NA:14). I do my homework in my book with my pencil (FN).*

She further cites that the advantage of technology is that it *helps you with everything, like writing (PI: TP). Inventing things make us learn better (FN).*

5.3.2.6 Participant J



Photograph 5.12: Participant J's understanding of technology for learning, *titled* "Balance"

Findings:

Participant J's photographs were titled, "Balance" because she too included images of a math apparatus and a whiteboard and a calculator with a desktop computer. In the discussion of her chosen photograph – that of a desktop computer – she pointed out that she needs mathematics counters and the computer, often simultaneously, to

learn. From further discussion based on her photographs, she believes that *technology helps you learn (PJ: TP)*.

Participant J uses technological tools with software downloads or applications to help her learn at home.

> *My dad downloads maths games on the iPad. I read story books on the iPad. I use the enternet to get research (PJ: NA: 2-4)*

Although she mainly agrees with the strengths of technology in that it *helps you learn*, she mentions that the overuse of technology is that it *rots your brain* (TP). When asked how this makes sense as it contradicts itself, Participant J explained that *sitting in front of the computer or Xbox or TV stops you from playing outside and you get lazy* (FN).

Unlike in Case 1, Case 2 did not only include photographs of technological tools, but also had images of various traditional tools such as books, writing apparatus and charts. Interestingly, there was also a participant whose interaction with technological tools was limited at home by her parents. The images from all participants did however, prompt responses that led to discussion and data that described the experiences of technology-based teaching and learning in the Foundation Phase. The following section will provide an analysis of the data that was generated in the interview with the teacher in Case 2.

5.3.3 Interview data

As with Case 1 (see 5.2.3), Case 2 only included one teacher and therefore the data generated from the semi-structured interview with this participant as well as data from the discussions of her chosen photograph and field notes is discussed in detail below. The interview schedule was the same as the teacher participant in Case 1 (see Appendix H).

Technology is integral to teaching for Participant 1 and is *needed daily. All our assessments, our reports … everything is technological* (P2; SSI: 90). Furthermore, the school environment is very supportive of using technology for teaching and learning and tries to keep up-to-date with trends and development in technological

tools and approaches to teaching, as well as developing the staff accordingly. Participant 2 mentions:

> *The school was already using computers, but that was girls going down to a computer lesson as such and then it's just been built on from there (P2: SSI: 9-10). (We) have all the content that the students need and if you don't - you have it available (P2: SSI: 92).*
>
> *This year we've had a staff development, just focusing on the 21st Century skills, critical thinking skills and we've been tasked to implement that in our teaching (P2: SSI :97-98).*
>
> *… Smart Board, software and they run workshops on what's new, how we can use the software integrated into our lessons (P2: SSI: 114-115).*

She describes technology as *anything that has been created to make improvements in our daily lives* (P2: TP) and she comments on using technology for teaching:

> *I think it just enhances your lesson. You can use so much in your lesson, I often tell the girls that I don't know everything, but because we have the internet, any question that I can't answer, we can go onto the internet, we can find out, and that also teaches them something like research skills - how to find information. So just to enhance my lesson, make them more interesting, more fun (P2: SSI: 12-15).*

As depicted in her chosen photographs, this participant makes use of a number of technological tools, such as *smartboards, laptops, computers, iPads, cameras* (P2: TP) as well as other software. The specific technology that Participant 2 chose endeavours to put *teaching and learning on par with the international world (P2: SSI: 52)*, in her teaching approaches so as to make improvements in the way in which she teaches.

> *We've got our iPads, mini iPads, so if we need to learn outside wherever, if we go on a field trip and we need to take photographs or if they need to answer questions, things like that, they can record it, it's portable (P2: SSI: 37-39).*

She also mentions that the technology spills over from the classroom and teaching and learning to enhance sport and homework by means of *various computerised*

programs (P2: TP) that the learners can work on at home. Similarly communication between home and school is simplified by using technology:

> *Okay, well, communication is the biggest thing. We use, the use of email, the use of SMS system to communicate with parents….um (P2: SSI: 18-19). When we need to set up interviews we can just email, if I need to send a message, or if a parent needs to send a message to me urgently, they send an email (P2: SSI: 21-23).*

Participant 2 cites many advantages of using technology in her approach to teaching, such as content being readily available. The disadvantages thereof are that it can be tedious to search for the appropriate material and technological glitches still have to be considered:

> *…you can also waste time going through everything and all that pops up when you're trying to find something. Also when your internet doesn't work, or your wireless doesn't work and you've planned your lesson around using that technology, then you're either stuck or you go back to basics (P2: SSI: 159-161).*

This participant believes that the weaknesses of using technology for teaching is that it often *takes time to learn how to use technology and sometimes there is no electricity to make electrical objects work (P2: TP). Yet,* she makes use of technology on a daily basis whether at home or at work as she believes it *enhances or improves what you can already do… saving time and energy* (P2: TP). In conclusion, Participant 2 advocates the use of technology for teaching as she remarks:

> *Technology makes it* (teaching) *so much easier (P2: SSI: 148). Technology has definitely refreshed what I do, I still have so much fun, I still have a passion for what I do because things change all the time and new things are exciting (P2: SSI: 172-174).*

5.3.4 Summary of data analysis: Case 2

Similar to the data analysis summary in Case 1 (see 5.2.4), Case 2 delivered a substantive array of topics after the participants' photographs, narratives and individual semi-structured interviews were memoed and coded. Table 5.5 indicates the topic clusters which were evident from analysis of the data. As with Case 1, four topic clusters, namely *digital versus traditional technology*', *4C's: creativity, collaboration, communication and critical thinking, benefits of TbTL* and *barriers to TbTL* emerged. It is evident that data from Case 1 and Case 2 largely corresponds.

Table 5.5: Data analysis of Case 2

CASE 2 SUMMARY OF DATA ANALYSIS						
Topic clusters	**TOPICS**					
	Participant 2	**Participant F**	**Participant G**	**Participant H**	**Participant I**	**Participant J**
Digital vs traditional technology	Computers, interactive whiteboard, iPad, car Cellular phone, Appliances	Computers, interactive whiteboard, iPad pencil, paper, tablet	Computers, interactive whiteboard, iPad	Computers, interactive whiteboard, iPad, television, phone, pencils	Computers, interactive whiteboard, iPad	Computers, interactive whiteboard, iPad, calculator, math apparatus, Wii, Xbox
4 C's: creativity, collaboration, communication & critical thinking	Communication, critical thinking, Adaptability, career development, ICT literacy	Play, research, time management	Self-development, play	Autonomy, time management	Limited due to parental restriction	Research, play
Benefits of TbTL	*Refreshes what I do* Interactive Makes life easier/quicker – *readily available*	Enhanced standard of living	Practice *Find out things*	Structure (time) Learning Practice	*Helps you with everything*	Helps you learn
Barriers to TbTL	'Learning' the different technologies Infrastructure	None mentioned	None mentioned	None mentioned	Parental restriction	Rots your brain

5.4 DATA ANALYSIS: CASE 3

Data collection, analysis and interpretation to this point in the study focused on teachers' and learners' experiences of TbTL at two 'technology-rich' schools. In order to ascertain official perspectives with regard to TbTL in the Foundation phase and specifically provide recommendations for TbTL in the Foundation Phase in South Africa, I treated Case 3 as an expert verification since the participants were able to describe teachers' and learners' experiences of TbTL based on the number of schools that they service. I chose to conduct a semi-structured interview with experienced Foundation Phase district officials in the Department of Education. The face-to-face interview was conducted with the two participants at the same time which allowed me to ask a small number of open-ended questions (see Appendix I) that gained responses of a shared understanding of the experiences of technology-based teaching and learning in the Foundation Phase from two Foundation Phase district officials from the Department of Education. I was the sole interviewer and I asked the questions, while taking field notes of pertinent responses. The interview was also recorded with a voice recorder and participants were asked to give their first names at the beginning of the interview in order to identify the different voices and transcribe the responses accurately. Although not a focus group interview *per se*, it was beneficial to interview both participants simultaneously since they were similar to and cooperated with each other, which promoted interaction and yielded the best information possible (Creswell, 2012: 218).

I also asked the two district officials to write an opinion piece which took the form of an open-ended questionnaire. The prompts that were given to the participants were guided by two questions (see 4.4.2.5) in order to acquire the written account of the current South African Foundation Phase landscape in light of TbTL with particular emphasis placed on the benefits and barriers thereof.

Analysis of the data includes background information on each participant, a discussion of interview data which is interwoven with discussions of opinion piece data. This section ends with a summary of data for Case 3 which presented TbTL in the South African Foundation Phase.

5.4.1 Background information

Data collection initially began with four participants from one of the districts in the Department of Education, however only two participants responded favourably. The selection of this specific district was twofold. Firstly, it is the same district in which Case 2 is situated and secondly, the education specialists were identified to yield valuable information to describe the experiences as well as to ascertain official perspectives with regard to TbTL in the Foundation phase. The two district officials (Participant D1 and D2) provided the data to explore and describe the technological environment of the general Foundation Phase population as opposed to the specific technologically rich research sites in Case 1 and Case 2. A brief description of each participant (see also Tables 5.1 and 5.2) is provided below to add to the background information of this case.

- Participant D1 is a 44 year female Foundation Phase senior education specialist. She possesses a Diploma of Education (Pre-Primary), a higher Diploma of Education and a Bachelor of Education (Honours) in Education Management. Her experience includes 4 years as a preschool teacher and the past 16 years as an education specialist in the Department of Education. The district in which she works services 130 primary schools in the Foundation Phase.

- Participant D2 is a 47 year old female Foundation Phase senior education specialist. She has a Pre-Junior Higher Education Diploma, a Bachelor of Arts degree and a Bachelor of Education (Honours) in Inclusive Education. She has 24 years' experience in education beginning as a Foundation Phase

teacher, being an ECD/Foundation Phase head of department and currently working in the Department of Education. She specifically supports 28 public primary schools, which include one farm school, five inner city (also known as ex-Model C) schools and 22 township schools.

5.4.2 Interview and opinion piece data

Data collection included a semi-structured interview (see 4.4.2.3) with two of the district officials who had knowledge of and experience with all four types of schools in the Foundation Phase, namely: township schools, rural schools, inner city schools and independent schools. The interview was conducted specifically with two of the Foundation Phase specialists since the E-learning specialists could not provide me with much information regarding the Foundation Phase since they are working from a top-down approach with technology integration in schools. In other words, emphasis on TbTL from the Department of Education has begun from Grade 12 in efforts to eventually filter down to the Foundation Phase. The questions in the interview probed into the Foundation Phase's technological, content and pedagogical knowledge which were derived from the TPACK framework (see 1.6 and 3.4). Further categories of questions included the technological environment, and how technology is used for teaching and learning in the various types of schools (see Appendix I).

After the interview took place, the district officials were requested to write an opinion piece based on the prompts, "who has access to what forms of technology and when and how is it used" and "based on the pros and cons of the educational landscape with regard to TbTL, what recommendations can be made?" to further understand their perspective and Foundation Phase teachers' and learners' experiences of TbTL in the Foundation Phase. The following section presents the data analysis of the interview with reference to the participants' opinion pieces and field notes where applicable and is structured according to key topics as evident from the data.

5.4.2.1 Technological landscape of TbTL in the Foundation Phase

In her discussion of her technological profile, Participant D1 explains that technology is *machines, laptops, computers, telephones, etc. designed to make life easier* (PD1: TP). Technology is integrated into her daily life and she attests that it *assists you to get a job done faster and more effectively where ever you may be* (PD1:TP). In her narrative she recognizes the importance of TbTL in the Foundation Phase and further adds that *we encourage teachers to make use of ICT when they teaching* (PD1:OP:2). In contrast, she experiences that technology is not always accessible, it is expensive as well as impersonal since *you don't spend time with other people, because there are all kinds of machines you can use to do a job* (PD1:TP).

Similarly, Participant D2 describes technology as *using practical; including digital products, technological processes, resources and electronics, as a tool for communication (teaching and learning)* (PD2: TP). She uses technology daily in her work as an administrative, communication and teaching or learning tool. Furthermore, she lists, amongst others, that using technology is advantageous since *it leverages 'lifelong' learning, caters for the current environment and it creates exciting, diverse leaning environments* (PD2: TP). On the other hand, Participant D2 describes that *not all individuals are adequately empowered to use various digital/technological equipment (tech-savvy)* and *digital/ technological equipment are being developed at such a fast pace that much of it quickly becomes obsolete,* as well as *safety* and *financial strain within institutions* (PD2: TP) as disadvantages of TbTL. The collection of this background information from the participants was the starting point of the interview conducted with Participants D1 and D2. A discussion of the data analysis thereof follows.

Participant D2 began her narrative explaining the lack of TbTL that she experiences.

> *Although the current educational platform targets differentiated methodology in curriculum delivery, my finding is that majority of the teachers are resistant to*

explore digital/electronic technology to assist them in preparing for their teaching and in delivery of their subject matter.

Since TbTL is not so prevalent in the Foundation Phase in South Africa, I sought to understand the participants' views of whether or not technology should be used in this phase of schooling. Participants were both of the opinion that TbTL was important for a number of reasons.

Firstly, technology can be used to support the curriculum by means of being a research tool as Participant PD1 explains:

> *… because foundation phase learners are visual, so it's always better for them to be able to see and do things and if the teacher uses technology and computers, it just makes it so much easier for them to understand and to really see you know, what's happening.* (PD1: SSI:14-17)

Secondly, including technology in the Foundation also assists with planning and preparation for teachers to teach this generation of *screen children* (PD2: SSI:33) but which does not always take place. The responses from each one of the participants is given to substantiate:

> *…it* (technology) *assists the teachers in planning good material that is aligned to the curriculum also so it streamlines things* (PD2: SSI:37-38).

> *Teachers are encouraged to develop themselves and to stay lifelong learners that keep abreast with the times. It is however very difficult, because it's not always possible to do this. Learners are sometimes more advanced than teachers when it comes to using technology. (PD1: SSI:50-53).*

5.4.2.2 TbTL in the different school categories in the Foundation Phase

The participants both expressed that TbTL is quite limited in the Foundation Phase in the township, rural and inner city school categories which they service. The independent schools, due to more financial backing, have more TbTL as discussed in Case 1 and Case 2. There are schools that do have physical technological tools which are often not used or misused. However, there are a number of exemplary schools or classrooms that are incorporating technology into teaching and learning by means of externally funded initiatives. I refer to these schools as exemplary schools since they are models of how TbTL can be accommodated, but they are not the norm. The above mentioned is highlighted in the question and response below:

> *Would you say that technology is being used more than less or is it the other way around…those small initiatives which have been externally sourced that are there and the majority don't have? (SSI:691-693)*
>
> *Yes, the majority don't have. And the one's that do have, it's their own. It's funded mainly by parents and trained and sustained and everything externally. But the majority of schools do not have technology (PD1: SSI:693-696).*

The exemplary schools were used as examples to elicit responses when participants answered questions in line with the elements of the conceptual framework (see Appendix I, questions 3-7). Questions were asked to the participants in order to establish the nature of technological, pedagogical and content knowledge that is evident in the Foundation Phase. Firstly, with regard to the technological resources that are available, it was evident that numerous support services are readily available such as electronic readers and electronic lessons which are all open education resources. While some schools have computers and few have tablets, Participant D2 mentions that the majority of the schools do not have the physical technology to support them:

> *So some of the resources are there. You see, but that's why it's important for the schools to have the tools you know...the physical technological tools to supplement them (PD2: SSI:64-66).*

Within the township school category, Participant PD2 gave an example to highlight how the space, classroom and environment are set up to support TbTL with technology that is provided by the school governing body.

> *They've got good security measures in place where they've got tablets, look, the principal motivated the teachers to purchase their own tablets and she had something going with the company that was providing it for them to do research in terms of their planning. And then the learners also have this where they bring technology into the classroom during their computer lessons. That is one of the very few schools... (PD2: SSI: 89-96).*

This participant also mentioned that the rest of the township schools do not have technology but there is a support centre for teachers where they can access technological resources.

> *There is a teacher centre in the township that provides such a resource in terms of planning. For the teachers there's a Vodacom Centre. They can come in, they can use the Mindset resources, or any other resource (PD2: SSI:120-123).*

> *The Department have embarked on sourcing teachers centres with computers and internet facilities to help teachers to do research for their lessons, but this can only be accessed from the physical centre. Teachers cannot all get to these teachers centres which should help them with preparing their lessons,*

*and then the learners are not exposed to working with computers (*PD1: OP:45-50).

In terms of manpower, there are a few people sitting there that can assist them. I must also admit that there are some teachers that just use their cell phones to Google information to communicate and so on in terms of curriculum, where they need to get to and so on. So that's the township schools (PD2: SSI:138-142).

Based on the examples given above, it is apparent that technology in the township school category is rare and also confined to a specific lesson or short-term teacher research rather than being seamlessly integrated into teaching and learning. A similar situation is taking place in the rural school category which is presented by the following example:

Like if I went into a classroom and perhaps the teacher was doing a song and she used a video or you get a teacher who is teaching punctuation using a YouTube video. It's not every day but... they do bring it in. A life skills lesson teacher showed a video on the Kruger Park for instance (PD2: SSI:145-147, 150-151).

In former Model C schools I find almost the similar scenario; however there is initiative from teachers to develop learning material electronically. The one farm School in the Circuit is innovative in using technology. The teachers use YouTube videos or other onscreen lessons to complement their lesson delivery (PD2: OP:22-25).

With regard to the inner city schools, technology is more readily available in terms of the physical devices which are supplied independently, but TbTL is still confined within limits to a specific computer period or to a single occasion. Participant D1's narrative as well as a response in the interview elucidates this:

> *The majority of the schools (about 30%) in the city centre, east area and central are equipped with a laptop, data projector and sometimes iPads which was procured by the school and not provided by the Department of Education. In these schools, the SGB also bought programmes such as CAMI Language and Mathematics to enhance the teaching of Maths and Language in the Foundation Phase. The school is then also responsible of buying and renewing licenses to be able to use these programmes (PD1: OP:3-9)*

> *It's all the SGB* (School Governing Body) *school initiatives, all the school initiatives. If I could say almost all of them are, besides the fact that they're using it in the classrooms where they've got programs running as well like Cami or Readers are Leaders or whatever. So there would be, in the Foundation Phase, there would be a time where each class, even if they don't use it in the classroom, they would have a period where they go to the computer you know, or they go to the lab (PD1: SSI:160-168).*

On the other hand, a few model inner city schools realise the importance of TbTL and efforts are being made to assimilate technology with the curriculum when they are planning as Participant PD1 mentions:

> *But what's currently happening now, is that many of the schools because they see the value of ICT, they are starting to now purchase more and more tablets and you know, the monitors and everything, and they're starting to use, to plan in terms of CAPS you know, the implementation and alignment to the curriculum and they look at how can they then you know, bring in ICT in their planning (PD1: SSI:176-181).*

5.4.2.3 Barriers to TbTL in the Foundation Phase

Participants mentioned that the financial burden of TbTL in terms of purchasing equipment, planning, training teachers and sustaining the use of technology are some of the challenges of TbTL. In her opinion piece, Participant D1 explains:

> *Using iPads or laptops or the internet comes with planning. It cannot be a separate plan, but should become part and parcel of the curriculum that's being taught. Many teachers are not skilled enough to be able to know how to use ICT and this makes the financial burden even heavier on a school, because it's of no use having the equipment, but teachers are unable to use it. For this reason, teachers are then obliged to attend training on how to use ICT and the SGB ends up paying for this as well. This, I think is also one of the main reasons why schools do not invest in purchasing equipment.*

One of the main explanations for the lack of accommodating TbTL is the teacher. If and when TbTL is available, the teacher's disposition towards technology is very influential in terms of the success or lack thereof.

> *Again, it's about teacher attitude… And the willingness to want to use technology in the classroom (PD2: SSI:151-152).*
> *From school visits it is evident that a large percentage of the teachers in the Foundation Phase are very 'senior' in years. Thus, there is a sense of 'fear' and 'inability' or lack of knowledge in using computers and programmes to assist with teaching and learning. Also many a teacher is in a 'comfort zone' and simply waiting to go on pension. I therefore, believe that attitude as well as a changed 'mind-set', is very necessary (PD2: SSI:6-10).*

As mentioned, a limitation to TbTL is the lack of support from government together with the financial cost of acquiring and sustaining technology. Throughout the

interview and in their opinion pieces, participants explained that the examples of best practice were few and far between and only possible due to external funding. An excerpt from Participant D1's opinion piece is applicable to substantiate the current state of TbTL:

> *The use of ICT in schools are encouraged, but cannot be forced as the financial burden rests mainly on the parents. The Department have not been able to provide schools with computers or Ipads or even the human resource to be able to teach learners (PD1: OP:19-22).*

The clarity of the above mentioned is outlined below after Participant D2 explained that teachers and learners as well as district officials need to be equipped with the necessary technological tools in order for successful TbTL to take place:

> *And if, I mean with us as well, give me a tablet where I can go into a classroom and show a teacher. You and I both have a tablet and we can work. Provide us with such resources. We don't have such resources. Okay, now we have laptops but I don't have data. So whatever data I'm using is my personal data. So that is a huge problem The budget which we don't get. (PD2: SSI:231-235).*
>
> *So it all seems to be that these initiatives are all privately... (SSI:235)*
>
> *It's all private. (SSI:PD1:236)*
>
> *Nothing coming from the government? (SSI:237)*
>
> *No. Not really (SSI:PD1:238).*

There are a few government resources, but participants mentioned that the sustainability of these has been problematic. Participant PD2 cites:

> *And the teacher needs to be equipped to be able to teach. And then the learner must be equipped to be able to learn (PD2: SSI:243-245).*

Both participants experience that the initial structures are not the problem, but the support thereafter is which then hinders successful TbTL.

> *It's more the system is in place, or they're working on the system but now from there you, to be able to make use of the system you need to have the resource you know. You have to have the training, you need to have a laptop, you need to be able to know how to use it which is a way that the department is trying to assist teachers in terms of their workload and planning and that kind of thing but it is just that it's taking very long you know (PD2: SSI:263-269).*

There are also other obstacles to TbTL such as unequal distribution of training, resources, and actual workforce which the following excerpts from participants describe*:*

> *But again, teachers, some of them were trained; some of them were not trained. Those who were trained have the program but they don't have the resource to be able to know how (PD1: SSI:282-284).*

> *And if you're looking at, I mean, your E-learning meeting there were three people in that unit you know...For the whole district. There was no foundation phase person even there. So, there's a lack already. (PD1: SSI:294-298)*

Yes. So there needs to be manpower. With the manpower must come equipment and training. And budget obviously. (PD2: SSI:305-307)

Moreover, both participants described that it is not always safe to have such expensive equipment at the school since it makes them susceptible to theft. The participants' opinion pieces voiced this concern:

Another reason is the security of the equipment. A school that have good equipment and programmes to enhance the teachers' teaching practises in class also have to ensure that the equipment is locked away or secured with security bars when mounted in the classrooms. There have been numerous cases where expensive equipment was stolen from the school premises which also is very demotivating (PD1: OP:33-37)

Another big challenge in the township schools is that of security. I found myself in situations when upon arriving at schools the Principal would announce that the school had been burgled and computers and or tablets were stolen (PD2: OP:31-33)

5.4.2.4 TPACK in TbTL in the Foundation Phase

Despite the above mentioned challenges, there are some schools which have technological tools and exemplary practice in TbTL. It is worthwhile to mention here that these schools are the exception, not the norm and the chalkboard is still the main technological tool being used in the majority of schools. Participants shared their experiences of how various technologies are used for learning in the Foundation Phase. The experiences were important to highlight that although TbTL is thinly distributed, it is possible to integrate. The following descriptions are an account of inner city schools but it is evident that technology is used *more to supplement their* (teacher) *teaching (PD2: SSI: 380)* in inner city, township and rural schools.

…presentations with the learners. If you go to computer classes, they learn to draw on the art program and they do the maths, they do some reading (PD2: SSI: 357-359).
They do some language, Afrikaans... (PD1: SSI:360)

Based on the participants' accounts, there is little evidence of technology acting as an enabler of pedagogy in all the school categories. If and when technology is available, the township and rural schools use the tools more as an additional teaching approach rather than integrating it with the content which does not alter the way in which teaching or learning occurs. Participants also describe that the focus is more on the technological tools and technological skills to use those tools instead of using technological content knowledge or technological pedagogical knowledge.

Admitting, learners in both township and former Model C schools do have access to computer lessons, weekly. They are taught basic computer literacy such as learning the naming of the parts of the hardware and working on the MS word and 'Paint'. What is a shortfall is that there is no real integration with any of the subjects that the teacher is currently teaching in her classroom (PD2: OP:26-31).

Often what happens, when these children go to learn how to use the computer, the skill in using the technology, it's a different teacher, not the class teacher as said to you earlier...There is a specific teacher - a computer teacher. So in most schools like in the township schools, they won't link the content to that computer lesson. So if they go to paint, they do a paint program, it's got nothing to do with the Visual Art in Life Skills. We want them to be learning something else and that's what we try to encourage them to do. It's to give that teacher your content for that subject, but it doesn't happen. It's

difficult because even at school level, they're not talking to each other in terms of learning communities. It's all separate. (PD2: SSI: 380-398).

Yet again, the inner city schools cater more for teaching with technology than the township and rural schools. Participants mentioned that these schools often have a very strong management and advocacy for the use of technology. Most often, the technology is used by the teachers to do research in terms of planning but in rare instances it is used to inspire their teaching. Participant D1 mentions:

You can't just go and say "we're going to…" You must have it ready. And that is where their teaching, is informed by technology. The ICT informs what they're going to teach the learners. So it's like a link. (PD1: SSI:418-421).

Participant D2 explains that the school management, or at least a person who supports TbTL, is needed in order for it to be implemented and sustained. Again, this is most often not the case.

Unfortunately what happens is, at the inner city schools *it will work with a strong management in place. At such schools, it will work. It's about policing also, but if you get the teachers in the township and rural schools and there's nobody that is encouraging or monitoring me or supporting me in using this, I'm not going to do it. (PD2: SSI:422-427).*

One example school has a principal who is very passionate about using technology in teaching and learning. Through sponsorships she has managed to procure tablets for each of her Foundation Phase teachers - teachers are able to 'beef-up" subject matter and use technology in their teaching (PD2: OP:18-21)

Again, it's about mindset and people's attitude and how they use it. (PD2: SSI: 437)

The reasons that the participants cited for the lack of technological pedagogical knowledge being evident were twofold. Firstly, due to the nature of Foundation Phase teaching and secondly, the curriculum and more so, assessment thereof is prescriptive. When asked whether or not technology was altering the way in which teachers are teaching, it was very clear that it is not as Participant D2 explains:

Very rarely because again, the Foundation Phase teacher believes in… if you say they must now concretely do fractions, they must have the orange or the chocolate and cut it or fraction strips, the child must be able to manipulate and handle it. And then if they go on to pictorial and they go on to a book, the DBE workbook is another thing preventing.. that is preventing them from using technology. It's an easy resource, it easily available, it is there and they stick to it. (PD2: SSI:454-460).

And we are also guilty I think because we say we want to see the written work. We want to see the work, the quantity of work in the child's book. We're not saying take us to your computer and show us Donna's folder to see what she did and how she's learnt (PD2: SSI:464-467).

In the same manner, the technological content knowledge is also unchanged due to what the curriculum sets. Teachers and learners in all the school categories are not using technology to form new representations of content. Although it was noted that publishers are producing content aligned with technology as well as to the curriculum, Participant PD1 describes the more common practice regarding the content that is taught in the Foundation Phase:

Look, the idea is that they use that they do, finding new as well you know, because the policy is minimum so they can go beyond that, but as long as they've done what is required and as long as they assess what is required because you know, you don't want a case where they go far beyond what is expected what the learner should be able to do and then the learner's disadvantaged because of that. So yes, they can go beyond, they would go beyond, but I don't think they really do (PD1: SSI:478-484).

And then in the same breath, our curriculum is written in such a way that it forces us to stick to a book. For instance, the language one - letter formation in cursive writing. Now for the life of me, you're assessing a child on cursive writing. Our common tasks are assessing children on cursive writing. Is it important? Shouldn't the ICT then feature in there? It's about teaching children to read and write. Whether I write cursive, print, I'm writing it. Whether I'm typing it, I'm writing. (PD2: SSI:663-670).

5.4.2.5 The way forward for TbTL in the Foundation Phase

Based on the responses given in the interview and the lack of TbTL in the Foundation Phase, I asked the participants to provide recommendations for South African Foundation Phase teachers and learners so that they can benefit from technology. Suggestions such as the teachers' disposition towards TbTL, proving resources and teacher preparation, and collaboration between stakeholders – all within the specific South African context were given as their responses below indicate:

Look, I would say attitude. You know, it starts with your attitude. It starts with embracing and looking at how… you know… how it will benefit you and your learner. So if your attitude and your mindset are right, you know, that's already a huge bonus because from there you can, 'jy kan berge versit'. But I

think sometimes it's the same, a lot of the people are not that way inclined. They're scared of it or they're not sure or you know, there's all kinds of things. So the mindset must change. Then the resources must be in place and the training must be there for those teachers (PD1: SSI: 497-504).
So we must go back to the way our policy documents are written. And in that we must say if you're saying children need to work concretely, you can also use ICT and this is how you can use it. We must show the people. It must be user friendly (PD2: SSI:670-674).

Resources from government, the department. If it's a public school, government. Parents can assist to a certain extent but yes, and also I think at university level... (PD2: SSI:508-510).

The teacher training is very essential. And we need to take back some HOD's to teacher training… (PD2: SSI:513-514).

All parties, all stakeholders must be collaborating. (PD1: SSI: 540)

I must say to you, we have all these ideas on what should happen in a class and how it works, we even talk about barriers to learning. That's another aspect that ICT would help tremendously with, but now the problem is, today's teacher is not sitting with twenty five children in a class you know. The whole thing of talking to each other in a school environment where… we assist this child, ask how can we do it… that doesn't happen, it's supposed to happen but manpower and load of work and number of hours… there's a lot of influences that's you know, blocking it (PD1: SSI:550-554, 556-559)

In her opinion piece, Participant D1 provided summative comments on the use of technology from her standpoint with a noteworthy recommendation that relevant departments with the Department of Education need to collaborate carefully.

> *The use of technology is incorporated in workshops that we present to teachers - we use technology to communicate and cascade information to teachers and schools. However, I must be candid in assuming that not all colleagues are 'au fait' with technology. The purpose is to motivate research of subject matter, cater for interactive teaching and learning and to empower teachers. Perhaps this needs to be a point of departure in identifying the gap in use of technology in curriculum delivery? Perhaps at District level, we should stop working in silos – implying that the Curriculum Unit and the E-learning unit should work together closely (PD1: OP:34-41).*

Finally, the participants concluded by asking and answering the pertinent question of how children can learn and how teachers can teach successfully using technology.

> *How can they learn and what should I use to support them? (PD2: SSI:611).*

> *Yes, that's where we have to come in now because it's all fair and well you know how to use a tablet, you know how to click a mouse but you now bring that into teaching successfully. Not just for the sake of using it you know, not just because I have a computer to put the screen up and say look, here is my computer, but... To actually know exactly how are they going to integrate this? And to reinforce what you're teaching and how our children are learning with the technological tools that you have. (PD2: SSI:648-656)*

5.4.3 Summary of data analysis: Case 3

In line with Case 1 and Case 2, Creswell's (2012) six steps frequently used in analysing qualitative data guided the analysis of the data provided by the district officials. The descriptions and experiences of the participants provided a multitude of topics from the district officials' interview, opinion pieces and field notes. The data were purposefully arranged into the same topic clusters as the previous data from

Case 1 and Case 2, namely: *digital versus traditional technology*', *'4C's: creativity, collaboration, communication and critical thinking',* '*benefits of TbTL'* and *'barriers to TbTL'* with the addition of the topic cluster 'TbTL gaps' (see Table 5.6). Although the names of the topic clusters remained the same, the topics themselves differed as district officials experiences of TbTL in the schools that are not technology-rich is vastly different to those of the teachers' and learners; experiences of TbTL in technology-rich schools. Moreover, the importance for including this set of data were to elucidate the fractured nature of TbTL in the Foundation Phase, to provide a connection between the various parts of this study as well as to guide the recommendations of this study.

Table 5.6: Data Analysis of Case 3

Case 3: TbTL in the South African Foundation Phase SUMMARY OF DATA ANALYSIS		
Topic clusters	**TOPICS**	
	Participant PD1	**Participant PD2**
Digital vs traditional technology	Computers, Laptops, whiteboard, data projectors, FP-specific software programmes	Chalkboard, Overhead Projector, interactive whiteboard, data projectors, tablets, computers
4 C's: creativity, collaboration, communication & critical thinking	General lack of TbTL does not yield development of 21st century skills in teachers or learners	
Benefits of TbTL	• Faster and more effective functioning • *Supplements the curriculum*	• Caters for this generation • Tool for learning • Teacher research • *Leverages 'lifelong' learning* • Teacher attitude

Barriers to TbTL	• Lack of support from Department of Education • Expensive • Not always accessible (physically and geographically) • Sustainability • Teacher attitude • Human resources	• Teacher attitude • Eskom • Safety • Rapid advancements • Geography • Lack of communication (government-school and within schools) • Manpower • Budget
TbTL Gaps	• Digital divide • Generation gap • Nil 'knowledges' • Discipline disparity • Communication breakdown ('Silo' mentality)	

5.5 SYNTHESIS OF THEMES AND CATEGORIES

The foundation for the analysis of data in this study was guided by the survey of literature in Chapter 2 and more specifically, the elements of the conceptual framework (see Chapter 3). During the analysis of data, the responses from participants were initially coded which enabled me to arrive at a variety of topic clusters. The sub-categories and categories were then arrived at by analysing the data into related groupings of a number of participant responses. This step in the data analysis led to a summary of data analysis for each case (see Table 5.4, Table 5.5 and Table 5.6). The synopsis of the data analysis for all three cases presents the sub-categories and categories which led to four themes, namely *technological tools, 21st century skills, TbTL* and *mind the gaps.* The themes and their subordinate categories are indicated in Table 5.7 below. The themes and categories of this study were further verified by an expert in the field of technology (see 5.6).

Table 5.7: Synthesis of data analysis

SYNTHESIS OF DATA		
Themes	**Categories**	**Sub-categories**
Technological tools	*Technology*	Digital devices Traditional devices
21st Century skills	*4 C's* *C1: Creativity* *C2: Collaboration* *C3: Communication* *C4: Critical thinking*	Research Play Problem solving Management
Technology-based Teaching and Learning	*Benefits of TbTL*	Enhanced teaching Enhanced learning Enhanced living Time saver Knowledge creator
	Barriers to TbTL	Infrastructure Inactivity Learning barriers
Mind the gaps	*TbTL gaps*	Digital divide Generation gap Nil 'knowledges' Discipline disparity Communication breakdown ('Silo' mentality)

5.6 EXPERT VERIFICATION

The synthesis of the data analysis produced various subcategories, categories and themes. It was evident that participant responses accounted for sub-categories which guided the categories of this study, namely: *technology; 4C's; benefits of TbTL'* and *barriers to TbTL*. Finally data produced the themes of *technological tools, 21st century skills, TbTL* and *mind the gaps* as evident in Table 5.7. The themes and categories were the basis of the systematizing expert interview with an expert in technology (see 4.4.2.5). The reason for including this step in data collection of the study was to verify the themes and categories that emerged to this point by having it critically reviewed by an expert in the field of technology and research. The following

section presents a brief biography of the expert participant, the reason for including an expert verification in this study and the course of discussion that took place.

The profile of the expert participant is that of a 56 year old female who currently lectures both graduates and post-graduates at a higher education institution. Although her career began with teaching maths and science to high school learners, she developed a keen interest in computers as soon as they became more available. Throughout the years, she studied further within the field of educational technology. She has completed Diplomas in Computer Science and Datametrics respectively, a Master's degree (MTech) which focussed on the challenges of first time computer users and how to support them and a doctoral degree (DEd) which focussed on using technology in the teaching of ICT.

Throughout her career, she has taught ICT subjects, supported postgraduate students and acted as a teaching and learning advisor, supported lecturers in all matters teaching and learning related, particularly E-learning. More recently and to date, she has lectured and researched at a higher education institution within the Faculty of Education, with an emphasis on teaching technologies. She mentioned in the discussion that she *loves gadgets and especially figuring out how to use them to support the teaching and learning process.* She l*ove*(s) *to do this with other educators and with students (EV).* In the past three years she has had the opportunity to initiate more focused research in the use of ICT in Education which is mainly in the Senior Phase but does not exclude projects that are based in the Foundation phase. Her current research is in emergent technologies and she supervises postgraduate students in the field, as well as developing training for Mobile Learning in higher education.

The strong motivation behind using an expert interview in this research field is because the expert's standing usually allows them to apply their insights to practice. Collins and Evans (2007:3) accept the "view that expertise is the real and substantive

possession of groups of experts and that individuals acquire real and substantive expertise through their membership of those groups". Furthermore, expert knowledge can be understood as such:

> *Expert knowledge has been redefined to view expert knowledge as an "analytical construction" and, at the same time, incorporates the expert's "formative power": expert interviews are neither characterized by an interest in limited special or specialized knowledge (as suggested in the sociology of knowledge debate), nor can they be adequately defined by separating the private sphere from the (generally occupational) functional context.* (Bogner, Littig & Menz, 2009:8).

In light of the definition of expertise and as alluded to in the expert's above mentioned credentials and experience, the expert involved in this study was well suited to provide a meaningful contribution to the consolidation of the themes of the research. Similarly, the expert is an established researcher and practitioner in the field of educational technology. Through these acknowledgements expert knowledge was obtained for the purpose of quality assurance of the data obtained in this study.
The discussion that took place was informal and followed a conversational style for two reasons. Firstly, communication during the discussion included shared experiences in the form of an informal dialogue between the expert and me. Secondly, there was a high level of personal knowledge of, and trust in the expert participant. This confidence in the expert established a good rapport and the discussion was treated as a partnership where the expert and I shared questions, knowledge, thoughts and understanding (Van Audenhove, 2007). There were no pre-established questions but rather the table of themes and categories (see Table 5.7) that emerged from data collected from teachers and learners was used as the basis for discussion. The discussion recording was transcribed shortly after the interview for the purpose of providing a narrative of the course of the discussion. I transcribed

the interview into text so as to detail the flow of the text while expressing the meaning of the interview.

The reason for providing the data in the form of an expert verification was not to generate new data but rather to confirm the themes and categories that arose from previously analyzed data, as well as to provide comments on Table 5.7 as given by the expert. In the case where the expert is quoted verbatim, reference will be provided as such: (EV).

The expert was very interested in the methodology of the study and therefore the starting point of discussion centred on the methodological route and in particular, the methodological analysis that led to the themes and categories. Questions posed by the expert in order to understand the process of data analysis and the compilation of Table 5.7 were, for example: *"How did you get to this [the terminology used in Table 5.7] (EV)? What was the basis for choosing these specific terms (EV)? How did you get to the themes? Which of these (topic clusters) do you see as traditional technology? What do you mean by the subcategory research?" (EV)* Since this information is provided for in the preceding sections (see 5.4) of the chapter, I specifically do not include an account of the information presented on these answers in a narrative. The expert was satisfied with the explanations that were provided and therefore did not further question the method or analysis.

Once the Table 5.7 was discussed at length, the conversation with the expert turned to the process of data analysis which is briefly explained (see 4.4.3 and 5.1). Up to this point, the expert did not question any of the themes and categories, nor did she suggest the addition or omission of the latter.

The intention of the interaction with the expert was to find convergences or divergences of this study in relation to the themes and categories. The discussion ended with the expert's question*, So you think about your theories and to link back*

with everything that you have said… Did you find anything that was not evident in the results? (EV) I answered by explaining that, although some aspects were highlighted more frequently, the data collected fitted neatly into the components of the conceptual elements of this study. The expert regarded the themes and categories that were discussed as comprehensive since she did not question nor add nor delete any of these themes and categories. Likewise, based on the general positive disposition of the expert (in both body language and verbal commentary), I can conclude that the themes and categories were expertly validated by the insight from the expert's account for participants' experiences of TbTL in the Foundation Phase.

5.7 DATA INTERPRETATION

This section presents a detailed account of the interpretation of the data according to the main elements of the conceptual framework (see Figure 3.3), namely technological knowledge, pedagogical knowledge and content knowledge in relation to the research themes, namely *technological tools, 21st century skills, TbTL* and *mind the gaps* (see Table 5.7). For the purpose of data interpretation and based on empirical findings, I adapted the conceptual framework (see Figure 3.3) to produce a data interpretation framework (see Figure 5.13). This framework as well as the research questions that guided the study (see 1.3) attribute meaning and significance to the different sources of data, such as photographs, narratives, interviews, opinion pieces and field notes of Grade 3 learners and their respective teachers as well as the district officials. Comprehensive interpretations of the data are presented below in order to make sense of teachers' and learners' experiences of technology-based teaching and learning in the Foundation Phase.

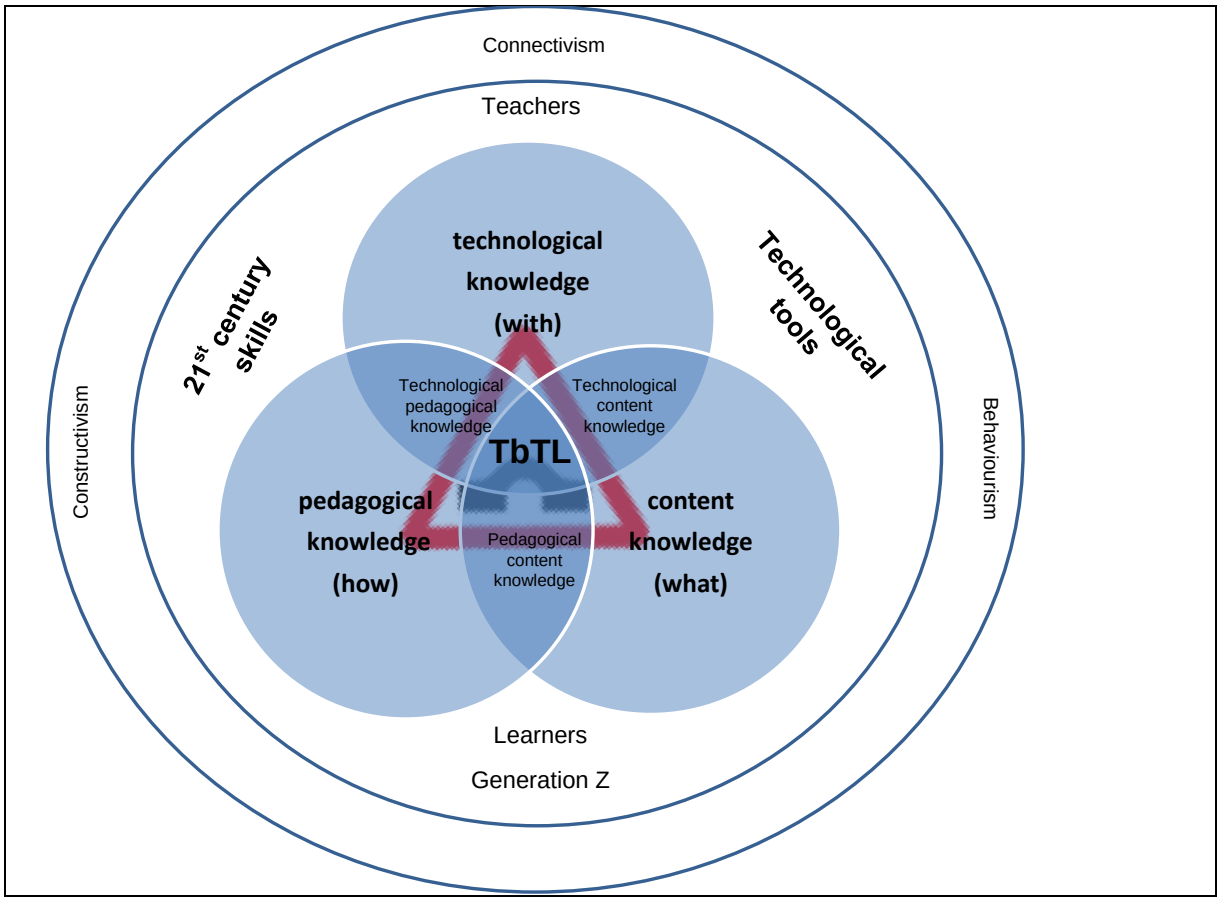


Figure 5.13: Data interpretation framework

In order to follow the data interpretation it is necessary to explain briefly the above mentioned data interpretation framework (see 5.13). This framework was adapted from the conceptual framework of this study (see 3.3) to show the themes of the research prominently. Firstly, on a practical level, this framework is built on the learning theories of constructivism, behaviourism and connectivism, which makes sense of how knowledge is created, built and applied in teaching and learning, specifically in the Foundation Phase (see 3.3). Secondly, these three learning theories are all influential when it comes to the teachers who are teaching the current generation, Generation Z as well as the understanding how this cohort of learners learn (see 3.2).

At this point, the theme of *technological tools* is included since it is the teachers and learners of this study that are using the latter for teaching and learning. Regarding the skills and competences that are required from teaching and learning in the digital era, the theme of *21st century skills* is also built in since the use of technology can positively develop the latter skills in teachers and learners. Lastly, the core of this framework is underpinned by the TPACK framework (see Figure 1.1 and 3.4). The main elements of technological knowledge, pedagogical knowledge and content knowledge are used as a point of departure in the subsequent data interpretation. At the heart of the data interpretation framework is the theme, and essentially the phenomenon of this study, *TbTL*, which is discussed in 5.6.4 and aims to provide teachers and learners in the Foundation Phase with the knowledge to successfully guide their teaching and learning. Finally, the red triangle symbolizes the final theme, *mind the gaps*. With regard to the framework, a bridge between elements such as teachers and learners symbolizes the generation gap that needs to close whereas a bridge between the various knowledges is especially crucial for those who do not have access to TbTL. In essence, the theme itself within the framework serves as a reminder that there are 'bridges' which need to be crossed for successful TbTL in the Foundation Phase to take place.

I structure the following interpretation of data on the premise that the main elements of the framework, technological knowledge, pedagogical knowledge and content knowledge (see Figure 5.13), can answer *inter alia* the questions: *With, how* and *what* of TbTL in the Foundation Phase? More specifically, *With* which technology is knowledge shared? *How* can teachers impart this knowledge to learners? And *what knowledge* can be taught or learnt? Furthermore, interpretation of TbTL as the core of this study is presented.

5.7.1 Technological knowledge (With?)

The following section of data interpretation presents the answer to the question, '*With' what do Foundation Phase learners learn and Foundation Phase teachers*

teach? Although not a formal research question, the latter yields insight into answering the secondary questions, *how do Foundation Phase learners experience technology to learn?* And *how do Foundation Phase teachers experience technology to teach?* (see 1.3.2, 7.4.2 and 7.4.3). Firstly, technology in this study was not only one digital device or piece of electronic equipment but rather an instrument that supports educational outcomes and necessary skills in order to function in the knowledge society (see 3.4.1). Participants cited numerous digital technologies in their responses to how they teach and learn. This data were classified under the theme, *technological tools* previously in this chapter (see table 5.7 and Figure 5.13) and as a theme which encompasses successful integration of hardware and software, various devices as well as applications and programmes respectively. Although all participants referred to using digital technologies, Case 1 and Case 2's incidences thereof were much greater than those in Case 3 since the majority of Foundation Phase schools do not have access to technology and therefore, limited TbTL occurs. The discussion which follows is based largely on Case 1 and Case 2 in order to benchmark effective TbTL and specifically answer to evidence of technological knowledge.

Secondly, Chapter 3 (see 3.4.1) noted that using technology for teaching and learning establishes dynamic conditions for reorganising learning and teaching. Chapter 2 (see 2.3) alluded to technology, specifically electronic technology, as transformative to the way that people work, live and play. Another theme that emerged from the empirical research of this study was *21st century skills* (see Figure 5.13) – those skills that are necessary to function effectively using technology in this era, as well as the skills necessary to reconstruct teaching and learning in the Foundation Phase. Case 3 presented a general lack of TbTL which therefore does not yield the development of 21st century skills in teachers or learners (see 5.4 and Table 5.6). However, Case 1 and Case 2's participants' responses (see Tables 5.4, 5.5) displayed shared 21st century skills such as communication, creativity and systems thinking under the categories of *ways of thinking* and *ways of working* as

well as cognitive, interpersonal and intrapersonal skill categories in literature (see 2.3.1).

Skills which fall under the category of *living in the world* such as self-development and autonomy were accounted for by individual participants (see 5.2.3.3 and 5.2.3.4). Learning to learn is another fundamental aspect of 21st century skill development which supports metacognition and is advantageous to the other key areas of communication, collaboration, creativity and play in children (see 2.3.1). Besides these skills, the overarching skills that data from the participants exposed, were the 4C's namely: creativity, collaboration, communication and critical thinking (see Table 5.7).

Thirdly, Chapter 2 (see 2.1) also elucidated that South African education has to change regularly to meet the requirements set out by the Department of Education, including the development of learning outcomes for the 21st century. 21st century skills go hand in hand with digital literacy on the grounds that 21st century skills are skills needed to conceptualize changes and define the parameters of 21st century education (see 2.3.1) while digital literacy refers to the capabilities that an individual possesses in order to teach and/or learn in a digital age (see 1.4.2 and 2.3.2). The one cannot exclude the other. Therefore, data interpretation which presents the theme of *21st century skills* has to include digital literacy in line with establishing that digital literacy is an essential component of the acquisition of 21st century skills (see 2.3.2). My own experience is that digital literacy, in terms of grasping the (21st century) skills that were evident in data, is a fundamental outcome to make TbTL beneficial.

Numerous reasons have been referred to for advocating the use of technology in education which provides learning opportunities in line with development of 21st century skills (see 2.3.2). Firstly, TbTL often produces a more motivated teacher or learner as indicated by participants (see 5.2.3). Secondly, it is widely acknowledged

that technology is spread throughout our daily lives and the culture we live in. Lastly, in order for individuals to meaningfully take part in the knowledge society, digital literacy and the resulting capabilities of 21st century skills should be cultivated. As a result, digital literacy is a prerequisite of teaching and learning at this point in time.

This in turn, implies that adopting technologies in the Foundation Phase should be supported by a positive learnedness of doing so, *with* the appropriate technological tool(s) and *with* acquired 21st century skills and resulting digital literacy. To this end, the secondary research question, *how do Foundation Phase learners experience technology to learn?* can partly be attributed to the acquisition of such skills and digital literacy through the use of technological tools.

In addition, the meaning of technological knowledge in TbTL in the Foundation Phase cannot be separated from pedagogical knowledge and content knowledge. It was already insinuated previously that pedagogy and content are influenced by technology (see 3.4). Again, Case 3 highlighted 'nil knowledges' and 'discipline disparity' based on the general lack of technology in the majority of Foundation Phase classrooms (see 5.4.2.3 and Table 5.6). Conversely, teacher participants from Case 1 and Case 2, in particular, experience technological pedagogical knowledge by means of applying numerous technologies to their teaching in order to adapt and make both teaching and learning applicable (see 5.2.2.1 and 5.3.2.1). Although not apparent from participants' responses *per se*, my interpretation is that teacher participants experience technological content knowledge based on their use of technology to teach and make the subject understandable. This notion of technological knowledge, when chosen correctly, presents technology as beneficial to learning in a particular knowledge area. Data interpretation that follows will firstly acknowledge pedagogical knowledge and thereafter content knowledge, in the context of TbTL in the Foundation Phase.

5.7.2 Pedagogical knowledge (How?)

This section deals with the 'how' of teaching and learning with technology in the Foundation Phase, which is closely linked to the secondary research question, *how do Foundation Phase teachers experience technology to teach?* (see 1.3.2 and 7.4.3). Questions underlying the concept of pedagogy in this study were how can pedagogy support the way in which Foundation Phase teachers teach? And what specific Foundation Phase pedagogy supports this idea? In light of this section of interpretation, technological pedagogical knowledge, from the TPACK framework (see 1.6 and 3.4), is important.

Firstly, empirical data exposed that teachers' applied methods of teaching are influenced by their possession of pedagogical knowledge. This knowledge is concerned with teachers' understanding of learners' development and their subsequent teaching approaches. The significance of the above mentioned for teachers lies in the discernment of how to choose and adopt suitable technologies to positively affect the quality of TbTL in the Foundation Phase. With reference to the above mentioned, it was evident that the meaning of pedagogical knowledge for teacher participants in Case 1 and Case 2 is that technology in the Foundation Phase provides opportunities for collaboration and communication, creativity and play between learners and teachers, as well as amongst learners when the appropriate pedagogical practice is used (see 5.2.3 and 5.3.3.). In contrast, technological pedagogical knowledge did not come to the fore in Case 3 due to the thin distribution of technology amongst the Foundation Phase population and therefore, technology is used as a supplement to already existing practices (see 5.4.2.4). In my own understanding, a sound pedagogy based on suitable technologies in the Foundation Phase is twofold. Firstly, such knowledge can inform and transform the method of teaching with technology to close the generation gap between teachers and learners. The gap in age is brought closer through the common interest of technology. Secondly, the same pedagogy that can close the

generation gap can bridge the digital divide insofar as it can be creatively adapted so that technology can benefit all learners.

Furthermore, the question of how can technology support the way we teach in the Foundation Phase is central to this pedagogical knowledge and the context of the study. To answer this question data from Case 1 and Case 2 specifically was interpreted by linking teacher participants' responses to the learning theories that are pertinent to teaching young children such as constructivism, behaviourism and in this era, connectivism (see 3.3) as well as the generation theory (see 3.2, 3.3 and Figure 5.13). Although teacher participants did not mention any teaching or learning theories by definition in their responses, their descriptions of the way in which they teach Foundation Phase learners implied a pedagogical knowledge. However, the idea of connectivism was strongly insinuated by teacher participants' citations of technology being integral to teaching and the latter enhancing teaching and learning (see 3.3.4, 5.2.3 and 5.3.3). Likewise, learner participants revealed the concept of an 'extended mind' (see 3.3.4) in responses of 'without technology we would not…' (see 5.3.2.2 and 5.3.2.4). A fundamental aspect of the learning theory connectivism, which places importance on the ability to find out (rather than what is known) was mentioned as using technology to find out things in one way or another (see 5.1, 5.2.2.2, 5.3.2.2, 5.3.2.3 and 5.3.3).

Secondly, when interpreting literature from the TPACK framework, the knowledge that applies to pedagogy includes pedagogical knowledge; pedagogical content knowledge and technological pedagogical knowledge (see 3.4, Figures 1.1 and 5.13). The first type of knowledge refers to the approaches of teaching which includes lesson planning, assessment, learning and management. Thereafter, pedagogical content knowledge alludes to the way in which a subject is made understandable to learners. Lastly, technological pedagogical knowledge suggests the way in which different technologies can be applied in teaching to affect change in both teaching and learning. With reference to these knowledge types in relation to

data, it was apparent that participants' teaching approaches included pedagogical knowledge. Teacher participants used technology suitably to plan lessons, assess learners, ensure learning and manage their teaching and subsequent learning (see 5.2.3 and 5.3.3). Furthermore, the teacher participants' understanding of how to make content understandable to learners in the Foundation Phase was evident in the manner in which they carefully select and research appropriate content (see 5.2.3 and 5.3.3). Finally, the teacher participants are forerunners in implementing TbTL and therefore, use different technologies to bring about a change in the way in which teaching and learning occurs in the Foundation Phase.

5.7.3 Content knowledge (What?)

The 'what' of teaching and learning refers to content knowledge and the specific knowledge of the content matter that is taught or learned. Another underlying question that arose from this study, "how does technology facilitate the gathering, finding, knowing of content for teaching and learning in the Foundation Phase?" leads the discussion that follows.

The literature of this study indicated that content knowledge primarily deals with what this generation of learners needs to know (see 3.4.2) while the empirical data noted that this content was very accessible largely due to the internet and technologies available in the context of the two technologically-rich research sites (see Tables 5.4 and 5.5) and much less so in the rest of the Foundation Phase (see Table 5.6). Within Case 3, the instances that cited technology use highlighted that technology does not have a substantial effect on content knowledge since the focus is more on learning the technology than the integration of it. The lack of development of content knowledge in the majority of the Foundation Phase is also caused by submission to the curriculum and adherence to policy (see 5.4.2.4). In contrast, Case 1 and Case 2's teacher participants in particular remarked on the wide variety of content but were cautious in the selection of digital content. Data explicated the standing of content

knowledge as participants cited the importance of content and specifically, its applicability (see 5.2.2.6, 5.2.3, 5.3.1 and 5.3.3). Chapter 3 (see 3.4.2) already explained that the content knowledge teachers need to have in order to meet the educational aims for this generation of learners is ever-changing. Regarding content knowledge in literature within the TPACK framework, various trans-disciplinary tools have been discussed (see 3.4.2.1 – 3.4.2.7 and Figure 3.3) pertaining to content in the TPACK framework.

The meaning of the latter, in the Foundation Phase, is interpreted below. For example, one of the trans-disciplinary tools, observing (see 3.4.2.1), would entail concrete, hands-on experiences in the Foundation Phase, as the first step to making sense of anything that a learner encounters. Thereafter, a higher level of thinking is necessary as the external stimuli become absent and a learner needs to rely on the ability to recall what was observed. The way in which technology supports this process of acquiring content knowledge is that teachers and learners in this study choose and use suitable technologies to complement the necessary concrete encounters Foundation Phase learners need with concepts in order for higher order thinking to take place (see 5.2.3, 5.3.2.2, 5.3.2.5 and 5.3.2.6). The development of higher order thinking skills is a key skill in the 21st century and *21st century skills* is a primary theme that is presented from this study but also only applicable to best TbTL practice as in Case 1 and Case 2.

Another example of one of the trans-disciplinary skills that was revealed through the empirical data were that of play (see 5.2.2.2, 5.2.3, 5.3.2.2, 5.3.2.3, 5.3.2.6). Deep play is distinguished from ordinary play in that it embodies open-ended thinking which transforms or produces new ways of being. In this study, all participants in Case 1 and Case 2 make use of interactive whiteboards for teaching and learning and it is through a tool of this nature, integrated with relevant content and pedagogy that teaching and learning is meaningful. Presumptively, the most important trans-disciplinary tool within content knowledge that was outlined in Chapter 3 (see 3.4.2.7)

is synthesizing since it combines the previous six tools of perceiving, patterning, abstracting, embodied thinking, modelling and deep play in order to complement knowledge derived from multiple understandings. In my opinion, synthesizing will make TbTL in the Foundation Phase successful by constructing composite content and by incorporating thinking tools – yet without omitting pedagogical or technological knowledge. The ability to synthesize will also provide the foundation for the type of curricula, based on specific skills that are expected for this cohort of Foundation Phase learners.

5.7.4 Technology-based Teaching and Learning

At the heart of the TPACK (see Figure 1.1 and 3.4), as well as central to the data interpretation framework (see 5.13) is TbTL which is the interaction of technological, pedagogical and content knowledge. This 'area' (see 5.13) where knowledges engage enables teachers, and as a result, learners, to teach and learn content that is appropriate in the Foundation Phase using fitting pedagogy and technology. It has already been established in previous sections that Case 3, which provides the majority of the Foundation Phase's experiences of TbTL, presents rare instances of TbTL but almost no interaction of technological, pedagogical and content knowledge. I therefore, purposively include a separate section of the data interpretation with specific reference to TbTL from Case 1 and Case 2 which is central to this point of the framework, as well as necessary to answer the main research question of this study, *how do teachers and learners experience TbTL in selected Foundation Phase classes?* (see 1.3.1 and 7.4.5).

Firstly, participants' use of technology is informed by their pedagogical approaches and their mastery of content as outlined previously in this section. With regard to teachers' experiences of TbTL in the Foundation Phase, self-taught knowledge and skills such as adaptability, self-management and research were evident in teacher participants' experiences of TbTL. These were not the only determinants that were

apparent from the data, but these 21st century skills were most stressed from teacher participants' responses.

Adaptability and self-management, cited as teachers' attitudes (see 3.4.3.1 and Figure 3.3), were established from the intrapersonal skill category of 21st century skills (see 2.3.1 and Figure 5.13) which asserts that the commonality between these qualities is the skill of self-development. The end result of self-development is an attainment of a desired goal which is achieved through a process by which the individual observes, upholds and customises behaviours which are congruous with the school level factor of professional development (see 3.4.3.6 and Figure 3.3). To this end, data revealed that teacher participants are able to work autonomously with the willingness and adaptability to procure new knowledge and skills (see 3.4.3.3, 5.2.3 and 5.3.3). Teacher participants in this study also displayed the ability to define verbally, or in sounds, images and key pieces of a complex idea using technology to create a mutual understanding between themselves and the learners which is central to communication and computer self-efficacy (see 2.3.1, 2.3.2, 3.4.3.3, 5.2.3, 5.3.3 and Figure 3.3). Although mentioned as 21st century skills, literature refers to the latter teacher skills under various subheadings of teacher and school level factors (see 3.4.3 and Figure 3.3). These various teacher and school level factors correspond with competences that are known as *21st century skills* as a theme of this study (see Figure 5.13).

Additionally, literature (see 2.3.3) and the responses from teacher participants attested to technology-based teaching having a positive effect on the content, pedagogy and administration within schools. Teaching and the implications that technology has for learning should be considered to meet desirable educational aims and not the other way around (see 2.3.3 and 3.4.3). Empirical data confirmed that teaching is complemented by technology, but that technology should not be the essence of teaching (see 5.2.3 and 5.3.3). Furthermore the discussion of 21st century teaching and learning in Chapter 2 (see 2.3.3) affirmed that technology is

constructive when it is required as a consequence rather than being used as determinant of teaching and learning. The idea, in essence, is that TbTL is most worthwhile when technology is the culmination of quality teaching and learning.

At the same time, the importance of Early Childhood Education (see 2.2.1) which includes the Foundation Phase has a firm place in the development goals for the country in recent years (DBE, 2015). There has been a noticeable increase on the emphasis placed on education in the early years and its positive affect on human development (see 2.2.1, 2.2.2 and 2.4.1). If this is the case, then it is imperative that teaching and learning that takes place will prepare learners to be global citizens. It also incorporates the notion of relevant learning for the generations of today. Fallows and Bhanot (2002) echo this sentiment using the term educational competence which refers to any innovative activity that aims to advance the productivity and efficiency of both teaching and learning. To this end, empirical data in Case 1 and Case 2 exposed a 'TbTL adequacy' of teachers and learners in their pioneering and successful practice of TbTL.

Secondly, in order to understand learners' experiences of TbTL in the Foundation Phase, the generation theory was discussed in Chapter 3 (see 3.2) and applied to the conceptual framework of this study (see Chapter 3). Generation Z learners are shaped by the internet, technology, the recession, and social media (see 1.4.3). Chapter 1 (see 1.5.1 and 1.5.2) and Chapter 3 (see 3.2) discussed this generation of learners which highlighted that there is a "need to make sense of all this change in order not only to assist their children to survive and thrive in an uncertain future, but also to help one through the chaos and change that will characterise life in the 21st century" (Bush & Codrington, 2012:9). My personal stance is that learners experience technology inevitably and ubiquitously in present times. It is therefore, crucial that a valuable encounter with the appropriate technology, in a suitable way for young children, occurs. This suitable experience of TbTL imparts knowledge and skills that are necessary for learners in today's changing times.

Data interpretation also made use of the learning theory, connectivism, as a lens to further understand the learners in this study (Figure 5.13). Technology-based teaching and learning is grounded in the socially constructed learning theory of constructivism, as well as in connectivism which highlights the importance of the connected network. In the discussion of connectivism in Chapter 3 (see 3.3.4), the idea arose that individuals learn and collaborate together - with individuals learning as well as networks of individuals learning - to break down the traditional roles between teachers and learners (see Table 3.1). The continual process of becoming a lifelong learner was evident from participants' references to research. Research encompassed both researching the technology as well as using the technology for research for both learners and teachers. As mentioned previously in this chapter, participants cited that technology is used for the latter (see 5.2.2.2, 5.3.2.2, 5.3.2.3, 5.2.3 and 5.3.3). Albeit unconsciously, teachers are teaching learners to do research through their technological pedagogical knowledge. It has already been mentioned previously (also in Chapter 3, see 3.4) that when technologies are applied to teaching, insight is obtained that the use of these technologies leads to a change in the way teachers teach and learners learn (see 5.3.3).

With respect to this, learning emphasises the capacity to inquire (rather than accept what is known) and the ability to form connections between sources of information and how to apply them to problem solve (see Table 3.1). Learner participants indicated that they used technology to find information through the process of research and furthermore, this knowledge could be assimilated to other learning situations (see 5.2.2.3, 5.2.2.4, 5.2.2.5, 5.3.2.3, 5.3.2.6). The notion of learners 'connecting' their learning with technology in the form of knowledge retrieval and subsequently the storage of the knowledge acquired on a technological device was particularly evident in this study. The idea of connectivism furthermore makes imparting, acquiring and storing knowledge limitless, which gives a new and exciting meaning to teaching and learning.

It is not sufficient to argue that only teaching and/or learning theories are the foundation for TbTL in the Foundation Phase without inquiring into the purpose of this phenomenon. With the ever-present nature of technology pervading and changing our lives and making our world borderless, it is necessary to view teaching and learning as globally informed. Concerning the aim of both teaching and learning in general and applied to TbTL, lifelong learning is the desired intent. The term 'lifelong learning' is apparent in documents relating to policy and curriculum in education, often stated as an end goal.

In essence and in partial answer to the main research question of this study (see 1.3.1 and 7.4.5), teachers' and learners' experiences of TbTL in the Foundation Phase are multi-faceted. Teachers experience technology positively on the grounds that they possess necessary skills and exist in circumstances that enable them to be proficient in TbTL. Learners in this study experience technology almost unavoidably and therefore, the task is in equipping learners for the 21st century at the point where 'knowledges' intersect (see Figure 5.13). Teaching and learning depends on how knowledge is created, accessed and imparted, through what is being taught and learnt in particular relation to technology. Likewise, teaching and learning have the ability to affect change and contribute on a global scale due to technological advancements and inclusions in education. The way forward relies on an education that creates teachers and learners who are digitally literate, lifelong learners with developed 21st century skills.

5.7.5 Framework for TbTL in the Foundation Phase

The above mentioned elements from the TPACK framework, together with the research themes, were applied to this study in order to establish the data interpretation framework for technology-based teaching and learning in the Foundation Phase. The interaction between and among technological knowledge, pedagogical knowledge and content knowledge produced the basis of the conceptual

framework (see Figure 5.13) which ultimately supplies guidelines for TbTL in South African Foundation Phase education. However, this study was not definitively confined to the TPACK framework and various other elements that arose from literature and the themes of the research, such as *technological tools, 21st century skills, TbTL* and *mind the gaps*, presented teachers' and learners' experiences of TbTL in the Foundation Phase.

The novel, original contribution that this study makes is a framework for TbTL in the Foundation Phase (see Figure 5.13). In essence this framework is relevant to understand teachers' and learners' experiences of the phenomenon of TbTL in the Foundation Phase. It is not a step-by-step guide as such but rather an indication of the core elements that are important to consider by any role players using TbTL in this phase. It is anticipated that using this framework as a guide to TbTL in the Foundation Phase will assist in creating teachers and learners who are digitally literate, lifelong learners with developed 21st century skills.

5.8 CONCLUDING REMARKS

This chapter presented a detailed description of the fieldwork that was conducted in this study. Upon reflection, it was evident that the data produced had strong links to the theory behind this research. I found it particularly useful to use the elements from the conceptual framework of this study to code and organise the data. It was also beneficial to analyse the data according to each case and, in turn, each participant to provide a methodical account of the details and experiences of TbTL in the Foundation Phase. The relationship between the findings from both Case 1 and Case 2 were obvious and I ascribe this to the fact that the context of the environment in both instances was a technology-rich school with similar resources. Likewise, the similarity of the two cases could be attributed to the fact that mainly a deductive analysis of the data, which was based on literature and the conceptual framework was employed. Furthermore, the analysis of data that described Case 3: TbTL in the

South African Foundation Phase counteracts all other data collected in this study. It served to highlight that TbTL is seemingly absent in schools and in the majority of the teaching and learning taking place in the Foundation Phase; the reasons for the gaps; as well as to enlighten recommendations of this study which are provided in the following chapter.

Particularly worthwhile to the data analysis in this chapter was the substantive comments that were provided for in the expert verification which validated and triangulated the data analysed from the empirical part of the study. Interpretation of data in this chapter was underpinned by a data interpretation framework (see Figure 5.13) that had reference to empirical data and relevant literature. A number of elements from this framework, such as technological knowledge, content knowledge, pedagogical knowledge, as well as the phenomenon of TbTL itself, were used to provide insight into teachers' and learners' experience of TbTL in the Foundation Phase. In the next chapter, I review significant issues emerging from the study in order to provide conclusions and recommendations of teachers' and learners' experiences of TbTL in the Foundation Phase.

CHAPTER SIX:
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Things have changed. What amazes me is how easy it is for people to incorporate it (technology) *into their lives.*

- Expert participant

6.1 INTRODUCTION

This study refers to the fact that teaching and learning is already and will become increasingly more digital, as well as the notion that technology has positive effects on both teaching and learning. The world is being transformed by digital technologies which make the role of such technologies and the subsequent content and skills that are taught important particularly in the way in which we teach young children and at the same time, the way in which they learn. In the previous chapter, data were interpreted according to a framework for TbTL in the Foundation Phase (see Figure 5.13) which included the main elements of the conceptual framework, namely technological knowledge, pedagogical knowledge and content knowledge and the research themes of *technological tools, 21st century skills, TbTL* itself and *mind the gaps*. In this final chapter I summarise the key literature and empirical findings. Thereafter, research conclusions according to the secondary research questions and ultimately, the main research question are made. I finally present recommendations and possibilities for future research, as well as the limitations of the study before concluding the study with the final comments.

6.2 CHAPTER OVERVIEW

This section serves as an overview of the thesis content and as orientation to the following sections.

6.2.1 Chapter 1

Chapter 1 provided an overview and orientation to this study. I outlined the rationale, research questions and key concepts of the study. I also introduced the TPACK theoretical framework which serves as the basis for the subsequent conceptual framework (see Chapter 3) in order to highlight some factors that influence Grade 3 teachers' and learners' experiences of technology for teaching and learning in the Foundation Phase. Lastly, Chapter 1 briefly explained how the qualitative research process of this study was followed by outlining the research design and the research methods as well as important ethical considerations.

6.2.2 Chapter 2

This chapter presented the literature that was reviewed in order to contextualize the study. An account of the relevant literature concentrated on studies that dealt with technology for teaching and learning in the South African ECE context. This chapter highlighted the importance of ECE and the provision thereof in South Africa. TbTL was then discussed according to 21st century skills, digital literacy 21st century teaching and learning and lastly, the benefits and barriers of TbTL. This chapter concluded with an account of TbTL in ECE from an international and local perspective.

6.2.3 Chapter 3

Chapter 3 provided the conceptual perspectives pertaining to this study. I specifically designed this chapter as a conceptual framework since it comprised of various theories that are pertinent to technology for teaching and learning in the Foundation Phase. Firstly, the generation theory was elucidated to understand the current generation of learners, Generation Z. Secondly, literature was reviewed on learning theories to discover the different aspects of what it takes to learn, and therefore what it takes to teach. Behaviourism, constructivism and connectivism were accounted for since these schools of thought were applicable to teaching and learning with technology. Lastly, the various elements of the TPACK framework were provided. The guidance for how teachers and learners in the Foundation Phase might approach technology in specific ways was given in the form of a conceptual framework diagram based on the above mentioned theoretical underpinnings.

6.2.4 Chapter 4

This chapter provided a detailed account of the research methodology of this study. A qualitative research approach and the case study research type used within the interpretive paradigm were discussed. Complementary data collection methods, such as photovoice, narratives, semi-structured interviews, opinion pieces, field notes and an expert interview, were also described. Thereafter, data analysis procedures were given. I also looked at how this study addresses trustworthiness in order to ensure that authenticity, accuracy and comprehensiveness were achieved. Finally ethical concerns, such as informed consent, anonymity and confidentiality, deception and privacy, were discussed.

6.2.5 Chapter 5

The findings from the data generated in this study were provided and interpreted in this chapter. An account of the background information followed by a description of the data were given for each participant in each case. Data analysis exposed several themes that were closely linked to literature, such as *technological tools, 21st century skills, TbTL* and *mind the gaps.* Verification of the synthesis of themes and categories from an expert in the field was presented. Furthermore, I included another set of data to describe official perspectives with regard to TbTL in the Foundation phase in South Africa which was provided by district officials at the Department of Education. This chapter also accounted for the interpretation of data which was based on a data interpretation framework (see Figure 5.13) that was adapted from the conceptual framework and featured the themes produced from the data in this study.

6.3 SUMMARY OF KEY FINDINGS

This section highlights this study's key literature and empirical findings.

6.3.1 Literature review

Literature based on the phenomenon of TbTL was critically reviewed in order to ascertain what was already known about the latter, as well as to map the process of answering the research questions of this study. The literature was broadly categorized into contextual and conceptual underpinnings in Chapter 2 and Chapter 3 of this study respectively. The significant findings are provided below.

The literature on the importance of ECE indicated that ECE has the ability to prepare and develop learners into competent adults, as well as have a positive effect on human capital investment (see 2.2.1). However, it is evident that ECE provisioning in

South Africa is still disparate in *inter alia* policy, practice, service and accountability. To this end, the government has a number of policies, programmes and initiatives in place to enhance the quality of ECE and benefit from the investment in this crucial phase of life. The prevalence of technology cannot be avoided and various research studies have been conducted to examine the technology in education. The global and national prevalence of TbTL in various projects, strategies and policies in ECE (see 2.4.1 and 2.4.2) represented efforts sought to increase access to technology for both teaching and learning as well as to improve the development of the nation, with ECE being the most suitable vantage area for effective change.

Furthermore, it is evident that technology, specifically electronic technology, is transforming the way that people work, live and play (Kruger, 2014). Since the Foundation Phase is such a fundamental period for learning in an individual, the type of skills – specifically in the 21st century - that are necessary for teaching and learning were analysed. Numerous definitions and categories of 21st century skills were cited (see 2.3.1), many of which are overlapping but each skill is fundamentally regarded as the competences that are required to function effectively in schools in this day and age. The term *digital literacy* was also found to be complex but primarily involves the knowledge, skills and understanding necessary for appropriate, safe and productive usage of digital technologies for learning and discovering (Kalaš, 2010: 119). The position of the above-mentioned two sections of literature, in light of what is required of teachers and learners, is crucial to understanding TbTL in the Foundation Phase. Since technology has driven change, it was established that educational outcomes also need to be adapted to meet the demands of new ways of work, thinking, learning and living (see 2.3.3). In line with adjusting educational goals, it was obvious that pedagogies and the implications which technology has for teaching and learning also needed to be thoughtfully considered.

Both positive and negative outcomes of TbTL were identified. The most noteworthy benefit of technology in teaching and learning emanated from the ability it has to

affect change and reformation in the school system. Further advantages of TbTL included, albeit not exclusively, that technology in schools enhances motivation, increases collaboration and enables learners to be globally connected to information. On the other hand, literature noted that development and the establishment of excellence in education by means of technology ought to provide for an increase in equity and access which are often reduced by circumstances such as capacity-related limitations, financial restrictions and spatial challenges. The latter items, coupled with the reality of the digital divide, comprise certain of the disadvantages of TbTL.

The second section of literature analysed was grounded in the conceptual elements that were pertinent to TbTL in the Foundation Phase. The unpacking of the generation theory brought to light that learners in the Foundation Phase differ from their teachers on the grounds that people born in a particular period of time share similar characteristics (see 3.2.1). The generation theory also classified the learners of this study into Generation Z which distinguished them according to characteristics such as being “proficient with and dependent on technology” (Grail Research Report, 2011:3). Moreover, reviewing the generation theory exposed similarities and differences between generations involved in TbTL in the Foundation Phase (see 3.2.3).

The way in which an individual acquires, creates and stores knowledge during TbTL in the Foundation Phase was attributed to various teaching and/or learning theories. The importance of learning theories in education was attributed to the role of such theories in providing theoretical clarification on learning processes that can be used and understood in facilitating learning, constructing educational environments and affecting educational change (see 3.3.1). Table 3.1 clearly presents key findings of teachers’ roles, learners’ roles, learning goals, curriculum characteristics, types of activities and assessment with respect to the theories of constructivism, behaviourism and connectivism.

The literature reviewed on the TPACK framework had the most implications for this study since it was the basis of the conceptual framework and likewise, used as a pertinent aspect of data interpretation. This framework "has given us a language to talk about the connections that are present (or absent) in conceptualizations of educational technology" (Mishra & Koehler, 2006:1044). The particular kinds of knowledge that teachers require to effectively teach and subsequently those that learners require to learn, with technology, were described as a complex interaction among three bodies of knowledge: content, pedagogy, and technology. Each body of knowledge was further unpacked which yielded insight into the way in which TbTL in the Foundation Phase is experienced.

6.3.2 Empirical research

It was apparent that the data produced had strong links to the conceptual framework (see Figure 3.3) of this research. Data analysed explored the participants' descriptions and experiences of technology for teaching and learning in the Foundation Phase. Themes, namely: t*echnological tools; 21st century skills, TbTL* and *mind the gaps* emerged which stemmed from the categories, *technology; 4C's; benefits of TbTL, barriers to TbTL* and *TbTL gaps* (see Table 5.7), were verified by an expert in the field of educational technology (see 5.6). Case 1 and Case 2 presented rich technology use in the Foundation Phase whereas Case 3 starkly contrasted such finding for the majority of the Foundation Phase population. To this end, gaps such as generational difference between teachers and learners; differences between those who have access to and use technology versus those that do not; lack of interaction between the various knowledges derived from the theoretical framework and disparate communication between stakeholders involved in teaching and learning in the Foundation Phase were highlighted (see 5.4.2 and Table 5.7)

On the other hand, data interpreted from Case 1 and Case 2 highlighted the main components derived from the TPACK framework (see Figure 1.1), conceptual framework (see Figure 3.3) and data interpretation framework (see Figure 5.13), namely technological knowledge, pedagogical knowledge and content knowledge. A distinct aspect that emerged was the fact that technological knowledge in TbTL in the Foundation Phase cannot be separated from pedagogical knowledge and content knowledge as all components are in reciprocal relation.

Regarding the three main components of technological knowledge, pedagogical knowledge and content knowledge, empirical findings pertaining to technological knowledge are outlined first (see 5.6.1). Teachers' and learners' experiences of technology in the Foundation Phase were connected to the developed knowledge of adopting technologies and associated digital tools. Various 21st century skills and the ability of such skills to culminate a sound digital literacy are also determinants which evidenced technological knowledge. Thereafter, empirical research elucidated pedagogical knowledge factors such as how appropriate technologies were chosen and implemented to positively affect the quality of TbTL in the Foundation Phase (see 5.6.2). Likewise, it was apparent that technology supported the way in which teaching and learning through understanding and applying pertinent learning theories occur (see 5.6.2). Thirdly, the accessibility and applicability of content in terms of what this generation of learners needs to know was made apparent while the skills of synthesizing accounted for how composite content could be constructed (see 5.6.3).

Lastly, it was found that TbTL has an encouraging effect on the content, pedagogy and administration within the schools under study. A distinct notion that teaching was complemented by technology, but that technology was not the essence of teaching was also revealed (see 5.6). Teachers' and learners' experiences of TbTL in the Foundation Phase were multi-faceted. Teaching and learning depended on how knowledge is created, accessed and imparted, through what is being taught and learnt in particular relation to technology. Empirical data were the result of the

participants' reported experiences to describe their experiences of TbTL which ultimately contributed to a framework for TbTL in the Foundation Phase (see Figure 5.13).

6.4 VERIFICATION OF RESULTS

This section presents a comparison of results from existing literature with the empirical findings of this study. I firstly present the literature which supports or contradicts findings in terms of the themes and categories of the study (see Table 6.1) and discuss the evidence. Thereafter, new insights from my findings are presented (see Table 6.2) and discussed.

Table 6.1: Comparing results to existing knowledge: confirmation or contradiction of evidence

Categories	Author and year	Existing knowledge	Confirmation ✓ OR Contradiction ✕	Interpretive discussion
Digital vs traditional technology	Kruger, 2014 Mishra, Koehler & Henriksen, 2011:23 Codrington & Grant-Marshall, 2011:86	Digital technology is transforming the way people work, live and play Digital technology is transforming the way the world works, people learn, live and function.	✓ In Case 1 and Case 2 it was evident the schooling in the Foundation Phase is being transformed by technology	
			✕ In this study, most schools do not have digital technology due to social, economic, historical and educational reasons. Although the study looked at two technology rich schools where data confirms findings in literature, the majority of the South African Foundation Phase starkly contrasts such findings.	
	Belshaw (2012:31)	Defined digital literacy as basic skills needed in order to function in the digital age. Suggests 8 fundamental elements of digital literacy (2.3.2)	✓ Teachers and learners in the two technology rich schools displayed developed knowledge of adopting technologies and associated digital tools.	
	Paul Gilster (1997)	Original work on *Digital Literacy*	✓ The term in this study, which implies the capabilities that an individual possesses in order to teach and/or learn in a digital age applies to Case 1 and Case 2's participants	
	Kalaš (2010:119)	Recognized potential of ICT in ECE	✕ The sample of this study presented ICT provisioning in South Africa as disparate in *inter alia* policy, practice, service and accountability.	
	Prensky (2005)	Conceptualised 'digital natives' and 'digital immigrants'	✓ The teachers and learners at technology-rich schools were proficient in TbTL whereas the broader South African Foundation Phase population of teachers and learners are much less so.	

Categories	Author and year	Existing knowledge	Confirmation ✓ OR Contradiction ✕	Interpretive discussion
4 C's: creativity, collaboration, communication & critical thinking	Griffin, Care & McGaw, 2012	Produced white papers to conceptualise changes and define the parameters of 21st century education	✓ Participants' responses from Case 1 and Case 2 displayed shared 21st century skills such as communication, creativity and systems thinking under the categories of ways of thinking and ways of working as well as cognitive, interpersonal and intrapersonal skill categories. ✕ In contrast, the lack of TbTL in the general Foundation Phase population provided no evidence of changes or development of 21st century skills.	
	National Research Council (2011)	Classified 21st century skills into cognitive skills, interpersonal skills and intrapersonal skills.		
	Siraj-Blatchford and Siraj-Blatchford (2006)	Recognize four key areas of TbTL to support 21st century skills specifically in ECE	✓ This study provided evidence that the meaning of pedagogical knowledge for teacher participants is that technology in the Foundation Phase provides opportunities for collaboration and communication, creativity and play between learners and teachers, as well as amongst learners when the appropriate pedagogical practice is used	

Categories	Author and year	Existing knowledge	Confirmation ✓ OR Contradiction ✕	Interpretive discussion
Benefits of TbTL	Mdlongwa (2011) e-Learning Africa report (2012)	TbTL increases collaboration and enables learners to be globally connected to information and to actively participate thereby producing knowledge for themselves.	✓ The learners in this study attested to the world being 'borderless' by means of technology as they could both collaborate and construct their own knowledge through TbTL.	
	Laurillard *et al*. (2009:290)	Argue for including digital technologies to transform pedagogy and enable an elaborate system of curriculum, assessment, professional development and advancement	✓ P1, P2, PD1, and PD2 all agree that integrating technology through various teaching approaches leads to positive changes in teaching and learning but at the same time, it is largely dependent on attitude of the individual using the technology (i.e the teacher themselves).	
	Hew & Brush (2007); Keengwe & Onchwari (2008) Nyambane & Nzuki (2014)	Argue that teachers' attitudes are an aspect that influences successful TbTL		
	Bialobrzeska & Cohen (2005) Mdlongwa (2011)	Advancement of teaching as management, administration and communication is better.	✓ This study highlighted that technology-based teaching has a positive effect on communication and administration within schools	
	Brooks-Young, 2007	TbTL promotes technological, inquiry, collaborative, and problem-solving skills much more than a 'non TbTL' school programme.	✓ Case 1 and Case 2 presented numerous 21st century skills that learners cited whereas; the lack of TbTL in the majority of the South African Foundation Phase did not bring such skills to the fore.	
	Peralta and Costa (2007)	Established that technical competences, as well as pedagogical and didactic competences were important elements for effective TbTL.	✓ Teacher participants in this study experience technological pedagogical knowledge by means of applying numerous technologies to their teaching in order to adapt and make both teaching and learning applicable	
	Kalaš (2010:30)	Benefits for learning especially becoming multi-literate.	✓ This study proved that learner participants are developing multi-literacy since they are co-creators of their knowledge through the use of original media and technologies.	

Categories	Author and year	Existing knowledge	Confirmation ✓ OR Contradiction ✕	Interpretive discussion
Barriers to TbTL	NCCA (2011:10) Kalaš (2010)	Digital divide – the gap between the 'haves' and 'have nots'	✓ This study clearly portrayed the unequal distribution of technology between the participants who successfully experience TbTL in Case 1 and Case 2 and the majority of the Foundation Phase population who do not have technological tools let alone TbTL.	
	Selwyn (2004:351)	Digital divide is twofold: 1. Unequal opportunities and 2. Unequal outcomes		
	Isaacs (2007), ICT Policy Green Paper (2013)	Infrastructure is not distributed evenly and is poorly linked. Information infrastructure is still disparate – especially between rural and urban areas in South Africa.		
	Codrington & Grant-Marshall, 2004:3) Prensky (2001a&b,2005)	Generation gap obstructs TbTL from being successful	✓ *From school visits it is evident that a large percentage of the teachers in the Foundation Phase are very 'senior' in years. Thus, there is a sense of 'fear' and 'inability' or lack of knowledge in using computers and programmes to assist with teaching and learning (PD2: SSI)*	
	Pelgrum & Law (2003)	Teachers' lack of knowledge and skills in using various technologies is one of the barriers to using technology		
	Crawford (1997)	Financial cost of purchasing the hardware and software to set it up	✓ It was evident in this study that the majority of schools experience the financial burden of TbTL in terms of purchasing equipment, planning, training teachers and sustaining the use of technology.	
	Howie, Muller & Patterson (2005)	Government is not in the financial position to equip schools with computers and the necessary infrastructure to support TbTL		
	Laurillard 2008a, 2008b) Laurillard et al. (2009:290)	Despite physical technology in schools, resulting curriculum and teachers' professional skills continue unchanged.	✓A recommendation that emerged from participants is that there cannot be a separate plan for TbTL - it should become part and parcel of the curriculum that is being implemented.	
	Laurillard (2005)	Technology advancement happens quicker than the education system can change or transform.	✓Technological content knowledge and technological pedagogical knowledge is unchanged in most instances due to what a prescriptive curriculum.	

Barriers to TbTL cont.	Isaacs (2007) Laurillard (2008b) Mdlongwa (2012)	Leadership within schools aggravates slow change and implementation of TbTL	✓ This study explained that the school management, or at least a person who supports TbTL – which is often lacking, is crucial for technology to be implemented and sustained.
	Mdlongwa (2012)	Lack of resources especially with regard to amount and access to internet; there was a shortage of qualified teachers to use the technology effectively; and there was restricted access to the technology.	✓ This study highlighted that TbTL in South Africa was experienced through capacity-related limitations, financial restrictions and spatial challenges as well as unequal distribution of training and resources.
	Tinio (2003)	English is used for 80% of software and the internet	✓ Most teachers and learners in South Africa are 2nd/3rd language English users.
	Ndlovu and Lawrence (2012)	South African ICT policy is being actualised ineffectively especially in instances where economic and social prejudice is the root of the digital divide	✓ The e-Education white paper's (2004) intention was for all school-going learners to become efficient in using ICT by 2013. This study's account of TbTL in the Foundation Phase highlights the inequality, especially between the various types of schools.

The summary of the comparison of results to existing knowledge above mostly confirms findings in the categories of 'Digital vs traditional technology' and 'Benefits of TbTL' since Case 1 and Case 2 were technology-rich and well-resourced schools. Similarly, in the category of 'Barriers to TbTL', findings also ratify existing knowledge since the findings stem from data from Case 3, where TbTL is unequal. The literature that portrays that digital technology is transforming the way the world works, people learn, live and function is however, not validated in the South African context. The same implies for the recognition of the potential of TbTL where findings indicate that policy and practice are disparate and the majority of the South African Foundation Phase still teach and learn in a very traditional manner. Furthermore, in the category of '4C's', defining the parameters of 21st century education which includes the development of 21st century skills is incongruous with findings in TbTL in the

Foundation Phase in South Africa since there is little or no TbTL taking place in the majority of schools.

Table 6.2: Comparing results to existing knowledge: new insights

Categories	Description	Interpretive discussion
TbTL	Technology-based teaching and learning implied the use of technological tools such as the internet, devices, applications, social networking and the likes that both teachers and learners use for teaching and learning respectively.	The acronym, TbTL was specific to this study and evolved due to the context and nature of the research. It was not technology *for* teaching and learning but rather technology-*based* teaching and learning since teaching and learning under research was grounded in the use of various technologies. Furthermore, it 'replaced' the heart of the initial conceptual framework to be situated at the point where all knowledge's from the TPACK framework converge.
Technological knowledge (with?)	*With what do Foundation Phase teachers teach and learners learn?* Adopting technologies in the Foundation Phase are supported by a positive learnedness of doing so, *with* the appropriate technological tool(s) and *with* acquired 21st century skills and resulting digital literacy.	Teacher and learner participants have access to and use a variety of technological tools for teaching and learning in the Foundation Phase which develops skills and literacy necessary for the current times. The technology-rich environment, which in itself is rare in this phase and also the leadership of exemplary schools, are the reason for this finding.
Pedagogical knowledge (how?)	*How can teachers impart this knowledge to learners in the Foundation Phase?* Pedagogical knowledge can inform and transform the method of teaching with technology to close the generation gap between teachers and learners. The gap is age in brought closer through the common interest of technology. The learning theory connectivism, was integrated into the conceptual framework of this study since it placed importance of the ability to find out (rather than what is known) which emerged through the use of technology.	Teacher participants are forerunners in implementing TbTL and therefore, use different technologies to bring about a change in the way in which teaching and learning occurs in the Foundation Phase. Secondly, this pedagogy that can close the generation gap can bridge the digital divide insofar as it can be creatively adapted so that technology can benefit all learners which would be the ideal in the South African context since education is still very unequal. The idea of connectivism was strongly insinuated by teacher participants' citations of technology being integral to teaching and the latter enhancing teaching and learning. Likewise, learner participants revealed the concept of an 'extended mind' in responses of 'without technology we would not…'

Content knowledge (what?)	*What content is facilitated through technology in the Foundation Phase?* Content was very accessible largely due to the internet and technologies available in the context of technologically-rich research sites.	This study proved that technology supports the process of acquiring content knowledge as a result of teachers and learners choosing and using suitable technologies to complement the necessary concrete encounters Foundation Phase learners need with concepts in order for higher order thinking to take place. Teacher participants experienced technological content knowledge based on their use of technology to teach and make the subject understandable.
Mind the gaps	• Digital divide • Generation gap • Nil 'knowledges' • Discipline disparity • Communication breakdown ('Silo' mentality)	In contrast to the benchmark of how TbTL can be integrated in the Foundation Phase, this study also highlighted the specific challenges as well as that which is lacking in TbTL in the Foundation Phase in South Africa.

The novel contribution of this study is the conceptual framework itself (see Figure 5.13) and the reasons for this new knowledge in the field are various. Firstly, the TPACK framework which is central to the conceptual framework is most often used for teachers but has been applied to both teachers and learners in this study to make connections between what is being learned (content knowledge), how it is taught (pedagogical knowledge) and the tools used (technological knowledge) during TbTL in the Foundation Phase. Furthermore, the coming together of technological, pedagogical and content knowledge was attributed to TbTL itself. Secondly, the conceptual framework was not limited to the elements of the technological, pedagogical and content knowledge. Instead, teaching and learning theories, especially connectivism because of their applicability to TbTL, the generation theory, 21st century skills and technological tools were integrated into the structure.

Lastly, the study explored teachers' and learners' experiences of TbTL in the Foundation Phase which confined the research to technology-rich schools. I found the themes, *technological tools, 21st century skills* and *TbTL* mostly in accordance with the literature reviewed due to the fact that the participants and context of this set

of data were similar to the euro-centric perspective of TbTL portrayed in literature. However, challenges such as the inequality of education in the South African context and the lack of TbTL were also addressed in another set of data. The data from TbTL in the Foundation Phase highlighted numerous gaps that hinder successful TbTL. The first gap is that of the digital divide which clearly presented those individuals that have versus those that do not have technology. Another challenge was the generation gap which accounted for the differences, due to age, between teacher and learners and which hinder TbTL. Thereafter, since technology is so uncommon in the Foundation Phase, it could not be aligned to any of the knowledge's from the conceptual framework because even the rare instances of technology in certain schools, was not integrated efficiently with teaching and learning. The gap, discipline disparity resulted from unequal training opportunities in TbTL for teachers, learners and relevant Foundation Phase stakeholders. Lastly, communication was seen as a barrier since relevant departments, institutions and individuals are involved in separate TbTL initiatives, if any, instead of sharing and exchanging knowledge and ideas.

6.5 RESEARCH CONCLUSIONS

This study was significant in that it provides an educational research perspective of the current generation of Foundation Phase learners and their teachers' descriptions and experiences of technology-based teaching and learning since children of today are being socialised in a vastly different way (See 1.1). The preceding chapters of literature and data have highlighted that we live in a global information society that is highly interconnected (See 1.5.2, 2.3.3, 2.3.4, 2.4.2, 3.4, 5.2.2.2, 5.2.2.6 and 5.3.3). At the initial stages of the information era, the impact was restricted to how we retrieved and replaced information or how we conversed, but it is currently influencing the way in which we teach (i.e., the pedagogy) and the way in which learners learn (i.e., content) with what we teach (i.e., technology).

In the subsequent section, I present the research conclusions which are based on the information that was generated by the literature survey and the data that was obtained with the empirical study. Conclusions are presented as answers to my research questions and depart from the secondary research questions, namely: *What is the 'technological profile' of Foundation Phase learners/teachers?* and *How can technology benefit teaching and learning in South Africa in the Foundation Phase?* and conclusions close with an answer to the main research question, *How do teachers and learners experience technology-based teaching and learning in selected Foundation Phase classes?* The final secondary question, *What recommendations can be made to ensure technology for teaching and learning in the Foundation Phase is successful?* is answered later in the chapter (see 7.5).

6.5.1 Secondary research question one

What is the 'technological profile' of Foundation Phase learners?

Before answering this question explicitly, it is necessary to give an explanation of the term 'technological profile'. The technological profile of learners in this study refers to the type of South African Foundation Phase learner that was portrayed through the interaction with technology (see 1.4.4).

It can be noted here, that although a rich account of the official perspectives with regard to TbTL in South African was provided in Case 3, the technological profile was based on how technology complements teaching and learning. This implies that the type of learner under study, were those that engage with TbTL regularly and successfully as evident in Case 1 and Case 2.

The description of learners is presented based on external, internal and educational reasons for the way in which the use of technology in the Foundation Phase influences them. Firstly, in response to the fieldwork question of why TbTL was used, literature and data revealed external reasons such as the natural impetus to use

technology; learners use technology as a lifestyle; and children's brains are wired to use technology (see 3.2.2, 3.3.4 and 5.7.2). Secondly, participants understood the value of technology and its influence on their own learning. These internal reasons for the inclusion of TbTL in the Foundation Phase were that participants were exploring their own research and development in TbTL; recognition that technology improves their performance and capabilities; and a personal drive to use technology to enhance learning (see Tables 5.4, 5.5, 5.6 and 5.7). Lastly, educational reasons were also brought to the fore as Kalaš (2014:28) acknowledges that technology provides opportunities which can affect positive changes in teaching and learning in the Foundation Phase. Data revealed educational reasons such as TbTL benefitting the development of 21st century skills; the ability to incorporate appropriate content in a technologically-rich, Foundation Phase environment; and the understanding of using technology meaningfully for learning (see 5.6.1, 5.6.2 and 5.6.4)..

Additionally, Chapter 1 (see 1.5.1) introduced the generation theory in order to typify the cohort of Foundation Phase learners in this study since they are born during a particular period of the same 20 years and share 'peer personalities' (see 3.2). The learners of this study all use technology on a daily basis and possess an array of digital devices that are used at home and at school (see Table 5.4 and Table 5.5). Furthermore, these learners are digitally literate as their proficiency in using technology when learning was visible. As alluded to in Chapter 3 (see 3.2.2) this generation, Generation Z, has never lived without the internet and technology which makes the latter an integral component of how they communicate, exchange ideas and acquire knowledge. In line with characteristics of Generation Z, a category that data presented from learners in the Foundation Phase was communication (see Table 5.7 and 5.6.1, 5.6.2 and 5.6.4). Similarly, data supported that technology enhances learning for this generation of learners.

Finally, this study put forth the notion of the digital divide – the disparity in achievement of technology-based learning between the 'haves and have nots' (see

2.3.5). With regard to the learners of this study, it was evident that they form part of the 'haves' by having access to and therefore, being capable of using technology to learn. Since this is a South African study, it is crucial to mention that the 'technological profile' of the majority of Foundation Phase learners is circumstantial which is evident in the contrasting description of the 'have-nots' (see 5.7.2).

This study highlighted that the technological profile of Foundation Phase learners is influenced by context. In other words, the participants of this study were situated at technology-rich, independent schools and therefore, their technological knowledge and skills were developed. On the other hand, the majority of the population of South African Foundation Phase learners, specifically those in township and rural schools, do not have technological tools, training and sustainability of TbTL which makes their technological profiles empty or at least much less developed.

6.5.2 Secondary research question two

How can technology benefit teaching and learning in South Africa in the Foundation Phase?

To begin with, technology as defined at the onset of this study referred to the use of technology tools that were used for technology-based teaching and learning (see 1.4.1). It was interesting that numerous participants similarly referred to it as something that helps you learn (see Chapter 5) which was probably due to the nature of the study. Furthermore, the descriptions and experiences of technology were strongly grounded in technology being a tool to enhance teaching and learning which is closely linked to the pedagogy of teaching.

Secondly, literature in Chapter 2 (see 2.3.4) and Chapter 3 (3.4) highlighted the transformative nature of using technology. Specific to teaching and learning, the effective use of technology has the potential to reinforce pedagogical, curricular and assessment transformation while reinforcing the progression of knowledge creation

(see 3.4.1). Bearing this in mind, numerous participants cited that technology helps you. Help referred to assistance in completing tasks in everyday life (5.2.2.2, 5.2.2.4 and 5.3.3), research (5.2.2.5, 5.3.2.3 and 5.3.2.6), self-management (5.2.3, 5.3.3, Table 5.4 and Table 5.5), learning (5.3.2.4 and 5.3.2.6) and teaching and pedagogy (5.2.3 and 5.3.3). Succinctly put, Howell (2012:5) posits that technology "changes how and what we learn." Participant 2 echoed this exactly by stating that the advantage of technology is using it to find what you need to teach and how you are going to teach it (see 5.3.3). When teachers and learners engage in technology-based teaching and learning, different types of knowledge creation is evident, thus altering the role of the teacher and altering the mode of learning (Howell, 2012).

The above mentioned accounts for a number of ways in which technology can benefit teaching and learning in the Foundation Phase. Firstly, TbTL is a tool that has the potential to enhance teaching and learning and thus, supports the pedagogy of teaching. Secondly, TbTL's transformative nature is particularly able to alter the pedagogy of teaching as well as the content that is taught. To this end, the theoretical framework of this study, the TPACK framework, places the relationship between content and technology, within a broader context of using technology for and with pedagogy (see 3.4). Technology benefits South African Foundation Phase teaching and learning by blending both content and pedagogy with the goal being to develop better teaching practices in this context and in this phase.

6.5.3 Primary research question

How do teachers and learners experience technology-based teaching and learning in selected Foundation Phase classes?

The conclusion to this question is presented in two parts. Firstly, I will derive how Foundation Phase learners experience technology to learn and thereafter, how Foundation Phase teachers experience technology to learn.

Generation Z was described in an attempt to understand the current generation of Grade 3 learners in this study (see 3.2.2). It was evident in literature (see Prensky, 2001a&b; Bush & Codrington, 2012) and observed in the learners of this study, that today's learners thought and information processing differs vastly from previous generations. Literature from Chapter 3 (see 3.3) also highlighted particular learning theories that were applicable to technology-based teaching and learning. Behaviourism, constructivism and connectivism were discussed so as to understand how learners construct new knowledge, construct existing knowledge and relate knowledge to new contexts. According to the constructivist learning theories of Piaget and Vygotsky, building knowledge is traditionally achieved through interaction with the environment or others respectively. Accordingly, the learners in this study construct knowledge in an environment that is rich in technology and cite that technology helps them learn (see 5.2.2.5, 5.3.3.2, 5.3.2.4, 5.3.2.5 and 5.3.2.6). A number of the participants also mentioned that more skilled persons, such as a parent or teacher, assisted them in constructing knowledge when using technology (see 5.2.2.2, 5.2.2.6, 5.3.2.3 and 5.3.2.6).

In addition, it was evident through empirical data that Foundation Phase learners experience technology to learn by playing. When referring to various technological tools that the participants use, they all cited that they *play* on the devices that they mentioned, and use applications and software with strong elements of play – making learning enjoyable. Play and the enjoyment of learning through the afore mentioned medium is substantiated by seven trans-disciplinary thinking tools (see 3.4.2.6 and 5.6.3) and provide the basis for the content of that which is important for learners in the 21st century.

From a theoretical standpoint, constructivism and connectivism support the way in which Foundation Phase learners experience technology to learn through play. Firstly, play is rooted in the constructivist approach to learning (see Table 3.1) which allows children to develop and make sense of their world through exploration. The

epistemology of constructivism claims that knowledge and meaning is produced via interaction between experiences and ideas. Regarding play as a fundamental feature associated with technology in the Foundation Phase, it refers to structured engagement which represents both exploratory and determined exercises to achieve learning that is valuable. With reference to the above-mentioned, the literature advocates that the use of technological tools in the Foundation Phase environment supports children's learning and play (see 3.4.3.8). It was evident from the data that Foundation Phase learners experience technology to learn, thus creating knowledge, through play-based experiences. Secondly, connectivism claims that knowledge is built through interaction with technology. In light of connectivism whereby knowledge is not stored personally and internally within the individual's mind, technology becomes exceptionally important since it is the agent used to store information. Upon the premise of connectivism, knowledge that Foundation Phase learners create and access is tangible and stored electronically and physically.

Foundation Phase learners experience technology to learn by playing with it. It can be argued that since this cohort of learners are literally born into technology, that it is learnt instinctively. That being said, the knowledge and skills that they acquire through their interaction with technology is established through structured play-based experiences and also are not necessarily ingrained in their minds but rather stored on the very devices that they are playing with.

In terms of how teachers experience technology-based teaching in the Foundation Phase, the following conclusions are given. In the first place, pedagogical knowledge is used as a point of departure to provide insight into the way in which Foundation Phase teachers experience technology to teach. Chapter 3 (see 3.4.1) noted that technology is a valuable tool for developing new teaching and learning avenues rather than just a device that can supplement or take the place of existing teaching approaches. This same notion of technological pedagogical knowledge was noted in the responses from the teacher participants (see 5.2.3, 5.3.3 and 5.6.1).

Furthermore, technology as an instrument that can enhance teaching and learning in the Foundation Phase does not rely solely on technological skills, although data revealed that the participants are apt in this area. Howell (2012:6) argues that a digital pedagogy which is how we teach using digital technologies is more important than merely introducing technology into the classroom. Rather, teachers must understand how technologies will affect learning and its outcomes and furthermore, which strategies are most suitable to reach this end (see 5.6). In Chapter 5 (see 5.2.3 and 5.3.3), both teacher participants shared their experience of their roles as co-creators of content and their digital pedagogies when using technology-based teaching.

Chapter 3 (see 3.4.3.1 - 3.4.3.2) discussed teacher level factors such as teachers' attitudes, ICT competence, computer self-efficacy, teaching experience and teacher workload that influence technological pedagogical knowledge. With reference to teachers' attitudes, it was evident that participants were self-motivated by the influence that technology, specifically the perceived usefulness that the technology itself has on teaching and learning in the Foundation Phase. ICT competence includes the confidence and competence of using technology as well as a pedagogical competence of how to use technology to provide meaningful learning. Data revealed that teacher participants were, to the greatest extent, self-taught in their technological competencies but highly proficient nonetheless (see 5.6.4). Participants' motivation and confidence in using technology-based teaching as well as their capabilities of using technology lead to the notion that they are also self-sufficient (see 5.6.3). In relation to teacher experience and teacher workload that was outlined in Chapter 3 (see 3.4.3.4 and 3.4.3.5), data in this study opposed the angle that newly qualified teachers are more experienced in using technology as well as that a lack of time is a shortcoming in merging technology into teaching. Teacher participants were middle-aged with a number of years of experience and although they cited that it is time-consuming to integrate technology into teaching, it did not inhibit them from doing so.

In addition, content knowledge influenced teachers' experience of TbTL in the Foundation Phase. To this end, empirical data from the teacher participants supported that technology assists in the gathering of content in the Foundation Phase which is a key component of technological content knowledge (see 3.4, 5.2.3, 5.3.3 and 5.6.3). Teacher participants were aware that using a certain technology can alter the way that learners grasp concepts in that specific content area.

Literature on content knowledge (see 3.4.2) emphasized seven key trans-disciplinary thinking tools, namely: perceiving, patterning, abstracting, embodied thinking, modelling, deep play and synthesizing. Although these tools embody content knowledge, they do not exclude technological and pedagogical knowledge. Since the discipline of teaching is ever-changing with the influence of technology, the type of content knowledge that learners are required to develop is also changing. Technology can complement the Foundation Phase teaching environment specifically in the decisions teachers make about what devices they will choose, their consideration of how these tools can enhance learners' growth, play and learning as well as the correct time and method of using the technologies (see 3.4.3 and 5.6.1 – 5.6.3). Accordingly, the above-mentioned key components are significant if technology-based teaching in the Foundation Phase is to be successful.

Teachers experience technology to teach mainly in terms of their technological pedagogical knowledge and their technological content knowledge. Technology is valuable in the Foundation Phase to select what you need to teach, and how you are going to teach it.

6.6 RECOMMENDATIONS

The final secondary question, *what recommendations can be made to ensure technology for teaching and learning in the Foundation Phase is successful?* (see 1.3.2) *is* answered in this section.

This study focused on the teachers' and learners' experiences of technology-based teaching and learning in the Foundation Phase. Technological, pedagogical and content factors from the findings were exposed. The technological landscape and official perspectives with regard to TbTL in the Foundation phase was also explored and findings boldly highlighted a stark contrast between the schools where TbTL is implemented versus those where it is not. As a result, the following recommendations are made with the aim of endorsing successful technology-based teaching and learning in the Foundation Phase.

6.6.1 Recommendation 1: Provision of technological infrastructure to all Foundation Phase classrooms

In order for teachers and learners to take advantage of digital tools for teaching and learning, I recommend that Foundation Phase classrooms are equipped with the necessary technological infrastructure. This arrangement must include connections to internet and Wi-Fi, appropriate devices, as well as relevant hardware and software. This study focussed on two schools that were technology-rich for the reason that the infrastructure and the use of technological tools with the necessary support were established (see 5.4.1 and 5.5.1). The two schools in this study are benchmarks of successful TbTL in the Foundation Phase in particular. TbTL has the ability to improve and transform teaching and learning but is dependent on a sound infrastructure. Findings revealed that the general Foundation Phase population have little, if any TbTL largely due to lack of technological infrastructure. The government should provide this infrastructure and ensure that all schools are adequately equipped with the resources to facilitate TbTL.

6.6.2 Recommendation 2: A policy framework for Foundation Phase TbTL must be developed

I recommend that the Department of Education provides a policy framework which integrates technology into the Foundation Phase curriculum across all subjects. Young children have a specific learning style and therefore a specific child-centric, play-based curriculum is necessary to which technology can provide support. The Action Plan to 2019 (Department of Basic Education, 2015:18) stresses the priority for dependably designed interventions from the government to contend with the digital divide in South Africa by taking charge of technology betterment. However, the latter plan lacks in outlining goals that include the 'how' or 'what' (pedagogy or content) of TbTL especially in the Foundation Phase. An important document, but not entirely sufficient to the Foundation Phase was the Green Paper on ICTs (Department of Communication, 2013). This policy framework does not focus on the Foundation Phase and moreover, does not explicate the pedagogical aspect of teaching and subsequent learning with technology. Findings further highlight the need to address the gap in the use of technology in the curriculum as well as the need for communication between and within relevant departments for successful TbTL (see 5.7.2).

6.6.3 Recommendation 3: Pre-service teacher training must include pedagogical knowledge of TbTL

I recommend that Foundation Phase teacher training programmes include appropriate pedagogical approaches which include knowledge about lesson planning, assessment, teaching methods, learner learning and classroom management so that new teachers know how to confidently use TbTL. New teachers appear comfortable with technological tools, but lacked a comprehensive understanding of how to incorporate such tools into teaching (see 3.4.3.4). On the other hand, the majority of teachers' and learners' experiences of TbTL showed little

evidence of technology acting as an enabler of pedagogy (see 5.7.2). Higher education institutions that train future Foundation Phase teachers must reconsider the way in which they prepare teachers and include technology in their approach.

6.6.4 Recommendation 4: Teachers' technological skills and pedagogical understanding should be developed through continuous in-service training

I recommend that teachers receive in-service training in two keys areas of TbTL, namely digital skills and pedagogical competence. Schools must enable teachers to teach learners who are going to be well-adjusted 21st century citizens. The first set of skills, technological skills, must be developed by teaching teachers how to use technological devices. Teacher training should be offered by departments of education (national, provincial, district and regional), schools and even online programme tutorials to meet this demand. The second skill of pedagogical understanding must be advanced by equipping teachers with the aptitude to integrate technology into the curriculum. To this end, suitable teaching approaches, such as connectivism where the task of knowing is offloaded onto the network itself, for teaching with technology need to be shared in communities of practice, professional learning groups and other platforms, such as discussion forums.

6.6.5 Recommendation 5: A new set of skills is required from teachers in order to successfully teach learners of the 21st century

I recommend that professional development workshops focussing on pertinent 21st century skills such as *inter alia* communication, collaboration, critical thinking and problem solving provide training and development to all Foundation Phase teachers. Teachers need professional development training in key 21st century skills to both understand the combination of competences that they have to cultivate in learners as well as to advance the way in which they communicate, collaborate and connect with

learners. The aptitude that an individual possesses in order to teach and/or learn in a digital age should be developed.

6.6.6 Recommendation 6: Teachers and learners need support in finding appropriate digital content

I recommend that a toolkit of appropriate South African content for specific technological tools is developed and shared by innovative teachers to meet the demands of technology-based teaching and learning in the Foundation Phase. Foundation Phase teachers and learners are involved in research which ranges from finding out simple information on the internet to looking for suitable content for successful lessons. The teacher participants particularly mentioned that it can be time consuming to sift through all the content but it is necessary to know what is offered and what is potentially suitable. In order to provide the appropriate support to choose the actual technology as well as the associated content for the technology, role players need to distinguish that using a certain technology can modify the way that learners grasp concepts in that particular content area.

The recommendations from this study are given in a top-down sequence which starts at the proposal that the government should provide technological infrastructure in the Foundation Phase. Secondly, a specific policy framework for TbTL in the Foundation Phase is needed from the Department of Education. Thirdly, teacher preparation programmes should include skills to incorporate technology into teaching and learning. Fourthly, Foundation Phase teachers require training that will supply them with technological skills and change the way they organize teaching to adapt to favourable implementation of TbTL. Also, teacher professional development in 21st century skills is necessary. Lastly, it is proposed that Foundation Phase learners should have access to the most appropriate content that is founded in and supported by technology.

6.7 FUTURE RESEARCH

Although this study provided valuable insight into teachers' and learners' experiences of technology-based teaching and learning, it was also not without limitations. To this end, further research on the following is recommended:

6.7.1 Suggestion 1: Further research that yields practical outcomes to support TbTL in the Foundation Phase should be conducted and completed timeously

I suggest that research is conducted by private sector partners, researchers and international partner agencies that can provide practical solutions to support teachers and learners and help stakeholders in the Foundation Phase understand the challenges of TbTL in an ever-transforming, diverse educational landscape. Although this study contributed to understanding the phenomenon of TbTL in the Foundation Phase, the findings reveal the need for further research based on two reasons. Firstly, this study does not draw a clear link between using TbTL and achieving the learning improvement goals established by the Action Plan (Department of Basic Education, 2015). Secondly, high quality impact evaluations on past technology interventions are scarce in South Africa and in the Foundation Phase context. With the continuous changes and advances in technology, a study that is lengthy to complete and yield results, does not help teachers or learners today. Additionally, research that is conducted at research sites that differ from the actual educational milieu in South African does not serve the wider population.

6.7.2 Suggestion 2: The manner in which photovoice is used as a research method should be refined

I suggest that further research opportunities include using the camera phone instead of disposable cameras to improve the quality of photographs and the ease and speed of collecting and distributing data from photo voice. From a methodological

standpoint and in line with the use of technology to benefit teaching and learning, the way in which photos are taken during the collection of data in the photo voice method can be updated. Similarly, photographic technologies have developed to include cost-effective, effortless systems as used in the widespread camera phone. Haldenby (n.d.) suggests that "there would appear to be a great opportunity at present to investigate how camera phone and point-and-shoot digital camera technology could be leveraged in the creation of new photo voice projects, not only in terms of how information is collected, but also how it is shared and organized."

6.7.3 Suggestion 3: The sample of future studies should represent the wider Foundation Phase population

I suggest that further research is conducted where data collection instruments from this study are adapted in order to produce results for the population that would be more representative of the demographic of the country. Findings from this study could be generalized to urban schools that are using technology for teaching and learning in the Foundation Phase. However, a study that can be generalized to the larger Foundation Phase population would necessitate sensitivity to sample representativeness and sampling procedures, test conditions and results that can be duplicated as well as partiality in the research process sample (MacNaughton, 2001:170). A larger sample of Foundation Phase teachers and learners at various types of schools in order to elaborate further on how TbTL should be structured and accommodated in South African schools is proposed.

6.8 LIMITATIONS OF THE STUDY

The execution of this research study was successful, yet certain limitations still existed as mentioned below:

Chapter 4 provides a detailed explanation of the methodology of this study. A delimitation of this study with regard to methodology was that participants that were selected were not representative of the South African population. As mentioned in 4.4.1, I employed a purposive sampling strategy in order to select two schools that were technology-rich. The rationale behind the sampling was based on the use of technology and the availability of technological resources in the Foundation Phase. This strategy was selected with the knowledge that it enabled me to target a particular group despite the fact that it does not represent the wider population; it simply represents itself (see 4.4.1). Furthermore, generalization of the findings in a purposive sample cannot be done outside of the sample as participants were selected "according to convenience of access" (Siraj-Blatchford & Siraj-Blatchford, 2006:156). Therefore another restriction of this study is that the findings do not lend to a profound understanding of the phenomenon inclusive of the entire South African Foundation Phase population.

A further limitation was the age of learner participants (Chapter 1.6.6.2,ii). Their abilities or lack thereof, was particularly evident in the narratives that learners provided which were short in length due to their limited writing abilities.

6.9 CONCLUDING REMARKS

On a personal level this study was the most challenging, yet rewarding task in my academic career. The many hours of reading, writing and researching the phenomenon of TbTL has sparked a keen interest in the field of educational technology for me as a young researcher. I feel that a novel methodological contribution of this study would be the way in which data were generated, both through images and text in the photovoice technique with teachers and especially young learners as well as the inclusion of an expert interview to substantiate findings. In future research endeavours, I aim to include original ways of collecting data in educational research since I find the methodology of research of particular interest. In terms of the theoretical contribution that this study makes, the framework for TbTL in the Foundation Phase which originated from literature surveyed and was substantiated by empirical data, provides a meaningful addition to TbTL in the Foundation Phase. All stakeholders involved in Foundation Phase education and anyone working with this generation of learners should consider the impact and use of TbTL. Researching TbTL in the Foundation Phase has proven that technology is a plausible tool to raise the quality of content and redefine pedagogy when role players understand how to use it beneficially.

REFERENCES

Ackermann, E. 2001. Piaget's Constructivism, Papert's Constructionism: What's the difference? *Future of Learning Group Publication*, 5(3): 438.

Aidoo, A.A. 2008. Positioning ECD Nationally: Trends in Selected African Countries. In: *Africa's Future, Africa's Challenge. Early Childhood Care and Development in Sub-Saharan Africa*. Edited by M. Garcia, A. Pence & J.L. Evans. Washington: International Bank for Reconstruction and Development/The World Bank, pp. 29–48.

Ail-Khan, C. & Siry, C. 2014. Sharing seeing: Exploring photo-elicitation with children in two different cultural contexts. *Teaching and Teacher Education,* 37:194–207.

Anderson, G. 2004. *Fundamentals of Educational Research*. Second Edition. London: Routledge Falmer.

Anderson, A., Anderson, J. & Thauberger, C. 2008. Mathematics Learning and Teaching in the Early Years. In: *Contemporary Perspectives on Mathematics in Early Childhood Education.* Edited by O.N. Saracho & B. Spodek. Durham, North Carolina: Information Age Publishing, pp. 95–121.

Anderson, A., Barham, N. & Northcote, M. 2013. Using the TPACK framework to unite disciplines in online Learning. *Australasian Journal of Educational Technology,* 29(4): 549–565.

Andrews, M., Squire, C. & Tamboukou, M. 2008. *Doing Narrative Research*. London: Sage Publications.

Anfara, V.A. & Mertz, N.T. 2006. *Theoretical Frameworks in Qualitative Research.* Thousand Oaks: Sage.

Angeli, C. & Valanides, N. 2009. Epistemological and methodological issues for the conceptualization, development, and assessment of ICT–TPCK: Advances in technological pedagogical content knowledge (TPCK). *Computers and Education*, 52(1): 154–168.

Archambault, L. & Crippen, K. 2009. Examining TPACK among K-12 online distance educators in the United States. *Contemporary Issues in Technology and Teacher Education*, 9(1), 71–88.

Archambault, L.M. & Barnett, J.H. 2010. Revisiting technological pedagogical content knowledge: exploring the TPACK framework. *Computers and Education,* 55, 1656 – 1662.

Australian Labor Party. 2007. The Australian economy needs an education revolution New Directions Paper on the critical link between long term prosperity, productivity growth and human capital investment. Retrieved from: www.alp.org.au Accessed 3 July 2014.

Babbie, E. 2004. *The Practice of Social Research.* 10th Edition. Wadsworth: Thomson.

Balanskat, A. 2012. *Study of the impact of technology in primary schools. Synthesis Report*. STEPS project. Brussels: Empirika and European Schoolnet.

Banks, M. 2001. *Visual methods in social research*. London: Sage.

Barton, L. & Armstrong, F. 2003. Engaging with disabling policies: Troubles and contests in a local education authority in England, *Research in Education*, 70:37-49.

British Educational Communications and Technology Agency (Becta). 2004. A review of the research literature on barriers to the uptake of ICT by teachers. Retrieved from: http://dera.ioe.ac.uk/1603/1/becta2004barrierstouptakelitrev.pdf Accessed 10 December 2014.

Belshaw, D.A.J. 2012. What is 'digital literacy'? A Pragmatic investigation. Unpublished thesis, Durham University. Retrieved from: http://etheses.dur.ac.uk/3446/ Accessed 24 April 2014.

Berg, B.L. 2001. *Qualitative research methods for social sciences*. 4th Edition. Needham Height, M.A: Allyn & Bacon.

Bernard van Leer Foundation. 2004. *Children are our future*. Submission to the United Nations Committee on the Rights of the Child: Implementing Child Rights in Early Childhood, pp. 1-8. The Hague: UNICEF.

Berry, L., Biersteker, L., Dawes, A., Lake, L. & Smith, C. 2013. *South African Child Gauge 2013*. Cape Town: Children's Institute, University of Cape Town.

Bialobrzeska, M. & Cohen, S. 2005. Managing ICT's in South African schools: A guide for school principals. SAIDE. Retrieved from: https://www.unterricht.educa.ch/de/literaturliste Accessed 8 August 2014.

Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., Miller-Ricci, M. & Rumble, M. 2012. Defining 21st century skills. In: *Assessment and Teaching of 21st Century Skills*. Edited by P. Griffin, B. McGaw & E. Care. New York: Springer, pp. 17–66.

Blatter, J.K. 2008. Case study. In: *The SAGE Encyclopedia of Qualitative research methods.* Edited by L.M. Given. Thousand Oaks: Sage Publications, pp. 69-72.

Blumer, H. 1969. Symbolic interactionism: perspective and method. New Jersey: Prentice-Hall.

Bogner, A., Littig, B. & Menz, W. (eds.) 2009. *Interviewing Experts: Methodology and Practice*. Basingstoke, England: Palgrave Macmillan.

Brooks-Young, S. 2007. *Digital-Age Literacy for Teachers: Applying technology standards to everyday practice*. Washington DC: International Society for Technology in Education.

Buckingham, D. 2007. *Beyond Technology: Children's Learning in the Age of Digital Culture.* Cambridge: Malden.

Burnett, C. 2014. Investigating pupils' interactions around digital texts: A spatial perspective on the "classroom-ness" of digital literacy practices in schools. *Educational Review,* 66(2): 192–209.

Bush, N. & Codrington, G. 2012. *Parenting the wired generation: Future proof your child*. Johannesburg: Penguin Books.

Christensen, R. & Knezek, G. 2001. Instruments for Assessing the Impact of Technology in Education. *Computers in the schools: Interdisciplinary Journal of Practice, Theory and Applied Research*, 18(2/3): 5–25.

Clark, A. & Chalmers, D. 1998. The extended mind. Analysis, 58, 10–23. Retrieved from: http://consc.net/papers/extended.html. Accessed 10 April 2014.

Clasquin-Johnson, M.G. 2011. Responses of Early Childhood teachers to curriculum change in South Africa. Unpublished Doctoral Thesis. Pretoria: University of Pretoria.

Codrington, G. & Grant-Marshall, S. 2011. *Mind the gap: own your past, know your generation, choose your future*. Johannesburg: Penguin Books.

Cohen, R. 1988. One Computer, Two Languages, Many Children. *Education and Computing*, 4: 145–149.

Cohen, R. 1994. How New Technologies Question Educational Practices and Learning Theories. In: *Exploring a New Partnership: Children, Teachers and Technology*. Edited by J. Wright, & D. Benzie. Amsterdam: IFIP and North-Holland, pp. 89–95.

Cohen, D. & Crabtree, B. 2006. *Qualitative Research Guidelines Project.* Retrieved from: http://www.qualres.org/HomeInte-3516.html. Accessed 2 April, 2012.

Cohen, L., Manion, L. & Morrison, K. 2005. *Research Methods in Education*.5th Edition. London: Routledge Falmer.

Collins, H. M., & Evans, R. 2007. *Rethinking Expertise.* Chicago: University of Chicago Press.

Conlon, T. & Simpson, M. 2013. Silicon Valley versus Silicon Glen: the impact of computers upon teaching and learning: a comparative study. *British Journal of Educational Technology,* 34(2): 137–150.

Conole, G, White, S, Oliver, M & Conole, G. 2006. The impact of e-learning on organisational roles and structures. In: *Contemporary Perspectives in E-Learning Research: Themes, Methods and Impact on Practice*. Edited by G Conole, M Oliver & G Conole. Abingdon: Routledge, pp. 69–81.

Crawford, R. 1997. *Managing Information Technology in secondary schools*. London: Routledge.

Creswell, J.W. 2003. *Research design: Qualitative, quantitative, and mixed methods approaches*. 2nd Edition. Thousand Oaks: Sage Publications.

Creswell, J.W. 2007. *Qualitative inquiry and research design: choosing among five approaches*. 2nd Edition. Thousand Oaks: Sage Publications.

Creswell, J.W. 2009. *Research design: Qualitative, quantitative, and mixed methods approaches*. 3rd Edition. Thousand Oaks: Sage Publications.

Creswell, J.W. 2012. *Educational research: planning, conducting and evaluating quantitative and qualitative research.* 4th Edition. Boston: Pearson Education

Creswell, J.W., Hanson, W.E., Plano Clark, V.L. & Morales, A. 2007. Qualitative Research Designs: selection and implementation. *The Counseling Psychologist,* 35 (2): 236–264.

Creswell, J.W. & Plano-Clark, V.L. 2011. *Designing and conducting mixed methods research*. 2nd Edition. Thousand Oaks: Sage.

Denzin, N.K. & Lincoln, Y.S. 2000. *Handbook of Qualitative Research.* London: Sage.

Department of Basic Education. (2015). *Action Plan to 2019 Towards the realisation of Schooling 2030 Taking forward South Africa's National Development Plan 2030.* Pretoria: Department of Education.

Department for Education and Skills. 2005. *Harnessing Technology: Transforming Learning and Children's Services*. London: DfES.

Department of Communications. 2013. *National integrated ICT policy green paper*. Government Gazette, 24 January 2014.

Department of Communications. 2014. "SA connect" – implementing the broadband policy and strategy. Retrieved from: http://www.doc.gov.za/mediaroom/media-statements/312-%E2%80%9Csa-connect%E2%80%9D-%E2%80%93-implementing-the-broadband-policy-and-strategy.html Accessed 8 August 2014.

Department of Education, 2001. *Education White Paper 5 on Early Childhood Development*. Pretoria: Government Printers.

Department of Education. 2004. *White Paper on e-Education: Transforming Learning and Teaching through Information and Communication Technologies (ICTs)*. Pretoria: Government Printers.

Department of Education. 2007. Progress Report to the Minister of Education Ministerial Committee on Learner Retention in the South African Schooling System. Retrieved from:

http://www.info.gov.za/view/DownloadFileAction?id=79404. Accessed 9 July 2014.

Department of Social Development. 2013. *An integrated Early Childhood Development Programme of action for moving for - moving ahead 2013 – 2018*. Cape Town: Research Unit.

Department of Women, Children and People with Disabilities (DWCPD). 2013. *South Africa's Periodic Country Report on the United Nations Convention on the Rights of the Child: Reporting period: January 1998 - April 2013*. Pretoria: Government Printers.

Devereaux, F.L. 1933. *The educational talking picture*. Chicago: The University of Chicago Press.

De Vos, A.S. 1998. *Research at Grass Roots*. Pretoria: Van Schaik.

Dewey, J. 1938. *Experience and Education*. New York: Kappa Delta Pi.

Dias, L.B. & Atkinson, S. 2001. Technology Integration: Best Practices Where Do Teachers Stand? *International Electronic Journal for Leadership in Learning*, 5(10). Retrieved from: http://www.ucalgary.ca/~iejll/volume5/dias.html Accessed 11 December 2014.

Drent, M. & Meelissen, M. 2008. Which factors obstruct or stimulate teacher educators to use ICT innovatively? *Computers and Education*, 51(1): 187-199.

Dolence, M.G. & Norris, D. M. 1995. *Transforming Higher Education: A Vision for Learning in the 21st Century*. Ann Arbor, MI: Society for College and University Planning.

Educational Testing Services (ETS). 2002. *A Framework for ICT Literacy: Digital Transformation: A Report of the International ICT Literacy Panel*. Princeton, NJ: Centre for Global Assessment.

Edwards, C. & Hiler, C. 1993. *A Teacher's Guide to the Exhibit: The Hundred Languages of Children*, College of Human Environmental Sciences, Lexington, Kentucky: University of Kentucky.

E-Learning Africa Report. 2012. The e-learning Africa report 2012. Retrieved from: http://www.elearning-africa.com/report2012 Accessed 8 August 2014.

Elias, M.J. & Theron, L.C. 2012. Linking purpose and ethics in thesis writing: South African illustrations of an international perspective. In: *Complete your thesis or dissertation successfully: Practical guidelines.* Edited by Maree, K. Cape Town: Juta, pp. 147–168.

Ellis, M.E. 2012. Managing a private higher education institution within the current higher regulatory context in South Africa. Unpublished Master's dissertation. Pretoria: University of South Africa.

Entwistle, N.J. 1991. Approaches to learning and perceptions of the learning environment, *Higher Education*, 22(3): 201–204.

Europe's Information Society Thematic Portal. 2007. Digital Literacy: Skills for the Information Society. Retrieved from:

http://ec.europa.eu/information_society/tl/edutra/skills/index_en.htm Accessed 30 June 2014.

Fallows, S. & Bhanot, R. 2002. *Educational development through information and communication technology*. London: Kogan Page.

Ferrari. A., Punie, Y. & Redecker, C. 2012. Understanding Digital Competence in the 21st Century: An Analysis of Current Frameworks. In: *21st Century Learning for 21st century skills: 7th European Conference on Technology Enhanced Learning.* Edited by A. Ravenscroft, S. Lindstaedt, C. Delgado Kloos, & D. Hernández-Leo. Berlin Heidelberg: Springer, pp. 79–92.

Feurzeig, W. & Papert, S. 1967. *The Logo programming language*. Retrieved from: http://el.media.mit.edu./logo-foundation/logo/programming.htl Accessed 10 December 2013.

Fleming, N.D. & Mills, C. 1992. Not another inventory, rather a catalyst for reflection. *To improve the academy,* 11, 137-155.

Flick, U. 2009. *An introduction to qualitative research*. London: Sage.

Franklin, C. 2007. Factors that influence elementary teachers' use of computers. *Journal of Technology and Teacher Education*, 15(2): 267–293.

Freire, P. 1973. *Education for critical consciousness*. New York: Continuum.

Garcia, M., Virata, G. & Dunkelberg, E. 2008. Positioning ECD Nationally: Trends in Selected African Countries. In: M. Garcia, A. Pence& J.L. Evans (Eds). *Africa's Future, Africa's Challenge. Early Childhood Care and Development in*

Sub-Saharan Africa (pp. 29-48). International Bank for Reconstruction and Development / The World Bank: Washington.

Gardner, H. 2006. *Changing minds. The art and science of changing our own and other people's minds*. Boston: Harvard Business School Press.

Gardner, H. 2007. *Five minds for the future*. Boston: Harvard Business School Press.

Gess-Newsome, J. 2002. Pedagogical content knowledge: an introduction and orientation. In: *PCK and science education.* Edited by J. Gess-Newsome, & N. Lederman. New York, NY: Kluwer Academic Publishers, pp. 3–17.

Giles, D. 2007. Humanising the researcher: the influence of phenomenological research on a teacher educator. *International Journal of Pedagogies and Learning*, 3(1):6.

Gilster, P. 1997. *Digital literacy*. New York: Wiley and Sons.

Gomez, M. L. 1997. Narrative inquiry. In: *Dictionary of multicultural education*. Edited by C. A. Grant & G. Ladson-Billings. Phoenix: The Oryx, pp. 195–196.

Graham, C.R. 2011. Theoretical considerations for understanding technological pedagogical content knowledge (TPACK). *Computers and Education*, 57: 1953–1960.

Grail Research Report. 2011. *Consumers of Tomorrow*. *Insights and observations about Generation Z*. Retrieved from: http://grailresearch.com/About_Us/FeaturedResearch.aspx?aid=107 Accessed 11 December 2013.

Griffin, P., Care, E. & McGaw, B. 2012. The changing role of education and schools. In: *Assessment and Teaching of 21st Century Skills*. Edited by P. Griffin, B. McGaw & E. Care. New York: Springer, pp. 1–16.

Groenewald, T. 2004. A phenomenological research design illustrated. *International Journal of Qualitative Meth*ods, 3 (1): Article 4.

Guba, E.G. & Lincoln, Y.S. 2005. Paradigmatic controversies, contradictions, and emerging confluences. In *The Sage handbook of qualitative research*. Edited by N.K Denzin & Y.S. Lincoln. Thousand Oaks: Sage, pp 191-215.

Gumbo, M.T. 2016. *The question of Technology Education: A pertinent issue*. Inaugural lecture, Department of Science and Technology Education, University of South Africa. Pretoria, 25 February 2016.

Haldenby, T. n.d. *Photovoice*. Design Research Techniques. Retrieved from: http://designresearchtechniques.com/casestudies/photovoice/ Accessed 11 November, 2015.

Hannaway, D. 2012. *The influence of ecosystemic factors on Black student teachers' perceptions and experiences of Early Childhood Education.* Unpublished Masters' dissertation. Pretoria: University of Pretoria.

Hannon, P. 2000. *Reflecting on Literacy in Education.* London: Routledge Falmer.

Harel, I. & Papert, S. 1991. *Constructionism: research reports and essays, 1985 1990.* Norwood, N.J.: Ablex Publishing Corporation.

Harnett, P. 2010. *Exploring learning, identity and power through life history and narrative research*. New York: Routledge.

Harris, J., Mishra, P. & Koehler, M.J. 2009. Teachers' technological pedagogical content knowledge and learning activity types: Curriculum-based technology integration reframed. *Journal of Research on Technology in Education*, 41(4): 393–416.

Hawkins, R. 2010. *10 Global trends in ICT and education.* Retrieved from: https://blogs.worldbank.org/edutech/10-global-trends-in-ict-and-education Accessed 19 March 2014.

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: 223–252.

Holloway, I. & Wheeler, S. 1996. *Qualitative research for nurses*. Oxford: Blackwell Scientific Publications.

Houston, J. 2007. Future Skill Demands, from a Corporate Consultant Perspective. Presentation at the Workshop on Research Evidence Related to Future Skill Demands, National Research Council. Retrieved from: http://www7.nationalacademies.org/cfe/Future_Skill_Demands_Presentations Accessed 3 July 2014.

Howe, N. 2014. *Introducing the Homeland Generation (Part 1 of 2).* Forbes. Retrieved from: http://www.forbes.com/sites/neilhowe/2014/10/27/introducing-the-homeland-generation-part-1-of-2/ Accessed 12 October 2015.

Howell, J. 2012. *Teaching with ICT: Digital pedagogies for collaboration and creativity*. Victoria, Australia: Oxford University Press

Howie, S., Muller, A. & Patterson, A. 2005. *Information and communication technologies in South African secondary schools.* Cape Town: HSRC.

Isaacs, S. 2007. *ICT in Education in South Africa*. Survey of ICT and education in Africa, 2 (53). *Country Reports*. Washington, DC: infoDev / World Bank.

Jansen, J.D. 2007. The research question. In: *First Steps in Research.* Edited by K. Maree. Pretoria: Van Schaik, pp.1-13.

Johnson, G.M. 2008. Functional Internet Literacy: required cognitive skills with implications for instruction. In: *Digital Literacies: Concepts, Policies and Practices.* Edited by C. Lankshear & M. Knobel. New York: Peter Lang, pp. 33–45.

John-Steiner, V. & Mahn, H. 1996. Sociocultural approaches to learning and development: A Vygotskian framework, *Educational Psychologist*, 31(3-4): 191–206.

Jonassen, D.H. 1994. Thinking technology: Toward a constructivist design model. *Educational Technology*, 34(2): 34–37.

Kaga, Y. 2008. Early childhood education for a sustainable world. In: The contribution of early childhood education to a sustainable society. Edited by: I.P. Samuelson & Y. Kaga. Paris: UNESCO.

Kalaš, I. 2010. *Recognizing the potential of ICT in early childhood education Analytical survey*. Moscow, Russian Federation: UNESCO Institute for Information Technologies in Education.

Kalaš, I., Laval, E., Laurillard, D., Lim, C.P., Meyer, F., Musgrave, S., Senteni, A., Tokareva, N. & Turcsányi-Szabó, M. 2014. *ICT in Primary Education: Volume 2 Policy, Practices, and Recommendations*. Moscow, Russian Federation: UNESCO Institute for Information Technologies in Education.

Kamper, G.D. & Steyn, M.G. 2011. Black students' perspectives on learning assets at a historically White university. *Journal of Asian and African Studies*, 46(3): 278–292.

Keengwe, J. & Onchwari, G. 2008. Computer technology integration and student learning: Barriers and promise. *Journal of Science Education and Technology*, 17: 560–565.

Kobler, R. & Moore, O.K. 1966. Educational Systems and Apparatus. *US Patent* # 3, 281, 959.

Koehler, M. & Mishra, P. 2005. What happens when teachers design educational technology? The development of technological pedagogical content knowledge. *Journal of Educational Computing Research*, 32(2): 131–152.

Koehler, M.J. & Mishra, P. 2008. Introducing TPCK. In: *The handbook of technological pedagogical content knowledge (TPCK) for educators.* Edited by AACTE Committee on Innovation and Technology. Mahwah, N.J: Lawrence Erlbaum Associates, pp. 3–29.

Koehler, M.J. & Mishra, P. 2009. What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education*, 9(1):60-70.

Koehler, M.J., Mishra, P. & Cain, W. 2013. What is technological pedagogical content knowledge? *Journal of Education*, 193(3): 13–19.

Koenig, J. 2011. *Assessing 21st Century Skills: Summary of a Workshop*. Washington DC: The National Academies Press.

Kozma, R. 2005. National policies that connect ICT-based education reform to economic and social development. *Human Technology*, 1(2).

Kruger, M. 2014. *Global trends for mobile learning: Focus on learning in Higher Education*. In: Proceedings of the 2nd Annual Technology for Teaching and Learning forum, held in Johannesburg, 19 - 20 March 2014.

Kuper, A. & Kuper, J. 2004. *The Social Science Encyclopaedia.* 3rd Edition. New York: Routledge.

Laerd. 2011. *Principles of research ethics*. Retrieved from: http://dissertation.laerd.com/articles/principles-of-research-ethics.php. Accessed February 28, 2012.

Laurillard, D. 2005. E-Learning in Higher Education. In: *Changing Higher Education: The Development of Learning and Teaching.* Edited by P. Ashwin London: Routledge Falmer, pp. 71–84.

Laurillard, D. 2008a. Open teaching: The key to sustainable and effective open education. In: *Opening up education: The collective advancement of education through open technology, open content, and open knowledge*. Edited by T. Liyoshi & M.S. Vijay Kumar. Boston, M.A: MIT Press, pp. 319–336.

Laurillard, D, 2008b. *Digital technologies and their role in achieving our ambitions for education*: *A professional lecture*. University of London: Institute of Education, pp. 1–40.

Laurillard, D., Oliver, M., Wasson, B. & Hoppe, U. 2009. Implementing Technology-Enhanced Learning. In: *Technology-Enhanced Learning: Principles and Products*. Edited by N. Balacheff, S. Ludvigsen, T. de Jong, A., Lazonder & S. Barnes. Dordrect: Springer, pp. 289–306.

Lave, J. & Wenger, E. 1991, *Situated Learning: Legitimate Peripheral Participation*. Cambridge: Cambridge University Press.

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): 575–614.

Leendertz, V., Blignaut, A., Nieuwoudt, H,D., Els, C.J. & Ellis, S.M. 2013. Technological pedagogical content knowledge in South African Mathematics classrooms: A secondary analysis of SITES data. *Pythagoras*, 34(2):232–240.

Levy, F. & Murnane, R.J. 2004. *The New Division of Labor: How Computers Are Creating the Next Job Market*. Princeton, NJ: Princeton University Press.

Lincoln, Y.S & E.G. Guba, E.G. 1985. *Naturalistic inquiry*. Beverly Hills: Sage.

Littig, B. 2013. *Expert Interviews. Methodology and Practice.* IASR Lecture Series, 17th September 2013. Retrieved from:

http://www.uta.fi/iasr/lectures/index/17.9.2013_Beate%20Littig_Tampere%20Expert-Interviews.pdf Accessed on 19 November 2014.

Livesey, C. 2006. The relationship between positivism, interpretivism and sociological research methods. *AS Sociology for AQA,* p. 1-5.

Maaga, T. 2009. Opening Address. In: *Nation Building from the Start. Early Childhood Development Knowledge Building Seminar*. Compiled by A. Viviers & J. Mabuchi. November 2008. Pretoria: UNICEF/South African Inter-departmental Committee for ECD.

Maree, K. 2007. *First Steps in Research.* Pretoria: Van Schaik.

Maree, K. & Van Der Westhuizen, C. 2007. Planning a research proposal. In: *First Steps in Research.* Edited by K. Maree. Pretoria: Van Schaik, pp. 23–45.

McDougall, A. & Jones, A. 2006. Theory and history, questions and methodology: current and future issues in research into ICT in education. *Technology, Pedagogy and Education*, 15(3): 353–360.

McMillan, J.H. & Schumacher, S. 2001. *Research in Education: A Conceptual Introduction.* 5th edition. New York: Addison-Wesley Longman.

Mdlongwa, T. 2011. ICT and enhanced learning at Pearson High School. Unpublished Master's dissertation. Port Elizabeth: Nelson Mandela Metropolitan University.

Mdlongwa, T. 2012. Information and communication technology (ICT) as a means of enhancing education in schools in South Africa: Challenges, benefits and

recommendations. *Policy Brief: Africa Institute of South Africa*, *Briefing No 80*. August 2012.

Meier, C. 2013. Windows of opportunity, use it or lose it: Early Childhood Development prospects in South Africa. Inaugural lecture, Department of Early Childhood Education, University of South Africa. Pretoria, 17 July 2013.

Merriam, S. B. 1998. *Qualitative research and case study applications in education*, San Francisco: Jossey-Bass.

Mertens, D.M. 1998. *Research Methods in Education and Psychology*. London:Sage.

Mishra, P. & Koehler, M.J. 2006. Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record,* 108: 1017–1054.

Mishra, P., Koehler, M.J. & Henriksen, D. 2011. The 7 trans-disciplinary habits of mind: Extending the TPACK framework towards 21st Century Learning. *Educational Technology*, 11(2): 22–28.

Meuser, M. & Nagel, U. 2009. The expert interview and changes in knowledge production. In: *Interviewing Experts. Methodology and Practice*. Edited by A. Bogner., B. Littig & W, Menz, W. Basingstoke: Palgrave Macmillan, pp. 17–42.

National Council for Curriculum and Assessment. 2004. *Curriculum Assessment and ICT in the Irish context: a Discussion Paper.* Retrieved from: http://www.ncca.ie/uploadedfiles/ECPE/Curriculum%20AssessmentandICT.pdf Accessed on 2 July 2014.

National Research Council. 2008. *Research on Future Skills Demands: A Workshop Summary*. M. Hilton, Rapporteur. Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

National Research Council. 2011. *Assessing 21st century skills: Summary of a Workshop Summary.* J. Anderson Koenig, Rapporteur. Board of Assessment, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

New Zealand Council for Educational Research. 2004. *The Role and Potential of ICT in Early Childhood Education*. A Review of New Zealand and International Literature. Wellington: New Zealand Council for Educational Research.

Ndlovu, N.S. & Lawrence, D. 2012. The quality of ICT use in South African classrooms. In: Conference Proceedings, *Strategies to overcome poverty and inequality:* "*Towards Carnegie III*". Cape Town, 3-7 September 2012. University of Cape Town, pp. 1-27.

Niess, M.L. 2005. Preparing teachers to teach science and mathematics with technology: Developing a technology pedagogical content knowledge. *Teaching and Teacher Education*, 21(5): 509–523.

Nieuwenhuis, J. 2007. Introducing qualitative research. In: *First Steps in Research.* Edited by K. Maree. Pretoria: Van Schaik, pp. 46–68.

Nieuwenhuis, J. 2007. Qualitative research designs and data gathering techniques. In: *First Steps in Research.* Edited by K. Maree. Pretoria: Van Schaik, pp. 69–97.

Nieuwenhuis, J. 2007. Analysing qualitative data. In: *First Steps in Research.* Edited by K. Maree. Pretoria: Van Schaik, pp. 99-122.

Noss, R. 2012. 21st Century Learning for 21st Century Skills: What Does It Mean, and How Do We Do It? In: *21st Century Learning for 21st century skills: 7th European Conference on Technology Enhanced Learning,* September 18 - 21. Edited by A. Ravenscroft, S., Lindstaedt, C., Delgado, K. & D. Hernández-Leo. Heidelberg: Springer, pp. 3–9.

Nutbrown, C., Clough, P. & Selbie, P. 2008. *Early Childhood Education: history, philosophy and experience.* London: Sage Publications.

Nyambane, C.O. & Nzuki, D. 2014. Factors influencing ICT integration in teaching – a literature review. *International Journal of Education Research*, 2(3): 1–18.

Organisation for Economic Cooperation and Development (OECD). 2001. *Learning to Change: ICT in Schools*. Paris: OECD Publications.

Official Oxford English Dictionary. 10th Edition. 2011. Edited by Simpson, J. & Weiner, E. Oxford: Oxford University Press.

Olivier, T, Wood, L & De Lange, N. 2009. *Picturing Hope: In the Face of Poverty as Seen through the Eyes of Teachers.* Cape Town: Juta.

Onchwari, G., Onchwari, J.A. & Keengwe, J. 2008. Teaching the immigrant child: application of child development theories. *Early Childhood Education Journal*, 36:267–273.

Osborne, J. & Hennessy, S. 2003. *Literature Review in Science Education and the Role of ICT: Promise, Problems and Future Directions.* Bristol: Nesta FutureLab

Pan-African Forum for Children. 2001. *Africa Fit for Children: The African Common Position*. Cairo, Egypt, May 28-31. Retrieved from: http://www.unicef.org/specialsession/documentation/documents/africapositio n-forum-eng.doc. Accessed 5 November 2010.

Papert, S. 1980. *Mindstorms: Children, Computers and Powerful Ideas*. New York: Basic Books.

Papert, S. & Harel, I. 1991. Situating Constructionism, in: *Constructionism: research reports and essays, 1985-1990*. Edited by I. Harel & S. Papert. Norwood, N.J.: Ablex Publishing, pp 1–17.

Partnership for 21st Century Skills. n.d. Framework for 21st Century Learning. Retrieved from: http://www.p21.org. Accessed 20 December 2016.

Patton, M. Q. 2002. *Qualitative evaluation and research methods.* 3rd Edition. Thousand Oaks: Sage.

Pearson, E. & Degotardi, S. 2009. Education for sustainable development in Early Childhood Education: A global solution to local concerns? International Journal of Early Childhood, 41(2): 97-111.

Pelgrum, W.J. 2001. Obstacles to the integration of ICT in education: Results from a worldwide educational assessment. *Computers and Education.* 37: 163–178.

Pelgrum, W. J. & Law, N. 2003. *ICT in Education around the world: trends, problems and prospects*. UNESCO: International institute for educational planning.

Peralta, H. & Costa, F.A. 2007. Teachers' competence and confidence regarding the use of ICT. *Educational Sciences Journal*, 3: 75–84.

Peterson, N., Mumford, M., Borman, W., Jeanneret, P. & Fleishman, E. 1999. *An Occupational Information System for the 21st Century: The Development of O*NET*. Washington, DC: American Psychological Association.

Phelps, R. & Graham, A. 2013. *Whole-school professional development for capability and confidence*. Washinngton, DC: International Society for Technology in Education.

Piaget, J. 1952. *The origins of intelligence in children*. New York: Norton & Co.

Piaget, J. 1964. Part 1 Cognitive Development in Children: Piaget Development and Learning. *Journal of Research in Science Teaching*, 2: 176–186.

Plomp, T., Anderson, R. E., Law, N. & Quale, A. (Eds.). 2009. *Cross-national information and communication technology: policies and practices in education.* Charlotte, N.C: Information Age Publishing

Pink, D.H. 2005. *A whole new mind*. New York: Riverhead Books.

Poggenpoel, M., Nolte, A., Dörfling, C., Greef, M., Gross, E., Muller, M., Nel, E. & Roos, S. 1994. Community views on informal housing environment: implication for health promotion. *South African Journal of Sociology,* 25(4): 131–136.

Posnick-Goodwin, S. 2010. Meet Generation Z. *California Educator*, 14(5):8–18.

Pound, L. 2011. *Influencing early childhood education. Key figures, philosophies and ideas*. Berkshire: McGraw Hill.

Prensky, M. 2001a. Digital natives, digital immigrants. *On the Horizon,* 9(6).

Prensky, M. 2001b. Digital natives, digital immigrants, Part II: Do they really think differently? *On the Horizon,* 9(6).

Prensky, M. 2005. Shaping Tech for the Classroom: 21st-century schools need 21st century technology. Retrieved from: http://www.edutopia.org/adopt-and-adaptshapingtech-for-classroom Accessed 10 April 2014.

Prensky, M. 2013a. Our brains extended. *Technology-Rich Learning*, 70(6): 22–27.

Prensky, M. 2013b. Digital Natives. [Blog] *Marc Prensky Practical and Visionary.* Available at: http://marcprensky.com/?s=digital+natives&x=0&y=0 Accessed 20 December 2016.

Pritchard, A. 2008. *Ways of learning: Learning theories and learning styles in the classroom.* 2nd Edition. New York: Routledge.

Ranie, L. 2013. The state of digital divides. *Pew Research Internet Project.* Internet: http://www.pewinternet.org/2013/11/05/the-state-of-digital-divides-video-slides/ Accessed 9 June 2014.

Resnick, M. 2009. Dispatches: Kindergarten for Life. Edutopia, June 2009: The Digital Generation. Retrieved from: www.edutopia.org/kindergarten-creativity collaboration-lifelong-learning Accessed 1 August 2014.

Richardson, L. & St. Pierre, E. A. 2005. Writing: A method of inquiry. In: *The Sage handbook of qualitative research.* Edited by N. K. Denzin & Y. S. Lincoln. Thousand Oaks: Sage, pp. 95 –978.

Richter, L., Biersteker, L., Burns, J., Desmond, C., Feza, N., Harrison, D., Martin, P., Saloojee, H. & Slemming, W. 2012. *Diagnostic Review of Early Childhood Development.* Pretoria: Department of Performance, Monitoring and Evaluation & Inter-Departmental Steering Committee on ECD.

Roberts, J. 2011. Biblical archaeo-tourism: a new vocational opportunity for biblical archaeology students. Unpublished doctoral thesis. South Africa: University of South Africa.

Roblyer, M.D. 2005. Educational technology research that makes a difference: series introduction. *Contemporary Issues in Technology and Teacher Education*, 5(2): 192–201.

Roblyer, M.D. & Knezek, G. A. 2003. New millennium research for educational technology: a call for a national research agenda. *Journal of Research on Technology in Education*, 36(1): 60–71.

Root-Bernstein, R.S. 1996. The sciences and arts share a common creative aesthetic. In: *The elusive synthesis: Aesthetics and science.* Edited by A.I. Tauber. Netherlands: Kluwer, pp. 49–82.

Root-Bernstein, R.S, & Bernstein, M. 1999. *Sparks of genius: The thirteen thinking tools of the world's most creative people.* New York: Houghton Mifflin.

Rule, P. & John, V. 2011. *Your guide to case study research*. Pretoria: Van Schaik Publishers.

Russel, M., Bebell, D., O' Dwyer, L. & O'Connor, K. 2003. Examining teacher technology use: Implications for preservice and inservice teacher preparation. *Journal of Teacher Education*, (54)4: 297–310.

Sandholtz, J. H., and B. Reilly. 2004. Teachers, not technicians: Rethinking technical expectations of teachers. *Teachers College Record* 106(3): 487–512.

Schiller, J. 2003. Working with ICT: Perceptions of Australian principals. *Journal of Educational Administration,* 41(2): 171–185.

Schmidt, D.A., Baran, E., Thompson, A.E., Mishra, P., Koehler, M.J. & Shin, T.S. 2009. Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers. *Journal of Research on Technology in Education*, 42(2): 123–149.

Schoeman, S. 2005. Educating Democratic Minds in South African Public Schools: African Teachers' Perceptions of Good Citizenship. *The Journal of Negro Education*, 74(3): 275-283.

Schulze, S. 2007. The usefulness of reflexive photography for qualitative research: a case study in higher education. *South African Journal of Higher Education*, 21(5): 536–553.

Schwandt, T. A. 2007. *The Sage dictionary of qualitative* inquiry. 3rd Edition.Thousand Oaks: Sage Publications.

Schwandt, T.A. 2015. *The Sage dictionary of qualitative inquiry*. 4th edition. Thousand Oaks: Sage.

Selwyn, P. 2004. Reconsidering political and popular understandings of the digital divide. *New Media & Society,* 6(3): 341–362.

Shaik, N. & Ebrahim, H.B. 2015. Children's agency in Grade R: A case for a child participation focus. *South African Journal of Education*, 35(2)

Shenton, A.K. 2004. Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information,* 22: 63-75.

Shulman, L. 1986. Paradigms and research programs in the study of teaching: A contemporary perspective. In: *Handbook of research on teaching*. Edited by M. C. Wittrock. New York: MacMillan, pp. 3–36.

Sicilia, C. 2005. The challenges and benefits to teachers' practices in constructivist learning environments by technology. Unpublished Master's disssertation. Montreal: McGill University.

Siemens, G. 2005. Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning*, 2(1): 3–10.

Siemens, G. 2006. *Connectivism: Learning Theory or Pastime of the Self-Amused?* Retrieved from: http://www.elearnspace.org/Articles/connectivism_self-amused.htm Accessed 26 March 2013.

Siraj-Blatchford, I. & Siraj-Blatchford, J. 2006. *A Guide to Developing the ICT Curriculum for Early Childhood Education*. Cambridge: Trentham Books.

Smola, K.W. & Sutton, C.D. 2002. Generational differences: revisiting generation work values for the new millennium. *Journal of Organizational Behaviour,* 23:363–382.

South African Government. 2014. State of the Nation Address by His Excellency Jacob G Zuma, President of the Republic of South Africa on the occasion of the Joint Sitting of Parliament, Cape Town. http://www.gov.za/node/632440. Accessed 4 November 2014.

South African Institute for Distance Education (SAIDE). 2005. Online Access and Connectivity of Primary School Teachers in Sub-Saharan Africa, South African Institute for Distance Education. Unpublished report commissioned for the TESSA Programme.

South African Institute for Distance Education (SAIDE). 2012. Foundation Phase *Newsletter: Teacher Education Expanding*, 18(2).

Stake, R. 1995. *The art of case study research*. Thousand Oaks: Sage.

Strack, R.W., Magill. C. & McDonagh, K. 2004. Engaging Youth through Photovoice. *Health Promotion Practice*. 5 (1):49–58.

Strauss, W. & Howe, N. 1991.*Generations: The history of America's future: 1584 2069.* New York: Harper Perennial.

Strauss, W. & Howe, N. 1997.*The fourth turning: An American prophecy*. New York: Broadway Books.

Tashakkori, A. & Teddlie, C. 2003. *Handbook of Mixed Methods in Social and Behavioural Research.* Thousand Oaks: Sage.

Taylor, G.R. & MacKenney, L. 2008. *Improving human learning in the classroom: Theories and teaching practices*. Maryland: Rowman and Littlefield Education.

Teo, T. 2008. Pre-service teachers' attitudes towards computer use: A Singapore survey. *Australasian Journal of Educational Technology*, (24)4:413–424.

Terre Blanche, M., Durrheim, K. & Painter, D. 2006. *Research in practice*. 2nd Edition. Cape Town: University of Cape Town Press.

Thompson, A. & Mishra, P. 2007 – 2008. Breaking news: TPCK becomes TPACK! *Journal of Computing in Teacher Education*, 24(2): 38–64.

Tinio, V. 2003. *ICT in Education.* New York: ICT for Development, United Nations Development Programme.

Trochim, W.M.K. 2006. *Qualitative Validity*. Retrieved from: http://www.socialresearchmethods.net/kb/qualval.php Accessed 28 February 2012.

Tudge, J., Mokrova, I., Hatfield, B. & Karuik, R. 2001.*Uses and Misuses of Bronfenbrenner's Ecological Theory of Human Development*. New York: Cambridge University Press.

University of Pretoria. 2009. *Research Proposal for Master or Doctorial* Study. Retrieved from: http://www/web.up.ac.za/sitefiles/File/46/1380/**Proposal**%20Guidelines%20Form.doc Accessed 9 April 2010.

UNESCO. 2004. Curriculum in Early Childhood Education and Care. UNESCO Policy Brief No 26 on Early Childhood. Retrieved from: unesdoc.unesco.org/images/0013/001374/137401e.pdf Accessed 8 May 2014.

UNESCO. 2011a. *ICTs and Teacher Competencies.* Policy Brief October 2011. Paris: UNESCO Institute for Information Technologies in Education.

UNESCO, 2011b. World Conference on Early Childhood Care and Education: Building the Wealth of Nations, 27-29 September 2010, Final Report, Moscow, Russian Federation. Paris: UNESCO.

United States of America Department of Education. 2009. *No child left behind, Act of 2001*. Retrieved from: http://www.ed.gov/nclb/landing.jhtml Accessed 3 July 2014.

United States of America, Department of Education. 2010. *Transforming American Education: Learning Powered by Technology. Draft National Educational Technology Plan 2010*. Washington DC: Office of Educational Technology.

Van Audenhove, L. 2007. *Expert interviews and interview techniques for policy analysis*. Brussels: Vrije Universiteit Brussel

Venezky, R. L. 2004. Technology in the classroom: steps toward a new vision. *Education, Communication and Information*, 4(1): 3–21.

Volman M. & van Eck, E. 2001. Gender equity and information technology in education: The second decade. *Review of Educational Research*, 71(4): 613-634.

Vygotsky, L. 1930. *The Instrumental Method in Psychology*. Text of a talk given in 1930 at the Krupskaya Academy of Communist Education. Retrieved from: www.marxists.org/archive/vygotsky/works/1930/instrumental.htm Accessed 8 August 2014.

Vygotsky, L. 1962. *Thought and Language*. Cambridge, MA: MIT Press.

Vygotsky, L.S. 1999. *The collected works of L.S Vygotsky.* Edited by. R.W. Rieber. London: Springer.

Wacker, J.G. 1998. A definition of theory: research guidelines for different theory building research methods in operations management. *Journal of Operations Management*, 16: 361–385.

Walker, M. 2005. Rainbow nation or new racism? Theorizing race and identity formation in South African higher education. *Race Ethnicity and Education*, 8 (2): 129–146

Walker, A., Huddlestone, B. & Pullen, D.L. 2010. An Overview of Technology in Society: An Introduction to Technoliteracy. In: *Technoliteracy*, *Discourse and Social Practice: Frameworks and Applications in the Digital Age*. Edited by D. Pullen, Gitsaki, C & M. Baguley. New York: IGI Global, pp. 1–19.

Webber, C. 2003. Introduction New Technologies and Educative Leadership. *Journal of Educational Administration*, 41(2): 119–123.

Weegar, M.A. & Pacis, D. 2012. A Comparison of Two Theories of Learning - Behaviorism and Constructivism as applied to Face-to-Face and Online Learning. *E-leader Manila.* Retrieved from: http://www.gcasa.com/conferences/manila/papers/Weegar.pdf Accessed on 11 March 2015.

Weiler, A. 2004. Information-seeking behaviour in Generation Y students: Motivation, critical thinking, and learning theory*. The Journal of Academic Librarianship.* 31(1): 46-53.

Wellington, J. 2000. *Educational research: contemporary issues and practical approaches*. London: Continuum.

Whetten, D.A. 1989. What constitutes a theoretical contribution? *The Academy of Management Review,* 14(4): 490–495.

Whittemore, R. Chase, S. K. & Mandie, C. I. 2001. Validity in qualitative research. *Qualitative Health Research*, 11, 522–537.

Williams, K.C. & Page, R.A. 2010. Marketing to the generations. *Journal of Behavioural Studies in Business*, 8-10.

Williams, T. & Samuels, M.L. 2001. *The nationwide audit of ECD provisioning in South Africa*. Pretoria: The Department of Education.

Wholey, J.S., Hatry, H.P. & Newcomer, K.E. (eds). 2004. *Handbook of practical programme evaluation*. San Francisco: Jossey Bass.

Wong, E.M.L. & Li, S.C. 2008. Framing ICT implementation in a context of educational change: a multilevel analysis. *School effectiveness and school improvement*, 19(1): 99–120.

Woodside, A.G. 2010. *Case study research: theory methods practice*. Bingley: Emerald Group Publishing Limited.

World Bank 1998. The World Communication and Information Report. Quoted in C. Blurton. *New Directions of ICT-Use in Education*. Hong Kong: UNESCO.

Yildrim, S. 2007. Current utilization of ICT in Turkish basic education schools: A review of teachers' ICT use and barriers to integration. *International Journal of Instructional Media*, 34(2): 171–186.

Yilmaz, N.P. 2011. Evaluation of the technology integration process in the Turkish education system. *Contemporary Educational Technology*, 2(1):37–54.

Yin, R.K. 2003a. *Applications of case study research*. 2nd Edition. Thousand Oaks: Sage Publications.

Yin, R.K. 2003b. *Case study research: design and methods*. 3rd Edition. Thousand Oaks: Sage Publications.

Yin, R. 2011. *Applications of case study research.* Thousand Oaks: SAGE Publications.

Yuen, H.K., Law, N. & Wong, K. 2003. ICT implementation and school leadership: Case studies of ICT integration in teaching and learning. *Journal of Educational Administration*, 41(2):158–170.

APPENDICES

Appendix A: Letter of consent to principals

April 2014

LETTER OF CONSENT FOR RESEARCH

Dear Principal

As a PhD student and lecturer from the University of Pretoria, I am required to do research as part of my post-graduate studies. The topic of technology is of particular interest to me and I have, therefore, chosen *A framework for technology-based teaching and learning in the Foundation Phase* as my focus.

It was my aim to select two schools in Pretoria that are technological rich, one being _____. In order to address the research questions, a qualitative approach will be followed which will involve several data collection methods:

1. With regard to technology-based teaching and learning in the Foundation Phase, I would like to use 5 Grade 3 learners and their respective teachers from your school. I will make use of the photo voice technique, supplemented with narratives from the learners, and semi-structured interviews with the teachers to gain an understanding of *inter alia* how the students learn, how the teachers teach and how technology plays a role in both.
2. Non-participant observations (which means that I will look at the environment, the learners and teachers from an 'outsider' perspective) will also be conducted, to further understand the teaching and learning environment in the Foundation Phase

I shall gain the necessary permission from the various role-players (the Department of Education, the ethical committee at the University of Pretoria, the parents, the teachers and the learners) to conduct my study. Once permission has been granted, I shall arrange a convenient time with the learners and teachers to begin my data collection without infringing on their teaching or learning time.

I can assure confidentiality and anonymity by omitting learners and teachers' names in any publications and blurring out faces in any picture where the person wishes to remain unknown. Only I and my supervisors will have access to the raw data. I will also assure you that your learners and teachers will not be harmed in any way. Please be informed that the respective research may be terminated should you or your learners and teachers wish to end

participation in this study. Similarly, should the data collection process elicit negative outcomes, participation in my study will be terminated.

Taking part in this study will hopefully give your school the opportunity to reflect on their technological environment, and to gain insights into the teaching and learning. It will also potentially highlight, to various role players, the strengths and weaknesses of using technology as a tool for teaching and learning.

Should you agree please sign the letter of consent below. Kindly e-mail me or your Informed Consent letter indicating your consent/non-consent to participate in the study.
Should you require any further information, please feel free to contact me.

Your assistance is greatly appreciated.

_____
Mrs Donna Hannaway
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_____
Dr MG Steyn
Supervisor

PERMISSION FOR RESEARCH
I,……,herewith grant ☐/do not grant ☐permission for my school, ……. to be involved in the study on technology-based teaching and learning in the Foundation Phase. I am aware that the sessions will be recorded with the participants for further reference. If any research is published, the name and photograph of the participant, as well as confidentiality, anonymity and privacy of participant will be protected at all times Signature…….. Date: ……

Appendix B: Letter of consent to teachers

April 2014

LETTER OF CONSENT FOR RESEARCH

Dear Teacher

As a PhD student from the University of Pretoria, I am required to do research as part of my post-graduate studies. The topic of technology is of particular interest to me and I have, therefore, chosen *A framework for technology-based teaching and learning in the Foundation Phase* as my focus.

It was my aim to select two schools in Pretoria that are technological rich, one being _____. Since I am exploring the use of technology as a tool for teaching and learning in the Foundation Phase, I am focussing on Grade 3 learners and their respective class teacher. I would therefore, like to request your consent to involve you in my studies. Firstly, I would like to meet with you, at school, to explain the nature and intent of my study and to perhaps, understand your specific profile with regard to using technology for teaching. Thereafter, I will have an orientation session where you will be familiarised with a disposable camera and invite you to photograph anything or anyone that best describes the way in which you teach. Since the disposable camera will be sent home with you, I will not prescribe what you should take photographs of as the outcomes may be affected. I will arrange to collect the camera after a given time and print the photographs. Here, it is important to mention that the photographs generated will be used as data, but that the faces of people, who wish to remain unknown, will be blurred out. After that, I will meet with you again where I will request that you exhibit and discuss your photographs according to the reason for choosing the image to portray how teaching occurs. I will follow-up by meeting again and asking you a few questions, in a semi-structured interview, explaining your chosen photograph. All the meetings with you will take place at school as it is a familiar environment. Please note that all sessions will be recorded for future reference by me and my supervisors.

I can assure confidentiality and anonymity by omitting your name in any publications and blurring out faces in any picture where the person wishes to remain unknown. Only I and my supervisors will have access to the raw data. I will also assure you that you will not be harmed in any way through the research. Please be informed that the respective research may be terminated should you wish to end participation in this study. Similarly, should the data collection process elicit negative outcomes, your participation in my study will be terminated.

Taking part in this study will hopefully give you the opportunity to reflect on the technological environment and to gain insights into your own teaching. It will also potentially highlight, to various role players in Foundation Phase education, the strengths and weaknesses of using technology as a tool for teaching and learning.

Should you agree please sign the letter of consent below. Kindly e-mail me or deliver by hand, your informed consent letter indicating your consent/non-consent to participate in the study.

Should you wish to query anything further, please feel free to contact me.

Your assistance is greatly appreciated.

Mrs Donna Hannaway
Lecturer
Department of Early Childhood Education
Faculty of Education, University of Pretoria
Tel: +27 12 420 5537
Cell: +27 72 435 2782
Fax: +27 12 420 5595
Email: donna.hannaway@up.ac.za

Dr MG Steyn
Supervisor

PERMISSION FOR RESEARCH

I,……., herewith grant ☐ / do not grant ☐ permission to be involved in the study on technology-based teaching and learning in the Foundation Phase.

I am aware that the sessions will be recorded with the children for further reference.

If any research is published, the name and photograph of the participant, as well as confidentiality, anonymity and privacy of participant will be protected at all times

Signature…….. Date: ……

Appendix C: Letter of consent to parents

April 2014

LETTER OF CONSENT FOR RESEARCH

Dear parent(s)/guardian(s)

As a PhD student from the University of Pretoria, I am required to do research as part of my post-graduate studies. The topic of technology is of particular interest to me and I have, therefore, chosen *A framework for technology-based teaching and learning in the Foundation Phase* as my focus.

It was my aim to select two schools in Pretoria that are technological rich, one being _____. I was then able to identify and obtain your child's name from his/her class teacher (_____), to include your child in my study. I would like to request your consent to involve your child in my studies. The research I am doing is exploring technology-based teaching and learning among 10 Grade 3 learners and their respective teachers. With regard to your children, I would like to get information from them about the way that they learn and use that information to develop a framework for the Foundation Phase.

The process of collecting my data will involve the following:

Firstly, I would like to meet with your child, at school, to explain the nature and intent of my study and to perhaps, understand his/her specific profile with regard to using technology for learning. Thereafter, I will have an orientation session where he/she will be familiarised with a disposable camera and invite him/her to photograph anything or anyone that best describes the way in which he/she learns. Since the disposable camera will be sent home with your child, I would also like to request that you do not prescribe what your child should take photographs of, as the outcomes may be affected. I will arrange to collect the camera after a given time and print the photographs. Here, it is important to mention that the photographs generated will be used as data, but that the faces of people, who wish to remain unknown, will be blurred out. After that, I will meet with your child again where I will request that he/she exhibits and discusses his/her photographs according to the reason for choosing the image to portray how learning occurs. I will follow-up by meeting again and asking your child to compile a short narrative explaining his/her chosen photograph. All the meetings with your child will take place at school as it is a familiar environment. You are very welcome to sit in on my discussions with your child, should you or he/she prefer it. Please note that all sessions will be recorded for future reference by me and my supervisors.

I can assure confidentiality and anonymity by omitting your child's name in any publications and blurring out faces in any picture where the person wishes to remain unknown. Only I and my supervisors will have access to the raw data. I will also assure you that your child will not be harmed in any way. Please be informed that the respective research may be

terminated should you or your child wish to end participation in this study. Similarly, should the data collection process elicit negative outcomes, your child's participation in my study will be terminated.

Taking part in this study will hopefully give your child the opportunity to reflect on their own life worlds, and to gain insights into their own learning. It will also potentially highlight, to various role players in your child's life, the strengths and weaknesses of using technology as a tool for teaching and learning.

I urge you to discuss this opportunity with your child. Should you agree please sign the letter of consent below. Kindly e-mail me or deliver by hand (at the school) your informed consent letter indicating your consent/non-consent for your child to participate in the study.

Should you wish to query anything further, please feel free to contact me.

Your assistance is greatly appreciated.

_____
Mrs Donna Hannaway
Lecturer
Department of Early Childhood Education
Faculty of Education, University of Pretoria
Tel: +27 12 420 5537
Cell: +27 72 435 2782
Fax: +27 12 420 5595
Email: donna.hannaway@up.ac.za

_____
Dr MG Steyn
Supervisor

PERMISSION FOR RESEARCH

I,……., herewith grant ☐/ do not grant ☐permission for my child, ……. to be involved in the study on technology-based teaching and learning in the Foundation Phase.

I am aware that the sessions will be recorded with the children for further reference.

If any research is published, the name and photograph of the participant, as well as confidentiality, anonymity and privacy of participant will be protected at all times

Signature…….. Date: ……

Appendix D: Letter of assent to learners

April 2014

LETTER OF ASSENT FOR RESEARCH

Dear _____

I am a lecturer (which is the same as being a teacher) and I am also studying at the University of Pretoria. One thing that I have to do to get my degree is a research study. I need your help because I have chosen to look at how you learn.

To be able to write about my study, I will ask you to do a few fun things for me.

1) I will meet you for the first time at school where I will explain everything about the process I'd like you to be involved in.
2) I will meet you again and explain an exciting way for you to tell me about how you learn. It is called photo voice and it's a process in which I will give you a disposable camera and ask you to take photo's of anything or anyone that you feel is linked to your learning. You will have three days to do this.
3) I will then collect your cameras and develop the films.
4) I will meet you another time and ask you to display your photo's and to chat to me about them.
5) Then we will meet again. I will ask you, this time, to write a short 'story' for me on your best photograph. (I will obviously explain exactly what you'll have to do on that day)
6) I will then meet you for the last time where I will ask you a few questions about everything that you would have done for me.

I want this study to help you in learning about your own learning, as well as helping all teachers and learners to use technology in school. (We'll hopefully find lots of ideas along the way!)

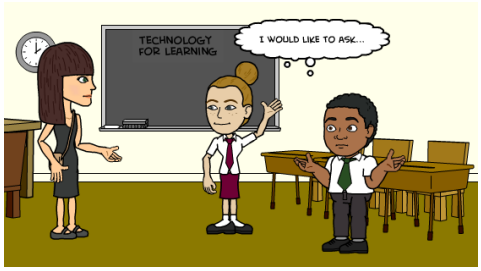
Please be as honest as you can in everything you do for me. Also know that if you feel uncomfortable and want to withdraw at anytime, you can.

I look forward to learning with you.

Donna

This form will be completed with the researcher during the individual administration sessions.

Name of participant: _____

	**Do you understand the information letter that I read to you and did I explain what today's activities are all about?**	Yes 👍 No 👎
	**Do you understand that it is your choice to help me today and that you can stop at any time you want to?**	Yes 👍 No 👎
	**Do you have any questions?**	Yes 👍 No 👎

Appendix E: Letter of consent to expert

September 2015

LETTER OF CONSENT FOR RESEARCH

Dear Expert

As a PhD student from the University of Pretoria, I am required to do research as part of my post-graduate studies. The topic of technology is of particular interest to me and I have, therefore, chosen *Teachers' and learners' experiences of technology-based teaching and learning in the Foundation Phase* as my focus.

Your role of expert will include critically examining the summary of data that was collected from 10 Grade 3 learners and their two respective teachers at two research sites. The process of collecting data from you will involve issuing you with a very brief synopsis of the study which includes the final table of a summary of data analysis. This table will form the basis of an open discussion with you. Please note that all sessions will be recorded for future reference by me and my supervisors.

I can assure confidentiality and anonymity by omitting your name in any publications. Only I and my supervisors will have access to the raw data. I will also assure you that you will not be harmed in any way through the research. Please be informed that the respective research may be terminated should you wish to end participation in this study. Similarly, should the data collection process elicit negative outcomes, your participation in my study will be terminated.

Taking part in this study will hopefully give you the opportunity to reflect on the technological environment in the Foundation Phase and to gain insights into your research in technology in education. With your valuable contribution it will also potentially highlight, to various role players in Foundation Phase education, the experiences of technology-based teaching and learning.

Should you agree please sign the letter of consent below. Kindly e-mail me or deliver by hand, your informed consent letter indicating your consent/non-consent to participate in the study.

Should you wish to query anything further, please feel free to contact me.

Your assistance is greatly appreciated.

Mrs Donna Hannaway
Lecturer
Department of Early Childhood Education
College of Education, UNISA
Tel: +27 12 429 6601
Cell: +27 72 435 2782
Email: hannad@unisa.ac.za

Dr MG Steyn
Supervisor

PERMISSION FOR RESEARCH

I,……., herewith grant ☐ / do not grant ☐ permission to be involved in the study on technology-based teaching and learning in the Foundation Phase.

I am aware that the sessions will be recorded with the children for further reference.

If any research is published, confidentiality, anonymity and privacy of participant will be protected at all times

Signature…….. Date: ……

Appendix F: Letter of consent to district officials

March 2016

LETTER OF CONSENT FOR RESEARCH

Dear District Official

As a PhD student from the University of Pretoria, I am required to do research as part of my post-graduate studies. The topic of technology is of particular interest to me and I have, therefore, chosen *Teachers' and learners' experiences of technology-based teaching and learning in the Foundation Phase* as my focus.

In order to address the research questions, a qualitative approach will be followed which will, amongst other methods, involve a focus group interview as a data collection method. With regard to technology-based teaching and learning in the Foundation Phase, I would like to interview Foundation Phase specialists in your district to gain an understanding of *inter alia* how Foundation Phase students learn, how their teachers teach and how technology plays a role in both.

Furthermore, the process of collecting data from you as a specialist in your district will involve issuing you with a very brief synopsis of the study and asking you a set of pre-established questions. (See attached interview schedule.) Please note that all sessions will be recorded for future reference by me and my supervisors.

I can assure confidentiality and anonymity by omitting names in any publications. Only my supervisors and I will have access to the raw data. I will also assure you that you as a participant will not be harmed in any way through the research.

Taking part in this study will hopefully give you the opportunity to reflect on the technological environment in the Foundation Phase and to gain insights into research in technology in education. With your valuable contribution it will also potentially highlight, to various role players in Foundation Phase education, the experiences of technology-based teaching and learning. An electronic version of the completed study can also be sent to you, should you wish.

Should you agree please sign the letter of consent below. Kindly e-mail me or deliver by hand, your informed consent letter indicating your consent/non-consent as a Foundation Phase specialist from the Department of Education to participate in the study.

Should you wish to query anything further, please feel free to contact me.

Your assistance is greatly appreciated.

Mrs Donna Hannaway
Lecturer
Department of Early Childhood Education
College of Education, UNISA
Tel: +27 12 429 4148
Cell: +27 72 435 2782
Email: hannad@unisa.ac.za

Dr MG Steyn
Supervisor
Department of Early Childhood
Faculty of Education, UP
Tel: +27 12 420 5289
Cell: +27 82 202 2133
Email: mg.steyn@up.ac.za

PERMISSION FOR RESEARCH

I,……., herewith grant ☐ / do not grant ☐ permission as a Foundation Phase Specialist to be involved in the study on technology-based teaching and learning in the Foundation Phase.

I am aware that the sessions will be recorded for further reference.

If any research is published, confidentiality, anonymity and privacy of participant will be protected at all times

Signature…….. Date: ……

Appendix G: Permission from Department of Education

For administrative use only:
Reference no: D2017 / 027
enquiries: Diane Buntting 011 843 6503

GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GDE RESEARCH APPROVAL LETTER

Date:	**20 April 2016**
Validity of Research Approval:	**20 April 2016 to 30 September 2016**
Name of Researcher:	**Hannaway D.M.**
Address of Researcher:	**50 Buckingham; 26 Lion Road; Sterrewag; Pretoria; 0181**
Telephone / Fax Number/s:	**012 346 6123; 072 435 2782**
Email address:	**hannad@unisa.ac.za**
Research Topic:	**Teachers' and learners' experiences of technology-based teaching and learning in the Foundation Phase.**
Number and type of schools:	**NONE**
District/s/HO	**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. A separate copy of this letter must be presented to the Principal, SGB and the relevant District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted. However participation is VOLUNTARY.

The following conditions apply to GDE research. The researcher has agreed to and 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:

CONDITIONS FOR CONDUCTING RESEARCH IN GDE

1. *The District/Head Office Senior Manager/s concerned, the Principal/s and the chairperson/s of the School Governing Body (SGB.) must be presented with a copy of this letter.*
2. *The Researcher will make every effort to obtain the goodwill and co-operation of the GDE District officials, principals, SGBs, teachers, parents and learners involved. Participation is voluntary and additional remuneration will not be paid;*

2016/04/21

1

Making education a societal priority

Appendix H: Semi-structured interview protocol 1

Teachers: Semi-structured interview schedule
Purpose and instruction In my letter requesting your consent, I indicated to you that I am busy with my PhD study on technology-based teaching and learning in the Foundation Phase. I would like to reiterate that the aim of this interview is to understand your opinions and experiences of teaching with technology for example how you integrate various devices into your teaching. The interview will take approximately 60 minutes and will include ___ questions. The information obtained will be used only for research purposes and no names of participants or any identifying data will be made known in my dissertation and/or future publications. . If at any time during the interview you wish to discontinue the use of the recorder or the interview itself, please feel free to let me know and we will stop. All of your responses are confidential. Do you have any questions before we start the interview? May I audio-record the interview, as it would help me to listen to it again later and to make a transcript to accurately document the information you convey? Then with your permission, may I begin the interview?
Interview questions
1. What are your knowledge and skills in using technology?
2. When and where do you use technology in your classroom? (i.e what subjects/areas, times etc)
3. How do you use technology to teach?
4. What specific technology is used in your teaching?
5. How does technology influence your pedagogy? (pedagogy = the various teaching strategies you use)
6. How does technology influence your content? (content = the material/concepts you present)
7. What are the advantages of teaching using technology?
8. What are the disadvantages of teaching with technology?
9. How can South African Foundation Phase teachers and learners benefit from technology to ensure accountable teaching and learning?
10. Are there any comments/final remarks that you would like to make before concluding this interview?

TbTL

11. Do you think TbTL should be used in the Foundation Phase? Why?
12. Who started the process of implementing TbTL at your school?
13. Why did you integrate TbTL?
14. What role does TbTL play in parent involvement at your school?
15. Are parents somehow involved in the process of integrating TbTL into education?

Environment

16. How is the space, classroom, environment at your school organized to facilitate the integration of TbTL?
17. Do you allow children to take technology from school home?
18. Do you allow children to bring their own technology to class?
19. How would you like to change the environment where TbTL is used to make it more supportive for teaching and learning?

Content

20. How do you choose the digital content for use at your school?
21. Do you have a set of selection criteria?
22. Which kind of digital content do you use?
23. Which new TbTL would you like to have? What do you plan to get and why?
24. What digital content do you wish you had? What dreams or hopes do you have for digital software – which may even not exist at present?

Technology tools

25. What else (i.t.o TbTL tools) do your learners need?
26. How much technology do you need to better meet your aims?
27. Do you have the content your students need?
28. If so, do you use and deliver it properly?
29. Do you create opportunities for students to develop all important skills?

Thank you for your participation!

Appendix I: Semi-structured interview protocol 2

District Officials: Semi-structured interview schedule
Purpose and instruction In my letter requesting your consent, I indicated to you that I am busy with my PhD study on technology-based teaching and learning in the Foundation Phase. I would like to reiterate that the aim of this interview is to gain an understanding of *inter alia* how Foundation Phase students learn, how their teachers teach and how technology plays a role in both. The interview will take approximately 60 minutes and will include ___ questions. The information obtained will be used only for research purposes and no names of participants or any identifying data will be made known in my dissertation and/or future publications. If at any time during the interview you wish to discontinue the use of the recorder or the interview itself, please feel free to let me know and we will stop. All of your responses are confidential. Do you have any questions before we start the interview? May I audio-record the interview, as it would help me to listen to it again later and to make a transcript to accurately document the information you convey? Then with your permission, may I begin the interview?
Interview questions
1. Do you think TbTL should be used in the FP phase, why? Comment on the advantages and disadvantages of using TbTL in the FP.
2. How is the space, classroom, environment at schools organized to facilitate the integration of TbTL? • Township • Rural • Inner city • Independent How would you like to change the environment where TbTL is used to make it more supportive for teaching and learning?
3. How is technology used for learning in the FP? • Township • Rural • Inner city • Independent
4. How is technology used for teaching in the FP? • Township • Rural • Inner city

• Independent
5. What specific technologies are used in teaching and learning? (Could be answered in question 2)
6. How does technology influence pedagogy? (pedagogy = the various teaching strategies you use)
7. How does technology influence content? (content = the material/concepts you present)
8. What recommendations would you make for South African Foundation Phase teachers and learners so that they can benefit from TbTL?
9. Are there any comments/final remarks that you would like to make before concluding this interview?
Thank you for your participation!

Appendix J: Photovoice discussion protocol

Photovoice discussion

Name: _____

Grade: _____

Age: _____

What is technology? _____

_____

What technology do you own? _____

How often do you use technology? _____

What are the strengths of using technology? _____

_____

What are the weaknesses of using technology? _____

_____

Thank you for your time x

Appendix K: Ethical clearance certificate

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

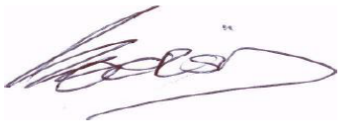
Faculty of Education
Fakulteit Opvoedkunde
Lefapha la Thuto

RESEARCH ETHICS COMMITTEE

CLEARANCE CERTIFICATE	**CLEARANCE NUMBER :** EC 14/04/02
DEGREE AND PROJECT	PhD Teachers' and learners' experience of technology-based teaching and learning in the Foundation Phase
INVESTIGATOR(S)	DM Hannaway
DEPARTMENT	Early Childhood Education
DATE PROTOCOL APPROVED	3 June 2014
DATE CLEARANCE ISSUED	18 March 2016

Please note:
For Masters applications, ethical clearance is valid for 2 years
For PhD applications, ethical clearance is valid for 3 years.

CHAIRPERSON OF ETHICS COMMITTEE Prof Liesel Ebersöhn



DATE 18 March 2016

CC Jeannie Beukes
Liesel Ebersöhn
Dr MG Steyn

This ethics clearance certificate is issued subject to the condition that the approved protocol was implemented. The Ethics Committee of the Faculty of Education does not accept any liability for research misconduct, of whatsoever nature, committed by the researcher(s) in the implementation of the approved protocol.

Please quote the clearance number in all enquiries.

Appendix L: Certificate of language editing

EDITING LETTER

This is to confirm that the doctoral thesis: *Teachers' and learners' experiences of technology-based teaching and learning in the Foundation Phase*, by Donna Hannawya has been edited for language use and technical aspects.

EM Lemmer

104 Charles St

Brooklyn

0181

20 August 2016