



**TECHNOLOGY INTEGRATION: TRACING IN-SERVICE PRIMARY TEACHERS'
TECHNOLOGICAL, PEDAGOGICAL AND CONTENT KNOWLEDGE
DEVELOPMENT**

By

CHAMELLÉ RENÉ DE SILVA

Thesis submitted in fulfilment of the requirements for the degree

Doctor of Education

in the Faculty of Education and Social Sciences

at the Cape Peninsula University of Technology

Supervisor: Dr Stanley A. Adendorff

Co-supervisor: Dr Agnes Chigona

**Mowbray
October 2015**

CPUT copyright information

The thesis may not be published either in part (in scholarly, scientific or technical journals), or as a whole (as a monograph), unless permission has been obtained from the University

DECLARATION

I, Chamellé René de Silva, declare that the contents of this thesis represent my own unaided work, and that the thesis has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

.....

Signed

.....

Date

ABSTRACT

The past decade has witnessed the proliferation and use of computer technologies or ICTs (Information and Communication Technologies) in varying levels in the traditional classroom within the South African context. The policy on e-Education (DoE, 2004) refers to the significance of e-Education and expects schools to be developed into e-Schools, consisting of a community of both teachers and learners. This policy also foregrounds how new models of learning are radically changing and challenging current conceptions of learning.

As schools acquire technological infrastructure, teachers are expected to become technically skilled in order to deliver the curriculum utilising technology as a tool. Practising primary school teachers are generalists who subscribe to a more holistic approach of teaching. Specialised knowledge influences the in-service primary teacher's perceptions with regard to technology in the classroom. Technology integration, therefore, represents particular challenges for teachers as they search to construct a coherent, technological content base to inform their teaching. Learners with diverse ranges of learning abilities and needs are also present in classrooms, which may further compound the challenges teachers face within the confines of a rigid curriculum and emergent technologies.

This study follows and documents the trajectory of a purposive sample of ten practising primary school teachers who had no specialised training in technology. A qualitative ethnographic research design, underpinned by an interpretive paradigm is employed. This research is premised on the argument that teachers can acquire the technical skill, underscored with the relevant pedagogical aims, needed for the seamless integration of emerging technologies required to enhance teaching and learning. "Without skilled pedagogical application of educational technology, technology in and of itself cannot provide innovative school practice and educational change" (Levin & Wadmany, 2006:158).

Positioned at the intersection of education, technology and continuous teacher professional development, specifically in primary classrooms, this investigation aimed at tracking the paths of how teachers acquire knowledge of this new domain. Furthermore, I wanted to understand how technological, pedagogical and content knowledge, as a unique construct, is situated in individual classrooms. Drawing robustly on the TPACK (technological, pedagogical, content knowledge) framework of Mishra and Koehler (2006) as a conceptual lens and applying an ethnographic heuristic, I immersed myself in the classroom culture of the participants as they developed and gained the technical skills, abilities and competencies necessary to become proficient at integrating technology in their teaching practice. A further aim of this research was

to find ways in which closer collaborative practises among Primary Phase teachers could be established to promote technology integration and expertise.

This investigation was confined to an independent school in the Western Cape Province of the Republic of South Africa. Multiple sources of data collection, which included, self-assessment questionnaires, video-recorded classroom observations, semi-structured interviews and artefacts designed by participants, as well as documentary data, were employed to answer the research questions.

Participant teachers in this study have expressed their concerns that the Curriculum and Assessment Policy Statements (CAPS, 2012) require that a vast amount of content is covered which leaves the teacher in the primary classroom with little time for innovation. The findings from this study further suggest that teachers' understanding of knowledge is idiosyncratic; that the measuring and understanding of teacher knowledge is complex and that a "TPACK-mind-set" (Morsink *et al.*, 2011:3-16) is necessary to successfully integrate technology within the curriculum.

This study also indicates that continuing professional teacher development increased the teachers' ability to connect technology with pedagogy and content. Thus on-going support emerged as an imperative in sustaining the teacher's knowledge, motivation and efficacies necessary to enhance classroom practice through technology integration. Despite the e-Policy's intention, this study has identified omissions in teachers' knowledge of the above-mentioned policy and other relevant policy frameworks.

An increase in the participants' ability and motivational levels was observed shortly after their participation in a professional development course. Teachers also reflected more rigorously on constructivism as a learning theory that underscores knowledge construction and how it might be translated into practical applications for both themselves as learners, and the learners whom they teach. The challenge still remains to sustain the impact of teachers' professional development upon return to school and to encourage continued collaborative practises through mentorship and professional school-based learning communities, as mechanisms for continued teacher development and innovation.

ACKNOWLEDGEMENTS

I wish to thank:

My supervisors, Dr Stanley A. Adendorff and Dr Agnes Chigona for the support and guidance you provided me since I started this journey. You have given me so much of your time and expertise. Thank you for your ideas, suggestions and valuable insights and inspiration.

A work of this magnitude can never be accomplished without the assistance of others. Thank you to the ten teacher participants who participated in this study, as well as the participants of the pilot study for offering your time to me. Thank you for receiving me in your classes so graciously, sometimes when you least expected a colleague researcher with video camera in hand. I learnt so much from you. Thank you for sharing your lessons and your knowledge so that I could do this study. Your knowledge and commitment to teaching, played a key role in deepening my understanding of the teaching and learning processes within the school context and your own journey's with technology integration.

Prof Rajendra Chetty, for co-ordinating the doctoral seminars and ensuring that it became a platform for rigorous debate and dissemination of research. These opportunities were invaluable in extending me intellectually while building my confidence as a knowledge producer.

The leadership at the school where this study was conducted, for allowing me to have access to the necessary resources and for accommodating my request for a sabbatical.

My husband, Tony and my daughters, Bonita and Roxanne, thank you for encouraging me to pursue my dreams. Your unwavering support and unconditional love put my stress into perspective.

My editors, Dr Chiwimbiso Kwenda and Dr Barbara Basel, thank you for your meticulous editing.

Thank you to Connie Park for technical expertise in formatting and the layout of this thesis.

Financial assistance from the University Research Fund towards this research is acknowledged. Opinions expressed in this thesis and the conclusions arrived at, are those of the author, and are not necessarily to be attributed to the University Research Fund.

Soli Deo Gloria

DEDICATION

"We are the inheritors, neither of an inquiry about ourselves and the world, nor of an accumulating body of information, but of a conversation, begun in the primeval forests and extended and made more articulate in the course of centuries. It is a conversation which goes on both in public and within each of ourselves ... and it is this conversation which, in the end, gives place and character to every human activity and utterance."

Michael Oakeshott, 1962

For my family

GLOSSARY, ABBREVIATIONS AND ACRONYMS

AI	Artificial Intelligence
CAPS	Curriculum and Assessment Policy Statement
CDA	Critical Discourse Analysis
CFT	Competency Framework for Teachers
CIP	Cognitive Information Processing
CPTD	Continuing Professional Teachers Development
CK	Content Knowledge
CIM	Classroom Integration Model
DoE	Department of Education
DBE	Department of Basic Education
DHET	Department of Higher Education and Training
DVD	Digital Video Disc
EMIS	Education Management Information System
FET	Further Education and Training
GET	General Education and Training
HEI	Higher Education Institutes
HSRC	Human Sciences Research Council
ICT	Information and Communication Technologies
IPE	Initial Professional Education
ITS	Intelligent Tutoring Systems
IWB	Interactive White Board
LAN	Local Area Network
LMS	Learning Management Systems
MAC	Mind As Computer
NCS	National Curriculum Statement
NPO	Not for Profit Organisation
OECD	Organisation for Economic Co-operation and Development
SACE	South African Council of Educators
SAIRR	South African Institute of Race Relations
SED	Socially Economically Disadvantaged
TK	Technological Knowledge
TIM	Technology Integration Matrix
TIM	Technology Integration Model
TI	Technology Immersion
TIAI	Technology Integration Assessment Instrument

TPACK	Technological Pedagogical Content Knowledge
TRI	Technology Readiness Index
PK	Pedagogical Knowledge
PCK	Pedagogical Content Knowledge
PLN	Professional Learning Communities
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
WCED	Western Cape Education Department
WIFI	Wireless Fidelity

LIST OF RESEARCH OUTPUTS

The following research outputs were produced during the course of this study.

Conferences:

Poster presentation. De Silva, C.R. **The integration and impact of digital storytelling in classrooms in Cape Town.** Proceedings of the 12th Education Students' Regional Research Conference, University of Cape Town, 28 September-29 September 2012. Faculty of Education, University of Cape Town, p. 26.

Poster presentation. De Silva, C.R. **Technology integration: Tracing in-service primary teachers' technological, pedagogical and content knowledge development: An ethnographic case study.** Proceedings of the 13th Education Students' Regional Research Conference, Stellenbosch University, 2 October-3 October 2013. Faculty of Education, Stellenbosch University, p. 41.

Articles:

De Silva, C.R., Adendorff, S.A. & Chigona, A. 2015. **Perspectives on technology integration in primary classrooms in India and South Africa: A comparison of two schools.** (Submitted to the *Africa Education Review Journal* (Taylor Francis) in November 2015). Under review.

De Silva, Chamelle, R., Chigona, A. & Adendorff, S.A. 2016. **Technology integration: exploring interactive whiteboards as dialogic spaces in the Foundation Phase classroom.** *The Turkish Online Journal of Educational Technology*. 15 (3): 141-150.

TABLE OF CONTENTS

Declaration	i
Abstract	ii
Acknowledgements	iv
Dedication	v
Glossary, abbreviations and acronyms	vi
List of research outputs	viii
CHAPTER 1: INTRODUCTION AND BACKGROUND TO THE STUDY	1
1.1 Introduction	1
1.2 An overview	3
1.3 Aim of the study	8
1.3.1 My personal rationale for undertaking this research project	8
1.3.2 The research context	9
1.3.3 Transformation through technology integration	11
1.4 Assumptions	12
1.4.1 Research questions	13
1.5 A brief motivation of the research design and methodology	14
1.6 Limitations of the study	15
1.7 Delimitations of the study	16
1.8 Contributions to the research body	16
1.9 Key definitions and terminology	18
1.10 Outline of the study	20
CHAPTER 2: LITERATURE REVIEW.....	23
2.1 Introduction	23
2.2 An explanation of the lines of enquiry	24
2.2.1 Concepts which locate the study	25
2.2.2 Digital competence	25
2.2.3 The digital divide	25
2.3 The development of the TPACK construct	27
2.3.1 The TRACK framework as it pertains to this research.....	30
2.3.2 A review of the TPACK framework and its conceptual underpinnings.....	31
2.3.3 The constructs of the TPACK framework	36
2.4 Learning theories and technology	39
2.4.1 Constructivist learning theory	39
2.4.2 Cognitivist learning theory	40
2.4.3 Complexity and connectivist theories	40
2.4.4 Socio-cultural theory	41
2.5 Teacher beliefs and attitudes about adopting technology	43

2.5.1	Factors relating to primary school teachers use of computers, teaching and learning practices	45
2.5.2	Technology and continuing teacher professional development.....	50
2.5.3	Access to ICT resources and support to teachers	55
2.5.4	A taxonomy to measure technology integration and lesson designs.....	56
2.6	Conclusions	58
CHAPTER 3: A REVIEW OF EDUCATIONAL POLICIES IN SOUTH AFRICA.....		60
3.1	Introduction	60
3.2	A brief overview of policy matters	60
3.3	Policies, discourses and concepts	62
3.4	The policy on e-Education (2004).....	65
3.5	Guidelines for teacher training and professional development in ICT	66
3.6	The national policy framework for teacher education and development in South Africa	67
3.7	UNESCO ICT Competency Framework for Teachers	67
3.8	Action Plan to 2014-Towards the realisation of schooling 2025	71
3.9	Conclusions	71
CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY		73
4.1	Introduction	73
4.2	Synchronising epistemological underpinnings, procedure and methodology	74
4.2.1	Qualitative approach	74
4.2.2	Quantitative approach.....	75
4.2.3	Interpretive paradigm.....	75
4.3	Research design	78
4.4	Case study methodology	80
4.5	Sample selection, participant demographics and characteristics	81
4.5.1	Skills set profile of the sample prior to the study	83
4.5.2	Sample's participation in a blended learning and 21st century learning design courses	84
4.6	Data collection plan and analysis strategies	86
4.7	Research instruments, data sources and procedures	89
4.7.1	Classroom observations	89
4.7.2	Self-assessment questionnaires	90
4.7.3	Semi-structured interviews	93
4.7.4	Artefacts designed by the participants	94
4.7.5	Documentary data	95
4.8	Data analysis procedures	95
4.8.1	The value and integrity of the data	98
4.8.2	Trustworthiness, validity and reliability	98
4.8.3	Enhancing design validity	100

4.8.4	The researcher's role	101
4.8.5	Ethical considerations	102
4.9	Conclusions	102
CHAPTER 5: FINDINGS		103
5.1	Introduction	103
5.2	Research questions	105
5.2.1	Findings from the self-assessment questionnaires.....	105
5.2.2	Permutations of TPACK and content knowledge.....	106
5.2.3	TPACK (Technology, Pedagogy and Content Knowledge)	108
5.2.4	Models of TPACK by Phase partners	111
5.2.5	Narrative responses related to specific episodes when ICT was demonstrated or modelled by the ICT instructor, Phase partners and participants	112
5.2.6	A reflection on the classroom observations	114
5.2.7	Findings from the classroom observations	115
5.2.8	Findings from the semi-structured interviews	119
5.2.9	Main themes identified from the analysis of the semi-structured interviews	120
5.2.9.1	<i>Professional development and policy guidelines</i>	<i>120</i>
5.2.9.2	<i>Teacher knowledge of technology</i>	<i>120</i>
5.2.9.3	<i>Teacher beliefs about technology</i>	<i>120</i>
5.2.9.4	<i>Teachers' motivation and deepening of TPACK</i>	<i>120</i>
5.2.9.5	<i>Technology as tool to address barriers to learning</i>	<i>121</i>
5.3	Artefacts designed by the participants	122
5.4	Documentary data	122
5.5	Reporting on the case profiles of individual participants.....	123
5.5.1	The case of Annabel	123
5.5.2	The case of Meredith	124
5.5.3	The case of Yolanda	124
5.5.4	The case of Dorothea	125
5.6	A reflection on participants' practices	125
5.7	Conclusions	126
CHAPTER 6: REFLECTIONS AND DISCUSSION OF FINDINGS.....		128
6.1	Introduction	128
6.2	Synopsis of variables that emerged from the data analysis	129
6.2.1	Sustainability of technology integration at the research site	129
6.2.2	Teachers personal views on technology integration	129
6.2.3	Technology integration and curriculum delivery	130
6.2.4	Whole school technology vision.....	132
6.3	Sustaining the change in classroom practices: Observations from the study	134

6.4	Affordances of and barriers to technology integration	135
6.5	Critical aspects emerging from the data that influence participants' TPACK	137
6.6	The TPACK Framework (2006) and the UNESCO ICT Conceptual Framework for Teachers (2011)	140
6.7	Conclusions	144
CHAPTER 7: A CLASSROOM TECHNOLOGY INTEGRATION MODEL		146
7.1	Introduction	146
7.2	Teachers' readiness and perceptions of learner engagement with computers	146
7.2.1	Teacher strategies for learner engagement with technology	149
7.2.2	Contextualising multi-literacies within emerging technologies	150
7.2.3	Exploring learners digital literacy practices	152
7.2.4	Curriculum supported positioning of ICT for learners	155
7.3	Evaluating technology use of learners	158
7.3.1	Learner access	161
7.4	The motivation for a classroom integration model (CIM)	162
7.4.1	Monitoring and assessing primary learners' use of ICTs	165
7.5	Conclusions	165
CHAPTER 8: CONCLUSIONS AND RECOMMENDATIONS.....		167
8.1	Overview of the study	167
8.2	Conclusions from the findings.....	167
8.3	Reflections	169
8.4	Recommendations	171
8.4.1	Teachers' personal views on technology integration	171
8.4.2	Technology integration and curriculum delivery	172
8.4.3	Whole school technology integration vision.....	173
8.5	Further research	176
8.6	Conclusions	177
REFERENCES		180

LIST OF APPENDICES

Appendix A:	LETTER OF PERMISSION TO CONDUCT RESEARCH.....	207
Appendix B:	LETTER OF PERMISSION TO PARTICIPANTS	209
Appendix C:	SELF-ASSESSMENT QUESTIONNAIRE	212
Appendix D:	TECHNOLOGY INTEGRATION ASSESSMENT INSTRUMENT (TIAI).....	219
Appendix E:	SEMI-STRUCTURED INTERVIEW QUESTIONS TO PARTICIPANTS.....	221
Appendix F:	'DESIGNING AN ONLINE TEACHING/INSTRUCTIONAL EVENT'	223
Appendix G:	ASSESSMENT RUBRIC TO EVALUATE TEACHER KNOWLEDGE	225
Appendix H:	QUESTIONNAIRE ASSESSING TEACHERS' AFTER DESIGNING AN INSTRUCTIONAL EVENT	228
Appendix I:	THE SEMI-STRUCTURED INTERVIEWS AND A SUMMARY OF CASE RESPONSES (SEE CHAPTER 5.3.1).....	231
Appendix J:	PROTOTYPE LESSON DISCUSSIONS FROM DOCUMENTARY DATA OF THE DESIGN AND ONLINE TEACHING/INSTRUCTIONAL EVENT (2012).....	236
Appendix K:	EXTRACTS FROM RELEVANT SECTIONS OF THE POLICY ON E-EDUCATION (2004): TRANSFORMING LEARNING AND TEACHING THROUGH ICT	240
	DECLARATION OF LANGUAGE EDITING (1).....	246
	DECLARATION OF LANGUAGE EDITING (2).....	247

LIST OF FIGURES

Figure 2.1:	Knowledge bases for teaching (Grossman, 1990:5 in Park-Oliver, 2008:263).....	32
Figure 2.2:	TPACK diagram: Mishra and Koehler (2006) http://tpack.org/	38
Figure 2.3:	Kelly's criteria and the teacher iceberg (Source: Johnson, 2005:218).....	44
Figure 2.4:	The teacher iceberg (Source: Malderez & Bodoczky, 1999:15)	44
Figure 2.5:	SAMR-model (Puentedura, 2011).....	57
Figure 3.1:	UNESCO ICT-CFT-model: developmental stages and modules	70
Figure 4.1:	Computer skill set profile of sample prior to the study	83
Figure 5.1:	I can teach lessons that appropriately combine Mathematics, technologies and teaching approaches	109
Figure 5.2:	I can teach lessons that appropriately combine Literacy, technologies and teaching approaches.....	110
Figure 5.3:	I can teach lessons that appropriately combine Science, technologies and teaching approaches.....	110
Figure 5.4:	I can teach lessons that appropriately combine Social Science, technologies and teaching approaches	110
Figure 6.2:	UNESCO ICT-CFT (2011) A reference framework (Consent by Miao, UNESCO, 2011:17)	143
Figure 6.3:	The shift of teachers' PCK to TPACK (Adapted from Miao, UNESCO, 2011:18).....	144
Figure 7.1:	Explicit Learning and Technology Strategies (Adapted from Papa, 2011:273).....	149
Figure 7.2:	Digital literacy and other related literacies (Source: Ala-Mutka, 2011)	151
Figure 7.3:	From teacher TPACK to learner TPACK	161

LIST OF TABLES

Table 2.1:	An adaptation to explain Shulman's major categories of teacher knowledge (1987)	33
Table 3.1:	The UNESCO ICT Competency Framework for Teachers (2011:9).....	69
Table 4.1:	Enhancing design validity	99
Table 4.2:	Ensuring trustworthiness (Krefting, 1991:215).....	100
Table 5.1:	Forms of ICT relating to participants' choice of digital/e-tools (Adapted: Bertram & Waldrup, 2013).....	108
Table 5.2:	Technology Integration Assessment Instrument (TIAI) (Harris <i>et al.</i> , 2010)	116
Table 5.3:	Key features of prototype lesson: Annabel	124
Table 5.4:	Key features of prototype lesson: Meredith	124
Table 5.5:	Key features of prototype lesson: Yolanda	125
Table 5.6:	Key features of prototype lesson: Dorothea	125
Table 6.1:	Definitions of knowledge constructs of Mishra & Koehler's TPACK model (adapted from Chai <i>et al.</i> , 2012)	142
Table 7.1:	Framework for the Classroom Integration Model (CIM)	164
Table 8.1:	Convergence of leadership vision and teacher roles towards technological innovation.....	179

CHAPTER 1

INTRODUCTION AND BACKGROUND TO THE STUDY

1.1 Introduction

The past decade has witnessed the proliferation and ubiquitous use of new computer technologies or ICTs (Information and Communication Technologies) in varying levels in the traditional classroom within the South African context. The view that technology is a catalyst to transform teaching and learning in classrooms is situated in the discourse of what 'good schools' do. Other discourses that abound are 'innovative practices' and '21st century learning'. Propelled by anecdotal evidence of the potential of technology, some schools have invested in technological infrastructure to exploit promises of enhanced educational attainment for learners. The proliferation of technology in classrooms and the notion of learning in a digital era imply a shift in education's organisational vision and culture, and how technology will influence the school's major foci in terms of academic outcomes and learner achievement. This research study was undertaken in an attempt to understand how teachers acquire knowledge of emerging technologies and how this shapes their classroom practices when employing technology as a tool for teaching and learning.

Such a shift towards technologically enhanced learning and teaching, therefore, necessitates a change in teachers' beliefs about and behaviour towards technology which necessitates teachers becoming digitally literate and technically proficient in the use of ICTs. Teachers in this study have all been trained prior to the proliferation of technology in classrooms. Technology now compels teachers to act in new ways in order to embrace these changes as technology converges with traditional teaching practises. DuFour and DuFour (2010:85) claim that technological innovations do not have the power to transform traditional school culture, it, however, can support teachers who are determined to make that transformation.

Hence opportunities for teachers to reflect on how the implications of applying emerging technologies within classrooms shape their teaching methodologies, should underpin the professional development of teachers. Although technology is an enabler, tensions also arise due to its constraints. The school at which this study was conducted is continually looking for ways in which technology can be employed to "liberate learning" (Gall *et al.*, 2005:415). The policy on e-Education acknowledges ICTs as a resource for curriculum integration and a collaborative tool for teachers and learners and hopes to provide a framework that will move technology away from the periphery of educational resources and teachers' currently limited view of its potential use for teaching and learning (DoE; ICT, 2004). This investigation

foregrounds teachers' development of technology, pedagogy and content knowledge and how these factors influence their classroom practices.

Processes of change in organisations are always complex, more so with the ill-defined nature of technology. An abundance of research has established that changes in behaviour precede changes in the assumptions, beliefs, expectations and habits that constitute the culture of an organisation (Fullan, 2007; Kotter & Cohen, 2002; Pfeffer & Sutton, 2006). As Kotter and Cohen (2002:175) point out, "In a change effort, culture comes last, not first". Culture changes only when new behaviours become the norm - "the way we do things around here." Thus through professional development teachers need to seek ways to gain skills and knowledge that will support the process of technology integration in the classroom that will ultimately influence change in classroom practice.

Teachers who participated in this research project are employed by an independent school and are less challenged by the lack of resources that face poorly resourced urban schools in South Africa. Commitment by teachers was, however, a necessary step in building shared knowledge and skills through the mechanism of collaborative practices that would enhance instruction through technology.

This chapter serves as an orientation to the study, starting with a general overview of the rationale behind this research project. It ends with a brief resume of the chapters listed below:

Section 1.1: Introduction

Section 1.2: An overview of the whole chapter;

Section 1.3: The aim of the study; personal rationale; the research context and transformation through technology integration;

Section 1.4: Related assumptions and research questions;

Section 1.5: A brief motivation of the research design and methodology; an explanation of the research orientation and data generation procedures;

Section 1.6: A discussion of the limitations of the study;

Section 1.7: A discussion of the delimitations of the study;

Section 1.8: A discussion of the contribution of the study to the research body of existing knowledge;

Section 1.9: Key definitions and terminology; and

Section 1.10: An outline of the remaining chapters.

1.2 An overview

Globally, school systems have invested in technological infrastructure for a number of decades, and digital technology has been used in schools since the 1980s (Pelgrum & Voogt, 2009:293; Starkey, 2012:19). Shifts in educational reforms have also acknowledged the use of ICTs. Subsequently, the demand for an increasingly digital working and learning environment has resulted in an escalation of technologically enhanced collaboration and learning in most spheres of our society. Gilster (1997:220), who coined the term 'digital literacies', argues that digital tools hold out the possibility of facilitating new forms of learning and, therefore, have profound implications for education.

While the 'uptake of the Internet' by educational institutions has boosted people's ability to communicate with others, using a variety of digital tools and applications, its rapid evolution now provides teachers with the potential to utilise these tools in the classroom. It has become obligatory to equip learners for today's global, collaborative and digital working environment. This raises the need for on-going training and technical support of teachers that enable them to find effective ways to employ technology for learning and teaching. Hattie (2009) underscores this view when he asserts that teaching decisions are an important influence on how individuals or cohorts are prepared to participate in society when they leave the schooling system.

The Internet has given rise to unprecedented global flows of information (PISA, 2006), by connecting vast networks of individuals across the globe at a negligible cost. 'Internet uptake', although more affordable due to a decrease in broadband pricing, cannot be separated from factors such as the deployment of ICTs and the penetration of the Internet within a certain context. Harasim (2012:2) claims that in such a technologically-driven world it is critical and timely to study the intersection of learning theory and technology (see Chapter 2).

Enabling legislative and policy frameworks are provided by various governmental departments (DoE, ICT, 2003:2), and by UNESCO, which endorse the support of integrating ICT into teaching and learning in educational institutions. The e-Education policy underscores the impact of ICT on curriculum development (DoE, ICT, 2004). For that reason schools were mandated through the e-Education policy goals to be optimal participants in the 'global community' by 2013. The UNESCO ICT (2011) updated competency framework for teachers is intended to inform educational policy makers, teacher-trainers, providers of professional learning and practising teachers, on the role of ICT in professional reform. In Chapter 3 I review this framework in greater detail.

Various initiatives by the Department of Basic Education (DBE) have seen an increase of connectivity at schools through partnerships. The International Telecommunications Union

report (ITU, 2013) notes that in Africa, internet user penetration has doubled over the past four years, and is set to climb to 16% by end 2013. Internet access at home by South Africans in 2002 was 6.4% (DoE, 2004). The latest statistics by Duff (2014) on Internet access at home has only shown a marginal increase since then and, in 2012, it stood at 10%.

While some educational researchers believe that technology may enhance teaching and learning, others remain sceptical (Fabry & Higgs, 1997:385-395). Cordes and Miller (2000) and Cuban (2001:132), also draw attention to the fact that teachers might have negative stances towards the use of technology in the primary classroom and advocate evidence-based approaches to ICT implementation to determine its impact. These polarised views, according to Green and Hannon (2007:11), dominate public discourse, and they cloud our understanding of the impact of emerging technologies on people's lives. Klopfer *et al.* (2009:2) state that the emergence of new technologies in classrooms induces teachers to understand and leverage these technologies for classroom use and instructional gain.

Teachers, who teach in high poverty rural schools as well as those who teach in poorly resourced urban schools, have many other challenges to face. Within these contexts the impact of technology is still distant. (Chisholm, 2011:57). As far back as 1991, there was the realisation (Rautenbach, 1991) that South Africans should become technologically literate in order to be part of the global economy. In 2001 former President Mbeki underscored the importance of ICT at the Imbizo for African Youth, for social and economic development, and succinctly declared: "We must continue to fight for liberation against poverty, against underdevelopment, against marginalisation [and] ... information and communication technology ... is a critically important tool in that struggle" (Mbeki, 2001). Educational reform globally, and also in South Africa, expects teachers to take on more responsibility for learners' achievements, which places teachers under greater pressure to perform in the classroom. Stigler and Hiebert (1999:2) venture to state that teaching is the next frontier in the continuing struggle to improve schools. As schools acquire technological infrastructure, teachers are expected to become technically skilled in order to deliver the curriculum utilising the tools of technology (DoE, 2007).

Notwithstanding this fact, limited research has been undertaken regarding the classroom teacher's development and knowledge of ICTs. Hofer and Swan (2008:179-200) and Harris and Hofer (2011:211-229) corroborate this statement and also acknowledge the current gap in the literature that addresses how teachers' knowledge and beliefs influence the pedagogical decisions teachers make while planning to integrate technology into their teaching. Due to this gap there is an advocacy (Ager, 2013:19) in more recent literature for the incorporation of technology, even in the primary grades. Starkey (2012:110) describes a 'digital age' teacher as

one whose practice of teaching is enabled by the use of digital tools and the extensive information on, and analysis of, students' learning progress. Extensive academic knowledge of their teaching domain, how students learn and create knowledge, how to critique and use evidence to inform their teaching practice, and how to establish and maintain learning relationships within their teaching and professional contexts, further characterises the 'digital-age' teacher.

This study's foremost relevance lies in its focus on how practising primary teachers acquire this new domain knowledge and how it translates into embedded classroom practice. Mereku (2011) posits that technology has a vital supportive role to play in the process of moving away from out-dated didactic approaches. This recognition should never be confused with the flawed notion that technology replaces teachers. Indeed, the opposite is true: realising the transformative potential of technology in education requires well motivated teachers who have been trained in a manner that equips them to be effective teachers in the 21st century. Mishra and Koehler (2006:1017) and Schmidt *et al.* (2009) contend that teachers require a TPACK mind-set and knowledge to successfully integrate technology into teaching. TPACK is an acronym for three kinds of knowledge: technology, pedagogy and content (Thompson & Mishra, 2008:4-14).

This research study does not only consider knowledge of technology as a construct in the teachers' development of TPACK (Mishra & Koehler, 2006), but also considers factors such as self-efficacy, motivation and continuing professional teacher development (CPTD) to be at the core of effective technology integration of practising teachers. For the purposes of this study I explore the impact of CPTD and how teacher development can improve knowledge and skills to teach effectively with technology. It reviews CPTD in detail in Chapter 2, because this process has a bearing on this study. The TPACK (2006) model proposes two basic arguments. The first argument looks at the thoughtful interweaving of the three main constructs of technology, pedagogy and content knowledge which is needed by the teacher to ensure the productive and pedagogically aligned application of ICTs in education. The second argument reiterates that no single solution applies for every teacher, every course, or every view of teaching (Mishra & Koehler, 2006). Teacher development activities, therefore, should consider the individual and personal ways in which teachers learn.

TPACK (2006), which constitutes the theoretical framework for this study (as discussed in detail in Chapter 2), is a combination of three sources of knowledge, which are technological knowledge (TK), pedagogical knowledge (PK) and content knowledge (CK) (Mishra & Koehler, 2006; Chai, Koh & Tsai, 2010). Fundamentally then, TPACK explores and describes teachers' comprehension of technology, and of how technology (ICTs) can be employed as a

pedagogical tool in teaching and learning (Mishra & Koehler, 2006:1017-1019). It is further argued that TPACK becomes a 'conceptual lens' with which to interpret and categorise the unique technological knowledge that teachers need to develop and to embed into their instructional practice so that it fosters student learning (Niess, 2012:1) Furthermore, teachers' thought processes and the decisions they make when planning for technology integration are intricately woven together with their knowledge of content, pedagogy and technology (Borko, Whitcomb & Liston, 2009). The shift towards technologically-enhanced teaching at the site where this research was conducted increasingly demanded that teachers embrace technology and become innovative in the classroom.

Practising primary school teachers are not specialists in any one subject area, and are considered to be generalists who have a more holistic approach to teaching. They are expected to teach all subjects in the Foundation Phase and a number of subjects in the Intermediate Phase curriculum (Motshekga, 2009:67). Very often this lack of specialised knowledge influences the primary teacher's perceptions of technology in the classroom. Teachers need to consider the use of digital tools for all the subjects that they teach and also evaluate how it impacts on their lessons. The application of technology, pedagogy and content can help teachers structure, organise, or enhance the activities that facilitate learning outcomes, as required by the Curriculum and Assessment Policy Statements (CAPS, 2012). Paper is no longer the dominant technology (Nov, 2010:276), new technologies are designed to store and retrieve information and resources which change the traditional planning paradigm. Teachers generally, as well as the participants in this study in particular, have expressed concerns that copious content must be covered in the CAPS curriculum, which leaves the teacher with limited time for innovation with technology. Teachers are expected to meet the learning needs of all learners, who, in turn, are expected to achieve the curriculum outcomes. Such an expectation often causes tension due to demanding schooling structures and diversity in the learner population (Slavin, 1987:175). Technology was perceived as an 'add-on' by teachers during the initial stages of this investigation and not as a tool for learning and teaching.

Teachers who want to explore the benefits of digital technology, therefore, need to integrate technology into all the subjects that they teach. This means that teachers have to understand and assimilate the content, develop the appropriate technological competencies and then link these skills to their pedagogy, in order to ensure compatibility between the chosen technology and the curriculum outcomes. Jones and Mooreland (2004:123) mention that for a new curriculum area such as technology, this process represents particular challenges for teachers as they search to construct a coherent, technological content base and appropriate assessment practices. This integration requires (Starkey, 2012:108) curriculum flexibility

because the learning is unpredictable and cannot be explicitly stated as a prescriptive content outcome. However, learners in classrooms possess a diverse range of learning abilities and needs. The ICT innovations in the classroom are not always geared towards learners who have barriers to learning (Williamson, 2014:1). Teachers might need to be skilled specifically to employ technologies in a supportive capacity in order to address these learning barriers.

The main focus of many teachers in the South African classroom remains the delivery of a curriculum thus, as mentioned above, employing technology to deliver this curriculum becomes an 'add-on'. Instructional methodologies of teachers who are fearful of technology then lack the potential benefits of emerging technologies. Klopfer *et al.* (2009:2) contend, therefore, that teachers need the necessary training to become skilled users of technology, and that changing existing instructional approaches is not an easy task, particularly when digital technology is involved. "Adopting and integrating technology-based instructional strategies according to Klopfer *et al.* (2009:2) has a long history of challenges, but with it has come a great understanding of how to achieve success with them." Therefore, until teachers become intimate with knowledge of technology, exploiting its full potential for teaching and learning will remain under-utilised. In the chapters that follow I will explore some pertinent aspects related to: specific challenges experienced when using technology in the classroom; strategies for overcoming these challenges in order to achieve successful learning experiences for both teachers and learners; and the future of these technologies and their impact on learning and teaching.

The Guidelines for Teacher Training and Professional Development (DoE, 2007) outline an initiative undertaken to implement the White Paper on e-Education. This Framework is also an attempt to provide direction in addressing the ICT training needs of teachers and endeavours to move away from imposing a narrow vision of the appropriate use of ICT in teaching and learning. It states unequivocally as one of its policy goals that "all teachers will thus require the knowledge, skills, values and attitudes, as well as the necessary support, to integrate ICT into teaching and learning ..." DoE, 2007:5). (In Chapter 3 I will outline the most salient aspects of literature on this Framework). Communication technologies are continuously developing and impacting ways in which we operate and, consequently, have brought about a period of transition for education. New opportunities and new concerns and problems about knowing when, where and how to use knowledge and strategies for guiding students' learning with digital, networked and open approaches can be both stimulating and perplexing for teachers in classrooms (Weller, 2011:27).

1.3 Aim of the study

The foremost aim of this investigation is to trace how practising primary teachers acquire this new domain knowledge of technology and how it translates into embedded classroom practice. The presence of technology in the classroom compels teachers who have not been trained during the technological era and who are not technically skilled, to first become efficient users of technology. A further aim of this investigation is to follow teachers' trajectories as they adopt and integrate technology-based instructional strategies and develop competencies to meet the requirements of mediating teaching through technology. Against this background this study follows and documents the trajectory of ten in-service primary school teachers who have not been trained in the use of technology and, therefore can be described as "digital immigrants", a metaphor used by Prensky (2008:5) to describe teachers who received their training prior to the emergence of digital technologies in classrooms.

1.3.1 My personal rationale for undertaking this research project

My interest in pursuing a study of this nature emanated from an extreme curiosity when, in the late 1980s, computers were utilised to manage business systems. At that time the lone computer could be seen at schools, such as the one where I was teaching. It was mainly the prerogative of the school secretary to type minutes for meetings and question papers for teachers who were not confident and competent enough for such a task. Increasingly schools employed available computer software programs to assist teachers to capture test scores and design the school timetable. It was in the early 1990s that research literature claimed that technology should be viewed as an enabler - and provided evidence of its potential uses in educational innovation.

The international literature which interested me at that time also attested to the powerful impact of ICTs on teaching and learning. Hernández-Ramos (2005:39) revealed that exposure to technology in teaching preparation programmes, knowledge of software applications, and constructivist beliefs, were found to be positively related to more frequent use of technology by teachers, both for themselves and their students. Erben, Ban and Castenda (2009) echoed similar claims to this effect in a summary of works produced by other researchers in which assertions are made about the benefits of computer-assisted learning. These claims increased my interest, thus when the opportunity arose for me to teach at a school with a forward-thinking vision, which provided teachers with classroom computers and well maintained technological infrastructure, I was inspired to change my classroom practise and enhance my teaching with technology. This adjustment has influenced my pedagogical stance and my journey with technology.

At a personal level, I have always been motivated to encourage professional colleagues to explore how technology might change their classroom practice and provide innovative ways for learners to construct knowledge and for teachers to transform traditional teaching practices in multiple effective ways. This study has developed out of my experiences and exploration of ways to assist learners with learning barriers through the utilisation of computers. As my own reading and research progressed, I realised that ICTs are inextricably bound both to the curriculum and to organisational transformation at schools, such as the one where this study was conducted.

1.3.2 The research context

I am currently a Learning Support teacher at a school which operates as an independent charitable school and is registered as a 'Not for Profit Organisation' (NPO). This school has more than seven hundred learners, who are mixed in terms of gender composition and come from multicultural backgrounds. These learners live in low socio-economic housing and informal settlements on the periphery of Cape Town. English, as the language of instruction, is only acquired when learners enter the school at reception year level (Grade R), consequently learners are admitted to Grade R with varying levels of English proficiency or none at all.

This school provides a technology-based learning environment to its learners and teachers due to its ICT capabilities and infrastructure. When I arrived at the institution ten years ago it had one computer laboratory with 30 stand-alone desktop computers. Each teacher had the use of a desktop computer in the classroom, which was mainly used for administrative purposes and e-mails. Having a classroom computer available contributed to teachers becoming skilled in using technology. The site now has three modern computer laboratories equipped with Internet-connected computers and associated accessories, such as printer scanners (which provide one-to-one computer to student ratio). Learners are timetabled to receive two ICT lesson periods (Information and Computer Technology) per week starting at Grade R through to Grade 7. The 'Computers 4 Kidz' curriculum is followed.

This curriculum links computer-based activity to themes in the CAPS curriculum for the Primary Grades. A qualified ICT trainer, who teaches from Grade R to Grade 7, manages the junior computer laboratory. The second and third laboratories are available on a rotational basis, or scheduled request, for teachers to use for instructional purposes when teaching learners from Grade 8 to Grade 12. The third laboratory has been furnished with laptop computers, which has introduced the learners to the possibility of mobile computing. Recently tablets were acquired to introduce the senior learners to asynchronous interaction in which learners and teachers have the freedom of time and location to participate in mobile 'anywhere, anytime' learning.

The school library is equipped with eight computers for research purposes by learners. Eight more computers are available for the site's Learning Support Unit. Interactive whiteboards (IWB) and, in some instances, electronic smart boards, have been installed in the classrooms and are connected to the Internet through Wi-Fi and Local Area Network (LAN). Data projectors and digital and video cameras are available on request. Older technologies such as overhead projectors are available for those who still prefer to use these older technologies.

Each classroom in the Foundation and the Intermediate Phases has a computer station for use by learners. The management of the school has provisioned two desktop computers for use by the learners in the classroom. As computers become available these stations will be extended. Computers in the classrooms enable teachers to provide learner enrichment and support and extend advanced learners. Thus, embedding computers within the classroom will facilitate a more interactive and collaborative approach between teacher and learners. It can also be utilised to provide engaged support as well as personalising and differentiating the learning experiences of struggling learners.

All teachers at the research site have been issued with laptop computers for both administrative and personal use. These laptop computers now afford the teachers the opportunity to access online learning from home after school hours. The possibility of connecting with other teachers or professionals, as well as preparing technology enhanced learning activities for learners, are some of the advantages of using ICTs, to name but a few.

Teachers at the research site are also exposed to the skills of integrating ICTs in their teaching through workshops and other professional development activities, which take place on a regular basis. However, these workshops are often met with resistance due to the top down approach which is used when deciding on training for teachers in terms of their professional development needs. These courses are mainly based on skills development and the ability to use a specific set of tools and/or applications.

Although technology and internet connectivity are readily available, embedding the use of ICTs in all subject areas across the Foundation, Intermediate and Senior Phases remains sluggish and at the pace of individual teachers. This observation is supported by the explicit view of Cuban *et al.* (2001:827) who purport that teachers only superficially accept technology into their work, even when technology is available to both themselves and their students. Typically, teachers use linear, authoritative, teacher-centred methods. They disregard computers and resist efforts to move the dominant paradigm away from teacher-centred teaching to a more student-centred classroom (Cuban, 2001:830).

Teachers, who are not assisted to manage technology in the classroom, resist this unavoidable ICT paradigm shift in education. More recent decisions by the leadership of the school promoted a move towards a more standardised provisioning of technology. An embedded approach of technological infrastructure in the classrooms will accommodate the individual teachers' daily classroom practise. The proposed shift is to first ensure that priority areas, such as Languages and Mathematics, are receiving the necessary ICT provisions.

Juxtaposing the resources of this school against the majority of schools within a radius of just a few kilometres highlights the dichotomy of well provisioned versus poorly provisioned schools. The stark reality of "digital divides" (Hsieh, Rai & Keil, 2008:16), poverty and inequalities are mirrored countrywide. The achievements of learners in poor communities in post-apartheid South Africa is noted by Chisholm (2011:57). She mentions how the benefits of education are largely obliterated by vast socio-economic inequalities, as well as disparities in learning outcomes and the exceptionally weak literacy and numeracy results of learners in poor communities. She further contends that the approach in basic education is informed by the view that schools can (and should) make a difference in poor communities.

1.3.3 Transformation through technology integration

Shortly before I embarked on this study and the review of the literature available on policy documents, I familiarised myself with the contents of the policy framework for e-Education (DoE, 2004). As a result, I came to realise that the staff at the research site did not consult this policy, and that the majority of teachers who participated in the sample project were not aware that such a policy existed. As my research progressed I realised that effective and transformative ICT integration cannot be separated from organisational transformation. Transformation through ICT integration implies changes to classroom practice and methodology. Such transformation should be guided by a supporting curriculum. Therefore, for ICT transformation and innovation to be sustained, appropriate professional development of teachers should be embedded in such transformation.

Mouza (2011:1-29) investigated how professional development influenced teachers' use of technology, content and pedagogy. She claimed that professional development increased teachers' ability to make this connection. Thus I addressed the research problem by posing the question of how teachers, through professional development activities, gain the domain or curriculum knowledge of technology necessary to integrate this technology effectively with their classroom and teaching methodologies. Secondary questions focused on the acquisition of content knowledge, the efficacies and barriers that impact on the integration, and the pedagogical benefits of this integration on teaching and learning. Anecdotal evidence and my observations during the fieldwork highlight that the participants initially viewed the integration of

computer applications in the regular classroom practice as complicated, unreliable and often time consuming. Teachers' exposure to technology at the research site has mainly been techno-centric and, therefore, skills-based.

Pritchard (2004:248-262) maintains that if teachers have not been introduced previously to meaningful technology-based approaches that provide a challenge and purpose to the activities (a frequent occurrence in authentic situations), they fail to visualise technology's potential to improve learning. Jacobsen (2001:488) believes that many teachers worldwide are unable to adopt technology for teaching or learning tasks, and that the gap between the presence of technology in schools and its effective use is too wide. Researchers (Roschelle, Pea, Hoadley, Gordin & Means, 2000:76-101) caution that the promises of ICTs to transform education could not be realised without a focus on cultural aspects such as curricular goals; compatibility with assessment; the need for teachers to collaborate; and the need for on-going pedagogical and technical support.

A gap has been identified in the research with regard to how teachers plan for pedagogically supported technology integration. A few case studies by researchers (Harris & Hofer, 2011; Hofer & Swan, 2008; Beeson, 2011) outline descriptions of teachers' thinking about technology, pedagogy and content when planning for technology integration. However, there is a need to further explore how teachers' own teaching philosophy influences their classroom practices with regard to technology. Chapter 2 briefly alludes to the metaphor of the 'teacher iceberg', through visual depiction, as a way to view the extent of the societal and cultural nature of an individual that lies hidden beneath the surface.

1.4 Assumptions

The school where this study was conducted made known its vision to provide computer-based technologies to teachers and learners in its policy documents and operational programmes. A general assumption of the school is that technology-supported teaching would enhance and promote learner achievement.

I also assumed that the majority of teachers would embrace these new "digital technologies" (Bransford, Brown & Cocking, 2000:218) to enhance their teaching practices and move closer towards preparing learners with 21st century skills so that they would be skilled for the notional knowledge economy. I also supposed that utilising these digital tools would stimulate teachers to explore, reflect and then embed technologically enhanced practices into their current practices, while, at the same time, grasping their pedagogical value within the ecology of the classroom.

A further assumption was that teachers would begin to realise that literacy practices were changing. That old methods were being replaced by new multi-literacies through multi-media, and that technology integration in the classroom could lead to higher levels of learner engagement. I believe that the potential of technology offers a more learner centred-approach, which will allow learners to engage in personalised and differentiated learning activities that help them build, construct and consolidate knowledge. A barrier to this belief is that one's understanding is impeded by the very complex nature of technology itself and how it might be rooted in current classroom practices. Technology also has the potential to be 'disruptive' and 'volatile'. Teachers are no longer the sole gatekeepers of knowledge, because technology allows learners to access alternative 'pools of knowledge'. This state of unpredictability can challenge teacher authority, causing tension in the teacher-learner relationship. Enumerating personal assumptions is difficult as it is usually a very subjective process. I interrogate and elaborate on the underlying values of these assumptions in Chapter 4.

1.4.1 Research questions

An overall objective of this study is to gain insight into teachers' development of technology, pedagogy and content knowledge (TPACK) and how this acquired domain of knowledge might impact their classroom practice and innovation through technology integration.

The key research questions that guide this research are:

- i. How can teachers acquire knowledge about instructional technologies to enhance their teaching?
- ii. Which factors impact on the development of teachers' TPACK?
- iii. How does the use of technology impact on the traditional pedagogic practices?

The following sub-questions focus on the teacher's 'thinking and beliefs' about technology and seek to understand how teachers' knowledge, beliefs and attitudes influence the decisions that they make when integrating their lessons with technology:

- a) What are the factors that impact the sustainability of a technologically enhanced classroom practice?
- b) What kind of decisions do teachers make when planning to integrate technology into their lessons?

The first sub-question explores how technology integration practices can be sustained by teachers as they adopt technologically enhanced practices.

1.5 A brief motivation of the research design and methodology

Deciding on a research paradigm requires the setting of parameters (in terms of width and depth), since each paradigm dictates, to a certain degree, its own guiding epistemology, axiology, ontology and methodology. However, within any one paradigm there are many variations that, in the case of this study, consisted of selecting factors that best suited this research project. Schunk (2000) argues that educational research that draws upon constructivism strives to empower participants' perspectives and ideas, and obtains rich descriptions of the contexts that surround their lives. Individuals' experiences often require strategies of inquiry (unstructured interviews, case studies) and offer an in-depth exploration of their experiences. In teaching and learning with technology, social constructivist approaches underpin reciprocal teaching, peer collaboration, cognitive apprenticeships, problem-based instruction and other methods that involve learning with others. The findings of educational research referred to by Schunk (2000) rely on the interpretation of multiple perspectives because they are constructed and voiced in the context of social interactions. Similarly the focus for this study needed to consider organisational values, assumptions, beliefs, observed practices, physical environment, relationships, leadership commitments and the micro-politics at the school, as outlined by Cohen, Manion and Morrison (2011:138). These factors all underpin the embedded transformation through ICTs which this study sought to investigate.

In order to satisfy the needs arising from the research questions I used a methodology that enabled me to analyse the experience from the teachers' perspectives. I also wanted a methodology that would maintain the integrity of the thesis and provide a narrative perspective of the participants' experiences using an interpretive frame through case study analysis. Data generation for this ethnographically based case study research took place over a period of eighteen months. This investigation was conducted with a purposive sample of in-service primary school teachers at an independent and socially-conscious school in Cape Town, South Africa. Six of the participants in this investigation are teachers in the Foundation Phase. Two participants are Language teachers in the Intermediate Phase, one participant is a Mathematics teacher in the Intermediate Phase, and one participant teaches ICT to both the Foundation and Intermediate Phases. All the participants have been teaching at the school for longer than seven years and subscribe to the ethos, spirit and culture of the school. They have experienced the progression from a traditional curriculum, to the introduction of Resnick's (1983) Principles of Learning, which underpins the teaching methodology at the research site.

The learning programme at the school encourages academic rigour, complemented with character development. Resnick (1998:89-118) contends that endorsing the constructivist argument that children have to be active learners in order for learning to take hold does not free

us from the obligation to offer a very solid, academically rigorous curriculum with important facts and ideas in it that children have to know. It strongly advocates an application of a 'constructivist theory of instruction' (Resnick, 1983). The link between technology and constructivist learning theories is outlined in Chapter 2.

The term 'thinking curriculum' was coined by Resnick (1983), and focuses on the need to engage students in the active process of constructing knowledge by linking intellectually stimulating content to real-world contexts.

Data generation included the following techniques: classroom observations, self-assessment questionnaires, semi-structured interviews, and artefacts designed by the participants. The final instrument was documentary data which records the participation of the participants in a blended learning course for teachers, namely: Designing an Instructional Event. Participants engaged in the programme over two phases during the period June-August 2012.

1.6 Limitations of the study

Teachers who were included in the sample were agreeable to participate in the study. The main instrument used was a self-reporting questionnaire that was triangulated with semi-structured interviews and classroom observations. These observations were video recorded. Employing a digital video recorder is an expedient way to capture field observations in ethnographic research. Repeated watching of the recordings exposes the participants' non-verbal signals and provides added layers of meaning. However, video recording can be intrusive and inhibits participant behaviour. The ethnographer might also over-focus on a single behaviour trait to the exclusion of everything else (Fetterman, 2010:81).

Many challenges also emerged during the initial stages of persuading the participants to participate in this study. This shaped my approach, because I initially had to draw on personal negotiation strategies to gain 'access'. The phenomenon of a peer as researcher, who is seeking access for the purposes of a research study, raised concerns from the participants. It must be noted that the participants were initially uneasy about being judged by a peer and the fact that other colleagues might uncover their 'inadequacies' in teaching effectively with technology. Implicit in all of these problems was the aspect of my collaborating with colleagues as both an equal and a researcher, a fact which raised anxieties around collegial trust. I sketch these challenges in Chapter 5.

Selecting a case study approach has limitations that pertain to lack of generalisability. This limitation must be acknowledged. Although advocating for a no less than "rigorous methodological path" (Yin, 2009:15), case study methodology has its strengths and

weaknesses, which are outlined in Chapter 4. A further challenging limitation was related to time constraints. As a full time in-service teacher I was committed to a set teaching schedule, which did not allow for much flexibility because it was not always possible to align it with an observation session with one of the participants.

Fieldwork requires considerable time to observe and video record the participants, make notes and archive the collected data for analyses. Participant observation requires understanding of the environment on the part of the researcher. In conducting ethnographic studies of schools, for example, it has been recommended that the time of study should, at the very least, span the school year (Wolcott, 1975). My workload as a firstly as a teacher and then as a researcher, the school programme, the term holidays and other scheduled term breaks, all presented possible 'stumbling blocks'. In addition, sensitive navigation was needed to comply with ethical considerations. For this reason the intended time frame for completing the fieldwork for this study had to be extended in order to collect sufficient data. I was also cognisant of the fact that as a colleague of the research participants and an employee at the research site, researcher bias could compromise the investigation. A more longitudinal study focusing on multiple cohorts would be appropriate for future research.

1.7 Delimitations of the study

The scope of this study was limited to one school, which was privileged in terms of its resource provisions and the educational levels of its teaching staff. All the teachers employed have at least a four year professional qualification. Only the Foundation and the Intermediate Phase teachers were included in the sample because I had easier access to these teachers and could schedule research in terms of my workload. The different timetables of the two Phases prevented a possible alignment with the time available for conducting observations. It is possible that the inclusion of Senior Phase teachers might have provided a different perspective to the study.

1.8 Contributions to the research body

After a thorough search of available databases at the time of writing the proposal, I have not found evidence of a similar study in South Africa, in which the TPACK (2006:1017-1054) framework and its underpinnings are used to explore and trace teachers' development of technological and pedagogical content knowledge within the context of the primary classroom. However, a recent search towards the end of this investigation revealed a study that has employed this conceptual framework to understand ICTs in marginalised schools in South

Africa (Nkula & Krauss, 2014). This current study endeavours to contribute to the research body in the following ways:

Firstly, through a qualitative case study, employing an ethnographic approach to provide a detailed multiple case study report on 'how practicing primary school teachers develop a technological domain knowledge approach to their instructional methodologies', and how this approach impacts technologically enhanced teaching and learning in the classroom. It is hoped that this current study will be a useful contribution to the existing literature in this regard.

Secondly, the study attempts to illuminate how professional development of teachers can be extended and supported when teachers implement new strategies after attending workshops on technology integration. It further attempts to provide insight into how collaborative practices (Fullan & Hargreaves, 1998:60) can provide a way for teachers who normally work in isolation, to learn from each other, gain moral support, coordinate action, and reflect on their classroom practices, their values, and the meaning of their work.

Thirdly, the study hopes to provide a model of what could become 'a best practice framework' in the classroom for technology integration practices, bearing in mind the goals of the policy on e-Education (DoE, 2004). Interview data revealed that participants were not aware of the existence of such a policy document - it appears to be an 'invisible policy' to the participants in this study, despite the policy designer's intentions.

Fourthly, this study also aims to provide insights on the alignment of teaching practices with teachers' epistemological beliefs and pedagogical practices "Such knowledge may help to distinguish between strongly and less strongly held beliefs, and this might explain why some beliefs may be resistant to change" (Zeidler, 1997:483-496). The study further aims to benefit teachers in equipping them with skills in the use of technology in teaching in order to improve classroom practice. Sutherland *et al.* (2009:213) propose that teachers need to be brought into the circle of knowledge production about their own practice, rather than be bystanders in a process that treats them as objects. In this way one can deal with concerns of epistemology and methodology.

Lastly, this research also aims to design a Classroom Integration Model (CIM), which will follow a blended approach and will focus on the use of computers in Grade 3 classrooms to support literacy practices. Computer-based activities will be tied to the current curriculum outcomes for the English Home Language Programme for Foundation Phase Grade R to Grade 3 CAPS curriculum (DoE, 2011). The conception for the design of this model/framework was propelled, firstly by the dearth of such a curriculum-linked model and, secondly, to promote authentic integration of technologically enhanced lessons. These lessons are embedded within the

Grade 3 Literacy and Language Programme. Such a model will ensure sustainability in terms of new pedagogical approaches by the teacher and encourage a more constructivist learner-based approach to technology integration. Teachers' acquired TPACK confidence needs to permeate towards the conceptualisation of a learner TPACK through constructs of technology and curriculum knowledge to foster such a learner TPACK in a technologically enabled environment (see Chapter 7). According to Pahomov (2014:6), technology can increase democracy in teaching-learning interaction in a variety of ways. The most obvious of these is curriculum-based. Integrated technology can also support an intentional shift toward a more democratised classroom structure because, together with the Internet, it allows for infinite possibilities for innovative learner-centred activities in the classroom.

1.9 Key definitions and terminology

Blended learning:

Blended learning combines several different delivery methods, such as collaboration software, web-based courses and computer communication practices with face-to-face instruction. Integrated learning combines the best of classroom learning with the best of online learning (Kim, 2007:1-8).

Digital competencies:

Digital literacy is the ability to appreciate the potential of ICT to support innovation in industrial, business, learning and creative processes. Learners need to gain the confidence, skills and discrimination to adopt ICT in appropriate ways. Currently, digital literacy is seen as an essential 'life skill' as literacy and numeracy (Ferrari, 2012:4).

e-School:

An e-School is any GET or FET institution (including Early Childhood Development Centres and ABET Centres that have: Learners who utilise ICTs to enhance learning; qualified and competent leaders who use ICTs for planning, management and administration; qualified and competent teachers who use ICTs to enhance teaching and learning; access to ICT resources that support curriculum delivery, and connections to ICT infrastructure (DoE, 2004).

Information communication and technologies (ICTs):

ICT is a term used to describe the items of equipment (hardware) and computer programmes (software) that allow one to access, retrieve, store, organise, manipulate and present information by electronic means. Personal computers, scanners and digital cameras constitute

the hardware category; and database programmes and multi-media programmes the software category (DoE, ICT, 2004).

ICT integration:

ICT integration into curriculum delivery involves acquiring ICT competency together with the "appropriate selection, use, mix, fusion and integration of many sets of competencies including, but not limited to, those in pedagogy and technology" (Information and Communication Technology in Education, UNESCO; 2003:18). These competencies, once achieved and contextualised, create new learning environments in which learners take decisions about their own learning while teachers facilitate the process.

ICT literacy:

The Programme for International Student Assessment defines ICT literacy as "the interest, attitude and ability of individuals to appropriately use digital technology and communication tools to access, manage, integrate and evaluate information, construct new knowledge and communicate with each other in order to participate effectively in an information society" (Partnership for 21st Century Skills, 2003). ICT literacy is the ability to use practical ICT skills in a particular context.

Teacher agency:

Teacher agency is typically viewed as a quality within teachers, a matter of personal capacity to act usually in response to stimuli within their pedagogical environment. It describes a teacher who has both the ability and opportunity to act upon a set of circumstances that presents itself within that individual's leadership, curricular or instructional roles. The teacher described would then draw from acquired knowledge and experience to intercede appropriately and effectively (Priestly *et al.*, 2012:191-214).

Teacher beliefs:

Teachers' beliefs are usually conceptualised as a tacit set of often unconsciously held assumptions regarding educational issues and processes such as teaching, learning, curriculum, schooling, and knowledge (Elen & Lowyck, 1999:145-169).

1.10 Outline of the study

This thesis consists of eight chapters.

Chapter 1 situates the context within which the study is located. It concentrates on, and sketches the background to the research problem, context of the study and the research questions. The study investigates and explores how teachers firstly, gain knowledge of technology and, secondly, how this new domain of knowledge is employed to use technology as a tool within teaching methodology. A multiple case study employing 'within-case' and 'cross-case' analysis (Yin, 2014:164) allowed me to analyse the data collected - through multiple instruments - from the ten participants as they engaged with technology in the primary classrooms. Individual case study reports of four of the participants are presented and compared for common themes.

Chapter 2 introduces the theoretical framework TPACK (2006) and its underpinnings in this study. It firstly summarises the development of the TPACK framework, thereafter I indicate what recent literature and on-going research reveals about the continued development of the framework. I review how TPACK (2006) is conceptually rooted in the PCK of Shulman (1987) and explain the lines of enquiry that were followed to explore teachers' knowledge of technology. I describe the views of Mishra and Koehler (2006) on a pedagogy driven approach as opposed to a technical approach to integrating technology within the curriculum. I alert the reader to the constructs and sub-elements of the framework, and provide a brief description of each of the seven construct domains that constitute the framework.

These constructs are employed in the self-report questionnaire as categories on how the participants understand and rate their development of TPACK. I reserve a section of this chapter to illuminate the Constructivist and Cognitivist learning theories, Complexity Theory and Connectivism and Wertsch's (1985) views on instrumentation and appropriation and its bearing on this study. The rest of the chapter reviews salient features pertaining to the educational practices of teachers when utilising technologies in their teaching methodologies. I finally situate the participant teachers within the frames of continuing professional teacher development (CPTD). I then conclude this chapter with views on teaching and learning practices, access to ICT resources and support to teachers as well as capacity building for ICT integration.

Chapter 3 focuses on the dominant discourses and debates around current policy documents and their relevant underpinnings in this research. The chapter also raises concerns that have emerged from the review of the policy on e-Education which was influenced by South Africa's political and economic development, curriculum change and the rapid development and uptake

of the Internet. The policy clearly recognises the shift in teaching and learning processes. There is consensus regarding the positive benefits of new forms of learning, because the range of sources of information through the Internet and "pools of knowledge have increased exponentially" (Sutherland *et al.*, 2009:5).

Chapter 4 synchronises the epistemological underpinnings, procedure and methodology employed in this study. I discuss the research design, the sample selection, the related components of the research design and focus on answering the research questions. I motivate the selection of the instruments employed for data collection and the utilisation of a case study methodology and then outline the data production plan and elaborate on the mode of enquiry which involves an ethnographic research approach. I exploit Vaughn, Schumm and Sinagub's essential steps (1996:99-104) associated with data analysis strategies in the data analyses procedure. I then explore the role of triangulation in supporting the value and integrity of the data. I use McMillan and Schumacher's (2014:353-354) list of ten strategies to enhance the design validity. I conclude this chapter with an explanation of the role played by ethical considerations in this study.

Chapter 5 presents the findings of this study. I describe the trajectories of a sample of teachers who teach in the Foundation and Intermediate Phases at a primary school and closely examine how they develop digital competencies and become familiar with technology. I present the findings gleaned from the various datasets. Pseudonyms are used so as not to compromise the integrity of the participants. Although this study is mainly qualitative, I employ quantitative data to supplement the findings of the self-report questionnaire. These findings suggest that teachers' understanding of knowledge is idiosyncratic and that measuring and understanding teacher knowledge is complex. There is also a suggestion that a TPACK-mind-set is necessary to successfully integrate technology within the curriculum. Despite the E-policy's intention, this study identifies omissions in teachers' knowledge with regard to this policy.

In **Chapter 6** the analysis of the data identifies three scaffolds that could have a significant influence on the long-term sustainability and growth of how primary teachers continue to integrate technology into their classroom practise. The first scaffold points to teachers' personal views on technology integration. The second scaffold suggests that activities should be curriculum linked, together with a technology integration framework that can act as a point of reference to select technologically enhanced activities. The third scaffold is a long-term whole school technology vision for future directions, a vision which, together with the school leadership, is negotiated within a consultative process.

Chapter 7 articulates the motivation for a classroom integration model (CIM). It is proposed that the model should be implemented in the Grade 3 English Language Literacy programme.

Although the advancement of technology integration to enhance the understanding of curricular content has permeated the daily activities in the classrooms, it lacks a well-designed technology integration model for the embedded use of technology in the primary classrooms. The provision of a framework for teachers to integrate technology, will not only serve to create interesting tasks for learners, but will also "deepen their understanding, and take learners beyond recall, recognition and reproduction" (DoE, ICT, 2004), a process which will move technology away from the periphery and the view that teachers currently have of its limited potential benefits for learners. A structured integration plan will result in closer collaboration between the same Grade teachers.

Chapter 8 concludes the thesis by offering a summary of the main findings before it proceeds to make recommendations, which emanate from the study. Suggestions for further research complete this chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The literature review was conducted to find a conceptually credible framework to understand teachers' learning about technology and how the adoption and integration of technology became reified in teaching methodologies. The introduction and integration of emerging technologies or ICTs in the classrooms, as an approach to transforming learning and teaching, requires teachers to reflect on their current classroom practices. TPACK, as a framework, is essential for teachers to promote effective teaching with technology. As newer technologies continue to emerge and permeate all levels of society, schools have been compelled to focus on how the professional development and support of teachers might contribute towards enhancing and developing this emerging knowledge domain as a means of enhancing teachers' digital competencies and skills. Koehler and Mishra (2009:61) explain that TPACK examines the entire teaching performance. Technology integration does not require one single pedagogical orientation but a spectrum of approaches to teaching and learning. Chapter 2 reviews some of the available literature on TPACK and how this framework links with this research.

The literature review is organised as follows:

Section 2.2: An explanation of the lines of enquiry, and concepts which locate the study;

Section 2.3: The development of the TPACK construct; the framework as it pertains to this research; the framework and its conceptual underpinnings; and the constructs of the framework;

Section 2.4: A review of learning theories and technology;

Section 2.5: A review of literature relating to teachers' beliefs concerning the adoption of technology; factors related to primary school teachers' use of computers; technology and continued professional teacher development; access to ICT resources and teacher support; and

Section 2.6: Conclusions drawn from the chapter.

2.2 An explanation of the lines of enquiry

This study, through a two-pronged line of enquiry, probes primary school teachers' (Foundation and Intermediate Phases) current usage, competencies and integration of technology into their classroom practices. The first line of enquiry investigates and explores teachers' knowledge of technology. It also examines how teachers' knowledge of subject content, pedagogy and teaching with technology, were characterised by a shifting or fluctuating relationship among the TPACK constructs, during the initial phase of adopting technology into their teaching practice. This integration process was followed by the various subsequent fluctuating phases that this trajectory of integration ran for each participant, during the investigation. The second line of enquiry probes the practical adoption and understanding of a new knowledge domain and its context, content, design, application and assessment, as teachers' technological knowledge deepened.

Donnelly, McGarr and O'Reilly (2011:1469-1483) situate the individual teacher as an important starting point in understanding change within the use of ICT in schools. Relevant teacher expertise (Ruthven, 2013:1) underpins successful integration of technology. Research by Niess (2005:509-523) observes that teachers are faced with challenges and questions regarding how to incorporate such technologies into teaching and learning. While there are still many hindrances and barriers faced by teachers, these teachers play a critical role in driving the use of technology as a teaching tool. While many writers view access to digital technology as a basic right of 21st century citizenship, Murdoch (2002) asserts that the 'digital divide' remains a threat to the development of an Information Society in developing countries, including South Africa (Bridges, 2002).

From an investigation and review of available literature by Wilkan and Molster (2011:209-218) it is noted that teachers' use of ICT often reflects the outside expectations placed on teachers to use ICT, rather than how its practice might contribute to student understanding. The use or uptake of the resources becomes the focus rather than the pedagogical application of ICT as a learning tool or, indeed, how it supplements existing mainstream teaching approaches.

Research, therefore, in recent years, focuses on the adoption of emerging digital technologies and loses sight of their pedagogical ideals and uses as learning tools. Bertram and Waldrip's (2013) study of secondary school teachers' views on technology as a tool for teaching revealed that ICT was being used for the sake of ICT rather than any meaningful pedagogical purpose. Similarly, Selfe (1990:119) remarked that, "until we share some theoretical vision of this topic [teaching with digital technology], we will never glimpse the larger picture that could give our everyday classroom efforts [greater] direction and meaning."

2.2.1 Concepts which locate the study

This study also sought to better understand teachers' skills, competencies and knowledge of technology and how emerging and pervasive digital processes determine how teachers think about technology. It was, therefore, appropriate to locate the study against the background of what constitutes digital competencies and digital divide theories.

2.2.2 Digital competence

With the rapid descent of emerging technologies in all spheres of society, and the uptake and adoption of ICTs by some schools and higher institutions of learning in South Africa, it becomes necessary to situate and understand this research in its proper context. This context is encapsulated within the policy framework on e-Education, which states that teachers who acquire digital competencies will enhance the quality and reach of their teaching. Ferrari (2012:4) provides an encompassing definition of digital competence in an analysis of ICT frameworks (see Definition of Terms in Chapter 1).

Ferrari (2012) further posits that Digital Competence is at the convergence of multi-disciplinary fields, and implies the ability to understand media and being able to communicate with others using a variety of digital tools and applications. The concept of Digital Competence is a multi-faceted moving target, covering many areas and literacies and rapidly evolving as new technologies appear. Being digitally competent today implies the ability to understand media (as most media have been/are being digitalised), to search for information and be critical about what is retrieved (given the wide range of material available on the Internet) and to be able to communicate with others using a variety of digital tools (mobile equipment and Internet) and applications (Ferrari, 2012:4).

2.2.3 The digital divide

The gap between those who have access to information, communication and technology and those who do not has been called the 'digital divide'. In knowledge economies digital inequality is a critical issue. Hsieh *et al.* (2008:16) further postulate that the 'digital divide' is a severe problem preventing the socio-economically disadvantaged (SED) from participating in a digital society. The United Nations (2008) highlights poverty and inequality as two of the greatest challenges facing mankind in this millennium. One of the major imbalances that must be addressed is universally known as the 'digital divide'. The term 'digital divide' came into use in the mid-1990s and describes the troubling disparities that currently exist in terms of access to information technology (ITU, 2007). The term originally referred to computer access. However,

the advent of technology has seen the term evolve and it now includes Internet access, broadband access, computer usage and, more recently, the full spectrum of ICTs.

The United Nations Development Programme (UNDP) defines ICT as including the full range of electronic technologies used to manage information and knowledge. Kebede (2004:273-279) mentions that ICTs are the core tools through which information is captured, processed, stored, manipulated and exchanged in the information age. ICT has renewed a discussion of knowledge; what knowledge can mean; what human beings can do and know and what machines cannot do and know (Dreyfus & Dreyfus, 1986; Dreyfus1992).

The OECD literature (Rosenkvist, 2010) reports that the development of digital competencies is part of the set of the so-called '21st century competencies' which are increasingly becoming an integral part of the goals of compulsory education. The OECD further explicates that, in a knowledge economy driven by technology, people who do not master these digital competencies may suffer from a new form of digital divide that may affect their capacity to fully integrate the knowledge economy and society. The report states that evidence unveiled that the digital divide in education goes beyond the issue of access to technology. The policy on e-Education (2004) lists a number of these issues such as: local content development; collective knowledge generation; the capacity of workforces to play roles in the Internet age; overcoming cultural inhibitions; insecurity about developing competence for surviving the constant evolution of the Internet; and the creation of a risk-taking culture; and concludes that ICT is a core feature of innovation and competitiveness. The most recent trend statistics (ITU, 2015) indicate that while 3 billion people globally were using the Internet by the end of 2014, accessing the Internet still remains a privilege that is denied to economically disadvantaged communities.

A new and second form of digital divide has been identified, the one existing between those who have the right competences and skills to benefit from computer use, and those who do not. These competences and skills are closely linked to the economic, cultural and social capital of the learner. The International ICT Literacy Panel (2007) echoes this view and regards digital competence as both a requirement and a right of citizens, if they are to function effectively in today's society. However, Lenhart (2002) discusses digital inequality between individuals with different backgrounds, arguing that this inequality prevents the socio-economically disadvantaged from exploring digital opportunities.

The next section of this chapter mentions various bodies of literature that focus on the TPACK (2006) framework and its conceptual underpinnings. It reviews the TPACK framework (Chapter 2.2) and its underpinnings in the PCK construct (Shulman, 1987:15). The TPACK model reinforces the importance of integrating pedagogical skills in ICT. Providing a pedagogy-driven strategy to incorporate technology into educational processes is the main objective of this

framework. The selection for this framework is applicable because it encapsulates the pedagogy-driven strategies when technology is incorporated in the educational process for effective teaching with technology. This framework is further expounded later in this chapter.

2.3 The development of the TPACK construct

The effective use of technology (ICT) within the mainstream curriculum as a pedagogical tool integrated into classroom practice forms the pivot of this research. Therefore, the focus is on the effective and competent use of technology by teachers as a pedagogical tool, as well as on an awareness of strategies, skills and knowledge that incorporate the use of technology to enhance learning and teaching (Cox *et al.*, 2013; Niess, 2011). The relationship between technology and education has led to an increased focus on this area of research. McDougall and Jones (2006:353-360) posit that, educational technology as a field has struggled for several decades to find its theoretical roots. Following an iterative process, I began a broad search of peer-reviewed journals to identify research related to relevant frameworks which would guide this research. This exploration has led me to the studies of scholars and researchers such as Mishra and Koehler (2006), Cox and Graham (2009) and Niess (2005, 2011) who have contributed to this body of knowledge of technology integration and the TPACK framework.

Current research reports that a growing number of teachers integrate computer tools and technological applications to support curriculum delivery. Computers and interactive white boards (IWB) are increasingly used in urban classrooms in South Africa and in urban centres on the rest of the African continent. "It has been realised that teachers who wish to integrate technology in their teaching should develop the necessary competencies required" (UNESCO, 2008:5). Three types of knowledge, namely technology, pedagogy, and content knowledge (TPACK) are necessary to implement and successfully integrate technology-enhanced activities. These three constructs interact to support teachers in effective technology integration. Technology modifies pedagogy and pedagogy dictates requirements to technology (Di Blas *et al.*, 2014:22).

Teachers are expected to become proficient users of technological applications. In empirical research by Angeli (2005:383), Angeli and Valanides (2005:292) and Mishra and Koehler (2006) deficits in terms of a theoretical and conceptual framework to inform and guide research in the area were identified. The lack of a suitable framework at the time to understand this unique and distinctive body of knowledge needed by teachers to teach with technology was a major weakness in the educational technology literature. Researchers, in recognising the lack of a sound theoretical orientation, initiated research efforts for the purpose of developing theory

and models to ground research in the area of teacher cognition about technology integration (Angeli, 2005; Angeli & Valanides, 2005; Margerum-Lays & Marx, 2003; Mishra & Koehler, 2006; Niess, 2005:509-523). Researchers such as Cox and Graham (2009:5) and Graham (2011) report on the value of the TPACK framework for issues related to facilitating the uptake of digital technologies. Other researchers (see, for instance, Archambault & Barnett, 2010:1656) have focused on measuring teachers' TPACK with a validated survey instrument. Notwithstanding this fact, the weaknesses of defining the boundaries of the interrelated constructs of how teachers acquire TPACK (Mishra & Koehler, 2006:1017-1021) have also been identified and these call for a more constructive theoretical development.

More recently I searched the literature again for further studies on how other researchers and scholars have interpreted and continue to develop the TPACK framework. A consequent review of Niess (2012:1) reveals a tendency to view TPACK as a dynamic lens that describes the teacher knowledge, which is required for designing, implementing and evaluating curriculum and instruction with technology. She also refers to a need for on-going empirical research to illuminate values and challenges for future research that is designed to identify a teacher's learning trajectory in the development of a more robust and mature TPACK for teaching with emerging technologies. Cox and Graham (2009:5) proposes an Elaborated Model of TPACK to analyse and depict teacher knowledge, noting that the centres of the TPACK constructs have been adequately defined by Mishra and Koehler (2006). However, the boundaries between the constructs need to be clarified to articulate a more precise definition of the core constructs and their permutations.

Ruthven (2013:2), in his research, refers to ambiguities in the way in which TPACK is - and has been - used. He firstly highlights that the character of the interactions between knowledge domains remain under-analysed and is, therefore, weakly defined. Secondly, there is a hierarchy implicit in the labelling rules under which content is more fundamental than pedagogy, and both of these are more fundamental than technology. According to Ruthven (2013:2), "more intensive research work at this more concrete level could serve to better operationalise the current frameworks or to fuel the development of a single, more powerful one."

Much of the research and scholarly work on TPACK, as described by Niess (2012:2), has emphasised a 'cognitive constructivist' approach in which teachers engage in transforming, organising, and reorganising their previous knowledge for teaching, using appropriate technologies. Harrington (2008) investigated TPACK of teachers using a social and cognitive perspective of teacher learning. She proposed an addition to the cognitive view of individual learning which views the TPACK lens that incorporates both the social and cognitivist

constructivist perspectives of learning as essential for teaching with technology. Such a tool could be employed for framing and characterising the teacher's developing knowledge for teaching with technology.

The authors of TPACK (Mishra & Koehler, 2006) root this framework on the seminal work of Les Shulman (1986:4-14). PCK, or Pedagogical Content Knowledge, which encapsulates and defines the character of teaching subject matter as PCK. Pedagogical content knowledge identifies the distinctive bodies of knowledge for teaching. It represents the blending of content and pedagogy into an understanding of how particular topics, problems or issues are organised, represented, adapted to the diverse interests and abilities of learners and then presented for instruction.

As far back as the 1980s, education systems globally started integrating digital technology into teaching (Pelgrum & Voogt, 2009). Starkey (2012:19) comments that its uses and functions have slowly changed over time and have been influenced by available technologies, pedagogical beliefs and practices, schooling structures and policies. The main focus at the time was not on how ICT could improve students' learning, but rather on developing students' knowledge and skills to use ICT to meet the emerging life demands of the 21st century.

Mishra and Koehler (2006) argue that technology was taught in schools as an independent discipline, prior to the development of the TPACK framework. The evidence abounds that technology was taught to develop technology experts specifically, rather than using technology as a tool to enhance learning and teaching. Starkey (2012:18) suggests an integrated approach, where technology is embedded in the classroom, for daily use by teachers and learners to communicate, access and share information and learn. This integrated and embedded approach, although ideal, could be inhibited (Ruthven, 2013:1) due to the nature of funding and resourcing in existence at many schools and other education institutions.

A pedagogy driven approach, as opposed to a technical approach, would be more desirable if it could improve the technology integration process within the educational setting, by providing guidelines for selecting appropriate technologies and incorporating them into the educational process, based on the posed educational needs (Mishra & Koehler, 2006). The latter authors also advocate that such an approach would further equip students with the necessary digital competencies to deal with the challenges of our current knowledge intensive era and to achieve control over their learning, while also improving the TPACK knowledge of teachers.

Calderhead (1996:709) observed that teacher knowledge has several origins, including teaching experience, formal teacher preparation and on-going professional development. Acquiring appropriate pedagogical practices is deemed more important than technical mastery

of ICTs (Trucano, 2005). The TPACK model reinforces the importance of integrating pedagogical skills in ICT. Providing a pedagogy-driven strategy to incorporate technology into educational processes is the main objective of this framework as it views TPACK from a "cognitive constructivist approach" (Niess, 2012:2).

2.3.1 The TRACK framework as it pertains to this research

The research literature in South Africa provides limited evidence of studies conducted on the pedagogic changes of primary school teachers attributed to the use of technology in primary classrooms utilising the TPACK (2006) conceptual framework. In my search of the domestic literature, I have not located a similar study that has been conducted in the South African context at the time when this study was conducted. However, a search of local databases through online search tools uncovered a growing body of research in Higher Education Institutions (HEIs) that have explored and employed the utilisation of TPACK as a conceptual tool. Adequate literature exists on the deployment of ICTs in schools in the various provinces. The Khanya project (2008) in the Western Cape is an example of how ICTs have been deployed in schools (Chigona, Chigona, Kayongo & Kausa, 2010:21). School leadership in well-resourced schools has realised that among the benefits of ICT is its elevated status as one of preferred choice.

Further afield a critical and analytical review of the literature revealed a number of developments in the area of the integration of ICT in education. Some literature addressed the issue of technology integration in the classroom as an effective tool (Dias, 1999; Harris, 2005); Jonassen & Carr, 2000). Other literature addressed teacher perspectives and understanding on integrating technology/ICT into subject teaching (Koehler & Mishra, 2003, 2006, 2008). More literature focuses on how to integrate technology into the language curriculum (Pedersen, 1995). There is also some literature available, such as the work titled *Emerging Trajectories and Sustainability of ICTs in Educational Reforms in Africa: Exploring the Prospects of the Teacher Laptop Policy in South Africa*, by Evoh (2009). Additional literature exists, for example one project titled *Technological pedagogical content knowledge: A new framework for teacher knowledge*, by Mishra and Koehler (2006). A search of databases revealed literature addressing theoretical considerations for understanding technological pedagogical content knowledge (TPACK), by Graham (2011), as well as literature on epistemological and methodological issues for the conceptualisation, development, and assessment of ICT-TPCK (Angeli & Valanides, 2009:154-168). Niess (2012:2) has researched teacher knowledge for teaching with technology through a TPACK lens.

The above list is by no means exhaustive. The review of the research literature further suggests that technology in education continues to be considered through traditional lenses,

primarily because currently a theory which allows researchers to understand and account for the world of communication as it is now has not yet been postulated and tested. A still limited but growing body of literature reveals that previous studies have focused on classroom teachers' perceptions of TPACK and self-efficacy (Bandura, 1997) as well as on levels in ICT (Kaya *et al.*, 2011). Voogt *et al.* (2012) point out, in an extensive literature review, the development and different understandings of the TPACK model and the success with which it has been implemented and developed.

The literature review for this investigation aimed further to illuminate the conceptual framework known as TPACK (Mishra & Koehler, 2003, 2006). It explored how TPACK is employed to describe the knowledge base for teachers to effectively teach with technology. The framework discusses the rationale for considering this approach. In an age of technological proliferation knowledge practices are changing. The literature reviewed discusses the importance of on-going professional development of teachers, emerging classroom practices in the digital age; defines digital tools and multi-media applications and how these can become a conduit for technology integration; how new media allows people to connect, communicate and collaborate easily with each other; discusses how language learning can be promoted through emerging technologies; and how digital literacies redefine being literate in a technological age.

2.3.2 A review of the TPACK framework and its conceptual underpinnings

In this section I pay particular attention to the seminal influences of the work of Les Shulman (1986). In the latter half of the 1980s the pedagogical content knowledge (PCK) construct was identified and developed by Shulman (1986:4-14) as the understanding and skill that was needed to teach learners the substantive and syntactic knowledge of a particular subject matter. Starkey (2012:95) sees PCK as a construct that is important for effective teaching. This distinctive body of knowledge emphasises the importance of the transformation of subject matter into subject matter knowledge for teaching. In Shulman's PCK (1987:8) the argument is premised on the notion that teachers develop a special type of "pedagogical content" knowledge which is more than a generic pedagogical knowledge. Teacher educators and researchers were challenged to consider the knowledge that teachers need, indicating that, as a minimal requirement teacher knowledge included: content knowledge; general pedagogical knowledge; curriculum knowledge; pedagogical content knowledge, knowledge of learners; knowledge of educational contexts; and, finally, knowledge of educational ends, purposes and values (Niess, 2012:2).

Shulman (1986, 1987) insisted on the importance of teachers' understanding of the pedagogy and content knowledge for an effective teaching profession. This model by Shulman (1986:4-14) emanated from the need for a comprehensive model of teacher knowledge. At the time

Shulman was concerned with the prevailing conceptions of teacher competency, which focused on generic teaching behaviours. Shulman (1986, 1987:117) also insisted on pedagogic reasoning and action "which is developed through the process of planning, teaching, adapting the instruction, and reflecting on the classroom experiences".

The model for pedagogical reasoning included six components as being essential characteristics of teachers' professional knowledge: comprehension, transformation, instruction, evaluation, reflection, and new comprehension. Shulman and his colleagues developed particular classifications. Although the specific boundaries and names of categories varied across publications, one of the more complete articulations is reproduced in Table 2.1.

Figure 2.1, modified by Grossman (1990:9), captures the classification of the major categories of teacher knowledge. It clearly visualises the aspects of PCK that influences subject matter, namely substantive and syntactic knowledge that Shulman (1987:1-22) alludes to. It also specifically points to the contextual nature of PCK. Grossman (1990) further elaborates on the knowledge bases of teaching by suggesting that possession of the knowledge described within PCK was anticipated as having the greatest impact on teachers' classroom actions.

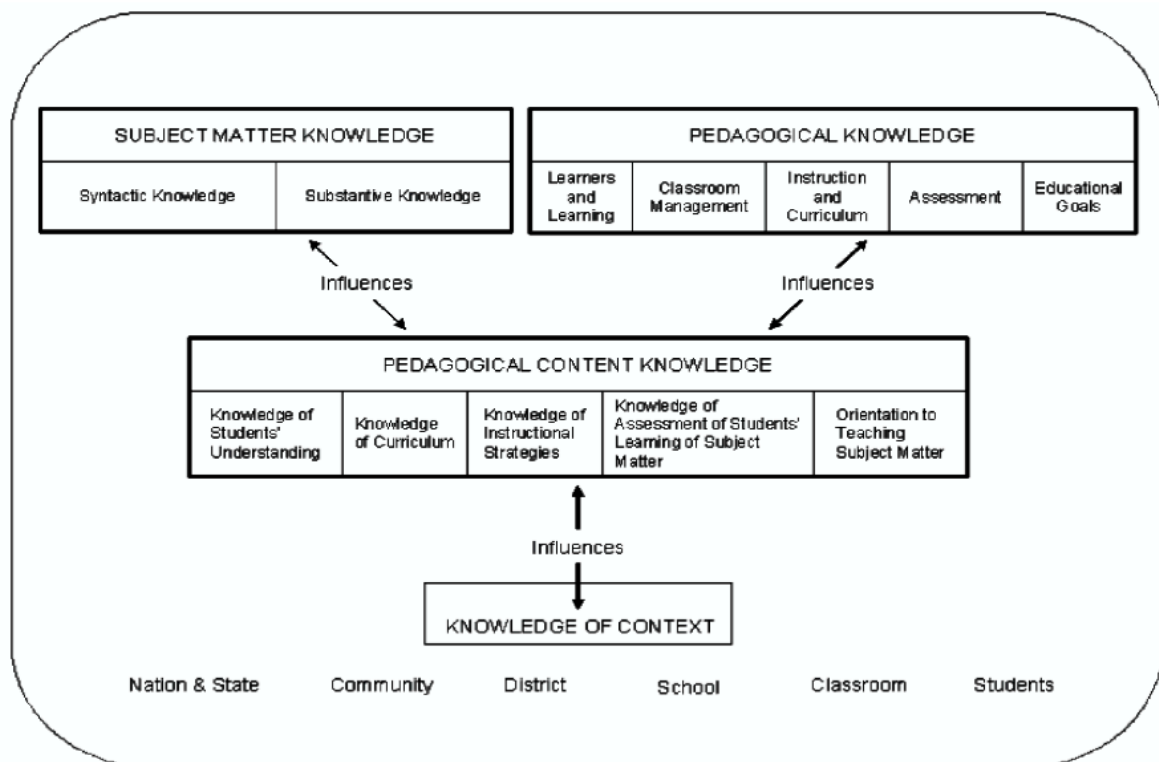


Figure 2.1: Knowledge bases for teaching (Grossman, 1990:5 in Park-Oliver, 2008:263)

Table 2.1: An adaptation to explain Shulman's major categories of teacher knowledge (1987)

General pedagogical knowledge with special reference to those broad principles and strategies of classroom management and organisation that appear to transcend subject matter:
Knowledge of learners and their characteristics,
Knowledge of educational contexts, ranging from workings of the group or classroom, the governance and financing of school districts, to the character of communities and cultures,
Knowledge of educational ends, purposes, and values, and their philosophical grounds,
Content knowledge,
Curriculum knowledge, with particular grasp of the materials and programs that serve as 'tools of the trade' for teachers,
Pedagogical content knowledge, that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding.

With the emergence of digital technologies, teachers were faced with new demands, such as how to incorporate these emerging technologies in their teaching. Numerous scholars and researchers proposed thinking about integration of technology and its intersection with content and pedagogy. TPACK was proposed as a dynamic framework for describing the knowledge that teachers needed to teach with technology (Niess, 2012:3). The TPACK framework, therefore, is an extension of pedagogical content knowledge (PCK) (Shulman, 1986). TPACK is further described as the type of integrative and transformative knowledge that teachers need for effective use of technology in classrooms.

As digital technologies emerged, the need arose to integrate technology into education. Koehler and Mishra (2005) and Niess (2005:509-523) considered the importance of teachers' knowledge of technology, pedagogy and content. According to Koehler and Mishra (2005), Mishra and Koehler (2006) and Niess (2005, 2006), for teachers to effectively integrate technology in their teaching, they need to develop an understanding of Technological Pedagogical Content Knowledge (TPCK). The TPACK framework connects technology to curriculum content and specific pedagogical approaches and describes how teachers' understanding of these three-knowledge bases can interact with one another to produce effective discipline-based teaching with educational technologies.

In understanding the integration of technology in the classroom, the Technological Pedagogical Content Knowledge (TPACK) model developed by Mishra and Koehler (2003) recommends the interplay of content, pedagogy and technology. The current study draws on the TPACK model

(Mishra & Koehler, 2003, 2006) to understand the relationship between pedagogy, content, and technology when teachers integrate technology into the curriculum. It also looked at the factors that impacted on the development of teachers' TPACK. Mishra and Koehler (2008) contend that teachers need to develop the flexibility to incorporate knowledge about students, the school, the available infrastructure and the environment, in order to effectively teach with technology.

One of the foci of the current study is on the participant teachers' pedagogical aims or 'value positions' (Stenhouse, 1970) and sought evidence of the extent to which (if any) those aims were influenced by the integration of technology and, more specifically, the pedagogical aims in the delivery of the curriculum. Teaching and learning are altered in the classroom setting when technology is used. Bos (2011:169) purports that technological knowledge is in continuous flux and requires a deep and essential understanding, as well as a mastery of technology for information processing, communication and problem solving. The TPACK (2006) framework views teaching as dynamic and complex and sees technology as an influential factor.

The TPACK (2006) framework acknowledges that teaching is a highly complicated form of problem seeking and problem solving, using flexible and integrated knowledge (Glaser, 1984; Putnam & Borko, 2000). Teachers interact with learners in a complex and dynamic environment and must, according to Spiro, Feltovich, Jacobson and Coulson (1991), integrate knowledge of student thinking and learning, knowledge of the subject matter and, ever increasingly, knowledge of technology. It is at the intersection of pedagogy, content and technology that TPACK (2006) represents this specialised type of teacher knowledge. TPACK (2006) also acknowledges the socio-cultural character of technology.

Trucano (2005) argues that the TPACK model reinforces the importance of integrating pedagogical skills when using ICT tools for delivery of the curriculum. This is because the acquisition of appropriate pedagogical practices is considered more important to educational outcomes than technical mastery of ICTs. Mishra and Koehler (2006) explain how teacher knowledge is described in detail, as a complex interaction among three bodies of knowledge, namely: content, pedagogy and technology. "When synthesising all three forms of knowledge for a particular group of students and a particular subject matter, the TPACK is formed and enacted" (Chai, Koh & Tsai, 2011:596). The interaction of these bodies of knowledge, both theoretically and in practice, produces the types of flexible knowledge needed to successfully integrate the use of technology into teaching. It becomes germane for researchers and teachers to understand the model of Shulman (1986) because TPACK (2006) is rooted and has its epistemological conceptions in this earlier framework.

The current trend toward constructivist teaching, according to Hermans *et al.* (2008:1499), has opened doors for integration of technology and education, because technology is viewed as the vehicle for enacting the change from traditional, teacher-centred classrooms to constructivist, student-centred classrooms. Social constructivists view knowledge as a human product that is socially constructed (Bruner, 1985:5-8). Individuals create their own subjective meanings of their experiences through interactions with each other and their surrounding environment (Gredler, 1997; Ernest, 1998).

With the emerging trend of defining learning outcomes in terms of understanding and performance (Fullan, 1996), constructivism becomes the common lens that people adopt in examining the effectiveness of using ICT in teaching and learning. Robin (2008:222) remarks that we are currently witnessing dramatic growth in the educational use of emerging technologies, as a convergence of affordable technologies interacts with a contemporary agenda for today's classrooms. Constructivists, according to Hartas (2010:44) argue that, by becoming actively involved in meaning-making we assume responsibility, whereas the acceptance of an 'objective truth', based on universal laws, removes responsibility from individuals.

Gibbons *et al.* (1994) argue that these shifts in knowledge creation require users, be they teachers or pupils, to be 'more socially accountable and reflexive', with the role of the teacher and pupils being negotiated in the context of communities of practice. For technology integration to be effective when teaching subject matter, knowledge is also required of content, technology and pedagogy, as well as of their relationship to each other. The main focus of this study was to help teachers understand the value of using a particular application, such as digital technologies, that could result in a shift in the appropriation of technology in their classroom practice. Research widely acknowledges that meaningful integration can impact on student learning and engagement if teachers take advantage of digital applications to enhance teaching and learning activities in the classroom.

Hickman (1990:131) views educational technology as a knowledge system. He states that teachers need to become fluent with educational technology because it has its own biases and affordances and, thus, is not neutral and unbiased. Zhao (2003:1-14) also illustrates the view that teachers need to become fluent with educational technology and emphasises their going beyond mere competence with the latest tools and developing an understanding of the complex web of relationships between users, technologies, practices and tools. Hence, for teachers to use a technology, they need to know its inherent functions. Knowledge of the functions of technology helps teachers to not only make the connections between the technology and the existing problems but also identify new problems.

2.3.3 The constructs of the TPACK framework

In this section I orient the reader to the constructs and 'sub-elements' of the framework by providing a brief description of each construct and the related 'sub-elements'. The TPACK visual representation of the framework is provided. Each of these constructs within the framework was employed as categories within the self-report measure in which participants in this study reported on and rated their levels of development within the constructs of the framework and how they developed their understanding of TPACK. A comparison was made between participants' first reported measure and the second reported measure of how they rate their own TPACK. The results of the participants' development of their TPACK are explained in Chapter 5. The intersections of the main constructs as illustrated in Figure 2.2 and the associated sub-elements form the seven knowledge domains. The seven knowledge domains put forward by Mishra and Koehler (2006:1026-1027) can be described as follows:

Content knowledge (CK) is the subject matter that is to be learned/taught for example, Science, Mathematics and Languages. Content knowledge thus involves a deep knowledge of the actual subject matter that is to be learned.

Pedagogical knowledge (PK) describes the collected practices, processes, strategies, procedures and methods of teaching and learning. Developing Technology as the 'new' domain knowledge or skill will impact on earlier embedded knowledge or pedagogy and how these elements are integrated. Pedagogical knowledge is multifaceted information about the processes and practices or methods of teaching and learning and encompasses overall educational purposes, values, and aims. "Pedagogical knowledge," according to Koehler and Mishra (2008:14), "requires an understanding of cognitive, social and developmental theories of learning and how they apply to students in the classroom". It also includes knowledge about the aims of instruction, assessment, and student learning.

Technological knowledge (TK) involves a fluency of technological information that goes beyond traditional notions of computer literacy. It requires persons to understand information technology broadly enough to apply it productively at work and in their everyday lives, to recognise when information technology can assist or impede achievement of a goal, and continually adapt to changes in information technology. TK encompasses a comprehensive understanding of modern technologies such as computers, the internet, digital video, interactive whiteboards (IWB) and data projectors, and multimodal software applications. A major advantage of the IWB, according to Asmawi (2005:213), is that its use in teaching can be categorised into three modalities of learning: (1) visual learning through the use of text and pictures, animation and video, (2) auditory learning through pronunciation, listening to sounds or music, and (3) tactile learning through the students' physical interaction with the IWB, all of

which makes it suitable for creating digital stories in the classroom. Research by Nes and Wikan (2013) explores the use of the IWB as artefacts to support dialogic learning spaces in primary schools and see it as a technical digital medium for multiple forms of interaction-technical, physical and conceptual. Similarly, research by Hennessy (2014:33) focused on pedagogic strategies for orchestrating dialogue in the context of IWBs. I elaborate on the use of IWBs in Chapter 8.

Pedagogical content knowledge (PCK) is the knowledge of pedagogy that is applicable to the teaching of specific content. It consists of knowledge of teaching practices and planning processes that are applicable and appropriate to teaching a given subject matter.

Technological content knowledge (TCK) is an understanding of the manner in which technology and content influence and restrain one another. Teachers need to master more than the subject matter they teach. Instead, they must also have a deep understanding of the manner in which the subject matter can be changed by the application of particular technologies. Teachers need to understand which specific technologies are best suited for addressing subject-matter learning in their domains and how the content dictates, or perhaps even changes, the technology, or vice-versa.

Technological pedagogical knowledge (TPK) is an understanding of how teaching and learning can change when particular technologies are used in particular ways. This includes knowing the pedagogical advantages and constraints of a range of technological tools as they relate to disciplinary and developmentally appropriate pedagogical designs and strategies.

Technological, pedagogical and content knowledge (TPACK) is an emergent form of knowledge that extends beyond all three 'core' components (content, pedagogy, and knowledge). Technological pedagogical content knowledge is an understanding that emerges from interactions among content, pedagogy and technological knowledge. Underlying truly meaningful and deeply skilled teaching with technology, TPACK is different from knowledge of all three concepts individually. Developing a TPACK mind-set is, thus modelled as a 'constructive and iterative process' where teachers need to reflect on and carefully revise multiple experiences and events for teaching their content with appropriate technologies, based on their "existing knowledge, beliefs and dispositions" (Borko & Putnam, 1996:673). I have adopted this approach that goes beyond seeing C, P and T (content, pedagogy and technological knowledge) as being individual constructs in themselves, but rather emphasising the interactions between these elements and the sub-elements.

The TPACK framework (2006) provides adequate plasticity in terms of how the various domains allow for embedding new expertise in the instructional methodology when the teacher

develops knowledge of technology and integrates it successfully to support and compliment the curriculum goals. Mishra and Koehler (2008:23) postulate that the "vision is, that these domains are embedded within important contexts including knowledge of particular students, school social networks, parental concerns ...".

The visual representation in Figure 2.2 illustrates the main constructs of Content, Pedagogical and Technological and Knowledge and their associated components. The dark centre of the visual depicts TPACK which represents this specialised brand of teacher knowledge.

Multi-literacies revolve around the concept of 'Content Knowledge, Pedagogical Knowledge and Technical Knowledge', and the TPACK (2006) framework suggests that the integration of these modes of knowledge allows for true technology integration and understanding within the classroom (Koehler, 2006). Teachers' understanding of pedagogy and the content knowledge that is developed is encapsulated in the three circles identified in Figure 2.2. The circles represent the domain knowledge of Content, Pedagogy, and Technological Knowledge. Content and Pedagogy overlap to form Pedagogical Content Knowledge, while Technology is seen as a separate and independent knowledge domain.

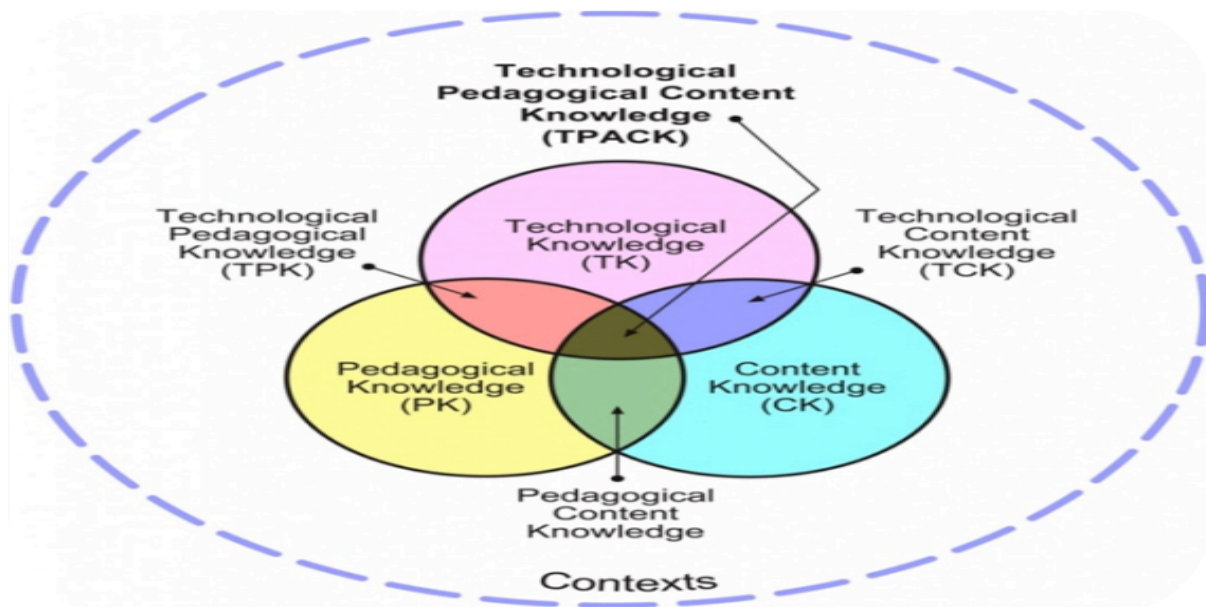


Figure 2.2: TPACK diagram: Mishra and Koehler (2006) <http://tpack.org/>

The overlapping circles in Figure 2.2 between Content, Pedagogical and Technological Knowledge imply that effective teaching with technology happens only in these areas of overlap that are optimally integrated (Harris, Mishra & Koehler, 2009:293-416). True technology integration involves understanding and negotiating the relationships between these three components of knowledge (Bruce & Levin, 1997; Rosenblatt, 1978). The TPACK (2006) perspective rejects notions of technology integration that focus on teachers developing

expertise in isolated technologies. Alternatively, it advocates the development of the TPACK mind-set that is flexible, adaptive and committed to orchestrating the best possible fit among the three constructs. The key features of the TPACK teacher mind-set as listed in Morsink *et al.* (2011:4) include:

- openness to the possibility that the content and procedures of yesterday might be improved with the help of new technologies;
- on-going professional reflection and a commitment to identify areas for innovation and improvement;
- a willingness to apply new methods and strategies;
- a critical stance toward novelty and innovation for their own sake;
- a critical awareness that all technologies have affordances as well as constraints; and that these aspects are likely to vary over time in relation to changing purposes, contexts, and audiences;
- an on-going commitment to maximize the affordances and minimize the constraints of technologies; and
- an on-going commitment to learn more about technological tools and options and to access the technological expertise and advice of peers and others.

2.4 Learning theories and technology

Numerous learning theories were generated in the 20th century, with three major theoretical frameworks shaping the study of learning: behaviourist, cognitivist and constructivist learning theories. These three learning theories were often utilised in instructional environments before learning was impacted by digital technologies. For the purposes of this study I will illuminate the salient features of constructivist (Bruffee, 1999:28) and cognitivist (Gagne, 1996) learning theories, as both are relevant to this study. In searching the literature, information provided on complexity theory and connectivism (Siemens, 2004) appeared to resonate with this study and provided a deeper understanding of its relevance in the context of technology and learning networks. I also include a short review on instrumentation theory (Wertsch, 1985) because it, too, has a bearing on this study.

2.4.1 Constructivist learning theory

Constructivist epistemologies hold the view that we construct new knowledge rather than simply acquire it via memorisation or through transmission from those who know to those who do not (Bruffee, 1999:28). Constructivism refers to both a learning theory and an epistemology

of learning. Constructivism posits that people construct their own understanding and knowledge of the world through experiencing the world, and reflecting on those experiences. Knowledge is thus viewed as dynamic changing and constructed and negotiated socially, rather than something absolute and finite. Such a view then has important implications for learning and teaching. This process of learning happens through asking questions, exploring, engaging in dialogue with others and reassessing what we know. As such, we are active creators and constructors of our own knowledge. In addition, as cited in Harasim (2012:60-64), the basic tenet of Piaget's (1977) constructivism is that knowledge is constructed in the mind of the learner and, therefore, knowledge is a 'fit with reality', whereas the traditional (objectivist) view of knowledge is that of a 'match with reality'.

2.4.2 Cognitivist learning theory

Cognitivist learning theory (Gagne, 1996) was a response to behaviourism's (1972) rigid emphasis on the direct link between "stimulus and response". Cognitive approaches understand learning in terms of the thought processes that lie behind any observable behaviour. As a theory, cognitivism seeks to understand and describe the mental processes that underpin the act of learning in the human mind. The mental processes of learning thus provide common ground for the alignment with technology-based education (Winn & Snyder, 1996:112).

2.4.3 Complexity and connectivist theories

Complexity can be identified in schooling systems as they are organised with multi-level structures (Starkey, 2012:1). These structures are: Grade levels, classes, terms, departments, and timetables. Participants in the system are: learners, teachers, administrators, leaders, fund raisers, social services, board members, communities and partner stake holders. These structures are relevant to Not for Profit Organisations (NPOs), such as in the case of this study. The emergence of digital learning in classrooms has necessitated the need for a theory such as complexity theory to consider learning and teaching in the digital age. Following below are reviews from the literature that can be applied to schools within the context of acquiring technological infrastructure and implementing its use. Complexity theory can also be applied to explore the emergent learning of the participants in this study through professional development within 'tightly bound and loosely bound' (Sullivan, 2009) ecologies of the classroom environments.

Siemens (2004) is linked to the development of a learning theory for the digital age. He purports that, "... that learning can be conceived in terms of the capacity to know more via digital technologies such as the Internet rather than a reliance on the individual accumulation of

prior knowledge of what is currently known." Complexity theory has emerged from the Physical Sciences where exploration of how communities of organisms change is focused on the complexity of the systems, rather than individual cause and effect processes within a deterministic universe (Chui, 2000:29). Complexity theory provides a model for considering how teaching and learning may change as a result of the digital age and how knowledge emerges and evolves within education systems (Starkey, 2012:124). The theory is being applied to Social Sciences to examine how complex systems, such as education, evolve and develop over time. Complexity theory suggests, according to Sullivan (2009), that emergent knowledge, a new way of thinking about or understanding something, develops on the 'edge of chaos'.

Siemens (2004) further asserts, as cited in Starkey (2012:26), that connectivism can be described as:

The integration of principles explored by chaos, network, and complexity and self-organization theories. Learning is a process that occurs within nebulous environments of shifting core elements - not entirely under the control of the individual. Learning (defined as actionable knowledge) can reside outside of ourselves (within an organization or a database), is focused on connecting specialized information sets, and the connections that enable us to learn more are more important than our current state of knowing.

To summarise, connectivism theory focuses on the inclusion of technology as part of our distribution of cognition and knowledge. Connectivism acknowledges the prominence of tools as a mediating object in our activity system, but then extends it by suggesting that technology plays a central role in our distribution of identity, cognition, and thereby, knowledge. Bell (2011:2) writes that connectivism is perceived as relevant by its practitioners but as lacking in rigour by its critics.

The discussion of the theories presented so far, positions knowledge as something to be acquired from autonomous and often 'solitary investigation'. However, socio-cultural theories are associated with a number of concepts related to the social and cultural nature of learning and the idea that learning is mediated through the learner's culture. The notion of learning as collaborative and socially situated has found resonance with academics working in the area of educational technology. Digital learning is rooted in the wider socio-cultural principles of "situated learning" and the associated notion of Lave and Wenger's (1998) "communities of practice" as cited in Selwyn (2011:78).

2.4.4 Socio-cultural theory

A key aspect of socio-cultural theory (Vygotsky, 1978; Wertsch, 1985; Wertsch, 1991) is the claim that all human action is mediated by 'technical' and 'cognitive' tools. Sutherland *et al.* (2009:10) interpret the idea of 'tool' to include a wide range of technologies and artefacts. Within this broad conception of tools, the master tool is language. Premises for investment in technology have lacked clarity at school level, while, at the same time, technology itself has undergone considerable changes. According to Haugsbakk (2011:249) teachers' pedagogical judgments have also often been replaced by more instrumental perspectives on the development of both technology and society. He claims that little or no attention has been paid to how the use of technology can result in greater complexity, doubt, and uncertainty. As a consequence of an instrumental approach, digital technologies have often been described metaphorically as 'instruments or tools'.

Tools are something we develop to ease or automate processes, to save time (and money) and to achieve results more efficiently. As Haugsbakk (2011:250) points out, the challenge of metaphors such as 'tools' is that they reduce or hide complexity. They also obscure the potential of digital technologies to go beyond and transform existing practices and to pave the way for new ones - not least in the field of learning and teaching (Hauge, Lund & Vestol, 2007; Lund & Hauge, 2011b). The latter authors make a critical observation, namely that there is a need to theorise the relationship between tool and agent in order to unpack this relationship's inherent potential and what is at stake when it is integrated in learning and teaching activities.

Wertsch's (1991:119) idea of "person-acting-with-mediational-means" considers concepts such as appropriation and instrumentation.

Appropriation is important to the analysis in which ICT tools are incorporated in subject domains, and instrumentation explains why different people appropriate the same tool in different ways. So, rather than conceiving the individual as having 'abilities and skills', the focus is on the 'person acting with mediational-means'. Sutherland and Triggs (2009:10-11) mention that a holistic perspective is necessary when we think of processes of change in the production, reception and use of ICT in teaching and learning. The context in which teachers teach and learners learn is salient. School-related factors, such as teachers' experiences of ICT outside school, how schools are managed, the ways different school subjects mediate how ICTs are used, how learning with ICT might be theorised in different subject domains - inter-relate and have an impact on what happens in classrooms. Another dimension is learners' 'out-of-school' experiences and how these relate to their 'in-school' learning.

Bearing in mind Sutherland and Triggs's (2009:11) holistic perspective of improving classroom learning with ICT, the following section of this literature review focuses on the various elements pertaining to the educational practices and professional development of teachers who are attempting to integrate technology into the classroom.

2.5 Teacher beliefs and attitudes about adopting technology

Teachers are often trapped in the false dichotomy of being either for or against the use of technology (Pahomov, 2014:13). If teachers are to benefit by the potential use of technology, they must be receptive to the integration of new technologies in their teaching practice environment. This view is expressed by Summak *et al.* (2010:2671). Similar views by researchers in the field of educational technology also claim that successful integration and effective use of technology in education by teachers depends primarily on teachers' attitudes and their willingness to adopt it. Parasuraman (2000:307-310) developed the Technology Readiness Index (TRI) to measure consumers' continuing willingness to embrace new technologies. It refers to people's propensity to embrace and use new technologies for accomplishing goals at home, in life and at work. This measure is useful to gauge and understand teachers' attitudes towards technology.

Colby (2001) introduced four constructs of technology belief that affect an individual's level of 'techno-readiness': optimism, innovativeness, discomfort, and insecurity. Parasuraman and Colby (2001:307) explain *Optimism*: as a positive view of technology; *Innovativeness*: as a tendency to be first in using new technologies; *Insecurity*: as distrusting of technology and scepticism about its ability to work properly; and *Discomfort*: as a perception of lack of control over technology and a feeling of being overwhelmed by it. Optimism and innovativeness are positive drivers of the TRI. On the contrary, insecurity and discomfort are the negative attitudes or inhibitors. This categorisation and the multi-item measurement scale are useful instruments to group and profile teachers who are in the process of adopting technology. It also allows for clarity on teacher beliefs on, and attitudes towards, technology, both of which are essential factors for understanding teachers' technology integration in the classroom.

From an investigation and a review of the literature, it is apparent that teaching is not only a matter of skill or competency alone. Figure 2.3, which depicts the teacher as 'iceberg' metaphor, explores teacher change. Kelly (1980) lists three criteria that are relevant when teachers consider changing classroom practice. Figure 2.3 represents Kelly's (1980) view of the teacher iceberg metaphor. Kelly (1980) lists critical criteria, within the context of attitudes, ideas and behaviours that must be satisfied in order for teacher learning to occur. Firstly, it must be feasible in terms of classroom practice; secondly, it must be perceived as relevant to

teaching-learning needs; and thirdly, it must be acceptable in terms of the teacher's underlying view of education.

In Figure 2.4 Maldarez and Bodoczky (1999:14) illustrate, through the same metaphor of the modified teacher iceberg, the inner nature of the teacher regarding choices and attitudes, beliefs and values towards technology. The image clearly provides a cursory view of how societal and cultural values in individuals are hidden below the surface of the individual and yet still form the 'bedrock' of the teacher's professional approaches towards teaching and learning.

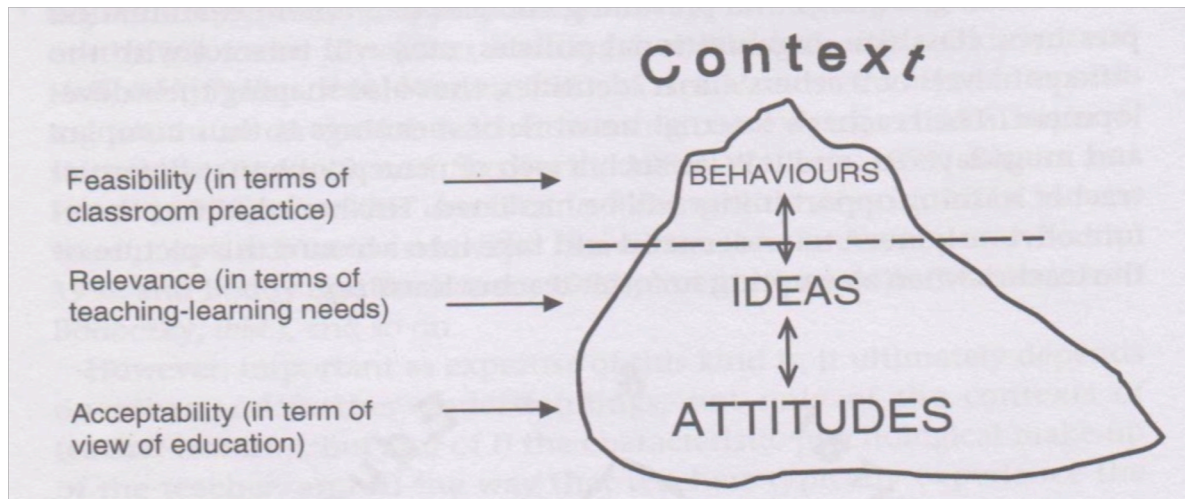


Figure 2.3: Kelly's criteria and the teacher iceberg (Source: Johnson, 2005:218)

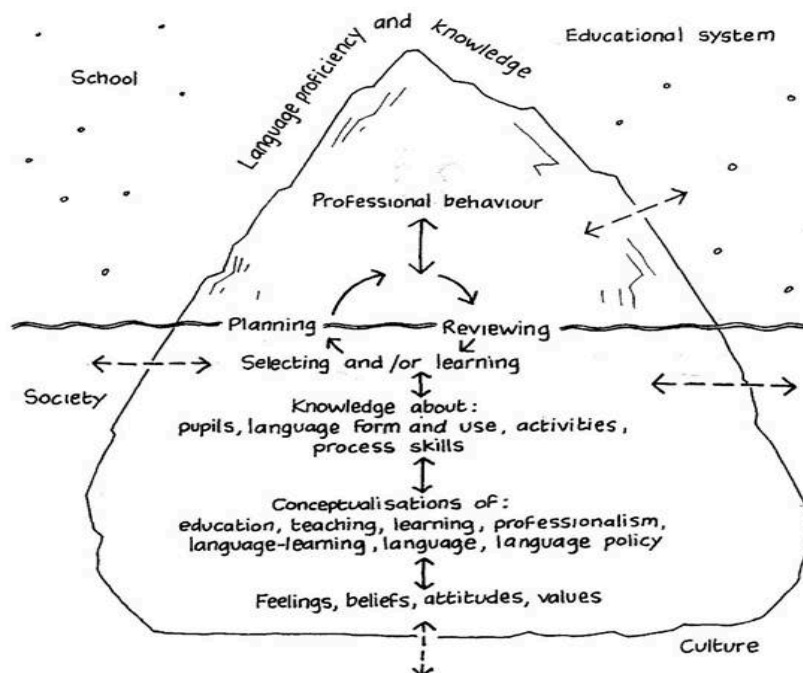


Figure 2.4: The teacher iceberg (Source: Malderez & Bodoczky, 1999:15)

Malderez and Bodoczky (1999:14) explain that the tip of the iceberg in this metaphor refers to the knowledge of the subject. This will be influenced by the 'air', which is represented by the culture of the whole school and, more specifically, the classroom in which the teacher works. The mass below the surface will be influenced by the surrounding 'sea' of the culture and society in which the teacher lives.

A teacher's decisions draw on constructs of the subject, the pupils themselves and a body of knowledge that covers a range of possible courses of action for the classroom and the wider professional world. These knowledge constructs, related to subject and learner knowledge, are embedded in deeper understandings of people, learning and teaching, all of which have been influenced by even more fundamental beliefs, attitudes, feelings and experiences. Finally, the two-way arrows indicate the reciprocal flow of influences which may be set in motion by an activity in the visible part of the iceberg. As the teacher reflects on what happened there may be a need to draw on the influences of the submerged layers for possible interpretations and alternative choices of action.

2.5.1 Factors relating to primary school teachers use of computers, teaching and learning practices

It has been widely recognised that the availability of classroom technology correlates to teacher use of computers (NCES, 2005). Cuban (2001), however, cites lack of teacher preparation as a factor that hinders primary schoolteachers' use of computers. The following factors are outlined by Dias (1999:10-13) and are major barriers to technology integration: lack of teacher training, lack of time, lack of resources, lack of support, lack of leadership, lack of financial support, lack of an on-site technology expert and the inability to deal with change. The following goals of technology integration require technology to be used ethically and safely to acquire, demonstrate, apply and communicate information. The teacher should ensure that learners understand these goals. Teachers who are not yet skilled users of technology should develop similar goals which will enable learners and the teachers themselves to:

- practise safe, ethical, and responsible use of technology;
- gather, research and evaluate information from a variety of sources;
- create original works such as reports, posters, presentations, and other documents;
- calculate, manipulate, and analyse data;
- categorise data using tables, graphs, and other organisers;
- summarise ideas using a variety of media;
- solve problems using technology;

- present information;
- communicate information effectively to an audience using a variety of media;
- interact and collaborate with peers to solve problems and share information; and
- transfer knowledge to new technologies.

The following section focuses on the critical importance and the implications of developments that impact upon teachers' professional practice. The Guidelines for Teacher Training and Professional Development in ICT (2007:1) also iterate the essential principles of the e-Education Policy (2004), namely that ICT skills cannot be practiced in isolation from their context and that ICT education should be an integral part of initial and continuing teacher development programmes, as reflected in the National Policy Framework for Teacher Education and Development in South Africa (2006:20).

Professional development activities very often refer to a person's attitude or interest in learning a new skill and this process involves trust and risk. Giddens (1990) points out the reciprocal relationship between trust and risk. Risk-taking fosters learning, adaptability and improvement. As a participant observer I reflected on this gap in sharing new skills and knowledge within the sample. The trust and rapport that I developed by gaining access to the sample was the ideal springboard to promote closer collaboration and sharing of skills when strategies are sought to implement technology. This was achieved by meeting regularly to share with one another in a closed group that came to be known as a 'Teach Meet' - a concept that is increasingly being used at schools in the process of technology integration. This initiative was a way of guiding the sample's technology implementation strategies. Further aims were also to assist participants that needed encouragement or to 'troubleshoot' the technical aspects of technology integration in the classroom. Those who preferred to explore new skills within the initial safety of the small group were accommodated in this closed group.

Mclaughlin and Talbert (2001) refer to such approaches as teachers' joint efforts to generate new 'knowledge of practice'. This collaboration also allowed everyone in the sample to share particular resources and discuss the benefits for using them or to seek clarification on the use of multi-media tools. What this study illuminated was that teachers preferred one-on-one sessions with me when they needed to understand how to use certain software applications or just needed guidance on how to find a 'fit' for content, pedagogy and technology together.

It is known that innovation and improvement (Fullan & Stiegelbauer, 1991) are accompanied by anxiety and stress, especially at the early stages of what the authors refer to as 'renewal'. Huberman (1992) argues for extending one's contact to a handful of colleagues, who are working on similar problems, and views different approaches as necessary to extend

opportunities for professional learning and an improved teaching repertoire. Jones and Moreland (2004:121-140) and Hofer and Swan (2008:179-200) concede that the integration of technology is a very personal undertaking for a teacher. They further recognise that contextual factors and many variables affect the development of teachers' TPACK. This notion that professional development is sometimes suffused by personal beliefs makes it difficult to address and has also been debated by sceptics such as Cuban (1990:13) who intimates that it takes time to effect change.

Even if teachers do change, the process can take years. Cuban (1990:13) observed that teachers would use technology based on their personal perspectives about curriculum and instructional practice. It is argued that digital technology has a particularly powerful role to play in this objective (John & Wheeler, 2007). Digital technologies continue to change at a rapid pace, and this has altered the balance in the traditional classroom. Integrating ICTs or digital technologies in the traditional classroom has implications for the way in which teachers reflect on current classroom practice and how organisations and individuals think about continued professional teacher development.

The principles of good quality professional development include the following, according to Campbell *et al.* (2004):

- support for professional development is an integral part of raising standards of teaching and learning;
- teachers should model lifelong learning to their students;
- lifelong learning should keep up with change and innovation;
- learning from experience is not enough;
- content and pedagogical knowledge cannot be divorced from teachers' personal, professional and moral purpose; and
- planned career-long development is the responsibility of teachers, schools and government.

Implicit in the above precepts is the notion that professional development, according to Campbell *et al.* (2004), takes many forms; from solitary, unaided, daily reflections on experience, to working with a more experienced or knowledgeable practitioner, observing and being observed, professional discourses, and attendance at workshops, courses and conferences. School administrators do not always perceive and/or acknowledge these gaps and assume that professional teacher development will necessarily impact on the teaching methodologies in the classroom. These administrators need to offer teachers the support to

meet their current challenges. Slavin (1996:4) contends that learner achievement cannot change unless teachers use markedly more effective instructional methods. Summak *et al.* (2010) posits that 'teacher readiness' supports the success of technology integration and its effective use in education, as well as teachers' attitudes toward technology and willingness to adopt it.

When teachers embark on professional development, according to Ajzen's Theory of Planned Behaviour (1985), it is a deliberate, intentional decision-making process. 'Teacher readiness' appears to be one of the most critical variables, alongside other constructs such as reflective practice. It is stated in The National Policy Framework for Teacher Education Development (DoE, 2006) that continued CPTD has the vital role of equipping teachers to undertake this introspective task. According to Stigler and Hiebert (1999:2), "teaching is the next frontier in the continuing struggle to improve schools." Researchers such as Bruner (1996) and Stigler and Hiebert (1999) agree that, although activities have been implemented to reform many aspects of education, little attention has been given to reform in the area of CPTD.

In Chapter 2 I have outlined Shulman's (1986, 1987) assertion on the importance of teachers' understanding of pedagogy and content knowledge as a prerequisite for effective teaching. Although the constructs of pedagogy, content and knowledge are firmly anchored in the PCK framework of Shulman, teachers have to confront the paradigmatic shift, which has been afforded by new ways of learning through the Internet and technology. The 21st century is referred to as the 'Knowledge Age', a time in which knowledge has key social and economic value. Yet current educational practice does not significantly reflect this new reality. Drawing on a cognitive perspective, Niess (2012:3) argues that the TPACK framework and its knowledge components present a different view on teacher knowledge than envisioned in previous centuries.

Niess (2012:3) adds that teacher knowledge is represented as a dynamic equilibrium among multiple domains (technology, pedagogy and content) of knowledge that a teacher needs for teaching certain content at specific grade levels. Opportunities for many teachers to reflect on the implications of how they might shape and apply new communication technologies within their practises, has been limited. Transforming classroom pedagogies by using opportunities afforded by new technologies has often resulted in teachers merely integrating technology in traditional ways of teaching (Harasim, 2012:2). Qualitative change, according to Harasim (2012:3) in how teachers perceive and practise teaching and learning, thus remains in the early stages of development. Harasim largely attributes this lack of progress to the fact that the field lacks a theoretical template to guide educational design, pedagogies and the use of online technologies within the framework of a traditional curriculum.

The understanding and the enactment of the curriculum influence teachers' teaching and classroom practices. The roles of the teacher and the learner are closely linked to a broader framework and aims within the curriculum. A curriculum involves a network of relationships in a context. Technology integration in teaching cannot take place in isolation and is linked to the curriculum, its interpretation and enactment (Booyse & Du Plessis, 2014:5). Education policies are an integral component of schooling structures and practices.

It becomes important to understand the key elements of the curriculum and its delivery (Starkey, 2012:120). Curriculum is viewed as a social construct by (Kraak, 1998; Grundy, 1987; Killen, 2007). The authors, therefore, acknowledge that a curriculum encompasses intended and unintended learning. This means that a particular society's culture will influence the development of a particular type of curriculum, just as that curriculum could contribute to shaping and forming that society and its culture. Kelly (2009) postulates that some planners see the curriculum content as central, so that the acquisition of that content by pupils becomes the central purpose of the curriculum, the organisation becomes a matter solely of effectiveness of 'delivery', and evaluation is focused on the degree of attainment achieved by pupils (Kelly, 2009:21).

Teachers cannot separate changes in classroom practice without considering and grasping the requirements of the curriculum and its expectations. Kitchens (2009:255) states that, by situating education in the space of local communities, and by connecting the curriculum with the everyday life of learners, situated pedagogy allows these learners to be involved in a conversation that creates new understandings of the world and their place in it. Wei (2009:271), in his reference to the enactment of the curriculum, explains that it "should meet the needs of all the learners and be oriented to the learners' development ... and even reflect the advance of modern science and technology."

Practising Foundation and Intermediate Phase teachers are not usually subject specialists and are mostly considered to be generalists with a more holistic approach to teaching. Teachers are expected to teach all subjects in the lower Grades (Motshekga, 2009:67). Very often this lack of specialised knowledge influences the primary teacher's perceptions on technology in the classroom. The integration of technology, pedagogy and content can help teachers structure, organise and/or enhance the activities that facilitate learning outcomes. Teachers wanting to explore the benefits of digital technology, therefore, need to apply technology in all the subjects that they teach.

Niess (2012:3) suggests that current teachers need to be engaged in reconsidering content specific concepts and processes along with the impact of the specific technology. This means that teachers have to understand and grasp the content and select the technology applications

linked to pedagogy and infuse the learning activity with technology. Mishra and Koehler (2006), as cited in Papa (2011:113), observe that this is no simple task, considering the variables such as: the individual teacher, the specific content of the subject, and the many different ways to approach teaching. This situation requires curriculum flexibility because the learning is unpredictable and cannot be explicitly stated as a prescriptive content outcome (Starkey, 2012:108).

2.5.2 Technology and continuing teacher professional development

Glatthorn (1995:41) defines teacher development as the "professional growth a teacher achieves as the result of gaining increased experience and examining his or her teaching systematically". Borko and Putnam (1995:55) support the notion that professional development plays an important role in changing teachers' teaching methods, and that these changes have a positive impact on students' learning.

Powerful evidence exists that experienced teachers' pedagogical content knowledge and pedagogical content beliefs can be affected by professional-development programmes and that such changes are associated with changes in their classroom instruction and student achievement (Borko & Putman, 1995:55).

A sound programme in professional development requires: a coordinated effort between teachers interested in enhancing their teaching using technology and a technical expert, continuous follow-up, and availability of resources (Brown *et al.*, 2009:50).

A growing body of literature has examined how teachers need to reframe classroom practice as the advancement of technology now permeates teaching and learning in the classroom. Teachers' technology beliefs are influenced by their teaching philosophy. Resistance to adopting new technologies stems from teachers' existing teaching beliefs (Norton, McRobbie & Cooper, 2000:87-109). For technology adoption to be successful, teachers must be willing to change their role in the classroom (Hardy, 1998). When technology is used as a tool, the teacher becomes a facilitator and students take on a proactive role in learning. Sadik (2008:487) suggests that, when integrating technology into the curriculum, the use of technology can only be effective "if teachers themselves possess the expertise to use technology in a meaningful way in the classroom".

Schrum and Levin (2012:61), highlight six aspects of 'know-how' a teacher requires to integrate technology effectively: teachers should be proficient in the use of productivity tools (word processing, presentation software, spread-sheets etc.); teachers should be able to troubleshoot tech-related problems that commonly crop up in the classroom; teachers should know where to

go for technical assistance; teachers should know what is available on the Internet in the subject area being taught; teachers should have well-honed internet searching skills; and, finally, teachers should be interested and flexible to explore new ways of doing things.

Technologies are integrated when they are used in a seamless manner to support and extend curriculum objectives and engage students in meaningful learning (Dias, 1999). The pedagogical approach to integrate technology involves judicious selection of technology as per the requirements of the content, framing objectives of learning and delineating the tasks and sub-tasks to be performed by the learners. Teachers also need "to see a direct link between technology and the curriculum for which they are responsible" (Rodgers, 2002:122).

ICT has to be fitted into the teacher education curriculum to facilitate instructions by teacher educators. Hirsch (2013) notes that professional learning has to raise the performance level of educators and their students. But schools have to implement strategies that are less episodic. Professional learning is more effective: when it is systemic; where it is being done as a sustained process inside a school; when it is on-going, experiential, collaborative, and connected to students.

The research literature on teachers' professional development attests to the powerful impact of ICT on the teaching and learning process. The literature claims that technology becomes an enabler, which affords a range of opportunities so that students become more effective citizens. When technology is embedded within the traditional/established subject culture it alters or 'disrupts' the balance between teacher and learner. Barton (1997) argues that teachers need to construct new roles for themselves and reconceptualise their practice. In his seminal work, *The Design of Everyday Things*, Norman (2002) states that, the critical variable in this adoption process, and subsequent integration, is the teacher. Teachers must be convinced of the feasibility of using a particular technology before adoption and integration occur. Known obstacles often cited in the research literature include funding, equipment, lack of time, and lack of knowledge (Hardy, 1998:119; Lam, 2000:390; Simonsen & Dick, 1997:239).

A critical component in meeting teachers' technological needs is responding to teachers' beliefs toward technologies. In fact, teachers' beliefs are essential in considering how a teacher teaches, thinks, and learns (Richardson, 1996:102). Hope (1997:158) writes, "teachers basically had to contend with two factors [with technology adoption]: (a) the psychological effect of change and (b) learning to use microcomputer technology". It appears that understanding teachers' beliefs towards this process of integration is an essential element in the adoption process. Cobb (1999) iterates that the relationship between teachers' beliefs and their practices is not straightforward or simple but dialectic, moving back-and-forth between change in belief and classroom practice.

Teachers in the sample were at various stages of their personal development in terms of their understanding, motivation, readiness and integration of technology in the learning context of the classroom. The self-progress survey instrument (Archambault & Grippen, 2009; Schmidt *et al.*, 2009), situates the teacher for the purpose of self-reflection and growth. It allows for clarity and identification of weak areas, and provides pathways for growth as successive surveys are completed. Professional development and the integration of technology are particularly complex because the attention is not on the technology *per se* but the improvement and enhancement of student learning through more effective instructional practices.

Professional development, therefore, acts as a catalyst to facilitate change from the traditional practise to a more constructivist and collaborative approach in student learning. The current thinking in professional development efforts aligns most closely with the 'change as growth in learning' perspective. Within this perspective, change is identified with learning, and it is regarded as a natural and expected component of the professional activity of teachers and schools (Clarke & Hollingsworth, 1994:153).

Defining professional development is highly dependent on the cultural and socio-economic climate prevalent at any given time (Day, 1999). Both Hargreaves (1992) and Day (1999) agree that, teachers' development is located in their personal and professional lives and in the policy and school environment in which they work. Day (1999) sees teacher development as a necessary and lifelong part of teaching which ensures that teachers keep up with changes in effective instructional use of new technologies for teaching and learning, and adapt their teaching to shifting school environments (Lawless & Pellegrino, 2007:575). Professional development is critical; Borko and Putnam (2000:673) pose the question of where teachers' learning should be situated. At a first glance, the idea that teachers' knowledge is situated in classroom practice lends support to the argument that all learning experiences for teachers should take place in actual classrooms.

Borko and Putnam (2006) clarify that all knowledge, by definition, is situated within a specific context. During the initial stages of my classroom observations, I realised that most teachers continue to work in isolation in their classrooms, meaning that their own learning is an individual activity. Although the organisation where this study was conducted invests in teachers' on-going professional development through workshops and training, the execution of acquired knowledge and skills after the training does not always translate into a whole school approach, for reasons that are not always clear. The implementation is fragmented and dependent on individual teachers' motivation and readiness to adopt new practices.

Nias (2005:223-227) contends that a teacher's relationships with colleagues has significant impact on the teacher's professional development by providing technical and emotional

support, a reference group with whom the teacher can identify, the scope and incentive to grow professionally and the opportunity to influence others. The 'situative perspective', according to Borko and Putnam (2000:4-15), gives rise to different kinds of knowing and can help teachers learn and change in powerful ways. One such approach is to ground teachers' learning experiences in their own practise by conducting activities at school sites, with a large component taking place in individual teachers' classrooms.

Interaction among teachers can also lead to collaborative efforts of a special kind, known as professional learning communities (PLN). According to DuFour and Eaker (1998), James *et al.* (2007), and Lieberman and Miller (2007) these networks of teachers seek to provide teachers with a sense of personal efficacy and responsibility, and a forum for critical reflection and professional development and the opportunity to influence and empower others. Fullan and Hargreaves (1998:94) state that teacher support groups can give focus for professional improvement in an informal and supportive environment, and can lead teachers to resist simplistically-conceived changes mandated from the outside in favour of improving themselves.

What I further observed during my study was that collaboration among the sample participants rarely occurred after they returned from workshops and other professional development initiatives. Hargreaves (2012:7-9) purports that sharing expertise contributes to professional development of all teachers. Co-operation leads to collaboration which is considered to be a deep process. Researchers, therefore, need to explore how teachers collaborate, how they give feedback to one another and how this is mirrored in their classroom practice.

New strategies gained during the professional development courses are often not implemented, or are applied in isolation and thus fail to impact the required changes. This means that professional development fails to have the desired bearing on teacher learning. Oberg and Underwood (1992) acknowledge that courses can themselves be a great spur to personal reflection. These kinds of reflection may require the time and safety of protected environments where enquiry and questioning are the legitimate focus of teacher activity.

Transformation, sustainability, innovation, and teacher professional development are discourses closely linked to technology integration within the context of the classroom. Transformation by its very nature, according to Reynolds (2009), implies sustainability. Innovations that are not sustained do not become embedded, and cannot transform either themselves or the environment. For technology to become embedded, contextual factors around capacity building for teachers should be understood, as should complexities around teachers' abilities to change their practice.

The shift to a technology-based curriculum and technologically enhanced practices begins with the teacher as an agent of change in the classroom. Ertmer and Ottenbreit-Leftwich (2010:255) state that sustainability of technology in the educational setting becomes imperative when aspiring to build the necessary capacity for technology integration. The view that enhanced practises begin with the teacher is iterated in the e-Education Policy (DoE, 2004). It elucidates, "... that ICTs are most effectively applied when viewed as integral to learning by both teachers and learners ... any ICT integration requires that teachers engage in rethinking and reshaping their engagement with the curriculum".

Change in beliefs, attitudes, and pedagogical ideologies, content knowledge, pedagogical knowledge of instructional approaches, methods, strategies and practices foreground capacity building. Technological changes present unique challenges due to their own constantly changing natures and complexities. These challenges mentioned leave many teachers feeling uncomfortable with technology due to their own personal lack of knowledge, existing attitudes concerning technology and, at times, low self-efficacy.

Capacity building for technology integration should be a whole school effort reflected in attitudes of school leaders and teachers alike. Furthermore, Afshari *et al.* (2009:77-104) state that capacity building should reflect in school policies and have links to the wider community; and ensure that the school's vision is integral to, appropriate, and effective for sustainable ICT integration. The e-Education (DoE, 2004) policy addresses teachers' capacity building by stating that, "... the competencies of teachers to use ICTs for their personal work, in their classrooms, must be developed [and] this will require extensive staff development and support".

It is only as recently as 2004, when the White Paper on e-Education (2004) in South Africa was promulgated, that a policy framework articulated the government's response to a new information and communications technology environment in education. ICT professional development for management, teaching and learning is mentioned as one of the key elements of the policy. The policy stated that a programme that urgently addresses the competencies of teachers to use ICT for their personal work in their classrooms must be developed. This resulted in the Guidelines for Teacher Training and Professional Development in ICT (2007). I review this and other related policies in Chapter 3.

In conclusion, Harris and Hofer (2011:211-212) contend that professional development aimed at increasing technological pedagogical content knowledge has led to more conscious, strategic, and varied student-centred learning activities, and a more deliberate and judicious use of technology due to raised standards of quality.

2.5.3 Access to ICT resources and support to teachers

School leaders need to build a professional culture of learning that is on-going and becomes a shared responsibility. Leaders should encourage attendance at professional development conferences by teachers, with appropriate sharing between colleagues to better institutionalise the knowledge gained. Arns (2008:12-15) suggests staff development in a comfortable environment with collaboration, individual focused time and food. Generic workshops on a scheduled basis throughout the year will be less effective. Technology efforts should be tailored to the individual teacher as far as possible and delivered both synchronously and asynchronously. An onsite technology coach can provide different methods of instruction, different technologies in instruction, and general follow-up as needed. 'Peer mentoring', according to Brown *et al.* (2009), can provide an effective process for assisting teachers to use technology.

Effective support should include the complexities of connectivity such as: access to online resources, sharing resources that have been archived in databases and that can be easily accessed should bandwidth become slow or unstable. Teachers should be familiar with the school's learning systems, be well-versed in whole-class instruction using technology, Internet usage, wiki text, embedding of audio/video/interactive tutorials, simulations and edu-games. Sawtelle (2008) argues for the setting of objectives before planning; planning before implementation; involvement of stakeholders; an evaluation design and criteria for judgement leadership in implementation management; appropriate physical environment and equipment; adequate training; prerequisite knowledge and skills; and for monitoring of implementation and evaluation. In conclusion, Sawtelle (2008) iterates that sound curricular frameworks should be built with the decisions as to what tools are needed and how their use aids in providing all learners with a greater opportunity for success.

Hargreaves (1994:268) writes extensively on collaborative relationships within changing school cultures. Not all collaborative efforts will accomplish the goals which one seeks, particularly if the participants feel pressured to participate or are not compatible. Moreover, collaboration requires some surrender of control by each party and, at the same time, requires the investment of time and other significant resources, with no guarantee of the outcome (Achinstein, 2002; Hargreaves, 1994; Lima, 2001). Collaboration is considered an 'articulating and integrating principle' for school improvement, providing a way for teachers to learn from each other, gain moral support, coordinate action, and reflect on their classroom practices, their values, and the meaning of their work. Hargreaves (1994:245-246) contends that in some contexts, "collaboration replaces false scientific certainties or debilitating occupational

uncertainties with the situated certainties of collected professional wisdom among particular communities of teachers".

2.5.4 A taxonomy to measure technology integration and lesson designs

As mentioned in the previous section, integration of ICTs requires that teachers rethink and reshape their engagement with the curriculum. E-Learning "... is about learning and teaching philosophies and methodologies within the context of outcomes-based education. The policy on e-Education views assessment as an important driver in education, [that], if not well managed, can become a barrier to innovation" (DoE, 2004). When embedding ICT in learning and teaching, learners will want to be assured that assessment does test the level, not only of content, but the acquisition of skills and competencies acquired through e-Learning (DoE, 2004).

According to Voogt and Roblin (2010:1), ICT is at the core of 21st century skills. It is regarded as both an argument for the need of 21st century skills and a tool that can support the acquisition and assessments of these skills. Schools are encouraged, as proposed by Crockett, Jukes and Churches (2012:17), "to move beyond traditional literacy to an additional set of 21st century fluencies, skills that reflect the times that we live in". The literature refers to these skills as essential skills in a knowledge-based economy. The skills that define 21st century demands are: critical thinking and problem solving; effective communication; collaboration and teambuilding, and creativity and innovation (Keane, Keane & Blicblau, 2013:75). Critical thinking is necessary for problem-solving. Teachers, as well as the learner in the milieu of the 21st century classroom, consequently, require a new set of competencies and skills. In this regard Darling-Hammond (2007) proposes a policy that enables schools to meet the intellectual demands of the 21st century. Teachers must shift their understanding of what learning means because learners need a deeper understanding of core concepts in the disciplines they currently receive. This demand for greater insight impacts how teachers scaffold instruction to give feedback to learners and how teachers assess learners. It becomes important that teachers reflect on how technology affects learning and so, it is necessary to measure the perceived learning.

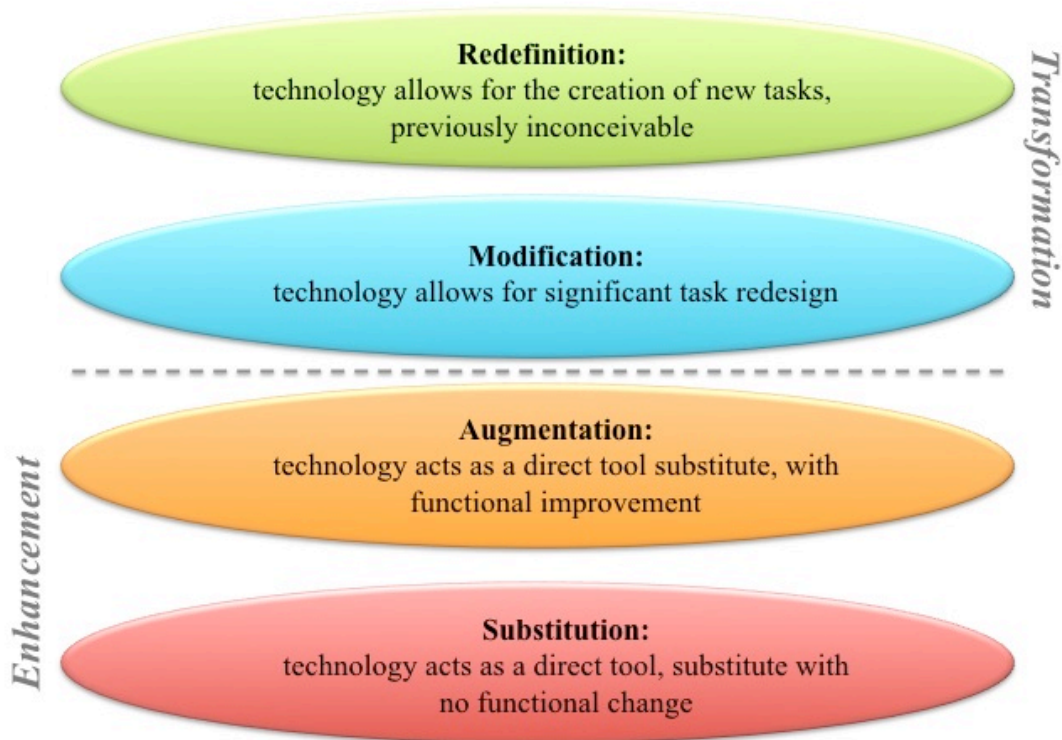


Figure 2.5: SAMR-Model (Puentedura, 2011)

In a technology-enhanced classroom teachers need to reflect on how technology integration leads to transformative and deep learning as posited by Puentedura (2011). The SAMR-model, developed and enhanced by Puentedura (2011) is a useful lens for teachers to evaluate levels of technology integration in their teaching. The model provides an opportunity for teachers to question how the lesson fits into each level of the SAMR-model to measure progression and transformation. The acronym SAMR (see Figure 2.5) represents the following constructs: substitution, augmentation, modification and redefinition. In a substitution level, teachers or learners only use new technology tools to replace old ones, for instance, using Google Docs to replace Microsoft Word. The task (writing) is the same but the tools are different. Augmentation: again using the example of Google Docs, instead of only writing a document and having to manually save it and share it with others, Google Docs provides extra services like auto saving, auto syncing, and auto sharing in the cloud. Modification: is the level where technology is being used more effectively not to replicate the same task, but using different tools to redesign new parts of the task and transform how learning happens. An example of this is using the commenting service in Google Docs, for instance, to collaborate and share feedback on a given task. Redefinition: means that learners use technology to create perceptibly new tasks. An example of redefinition is when learners connect to a classroom

across the world where they would each write a narrative of the same historical event using the chat and comment section to discuss the differences, and then use the voice comments to discuss the differences they noticed, finally this link is then embedded in the class website. If technology is aligned at the levels of substitution and augmentation, it enhances teaching. By crossing the line towards modifying and redefining lesson designs, the integration of technology can transform the learning. In the transformation level it becomes possible for learning to exploit higher order thinking skills, such as analysing, evaluating and creating. The SAMR-model enhances a social constructivist approach which also emphasises other skills such as collaboration, communication and problem-solving.

2.6 Conclusions

The literature makes reference to evidence of the transformative nature of technology integration in classroom practices. Critical evidence of its impact has yet to be widely published, especially in South Africa. Scholarly and robust research in this field still appears to be in its infancy. The bodies of literature reviewed for this study point to the fact that researchers are clearly articulating existing weaknesses and the strength of the current TPACK framework. In this chapter I sought a conceptually accountable approach to understand teachers' usage of technology in the classroom. Many educationalists value TPACK as a conceptual lens to understand the framework one needs to guide educational design. In addition, I reviewed Puentedura's SAMR-Model (2011) as an instrument for evaluating teachers' levels of technology integration. The model also provides a deeper understanding of pedagogies and the use of technology to effect transformative practices in teaching and learning and, more specifically, technology enhanced practices in the primary classroom.

Admittedly, this study drew robustly on the research of Mishra and Koehler (2006) and explored how the modelling of a TPACK mind-set is a constructive and iterative process when teachers reflect with 'appropriate technologies based on their existing knowledge, beliefs and dispositions'. The literature path in this chapter clearly points to constructs of technology integration; curriculum delivery; technological, pedagogical and content knowledge; professional development; teaching and learning practices and how these constructs are intricately inter-woven and explained by constructivist and cognitivist learning theories. A section in this chapter discussed the significance of CPTD of teachers. The section clarified the situated nature of teacher development and explained the significant discourses around teachers' continued professional development. Discourses of isolation, motivation, collaboration and personal reflection were explored in the context of teachers' continued professional development. The section then concludes by discussing how risk taking fosters learning

adaptability and improvement. The literature reviewed in this chapter gave impetus to, and framed the classroom observations.

In Chapter 3 I review relevant educational policy documents that are available in the domestic literature. I also explore dominant discourses that situate the policy on e-Education (2004) within the context of this research.

CHAPTER 3

A REVIEW OF EDUCATIONAL POLICIES IN SOUTH AFRICA

3.1 Introduction

The objective of this chapter is to reflect on the dominant discourses and debates around current policy documents and their relevant underpinnings in this research; to critically examine the implication these educational policies have for technology integration in education and understand their discourse. For the purposes of furthering the professional development of teachers in the 21st century milieu, I argue that school leaders should ensure that when implementing technology integration at school level, teachers should be made aware of critical policy documents, legislative frameworks and government initiatives to deepen their understanding of the impact of policy. The following policies have been selected: The Policy on e-Education (2004); Guidelines for Teacher Training and Professional Development in ICT (2007); The National Policy Framework for Teacher Education and Development in South Africa (2007); and the most recent UNESCO (2011) ICT Competency Framework for Teachers (ICT CFT).

The rest of the chapter is organised as follows:

Section 3.2: A brief overview of policy matters;

Section 3.3: Policies, discourses and concepts;

Section 3.4: The policy on e-Education (DoE, 2004);

Section 3.5: Guidelines for teacher training and professional development in ICT (2007);

Section 3.6: The national policy framework for teacher education and development in South Africa (2007);

Section 3.7: UNESCO (2011) ICT Competency Framework for Teachers;

Section 3.8: Action Plan to 2014 -Towards the realisation of schooling 2025; and

Section 3.9: Conclusions of Chapter 3.

3.2 A brief overview of policy matters

The following factors have emerged as concerns from the review of the policies:

- **Research on technology integration and lack of visible objectives**

Educational research in South Africa on ICTs and, more specifically, technology integration at school level is still in its infancy phase. However, a review of relevant databases show an increase of robust research that is beginning to emerge on technology integration and especially in the disciplines of Science, Mathematics, research in Open and Distant Learning (Kruger, 2012:519) and Higher Education Institutions (HEIs) (Evala, 2013:199). Objectives as set out in the Policy on e-Education have yet to become visible in the majority of schools.

- **Inequalities and disparities among schools**

Technology infrastructure and broadband access at schools are determined by the economic situation of the province in which the schools are situated, with rural, low-income residential areas and farm schools at a distinct disadvantage in all of them. There are significant differences and disparities between provinces, which further elucidate the stark inequalities when it comes to provision of basic resources at schools (Chisholm, 2011).

- **Policy constraints and complexities**

There appears to be consensus in the literature that policies denote processes that guide future action (Sayed & Kanjee, 2013:5). In a report for InfoDev/World Bank, policies, according to Trucano (2005) only signal intent, and typically contain little insight into whether a given policy (or policy component) was or is being implemented faithfully, nor do they document what impact (if any) resulted from the implementation of related policy guidance. Ball (2008) contends that policy is contested, interpreted and enacted in variety of arenas of practice, and that the rhetoric, texts and meanings of policy-makers do not always translate directly and obviously into institutional practice. Sayed (1997) and Jansen (1998:321) argue that policies are constrained by the broader socio-political context and must be scrutinised within the context of power. While policies are transformative, they also act as symbolic devices that could promote the illusion of change and help to manage stakeholder contestation. Policy implementations are, therefore, complex tasks.

- **Poor policy-to-practice implementation**

This complexity is visible in South African education's practice-to-policy advancement, which has been compromised by poor planning, a lack of trained policy personnel within the bureaucracy and poorly trained teachers. Implementing policy in a post-apartheid environment requires substantial human resource development on the part of the government as a result of paradigmatic shift away from the apartheid doctrine. The afore-mentioned complexities on understanding and implementing policy also filter down to how schools interpret and implement

policy objectives, and quality is often compromised when policy is misinterpreted or ignored (Naicker, 2013:332).

However, Ball *et al.* (2012:6), posit that teaching is set within policy regimes and policy discourses which speak of teachers as practitioners "... through the language of curriculum and pedagogy and through subjective possibilities that the relation to knowledge and to learning in policies make possible". Above all, as alluded to by Fenwick and Edwards (2010:126) implementing policy is only ever a part of what teachers do:

"There is more to teaching and school life than policy. There are "discretionary spaces" in and beyond policy, corners of the school where policy does not reach, bits of practice that are made up of teachers' good ideas or chance or crisis - but this space for action is also delimited by policy".

The most crucial questions pertaining to the implementation of the policy on e-Education still remain. To what extent has this policy translated into practice? How are the set targets being met, and how has it impacted the educational landscape? How are schools providing their own resources to meet the policy goals? Chisholm (2003) states that the disparities of the past are still visibly evident in many schools. It is understandable that the White Paper on e-Education acknowledges the magnitude of the task of delivering the necessary infrastructure for ICTs at schools.

3.3 Policies, discourses and concepts

The policy on e-Education (2004) prefaced the introduction to the policy by referring to the global revolution in education and training which is driven by the changing nature of work, the realities of the information age, the necessity of global partnerships and the need for equal distribution of educational opportunities. With regards to e-Education, it states unequivocally its main e-Education policy goal by stating that:

"Every South African learner in the general and further education and training bands (FET) will be ICT capable (that is, use ICTs confidently and creatively to help develop the skills and knowledge they need to achieve personal goals and to be full participants in the global community) by 2013".

A decade after this policy became effective, we are yet to see a significant impact of its vision in all the provinces and schools in this country in terms of: ICT infrastructure in schools; skilled teachers *aufait* with technology and who have fully embraced and understand technology's full and transformative potential. This view is underscored by (Naicker, 2013:332) when he refers to this complex practice-policy-advancement in a post Apartheid South Africa. The draft contained a ten-year plan for promoting e-Learning in South Africa and was to be phased in

over three stages. The implementation of the final phase, which according to the policy, was expected to be completed in 2013 and would herald in:

- education departments in the country using ICT for planning, management, communication and monitoring and evaluation;
- schools with access to networked computer facilities for learning and teaching with high quality educational resources;
- schools, teachers and learners who are confident and competent ICT users, and ICTs that will be integrated into teaching and learning; and
- communities that are involved in ICT development at all schools (DoE, 2004).

As far back as 2004, Conradie and Roodt (2004) asserted that there were large disparities between e-Learning ideals formulated by South African policy makers and e-Learning practitioners. Practice (Kress, 1989) therefore, is likely to be embedded in a number of different discourses. Barker (2010:89) declares that "discourses are social processes formed within and by wider events, beliefs and 'epistemes' to produce common sense notions and normative ideas. In many ways schools are captured by a version of 'doing school' that is contained within the dominant discourse of raising attainment". The discourses around teachers' efficacy, proficiency and attitude towards technology integration in the classroom are buttressed by the discourse of "technology as delivery of learning", and also resonate within the research arena internationally (Hannon & Bretag, 2010:106). Debates centre around teacher readiness in adopting technology to support instructional methodologies. Underscored by the appropriate pedagogy; and how to skill teachers through 'critical dialogue'; firstly through Initial Professional Education (IPE) and then through ongoing professional teacher development (CPTD) and training through situated and contextualised learning experiences, to become proficient and competent in technology integration.

In general these debates about teacher readiness etcetera, suggest a developmental trajectory for teachers within which to develop from entry through adoption to the adaptation, appropriation and innovation levels, as set out in the Guidelines for Teacher Training and Professional Development in ICT (DoE, 2007), as the targets to obtain. See Chapter 3.5 in this regard. The discourse around Lifelong learning and continuous professional development of teachers continues to be researched.

Research is clear that good teachers help students learn (Sanders & Horn, 1998:247). How then do we prepare 'good teachers' - teachers who can systematically establish connections between their actions and the learning of their students? According to Wenger (1999) learning and teaching are not inherently linked, much learning takes place without teaching, and indeed

much teaching takes place without learning. The question that must be asked now, is how one changes this paradigm, where teachers' view the onus of learning as, something that relates only to those being taught and teaching is what the teacher does. Hargreaves (1992:9) "believes that teachers teach in the way that they do not just because of skills they have or have not learned. The ways they teach are also grounded in their backgrounds, their biographies in the kinds of teachers they have become". Ball, Maguire and Braun (2012:74) posit that there are relationships between the educational values and philosophies of teachers and how policies are pursued and enacted.

For many teachers technology, as delivery of learning, interferes with delivery of curriculum. In this regard Ball *et al.* (2012:27) allude to standards in the delivery of policy and curriculum. Policy standards, they contend 'work' through a very effective and very public technology of performance. Benchmarks are intended to instil into schools a 'performance culture'. This in turn creates expectations of performance as 'delivery', namely the delivery of improved systemic performances and the achievement of examination benchmarks by individual schools and individual learners who form part of a broad audit culture. The Western Cape teachers are familiar with benchmark assessments such as the WCED Systemic tests for Grades 3, 6 and 9, as well as the Annual National Assessments (Grades 1-6 and 9) which attempt to measure the literacy and numeracy performance levels of schools.

"Leadership and learning are crucial concepts in contemporary debates on policy and practice regarding improving performance and achievement in education" as asserted by Bell and Stevenson (2006:12). Leadership, therefore, plays an important role in implementation at school level of relevant policy documents that impact learning. It points to how the leadership can facilitate the adoption of technology. Bell and Stevenson further assert that "what is certain is that within education, across phases and across continents' the policy context impacts decisively on shaping the institutional environment" (*ibid*). School leadership need to understand where policies come from, what these policies seek to achieve, how they impact on the learning experience and the consequences of their implementation.

In Section 3.4 salient aspects of the e-Education policy (2004) are reviewed although the formulation of this policy is not examined. This section draws attention to the objectives, together with the planned roll-out outlined in the e-Education policy. Section 3.4 also lists the key elements set out in the policy framework. Furthermore I hope that, through this study, teachers will give due consideration to existing policies and relevant frameworks in order to grasp policy intentions.

3.4 The policy on e-Education (2004)

The South African government, through its White Paper 7 on e-Education (gazetted in 2004) has signalled its intention to progress education through the use of Information Communication Technologies (ICT). South Africa is in the process, as are many other countries, of charting its own developmental pathway in the digital age. Our present milieu is a digital one: according to Prensky (2001:5), this fact is signalled by the "arrival and rapid dissemination of digital technologies". Lundall and Howell (2000) maintain that the primary commodities of our time, "information and knowledge", are available to us as a result of the emergence of ICTs. The White paper on e-Education (2004) views ICTs as a vehicle to access learning opportunities and, at the same time, redress inequalities and improve on the past. It furthermore sees the improvement in the quality of teaching and learning and the provision of personalised learning experiences as critical areas for effective growth.

The perversions of this digital era propose a technology push and an educational pull. It is against this background that the contributions of the WCED to e-Education are proposed. The WCED's vision is to work towards quality educational outcomes and to employ ICTs, in a safe, and responsible manner, to support the teaching and learning process. Providing equal and quality education to previously disadvantaged schools is a challenging task and it becomes even more taxing when these schools lack basic infrastructure with ICT resources. This policy proposes that the integration of ICT into schools take place over three phases within different timeframes (see Appendix K).

- Phase 1: Enhance a system-wide and institutional readiness to use ICT for learning, teaching and administration;
- Phase 2: System-wide integration of ICT into teaching and learning;
- Phase 3: ICT integrated at all levels of the education system-management, teaching, learning and administration.

The final phase was envisaged to be completed in 2013. This has not realised fully. A revised implementation strategy for e-Education 2013-2025 now serves as an implementation of e-Education in South Africa (DBE, 2012). The White Paper on e-Education, published by the former Department of Education in 2004, states that e-Schools are further defined as having: learners who utilise ICTs to enhance learning; qualified and competent leaders who use ICTs for planning, management, and administration; qualified and competent teachers who use ICTs to enhance teaching and learning; access to ICT resources that support curriculum delivery and connections to ICT infrastructure (DoE, 2004). In such institutions, the teachers and learners will be able to function across the following three dimensions:

Operational: referring to the skills necessary to use ICTs. Demonstrate acquisition of these skills is as important as the process by which they are acquired.

Cultural: stepping into, and developing, the culture that supports the practices of using ICT for educational purposes.

Critical: capable of challenging assumptions embedded in the success stories about ICT. E-education is defined as much more than just developing computer literacy skills and the skills necessary to operate various types of ICTs. It is also the ability to: apply ICTs, access, analyse, evaluate, integrate, present and communicate information; create knowledge and information by adapting, applying, designing, inventing and authoring information.

Teachers and learners must be able to function in a knowledge-society by using appropriate technology and mastering communication and collaboration skills (DoE, 2004).

The policy on e-Education (2003:27) lists the following key elements: equity, norms and standards, strategic objectives and funding. It is around these key elements that institutions such as schools make "choices around equipping and re-equipping their choice of technology". The most crucial choice concerns "equity as it centers on competence, which is the objective of our education system" (2003:27). Crucial to the implementation of this policy is the monitoring of targets which will be reflected in national and provincial plans.

3.5 Guidelines for teacher training and professional development in ICT

This statement was made by the then Director General of Education in the foreword of this guideline document. "These guidelines for training and professional development should be seen as an attempt to move away from imposing a narrow vision of the appropriate use of ICT in teaching and learning and contribute towards the meaningful use of ICT in education as teachers become more conversant with ICT [and thus able] to harness its potential" (DoE, 2007:1). The guidelines iterate the Policy on e-Education's redress of inequalities and creating greater access and learning opportunities as stated in its preamble. These guidelines must also be viewed as professional development routes towards ICT enhanced learning for teachers in Initial Professional Education (IPE) and also those in-service teachers who will continue on their personal learning trajectories. Situated within an empowerment paradigm, the Guidelines place a high premium on personal development of teachers. The document incorporates and reflects a holistic approach to teacher development in ICT and cannot be practised in isolation from their context (DoE, 2004:1).

The dimensions which encapsulate the holistic approach to teacher development have:

- A pedagogical dimension, which implies: an understanding and application of the opportunities of the use of ICT for teaching and learning in a local curriculum context.
- A technical dimension, which implies: an ability to select, use and support a range of ICT resources as appropriate to enhance personal and professional effectiveness, and the willingness to update skills and knowledge in light of new developments.
- A collaboration and networking dimension, which includes: a critical understanding of the added value of learning networks and collaboration within and between partners; and the ability to create and participate in communities of practice.

The following key principles should thus be followed in professional development programmes for teachers:

- Educational goals should be primary and not on providing *technical* ICT skills only, but on the use of ICT to achieve *learning outcomes*.
- Teacher development programmes should provide teachers with situated/contextualised learning experiences. Programmes should be *subject-specific* and relevant to the *learning areas*.
- Teacher development programmes should be needs driven and respond to the requirements of subjects.
- Ongoing support should consistently be available, particular pedagogic support from subject advisers, technical support and creating communities of practice.
- Teacher development should be ongoing, due to the changing nature of ICT and programmes should reflect new technologies and applications.

3.6 The national policy framework for teacher education and development in South Africa

This policy mentions that the onus remains on the school to respond directly to inequalities by helping to prepare each succeeding generation of children with the appropriate knowledge, skills and values to understand challenges and contribute to overcoming them, as well as to fulfil their personal potential and aspirations. Initial Teacher Education (IPE) including Continuing Professional Teacher Development (CPTD) has the vital role of equipping teachers to undertake this task. In the policy preamble teacher education seeks to develop a teaching profession ready and able to meet the needs of a democratic South Africa in the 21st century. The overarching aim is to equip teachers to undertake their essential and demanding tasks, to

enable them to continually enhance their professional competence and performance. It, consequently, represents a competence-based approach to teacher training.

The technical report prepared by the DHET and DBE (2011) on the new integrated strategic planning framework for teacher education and development in South Africa, 2011-2025 seeks to support continuous professional development of teachers to adopt new orientations and approaches, and to improve their subject content knowledge, pedagogical content knowledge, practice and situational knowledge through a recognised, accredited system of professional learning communities. Significant to this initiative is the commitment of this strategic planning framework to content-rich, pedagogically sound continuous professional development courses for teachers. This policy framework for teacher education and development in South Africa is designed to equip a teaching professional to meet the needs of a democratic South Africa in the 21st century. It brings clarity and coherence to the complex matrix of teacher education activities, from initial recruitment and preparation to self-motivated professional development.

The policy is underpinned by the belief that teachers are essential drivers of a good quality education system. However, it is the responsibility of teachers themselves, guided by their own professional body, the South African Council for Educators (SACE), to take charge of their self-development by identifying areas in which they wish to grow professionally. The provincial education departments are obliged to provide an enabling environment for such preparation and development of teachers to take place (DBE, 2007:5). According to Booyse and Du Plessis (2014:30) working in an outcomes-based teaching and learning environment changed the role of the teacher which is linked to the broader framework and aims in a curriculum. Regarding the influence of educational policy on curriculum interpretation and implementation, teachers need to take many factors into consideration. They must have a sound knowledge of the intended policy documents and the ability to interpret and plan according to these documents, as well as select and prepare suitable textual and visual resources for learning. To this effect Kramer (1999:128) holds that all learning must be recognised and valued, and that achievement standards should be transparent and uniform.

3.7 UNESCO ICT Competency Framework for Teachers

The UNESCO ICT Competency Framework for Teachers (ICT CFT) articulates that the overall goal of the ICT Competency Framework for Teachers' in Education Programme is to assist member states in harnessing the potentials of ICT towards achieving quality education for all. It provides a framework for teacher competencies, learning materials, ICT equipment and learner and teacher motivation. The activities allow for free access to credible data and information and aims to define various ICT competency skills for teachers in order to enable them to integrate

technologies into their teaching. It further seeks to develop teachers' skills in pedagogy, collaboration, and school innovation using ICT. The research site where the study was conducted, has formulated a framework with set standards and competences for the training and the up-skilling of in-service teachers and new incumbents who lack technology literacy and digital competences.

The ICT CFT consists of a policy framework, a set of competency standards and implementation guidelines. The standards include training in ICT skills as part of a comprehensive approach to education reform. Key deliverables pertinent to teacher training in ICT make provision that teachers should be trained according to the UNESCO Teacher Development Framework with ICT (2011) development levels which include skills levels for the integration of ICT into curriculum delivery. The ICT CFT focuses on six areas of a teacher's work: understanding ICT in education; curriculum and assessment; pedagogy; ICT; organisation and administration; and teacher professional learning.

Table 3.1: The UNESCO ICT Competency Framework for Teachers (2011:9)

	TECHNOLOGY LITERACY	KNOWLEDGE DEEPENING	KNOWLEDGE CREATION
Understanding ICT education	Policy awareness	Policy understanding	Policy innovation
Curriculum and assessment	Basic knowledge	Knowledge application	Knowledge society skills
Pedagogy	Integrate technology	Complex problem solving	Self management
ICT	Basic tools	Complex tools	Pervasive tools
Organization and administration	Standard classroom	Collaborative groups	Learning organizations
Teacher professional learning	Digital literacy	Manage and guide	Teacher as model learner

The UNESCO ICT-CFT (2011) policy outlines four developmental stages of a teacher's development in technology. Below is a brief definition of skills acquired in each stage of ICT usage: *Emerging*: becoming aware of ICT; *Applying*: learning how to use ICT in subject teaching; *Infusing*: understanding how and when to use ICT; *Transforming*: specialising in the use and design of ICT.

Employing the same stages of usage, the policy defines pedagogy integration in ICT, namely:

- Emerging: Applying productivity tools
- Applying: Enhancing traditional teaching
- Infusing: Facilitating blended learning within or across subject areas
- Transforming: Facilitating blended learning within or across subject areas

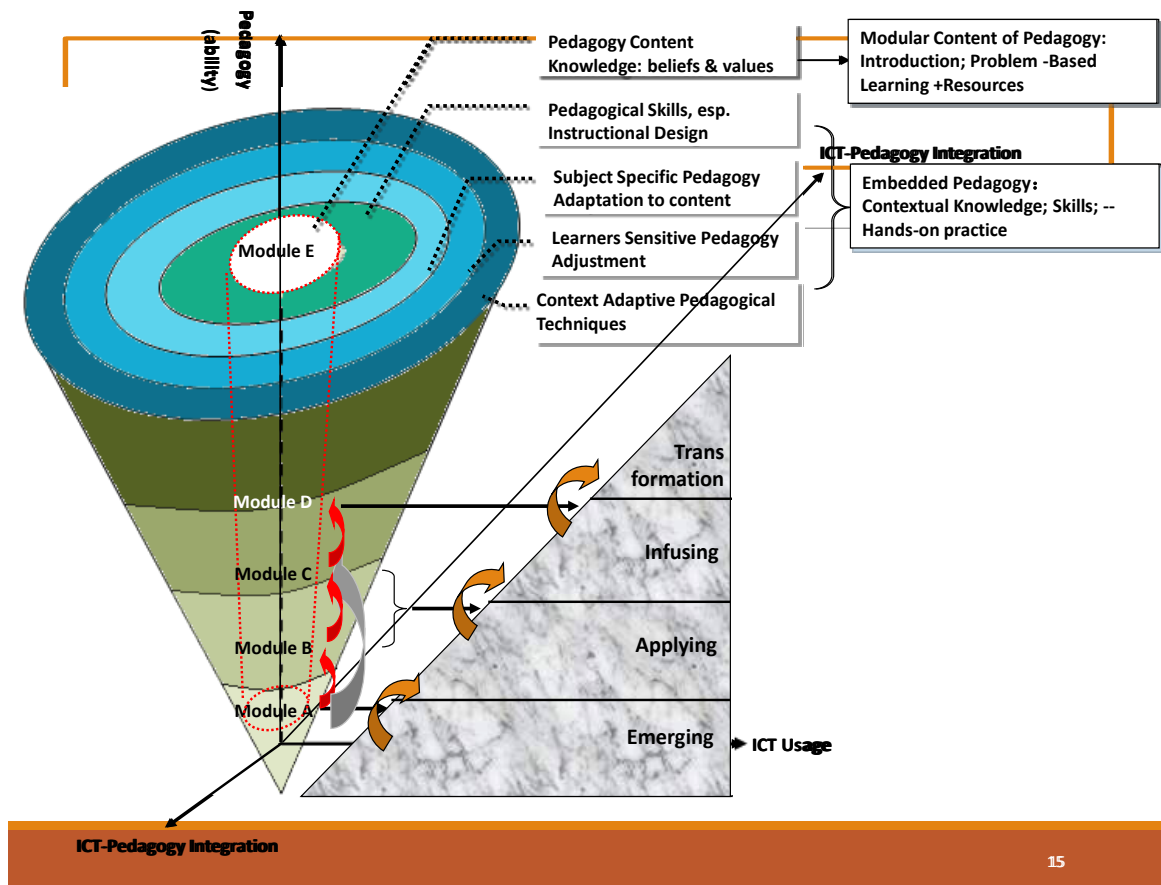


Figure 3.1: UNESCO ICT-CFT-model: developmental stages and modules

These stages of ICT usage are never linear and would also overlap as depicted in Figure 3.1, until the teacher reaches the stage when technology integration becomes seamless and it is embedded within the classroom ecology. A strong emphasis is placed on pedagogy, content knowledge, skills and values when the upper levels of the stages of technology integration is reached.

In conclusion, the use of new technologies in education implies new teacher roles, new pedagogies and new approaches to teacher education. The framework specifies the competencies which teachers need in all aspects of their work (UNESCO, 2011:8).

Understanding what teachers' do in their classrooms is not straightforward and may require rethinking teacher education and teacher professional development. It is suggested in the ICT-

CFT that countries wanting to use the UNESCO framework may wish to start by conducting a baseline study of the current competency levels of teachers. Such a study would be relevant in South Africa and would identify priorities for providers of teacher education and professional learning.

3.8 Action Plan to 2014-Towards the realisation of schooling 2025

The Department of Basic Education, in its Goals to Action Plan to 2014, towards the realisation of schooling 2025 (DBE, 2011) attempts to provide direction in addressing the ICT training needs of teachers. The Action Plan to 2014 has 27 goals. Goal 16 is seen as one of the priority goals and focuses on professionalism, teaching skills, subject knowledge and computer literacy of teachers throughout their entire careers. Goal 27, which is also a priority goal is about improving the frequency and quality monitoring and support services through better use of e-Education. The Action Plan guides those involved in monitoring progress in the schooling system, and researchers examining trends and patterns.

Specifically, the Action Plan provides a framework for an annual review of progress in the schooling sector (DBE, 2011:14). The following are some of the more important e-Education milestones reported by the Department of Basic Education:

In 2012 a new strategy was released which updates and adds details to the 2004 White Paper and includes targets for ICT access in schools.

In 2013 all school principals have access to a computer and to the Internet at school and the Teacher Laptop Initiative is concluded.

In 2014 Using ICTs for teaching becomes a mandatory component of all pre-service teacher training. "However, studies have shown that by this date new teachers graduating from teacher education still feel underprepared by the teacher training to teach with ICTs" (Chigona, 2015:240).

3.9 Conclusions

Chapter 3 attempted to provide a broad overview of current and relevant educational discourse that contains policy objectives and guidelines for implementation. Teachers are expected to be familiar with the contents of policy documents that aim to equip the "teaching profession to meet the needs of a democratic South Africa in the 21st century" (Booyse & Du Plessis, 2014:50). This chapter firstly, sought to provide a broad definition of policy within the context of an educational institution such as a school. In addition, the chapter focused on the dominant discourses and debates around current policy documents and their relevant underpinnings.

Further aims of this research are developing teachers' technology skills enforced by pedagogy, through collaborative practices of ICTs. Some concerns that have emerged from the review of the policy on e-Education are raised. The e-Education policy was influenced by South Africa's political and economic development, by curriculum change and by the rapid development and uptake of the Internet and clearly recognises the shifts in teaching and learning processes. Since teachers are the drivers of a quality education system, they should be seen as the nexus that drives such a system. The literature on how schools react to policy explored how teaching policy regimes, and the afore-mentioned complexities on understanding and implementing policy also influence how schools interpret and implement policy objectives. Quality is often compromised when policies fail to produce the intended outcomes due to poor policy interpretation and implementation.

In Chapter 4 I focus on the research design and methodology for this thesis.

CHAPTER 4

RESEARCH DESIGN AND METHODOLOGY

4.1 Introduction

Chapter 4 outlines the research methodology of this study. This research concentrates on the factors that impact on the development of teachers' technological, pedagogical and content knowledge (TPACK) for technology integration into their classroom practices. The TPACK model (2006) is the underpinning framework for this study. This study is concerned with the participants' individual learning trajectories and accumulation of emerging technological domain knowledge. It explores how the participants gained the necessary perspectives on utilising technologies in teaching methodologies and the technical expertise needed for employing technology-enhanced lessons. Furthermore, as a researcher I was interested in exploring how technology use might be successfully exploited and integrated into existing traditional classroom practices to transform learning and teaching. In addition this study examines how that practice begins to evolve as the participants adopt new and emerging technologies to enhance their current traditional teaching methodologies. To study and document the experiences of the participant teachers, a qualitative approach, based on a subjective-interpretive paradigm was used and conducted as an ethnographic case study.

This chapter presents a discussion of the following issues:

- Section 4.2: The synchronisation of epistemological underpinnings, procedure and methodology;
- Section 4.3: The research design;
- Section 4.4: The case study methodology;
- Section 4.5: The sample selection, demographics and characteristics;
- Section 4.6: The data collection plan and analysis strategies;
- Section 4.7: The instruments used for data generation as well as procedures followed;
- Section 4.8: The data analysis procedure, coding and analysis and matters pertaining to the integrity of the data; the role of the researcher; and ethical considerations; and
- Section 4.9: Concludes the chapter.

4.2 Synchronising epistemological underpinnings, procedure and methodology

4.2.1 Qualitative approach

In this thesis I have chosen [as indicated earlier] a predominantly qualitative paradigm in which the choice of method is a multiple case study that adopts a within-case and cross-case analysis approach. Merriam (1998:40) notes that the inclusion of multiple cases within a case study is a means by which the external validity or generalisability of study findings can be enhanced. Nevertheless, selecting a case study for this research, proved to best fit the data collection and analysis for this study for several reasons. I wanted to investigate a particular phenomenon thoroughly, not to generalise but to begin to understand a particular problem. Case studies are "intensive" and according to Sayer (1992) calls for "intensive research" that requires detail, richness, completeness and variance or depth. In this case study the issue is probing primary school teachers' acquisition and development of TPACK to support their learning about instructional technologies.

This approach offers a detailed look into each of the four selected cases for reporting the data as a bounded case (Yin, 2014:33), see Chapter 5. Case studies focus on 'relation to context'. This requires a researcher to draw boundaries around a case in such a manner that a differentiation can be made between context and case. The context in this study relates to the complex school environment and the influences of professional development within a technology enhanced teaching environment. The 'case' in this study, relates to participants learning about technology, acquiring knowledge of technology and integrating technology enhanced teaching activities and practices into the primary school class curriculum. Denzin and Lincoln (2012:4) explain that qualitative research is a situated activity that locates the observer in the world. Qualitative research according to these authors consists of a set of practices that make the world visible. They go on to state that these practices turn the world into a series of representations, including field notes, interviews, conversations, photographs, recordings and memos to self. It is through this wide range of interpretive practices that the qualitative researcher hopes to get a better understanding of the subject matter at hand (Denzin & Lincoln, 2012:4). Qualitative research is interested, in the way in which the world is "understood, experimented, or produced" (Mason, 1996:4) by people's lives, behaviour and interactions (Strauss & Corbin, 1990:17). It is also takes interest in processes, change and social context dynamics (Mason, 2006:16; Maxwell, 2004a:36), participants' "perspectives on their own worlds" (Marshall & Rossman, 1999:7; Creswell, 1998:15), and in trying to appreciate those worlds through such perspectives (Savage, 2006:384).

4.2.2 Quantitative approach

Quantitative supplementary data was also generated by the self-progress questionnaire. This dual approach provided a measurable and comprehensive analysis of the data generated by the self-report instrument. I explain my decision for this dual approach in detail in Section 4.7.2 of this Chapter. In this study both deductive and inductive approaches are employed. When conducting case studies with an inductive strategy, it offers additional promise if it happens to call for quantitative data. Yin (2014:138) qualifies this statement by stating that the data may be related to an embedded unit of analysis within the broader case study. The self-report instrument employed in this study called for quantitative data as self-measure by participants. The self-assessment questionnaires completed by the participants included items that measured quantitative Likert-scale responses: strongly disagree; disagree; neither agrees nor disagrees; agree and strongly agree, and expected the participant to answer questions on the constructs of the TPACK framework. A Likert-scale is one way of moving away from dichotomous questions to measure overall opinions of respondents. According to Fisher (2002:153) the basic structure of a Likert-scale provides a range of responses to a given question, some negative, some positive in tone, and where respondents have to choose between categories, a five -point scale ranging from strongly agree to strongly disagree.

4.2.3 Interpretive paradigm

The interpretive paradigm does not only see people as a primary data source, but seeks their perceptions or the 'insider view' and, therefore, is concerned with the individual (Blaikie, 2000:115). Interpretive research according to the author describes aspects of the social world by offering a detailed account of specific social settings, processes and relationships. Interpretivism seldom perceives experiences as uncomplicated. Shutz (1962:5) as cited in Flick (1998) discusses how people participate in this indeterminate life-worlds. Facts are always interpreted and become open to levels of interpretation, which, therefore, have multiple realities or different interpretations according to Shutz (1962:5). Cohen, Manion and Morrison (2011:116) state that:

"An interpretive paradigm rests, in part, on a subjective, interactionist, socially constructed ontology and on an epistemology that recognized multiple realities, agentic behaviours and the importance of understanding a situation through the eyes of the participants".

A researcher in this paradigm seeks to understand rather than explain. I also recognise that my viewpoint is a subjective one, that there is no single truth, but multiple perspectives and multiple truths, according to Cohen *et al.* (2011:116).

Vasilachis de Gialdino (1992:153) proposes that qualitative methods "presuppose and draw on interpretive paradigm assumptions", and the following are its four basic principles:

1. Resistance to the 'naturalization' of the social world;
2. Relevance of the life-world concept;
3. Transition from observation to understanding and from the external to the internal point of view; and
4. A recognition of double hermeneutics.

This author further asserts that assumptions are specifically linked to a view of language "as a resource and a creation, as a way of producing and reproducing the social world." Gay and Airasian (2003:16) postulate that the researcher collects data in waves, making initial observations and interpretations about the context and participants. Collecting and examining more data in a second wave of refining the initial interpretation, and so on, until the researcher has obtained a deep understanding of both the context and the participant's role in it. In the sections to follow, I discuss some of these characteristics and, more specifically, I illustrate through the five data collection phases how I collected the data for this study as outlined in the data collection plan and analysis strategies presented in Section 4.6 of this Chapter.

According to Bassey (1999:42) paradigms are: a network of coherent ideas about the nature of the world and the function of researchers which, adhered to by a group of researchers, condition the patterns of their thinking and underpin their research actions. Angen (2000:378) explains that interpretive approaches rely heavily on naturalistic methods (interviewing and observation and analysis of existing texts). These methods ensure an adequate dialogue between the researchers and those with whom they interact in order to collaboratively construct a meaningful reality. Generally, meanings are emergent from the research process. In this study there were numerous opportunities for dialogue through collaboration with myself as the researcher and the participants. It was this study's main goal to seek an understanding of the relationship between the various constructs represented in the framework central to the participants' perceptions, views and their experiences which further grounds the research in an interpretive paradigm.

The interpretivist paradigm is founded on the belief that reality is fluid and socially constructed. All interpretations according to Angen (2000:378) are based in a particular moment and are open to reinterpretation and negotiation through conversation. This is a phenomenon termed a 'double hermeneutic' (Habermas, 1984:109) indicating the interpretation of an already interpreted world. In this enquiry, the setting is the multicultural Foundation and Intermediate Phase classrooms at a primary school. I observed the interactions between the teacher and the

learners during technology integrated instructions. These observations allowed me to gain insight into the teachers' integration of technology and how it aligns with the curriculum, as well as the decisions that teachers make when they teach with technology. Over a period of eighteen months I was able to make conjectures about each participants' growth and fluidity with technology applications as they gained expertise, confidence and digital literacy skills and competencies.

Methodologically, my stance as the researcher relates to the role of participant observer. The role of participant observer required all descriptions to be through narrative interpretation. Hammersley (1992:58) states that both ethnography and participant observation represent a uniquely humanistic interpretive approach. Since the participants are both peers and co-workers, I needed to consider the possibility of bias. One way of minimising bias, which could result in skew data, is for the researcher to identify personal biases and employ strategies to minimise or counter them (Hopkins, 2008). For the duration of the enquiry my intention was to distinguish my relationship with the participants as a co-worker from that of a researcher. Cohen *et al.* (2011:474) suggest the following considerations: the need to operationalise the observation so that what counts as evidence, is consistent, unambiguous and valid; the need to choose the appropriate kind of structured observation and recording; problems that might be encountered; identifying the 'unit' of observation. For this purpose I employed a rubric to guide the observation in the classrooms. I discuss this instrument in Section 4.7.1.

In observation studies according to Basit (2010:6), investigators are able to discern ongoing behaviour when it occurs. They are able then to make appropriate notes about its salient features, and, because study observations take place over extended periods of time, researchers can develop more informal relationships in more natural environments. Consequently, case study observations are less reactive than other types of data-gathering methods.

As a researcher I needed to understand how the participants engage with and through technology and also describe their acquisition of technology knowledge and skills. Therefore it was appropriate to select a methodology that would be appropriate to the subjective description of the human experience.

My epistemological position is concerned with how knowledge can be created, acquired and communicated, in other words what it means to know (Cohen *et al.*, 2011:116). My ontological position, in terms of 'how things are and how things really work' (Crotty, 1998:10), allowed me to take a position concerning the participants in this study. The interpretive paradigm, locates the participants in this study, through my subjective understanding of how they acquire knowledge of content, pedagogy and technology.

Ontologically, social entities are regarded as objective constructions built up from the perceptions and actions of social actors, such as politicians and certain government/public officials. Defining the meaning and content of a phenomenon is dependent upon the relevant actors (Bryman, 2008:18). The constructivist approach to learning is linked to interpretivism by the focus on understanding and its relation to the nature of the learners' knowledge of the social world. All research methodologies employed in Social Sciences are a means of soliciting information about human nature from human participants (Tuli, 2010:99).

A consideration of epistemology, ontology and methodology must be a central feature of any discussion about the nature of Social Science research, because these elements give shape and definition to the conduct of an enquiry (Popkewitz, Tabachnick & Zeichner, 1979:17-29) as cited in Tuli (2010:99). All of these fields are central elements in my research and necessitated my considering the participants' views of epistemology and teaching philosophies, and are factors that influenced my methodology. Methodology is the strategy or plan of action which lies behind the choice and use of particular methods (Crotty, 1998:3). Thus, methodology is concerned with why, what, from where, when and how data is collected and analysed. Guba and Lincoln (1994:8) explain that methodology asks the question: how can the inquirer go about finding out whatever they believe can be known?

4.3 Research design

Having clarified the epistemological underpinnings, procedure and research methodologies, I describe the research design, methodology and approaches, including the data collection plan and analysis strategies.

"Qualitative research begins with assumptions, a worldview, the possible use of a theoretical lens, and the study of the research problems inquiring into the meaning individuals or groups ascribe to a social or human problem ..." (McMillan & Schumacher, 2014:344).

For the purposes of conducting this study I have opted to follow a 'rigorous [and] methodological path' (Yin, 2014). I have also selected to employ an ethnographic case study approach as the main methodology. Simons (2009:22-23) explains that ethnography has its origins in anthropology and prefers qualitative methods, such as participant observation. The research setting for this study simulates that of an ethnographic case study. The intent of ethnographic research is to obtain a holistic picture of the subject of study with emphasis on portraying the everyday experiences of individuals by observing and interviewing them and relevant others. Ethnography, allows considerable flexibility in the choice of methods used to obtain information about a culture (Creswell, 1998). Ethnography is defined as a qualitative approach that studies participants in their natural culture or setting (Gay & Airasian, 2003:16).

The selected context and participants are observed in the setting. "Ethnographers supplement what they learn through participant observation by interviewing people who can help them understand the setting or group they are researching" (Hall, 1999). The researcher observes rather than manipulates the participants and spends much time in the context observing and interacting with the participants. Over time, a tentative research design emerges based on the data provided by the participants. In this investigation, observations focused on the use of information and communications technology in the classroom and its integration in the delivery of the curriculum.

The context of this investigation is also dynamic and provides an example of real teachers in a real classroom situation (Cohen *et al.*, 2011:468). Stenhouse (1985) identifies an ethnographic case study as a single in-depth study. My primary aim with this enquiry was to capture the full complexity of a novice teacher's trajectory with instructional technology, and the resulting implementation endeavour, by building a richly described portrait of the highs, lows, patterns, and dynamics of the process. Fetterman (2010:93) highlights the iterative nature of ethnographic analysis and how it builds on ideas throughout the study. The individual constructs which underlie the theoretical framework and the interactions between these elements, namely content, technology and pedagogy, can be observed when participants are engaged in teaching and learning in the classroom context. It is both possible and common for researchers to conduct interpretive ethnographies.

While sharing methods in common with classic ethnography, such as participant observation and interviewing, researchers engaged in ethnographic case studies still aspire to understand the case in its socio-cultural context and with the concepts of culture in mind. As a researcher, I acknowledge the limitations of case study research, but at the same time, according to Simons (2009:23) its unique strengths are its ability to deal with a full variety of evidence - documents, artefacts, interviews and observations - which underpin the nature of this kind of study. She [Simons] postulates that ethnographies usually require long periods in the 'field' and emphasise detailed, observational evidence, a prerequisite I could adhere to, due to my unique position in relation to the research site.

Simons (2009:23) asserts that a case study is not constrained by method, nor is it time-dependent. Participant observation also assumes a 'hefty investment of field efforts.' It is a special mode of observation in which the researcher is never a passive observer. I have found myself assuming many roles as I worked in the 'field' to collect rich data. As an 'insider' I was able to immerse myself within the ecology of each classroom. Classic ethnographic participant observation as a method, represents the convergence of ethics as well as the insider/outsider stance, balanced with scientific objectivity and culturally sensitive subjectivity. Unique

opportunities were encountered that allowed me to assume an 'insiders' role. These opportunities only arose a number of weeks into the commencement of the research. I discuss my role in the 'field' in succeeding chapters in terms of how it relates to my interaction in the data collection process and teaching.

4.4 Case study methodology

Firstly, a case study has a distinctive advantage over other research designs because the strategies employed constitute "how or why" questions asked about a contemporary set of events over which the researcher has no control (Yin, 2003:9). Secondly, a case study design is also favoured when there are multiple data sources. Merriam (1998:29) and Yin (2003) identify the case study research approach's reliance upon multiple sources of evidence as its unique strength. Thirdly, case studies have the potential to provide specific insight into how individuals confront and solve problems.

Merriam (1998:29) defines case studies as "being pluralistic, descriptive, and heuristic", indicating that the case study is focused on a specific event and has the potential to provide meaningful insight into how individuals confront problems through a holistic view of the situation. The rationale for a single case study design is appropriate under several circumstances. Yin (2014:51-53) proffers five rationales, which I list verbatim below:

"... when the single case represents an extreme or unique case; when a single case is representative or typical, lesson learned are assumed to be informative about a person or institution; when a single case is a revelatory case which can stimulate further research; when a single case could be a longitudinal case: studying the same single case at two or more different points in time."

A case study (Hitchcock & Hughes, 1995:322) has several hallmarks: it is concerned with a rich and vivid description of events related to the case; it provides a chronological narrative of events the researcher is integrally involved in the case; and an attempt is made to portray the richness of the case in writing up a report.

Each of the ten teacher participants in my study constitutes a unique case which is influenced by their past experiences, perspectives of teaching and learning, formal teacher preparation and ongoing professional development. I discuss the sample and sampling procedure in Section 4.5. Teachers were observed within their natural setting, which is within the ecology of the classroom. As a research method the case study is used in many situations to contribute to people's knowledge of the individual, group, organisational, social, political and related phenomena. It allows investigators to retain the holistic and meaningful characteristics of real-life events. Bhattacharya (2007) reiterates that people make meaning of their experiences that

vary across time, space, and cultural norms. Therefore, qualitative researchers do not conduct their inquiry to predict or generalise but rather to understand, interrogate and deconstruct.

This study sought to understand and deconstruct firstly, the data generated through the semi-structured interviews and, secondly, the data collected through the classroom observations. Applying this strategy to deconstruct the data led to the identification of specific themes within the data.

In the following section I detail the logic for the sample size and the strategies used to find an information-rich sample. I also elaborate on the sample's participation in technology related staff-development activities, because this significantly influenced the sample's knowledge, skills and instructional strategies.

4.5 Sample selection, participant demographics and characteristics

I have purposefully selected all ten participants from the primary school where the research was conducted as the unit of analysis. The method of purposive sampling is based on the assumption that the qualitative researcher wants to discover, understand, and gain insight and, therefore, must select a sample from which the most can be learned "... from people who know what cases are information-rich; that is, good examples for study, good interview subjects" (Merriam, 1998:71).

Through purposive sampling researchers can manipulate their data generation, analysis, theory, and sampling activities interactively during the research process, to a much greater extent than in statistical sampling (Mason, 2006:137-138). For the purposes of this study it was desirable to seek a sample of not only teachers who showed a willingness or eagerness to use technology in their instruction, but also those who were known by their peers as being skillful in their practice. The respondents have been included in the sample based on the judgment of their typicality and might not represent a wider population (Cohen *et al.*, 2011:153).

Mason (2006:136) further posits that sampling strategically will help develop theoretically grounded arguments, which will be focused on the research questions. She additionally states that "qualitative samples are usually small (in Mason's study, five) for practical reasons related costs ...". She also mentions two available purposes of sampling in a qualitative enquiry, namely: to provide useful and meaningful explanations (that is the people, groups, countries, organisations, policies, discourses, social practices or activities). Denzin (1989:73) clarifies that generating data and ideas, which advance the researcher's understanding, are always theoretically informed. The sample in this study is small, in line with Mason (2006:26) and

comprises ten in-service teachers in the Foundation, Intermediate and Senior Phases, each with not less than ten years teaching experience.

The sample was also selected based on the participants' existing well-developed PCK. Schulman (1986) noted that PCK is a form of teacher knowledge, which draws heavily upon individual's knowledge of content, therefore, the researcher's knowledge of content is important. Van Driel *et al.* (1998) postulate that PCK is both topic- and context-specific and includes knowledge of subject matter, learners, representations, instructional strategies and assessments of subjects taught. Two dimensions encapsulate teachers PCK, understanding and the enactment of the curriculum. Park (2014) illuminates dilemmas relating to how a teacher's PCK is measured and portrayed. She theorises that methodological predicaments are associated with self-report measures, observation-based measures and further contends that a teacher's PCK is both idiosyncratic and unique. The analytic lens in this study focused on how this sample of participants developed their own TPACK through technology implementation and integration in their classrooms and how their practice was shaped by their TPACK.

Observations focused on the participants' perceptions, attitudes to and beliefs regarding technology and how the individuals' levels of efficacy developed. This study followed each participant's individual trajectory from being a novice or unreceptive user of technology to becoming expert users of technology in some instances. A gradual process of evolution in terms of participants' TPACK unfolded throughout the research process and became apparent as the study progressed. Participants were trialing new strategies specifically for mediating technologically integrated and supported learning and teaching.

Figure 4.1 presents a graphic skills profile of the ability levels of the participants prior to the commencement of the study. A generic survey tool was used to ascertain teachers' skill levels in the use of technology. The data generated by this survey allowed the ICT trainer and other skilled staff members to select suitable course material to support teachers' digital literacy skills through professional development workshops at the school. My reason for including this visual as a forerunner to this study is to provide the reader with evidence that has a bearing on the participants' self-reported digital and perceived abilities just prior to the start of this investigation.

4.5.1 Skills set profile of the sample prior to the study

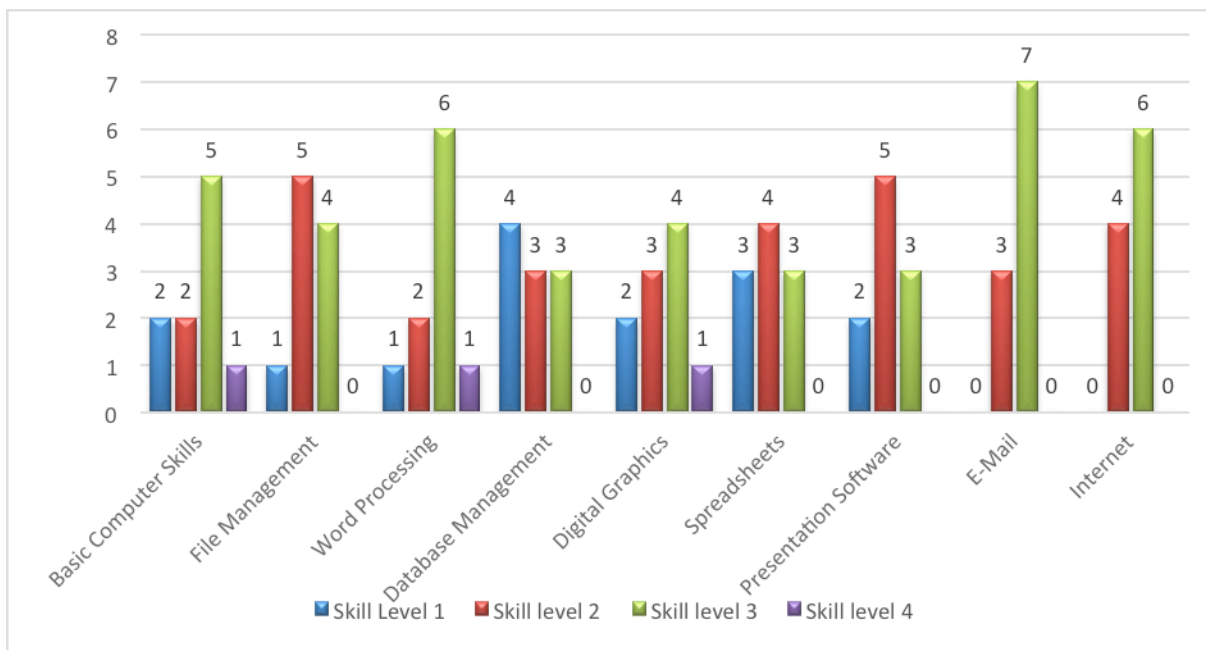


Figure 4.1: Computer skill set profile of sample prior to the study

Figure 4.1 depicts the competency levels and skills set ranking of teacher participants in this study. Very few participants ranked their competencies at skill level 4. Skill level 3 had a higher ranking for competencies that participants engaged in daily such as sending emails, using word processing for typing learning activities and surfing the Internet. The rankings, although subjective, indicate that most of the participants are fairly skilled in their abilities to use a computer and some of the applications for administrative purposes. The survey data was collected at the commencement of the annual staff training session held at the research site a few months prior to the writing of the proposal for this study. All the participants who were included in the sample for this study also attended this training session. The horizontal axis lists the skills that the participants were requested to rank, using the following scale of 1-4 where: 1 = little knowledge or none at all, and 4 = expert knowledge by which a teacher would be able to assist others in learning this skill.

The skills listed in the survey included: basic computer skills, file management, word processing, database management, digital graphics, spread-sheets, presentation software, e-mail and Internet. The data generated by this generic instrument allowed the teachers to reflect on their own computer skills. Areas for development, were identified from the data for future staff development workshops of this nature. Soon after this workshop, the staff participated in a blended learning course on 'Designing an Online Teaching/Instructional Event' (Stoltenkamp, 2012). This course and its contents have been outlined below. The data from the generic survey was used to design the content of the Online Teaching/Instructional Event, more

specifically the course presenters considered the varying ability levels of the participants in the design activities of the course.

4.5.2 Sample's participation in a blended learning and 21st century learning design courses

The academic year 2012 was set aside for the development of the staff's ICT skills. Shortly before the commencement of this study, the participants included in the sample attended a workshop on designing an Online Teaching/Instructional Event (Stoltenkamp, 2012). This course took place at a local university. Training programmes at the research site prioritises teachers' professional development. Technology skills, and learning how to teach with, and through technology, were identified as foci for staff development. This focus has seen a progression in terms of technological skills development. This staff development workshop was designed to introduce the uninitiated and non-conversant, with selecting and utilising the most appropriate digital tools which best supported the learning activity of a particular learning area. More specifically the staff development aimed at creating awareness that technological competency, once achieved and contextualised, enables the creation of new learning environments in which learners take decisions about their own learning, while teachers facilitate the process.

The workshop followed a blended learning model. A blended learning model is defined by Kim (2007:1-8) as one that combines fragments of traditional learning types with fragments of a technology enhanced learning or e-Learning types. The first phase of the workshop session consisted of a weeklong face-to-face training and the second phase consisted of a four-week online phase. This training was designed within an e-Learning platform known as a Learning Management System (LMS). Within this platform teachers were introduced to e-Tools, also referred to as digital applications or multi-media applications, - in the common parlance referred to as APPS - and its pedagogical value in learning and teaching.

The participants in the selected sample were enthusiastic and have all indicated that they wanted to integrate technology into their classroom practice to facilitate learning and innovation in their current teaching strategies and not only for administrative purposes as has been the case for a number of years. The Online Teaching Event Course (July 2012) was the first course which was designed specifically for a group of teachers with varying degrees of skill, proficiency and competencies (see Chapter 5 and Appendices F and H for the programme outline and the follow-up assessment questionnaire).

Unlike previous computer mediated workshops held at the research site that aimed to teach computer knowledge of a technical nature, this course was a blended one which followed a

hands-on design approach. It allowed the participants to become familiar with technological applications.

The importance of this course was that teachers would be equipped to engage within online and offline environments for the Designing an Online Teaching Event Course. It also allowed the participants access to resources; while a further focus was placed on time management; skills/e-skills, competencies and attitudes and team work. This blended approach enabled the facilitators and coordinators to collate a comprehensive analysis which was shared with the participants after the course had ended.

The decision that all teaching staff should attend the Designing an Online Teaching Event Course was taken by the management of the school and the staff were just informed that all staff members were expected to attend the 'skills development' course. When the announcement was made that staff had to attend this course as part of a professional development programme, some teachers met it with some trepidation, others questioned the 'one size fits all' approach to the course.

Although this affordance would provide structure and support to the skills of the teachers and would engage them in the kinds of thinking and learning required to use technology for teaching, it was not viewed in a positive way by everyone. Research by Billet (2010:19-35) refers to the tensions between an individual's interests in participating in professional development opportunities afforded by the workplace. He further states that the quality of learning is contingent on the kinds of activities individuals engage in and the guidance they can access during and after the training. These anxiety issues with regard to professional development courses should be addressed by allowing staff more freedom to choose the courses and development activities that they would like to engage in.

Extant studies which focus in detail on teacher practices with ICT have selected the participants' on the basis of recommendations as effective teachers (Mercer *et al.*, 2010). The purpose of this selection strategy is to identify practice that leads to successful learning; however, the findings clearly show that the influence of ICT use, depends on the teacher's practice and there is no reason to believe that the influence will be the same when the same ICT is used by teachers who are less skilled pedagogically, less enthusiastic, or have different beliefs about pedagogy and learning.

Individual teachers consider different strategies when planning for technology integration, based upon their level of skill, expertise and motivation as well as technological construct knowledge. It is illustrated by Angers and Machtmes (2005:771-794) and Ertmer (1999:25-39) that teachers pedagogical beliefs about technology integration often reflect their instructional

practices, suggesting, for example, that a traditional teacher might use technology in traditional ways which is less creative and mostly involves automating traditional teaching practices.

Realising the need for continuous professional teacher development, the same group of teachers (the sample in this study) again attended an Innovative Teaching and Learning (ITL) professional development workshop in April 2015, entitled 21st Century Learning Design. The workshop was sponsored by Microsoft Partners in Learning, and focused among other factors on the use of 'cutting edge' technology for learning. Participants were introduced to 21st century learning dimensions (collaboration; self-regulation; knowledge construction; extending learning and innovation, skilled communication). The 21st Century Learning Design workshop is based on the way ITL Research measures innovative teaching practices and challenges teachers and school leaders to:

- Analyse and 'code' learning activities to see how deeply they integrate 21st century skills;
- Collaborate in designing new learning activities that provide deeper 21st century skills development;
- Examine the impact of these learning activities on learners' work;
- Use ICT as part of the process.

ITL Research reports that teachers who undergo this process say it gives them a clear and practical way to integrate 21st century skills in their own teaching. 21st Century Learning Design programs require that teachers be active and engaged knowledge-builders, adopting and using the very skills they are seeking to instil in their learners, namely: collaboration, knowledge-building, self-regulation and assessment (or learning to learn) and use of technology for learning. Participation in this program, enables teachers to become learners of their own teaching practices by studying the impact of their teaching on learners.

4.6 Data collection plan and analysis strategies

In the following section I illustrate the five data collection phases of McMillan and Schumacher (2014:353) and how I incorporated these phases during this investigation.

"The qualitative phases of data collection and analyses are interwoven and occur in overlapping cycles" (McMillan & Schumacher, 2014:353-354).

Phase 1: Planning: Following the completion of the proposal for this investigation and after receiving permission to conduct the study, the participants were approached and recruited by me to participate in the study. All matters concerning informed consent and an explanation of

the research proposal were shared with the participants. This process took a number of weeks, as I had to approach each participant individually when time allowed it during the school day. Once the participants agreed to participate in the study, the first of the two self-assessment questionnaire was issued to each participant (one to be completed prior to the research period and one after). Only six participants opted to complete the first self-assessment questionnaire. I tried a number of times to encourage the four remaining participants to complete the first questionnaire and eventually two more participants complied. The completion of these self-assessment questionnaires was an important step because it set the tone for Phase 2, which was the collection of the data in the participants' classrooms.

Phase 2: Beginning data collection: Phase 2 was conducted over a period of eighteen months. I started the classroom observations only after receiving the self-assessment questionnaires from the participants. During Phase 2 the fieldwork was started and completed. The first few weeks of this phase were dedicated to establishing rapport with the participants and attempting to gain a sense of various matters related to the observations, such as my role as a participant observer. I also reviewed the interview questions and piloted these with two other participants who were not part of the main sample. The significance of this pilot process was that it allowed me to refine the questions for the semi-structured interviews with the main sample, which took place in Phase 3.

A few weeks into the fieldwork, a natural rhythm started to characterise the observations as my presence became less obtrusive. An extract from my journal notes at the time reads: "Circumstances at school presented the right opportunity for field work! Every day I had an opportunity to collect significant quantities of video data. I could manage two observation sessions per day! Mentally I have crossed the Rubicon" (Journal Entry: De Silva, 2012). These comments indicated that I had achieved my objective of fully immersing myself within the classrooms of the participants. The participants also seemed to find my presence supportive in the classroom when they explored new strategies and methodologies infused with technology. My presence in the room, for a brief moment put the attention on me with the video camera in my hand. Soon the learners were engaged in the learning activity, and I was forgotten. Each session allowed for rich data collection.

Phase 3: Basic data collection: Phase 3 was allocated to conducting the semi-structured interviews and encouraging the participants to complete the second self-assessment questionnaire. Collecting these questionnaires came with its challenges. I had to request some participants to complete the questionnaires a number of times. All interviews were recorded, after which they were transcribed and then archived for later retrieval. Archiving the data was a means of protecting the integrity of the study and it became useful to retrieve the data when I

needed to begin the process of analysis. Initial descriptions were summarised to identify themes. According to McMillan and Schumacher (2014:353) the inquirer begins to "hear and see" what is occurring, which goes beyond just "listening and looking". During this phase I also tentatively started the data analysis process.

Phase 4: Closing data collection: After conducting the last interview and collecting the second self-assessment questionnaire from the participants, I could leave the 'field'. Multiple forms of data were collected for this study, including classroom observations whereby each teacher participant was observed within real-life context in the classroom and videotaped a number of times. The number of videotaped observations of lessons varied for each participant. I had made fewer recorded observations of participants who appeared more fluid and competent. On average I had between 6 to 8 observations for each participant. Data collection protocols were identified to provide a holistic view of teacher knowledge. I deployed an observation rubric to guide my classroom surveillances so that I could follow a more structured approach. (I discuss the technology integration assessment instrument (TIAI) (Harris *et al.*, 2009:393-395) in more detail in Section 4.7.1.) The primary data collection protocols consisted of field observations, and the completion of two self-assessment questionnaires, one of which was given to each participant prior to the fieldwork in the first phase of the data collection and the other one at the end of the third phase.

Secondary data sources consisted of documentary evidence and participant artefacts. The purpose for using the documentary data source was that it gave me insight into the participants' early "thinking and beliefs" about technology. These two concepts formed the focus of the sub-questions. The documentary data also provided background information on the skill levels of the participants. I was able to utilise this information to give an introductory voice to each case written up in Chapter 5.

The documentary data from the professional development initiative titled "Designing an Online Teaching/Instructional Event" was analysed for evidence relating to participants attitudes and values pertaining to new knowledge gained during the training (see Chapter 4.5). The data collected by means of the self-assessment questionnaires was used to profile each participant's perception of their own skills and proficiencies and "TPACK strategic thinking" (Niess, 2012:2). Techniques suggested by Ryan (1999) were used to identify new themes by examining text that was not already associated with a theme. In this way, new and less obtrusive themes can be identified through an iterative process of exploring potential research questions and methodologies that would fit the research. The key research questions that guided this research are:

- i. How can teachers acquire knowledge about instructional technologies to enhance their teaching?
- ii. Which factors impact on the development of teachers' TPACK?
- iii. How does the use of technology impact on their traditional pedagogic practices?

The following sub questions focused on teacher "thinking and beliefs" about technology and were utilised to try and understand how teachers' knowledge, beliefs and attitudes influence the decisions that they make when integrating classroom practice with technology:

- a) What are the factors that may impact the sustainability of a technologically enhanced classroom practice?
- b) What kinds of decisions do teachers make when planning to integrate technology into their lessons?

Phase 5: Completion: All aspects pertaining to the collation and analyses of data took place during this phase. Data collecting blends into formal data analysis and construction of meaningful ways to present the data. Once I reached data saturation, I was ready to leave the field, in the words of McMillan and Schumacher (2014:354) "the field residence terminates."

4.7 Research instruments, data sources and procedures

Case studies generally employ a diverse range of measures or techniques and can document multiple perspectives (Simons, 2009:23). The key research instruments employed in the current study, together with a more detailed description of the data sources are provided below. Through the triangulation of the research data-generating instruments I wanted to explore and establish if this shift towards technology integration was motivated by an internal change through 'reflective practice' by the participant, or was just a means to satisfy expectations as set out in the key performance indicators in the annual teacher observation report. According to Schön (1983:40) practitioners continue to reflect in and on action and to learn from their practice, this process of reflection spirals through various stages (see Chapter 2). Mishra and Koehler (2006) and Schmidt *et al.* (2009) contend that teachers require a TPACK mind-set and knowledge for the successful integration of technology into teaching.

4.7.1 Classroom observations

Since teachers' planning is conceptualised around content goals and organised according to learning activities and, more specifically, curriculum outcomes, technology integration methods should be similarly focused (Koehler & Mishra, 2005:131-133). Although the focus in this study is not primarily on affordances and constraints of emerging technologies, these factors and how

they impact on technology integration cannot be ignored. The afore-mentioned factors illuminated how the integration of technology evolved as the participants adapted their instructional approaches to include technology, and how this process was impacted on by the affordances and constraints of technology.

The participatory observation sessions were recorded and field notes were kept during the field observations. Video-taping was useful in minimising the possible risk of researcher bias and to ensure that the accuracy of this dataset during the transcription of the raw data was maintained. Simpson and Tuson (2003:51) observe that video recording can offer a more 'unfiltered' observational record than human observation. It has the capacity for completeness of analysis and comprehensiveness of material, reducing the dependence of prior interpretations by the researcher. I obtained the necessary permission from the participants to video-record the lesson observations. I was aware that I might not be able to anticipate all the responses of the participants when video-recording. I was also concerned that participants would become inhibited in the presence of a video camera. As the study progressed, participants were less conscious of the use of the video camera. Murray (2008) argues that participants quickly become accustomed to the filming of their activities. The classroom observations were furthermore guided by using a rubric, namely the Technology Integration Assessment Instrument (TIAI) (Harris, Grandgenett & Hofer 2009:99).

The criteria as set out in this instrument (TIAI) (Harris *et al.*, 2009) (see Appendix D) included: curriculum goals and technologies; instructional strategies and technologies; technology selection and the 'fit' of content, pedagogy and technology. The criteria in the instrument are keyed to different aspects of teacher knowledge for technology integration. It was designed to focus on the use of technology integration knowledge in observable teaching.

4.7.2 Self-assessment questionnaires

A significant component of this research focuses on teacher behaviours as it pertains to the development of their TPACK (2006) in the integration of technology in their teaching practices. These behaviours are discussed in Chapter 5. The first mode of measuring teacher behaviours, is to have teachers assess their own practices. Though not as accurate as direct observation due to bias when teachers' self-report, a self-assessment survey may still be useful for research or documentation of instructional practice, according to Rowan, Jacob and Correnti (2009:13). In line with this argument, Kopcha and Sullivan (2007:640) concur that self-report measures "may yield data that are inaccurate because they [often] indicate greater-than-actual use of these practices". It is suggested that in addition to self-report data, evaluation should include performance measures and teacher observations to improve accuracy of the evaluations.

Some quantitative data was generated by a section of questions in the self-assessment questionnaires, which measures the TPACK domain constructs. The SPSS software was employed to analyse pre- and post-correlations between the two questionnaires, and to determine, if the data showed any statistical significance (see Appendix C). This data is presented in graph format (see Chapter 5). Completing both the questionnaires allowed the participants in the sample to reflect on their levels of development of their Technological, Pedagogical and Content Knowledge. TPACK is viewed as the new and emerging knowledge domain through the synthesis of the main constructs (CK, PK & TK). The self-assessment questionnaire, which I adapted for this study, was based on questionnaires and surveys developed by Archambault and Grippen (2009) and Schmidt *et al.* (2009).

The information that was sought in an attempt to satisfy the objectives of this study was: determining the participants use of emerging technologies and the skills that have been acquired; developing proficiency and confidence levels and their perspectives on the use of instructional technologies after the professional development workshop on e-Learning and creating an Online Instructional Teaching Event; how these skills are used to teach through technology; the frequency and levels of functional and pedagogical use; their self-reported stages of technology integration into the curriculum; how this integration advances the achievement of the pedagogical aims of the curriculum; accumulating data on the participants' experiences during the data collection process; measuring and gaining insight into the participants' development of TPACK.

For the purposes of the self-assessment questionnaire, technology refers to digital technologies, which encompass the digital tools that the participants would most likely encounter in the classroom, such as computers, laptops, iPods, handheld devices and inter-actives (clickers), interactive whiteboards, web-based and other software programs. Question items in the survey were worded in a general and abstract manner: "I keep up with important new technologies", "I know a lot about different technologies", "I am thinking critically about how to use technology in my classroom" (see Appendix C).

The categories of the self-assessment questionnaire included:

- Demographic information about the participants (see Appendix C). (Participants self-reported on their proficiency levels of technology within the constructs of the framework.)
- A combination of a five level Likert-scale response: strongly disagree; disagree; neither agrees nor disagrees; agree and strongly agree, expected the participant to answer questions on the following constructs of the TPACK framework. Technology Knowledge

(TK), Content Knowledge (CK), which included questions on the content knowledge of Mathematics/Numeracy; English/Literacy; Social Sciences; and Science.

- The next category of questions also employed the Likert-scale response for questions on the participants Pedagogical Knowledge (PK); Pedagogical Content Knowledge (PCK); Technological Content Knowledge (TCK); and Technological Pedagogical Knowledge (TPK).
- In the following category the participants had to rate their TPACK in each of the subjects mentioned.
- Rating how Phase partners and the Lead Teacher modeled TPACK followed this category.
- In the subsequent section on Models of TPACK, participants had to give a percentage estimation of effective demonstrated modelling of TPACK by firstly, Phase partners, then Senior Phase colleagues and lastly GET Phase teachers. Data generated by this section provided insight with regard to teacher collaboration.
- The last section (Questions 55, 56 & 57) for this self-assessment questionnaire contained open-ended questions about specific episodes when effective technology integration was observed with firstly the ICT instructor, then the Phase partner and lastly the participants own modelling, which effectively demonstrated a combination of content, technologies and teaching approaches during a lesson.

Participants were requested to complete the self-assessment questionnaire twice. The first self-assessment questionnaire was completed before field observations were conducted to glean insight into their levels of TPACK and the final one was completed at the end of the fieldwork and shortly before I began the interview process. The aim of the post questionnaire was to interpret the data for evidence and, by way of inferring, determine a shift in each participants' development towards effective integration strategies, and determine how the decision making process is buttressed by the participants' cognitions about pedagogy, practice and technology use.

It is commonly known in the research literature that participants tend to have an upward bias when they rate themselves or tend to provide socially desirable answers (Rowan, Jacob & Correnti, 2009:14). Data triangulation is encouraged by researchers (Patton, 2002:247) to collect information from multiple sources aimed at corroborating the same fact or phenomenon. Triangulation provides the opportunity to identify converging lines of enquiry. Yin (2009:118) attests that without multiple sources, an invaluable advantage of the case study strategy would be lost. Yin (2009:122) explains three tactics that are available to increase construct validity

when conducting case study research. Firstly, the use of multiple sources of evidence encourages convergent lines of enquiry. This tactic is relevant during data collection. Secondly, establishing a chain of evidence is also relevant during data collection. Thirdly, key informants can review the draft case study report. This review is more than a matter of courtesy. Schatzman and Strauss (1973:134) view construct validity as a way of corroborating essential facts and evidence presented in a case study report. According to Eisenhart and Howe (1992:648) construct validity should reflect the way in which the participants actually construe or experience the situations in the research, that they see the situation through the actors' eyes. According to Yin (2009:179) the corrections made through this process will enhance the methodological accuracy of the report and increase the construct validity of the study.

4.7.3 Semi-structured interviews

I chose to employ qualitative interviewing as a research method, for the following reasons, Mason (2006:16) asserts that, ontologically people's knowledge, views, understandings, interpretations, experiences, and interactions can be meaningful properties of the social reality. Epistemologically, the qualitative interviewing process is often viewed as a conversation with the qualitative interviewer. Rorty (1979), as cited by Kvale (2008:51), sees the constitution of knowledge, through conversation, as a social practice. Knowledge is, therefore, brought into being through dialogical interaction. This view resonates with qualitative interviewing because it creates an awareness of the constructive nature of social interactions and the part played by participants in making sense of their experiences.

Individual semi-structured interviews were conducted with the participants at the end of the data collection process. Interviews can yield a great deal of useful information. In a qualitative study interviews are rarely structured but mostly semi-structured or open-ended revolving around a few central questions (Silverman, 1993:1). Interviews are considered the most popular method of gathering data for researchers working within an interpretive paradigm using a qualitative methodology and, therefore, interviews have a clear advantage when in-depth data are sought (Yin, 2009:106).

Following an open ended and semi-structured approach, the interviews aimed to generate rich data. By selecting this approach, it afforded me the liberty to add questions or to modify them as I saw fit, depending on the responses of the participants. Initially, I piloted the interview questions with two participants who did not form part of the main sample. This piloting process allowed me to refine the interview questions in advance, and resolve any interpretations of questions that might be vague or ambiguous.

Interviews require verbal interaction and language skills, as well as an ability in the commodity of discourse. Ethnographers use interviews to help classify and organise an individual's perception of reality (Fetterman, 2010:40-42).

Ethnographic interviews are open-response questions. The aim is to obtain data on how participants conceive of their world, and how they explain or make sense' of the important events in their lives. There are three types of interviews: namely informal conversation interview, interview guide approach interview, and standardized open-ended interviews (McMillan & Schumacher, 2014:382).

4.7.4 Artefacts designed by the participants

Participants in the study also produced digital artefacts, which presented another way to collect data. Yin (2009:113) defines artefacts as a technological device, a tool or instrument, a work of art, or some physical evidence that maybe used as evidence in case study research which leads to a broader perspective. These digital stories (artefacts) were linked to literacy activities. Learner (at the research site) excursions are photographed and video-taped. The footage and images are then archived for later use. The images of these excursions are often the theme for a digital story. Learners write about their experiences and the writing and the images are combined to generate a digital story, audio effects such as music and learner voices are included. These artefacts are used as resources to support the teaching process. I also employed the technology integration assessment instrument (TIAI) to rate the artefacts designed and created by four of the participants and which formed part of their technological resources when teaching a technology-enhanced lesson. Each of the artefacts was viewed a number of times, first within the context of the lesson taught and then afterwards to determine its fit with the lesson, in terms of pedagogy and the curriculum.

The criteria as listed (Table 5.2) in the TIAI were useful for determining if the designed artefacts met with curriculum-based technology use, were compatible with instructional strategies, and if there was a 'fit' with content, pedagogy and technology together. During the analysis process the artefacts were viewed firstly within the context of a technology enhanced lesson and then again a number of times after the lesson.

Reviewing and evaluating the completed products of the teacher generated digital stories, power point presentations embedded with animation and audio, videos and other multimedia artefacts, can yield rich data with regard to the participants' understanding of aligning the content of the learning area and supporting the aims of the curriculum by their choice of the technological application. This process can also provide insight on participants' digital skills, creativity, motivation and authentic learning as well as how the learners were able to create

knowledge, solve problems and collaborate in groups, together with other related higher order skills utilised when they create their own digital stories. Rakes and Casey (2002:124) assert that to integrate technology into learning, teachers must view it in a positive manner, be comfortable with it and use it effectively.

4.7.5 Documentary data

The documentary data which emanated from the Design an Online Teaching Event Course was useful to understand teachers' knowledge of technology. The discussion forum in the LMS provided a platform for the participants to share ideas around pre-determined questions about their learning and understanding of instructional technology. This sharing of knowledge within the confines of this forum elicited debate among the participants. The analyses of this discourse gave me insight to participants' personal views about their engagement with technology. I used the participants' comments in the discussion forum to create a framing vignette case profile for each of the four selected case reports. These comments articulated the beliefs and thinking of participants with regard to technology (see Chapter 5 and Appendix K).

4.8 Data analysis procedures

De Vaus (2001:9) argues that "the function of a research design is to ensure that the evidence obtained enables us to answer the initial question as unambiguously as possible". Multiple data sources (self-assessment questionnaires), classroom observations (fieldwork), semi-structured interviews, documentary data and artefacts designed by participants) were employed in this research project to collect the data. Thereafter, each data set was analysed for emerging themes (within-case analysis). Four descriptive cases were written and then compared for common themes (cross-case analysis).

Qualitative analysis results in a different type of knowledge than quantitative inquiry. Qualitative researchers seek illumination, understanding and extrapolation to similar situations (Hoepfl, 1997:47-63). The success of data analysis depends on the thoroughness of the process and maintaining the integrity of the data. Henning (2004:36) recommends that qualitative data can be analysed right from the beginning of the data collection process, with the researcher constantly reflecting on impressions, relationships and connections as he/she continues with the process of collection, dividing, categorizing and grouping data into smaller and more meaningful units. Vaughn, Schumm and Sinagub's (1996:99-104) description of the essential steps associated with data analysis strategy is listed below. I followed these essential steps as closely as possible to ensure validity of the data analysis strategy.

The first step is the drafting of a detailed description of the participants. In this regard I made provision for a section in the questionnaire on the demographics of the participants, such as age; gender; professional qualifications; years of teaching experience; and levels of ICT competency, to yield the data that might provide demographic evidence to support the participants' attitudes and perspectives on technology integration.

Considerations applicable to the study prior to data analysis were taken into account. Emphasis was placed on preparation activities, such as how, when and how often the classroom observations would take place' how information would be transcribed and categorised.

Determining methods of analysis is the third step. The case study analysis approach suggested by Hall (1999), argues that ethnographers recommend a schedule of analysis and interpretation with these general steps: "case-study data must be analyzed; the analysis must be examined and reorganized; the reorganized data must be synthesized; and the synthesis must be interpreted" (Hall, 1999). Case-study analysis is thus one means researchers have for testing research questions.

In technological and industrial education, the most typical procedure is for the researcher to visit a site many times, conducting observations and interviews, which are recorded by hand or mechanically through audio and video equipment. The data from these visits is then analysed and synthesised in response to the research questions, not only because these studies seek to investigate a topic in depth, but also because they investigate an area in which little prior research has been conducted (Evanciew & Rojewski, 1999:24-54). "Addressing issues of identifying and implementing integrated curriculum through technological education for all children taught in a constructivist manner", is perhaps an even better candidate for case-study research (Zuga, 1996:11).

The video data obtained during the classroom observations was analysed using a combination of discourse analysis (Fairclough, 2003) and case-study analysis. Habermas (1972) argues that utterances are never simply sentences that are disembodied from context, but, rather, their meaning derives from the inter-subjective contexts in which they are set (Habermas, 1972: 368). Similarly, Fairclough (1993:135) defines critical discourse analysis (CDA) as discourse analysis which aims to systematically explore often opaque relationships of causality and determination between (a) discursive practices, events and texts, and (b) wider social and cultural structures, relations and processes; to investigate how such practices, events and texts arise out of and are ideologically shaped by relations of power and struggles over power; and to explore how the opacity of these relationships between discourse and society is itself a factor securing power and hegemony.

In discourse analysis Miles and Huberman (1984) suggest the use of coding at an early stage of analysis. The next step is the development of coding protocols consistent with the TPACK framework and then actually coding the data. After exploring various traditional options of coding raw video data, I have opted to employ digital tools for qualitative data analyses, which save time, and can add depth and robustness to qualitative work. Kelle and Laurie (1995:27) suggest that computer-aided methods can enhance: (a) validity (by the management of samples) and (b) reliability (by retrieving all the data on a given topic, thereby ensuring trustworthiness of the data). The computer software application (Atlas.ti, version ti 7.1.8) for qualitative data analysis, allowed me to manage the data, transcribe and analyse both textual data (semi-structured interviews) and audio data (video recorded observations and interviews).

The semi-structured interviews with the participants were then transcribed, using an open source generic interview transcription tool. After checking a number of times that they were transcribed verbatim, each of the written transcripts were imported to the Atlas.ti software programme to begin the process of initial coding, using open or in-vivo coding, protocols. Several features in the software allowed me to manage the data through 'document families' and 'quotations' (Lester & Paulus, 2011:671), which helped to narrow the analytic focus. Konopasek (2008) describes Atlas.ti, as a kind of "textual laboratory" within which every aspect of the research project can be connected, made visible on the screen, and become instantly accessible. Atlas.ti software was also used to label specific paragraphs based on their meaning.

This process of coding chunks of data is more time consuming, but also more powerful and precise than other methods of analyses. Searching for and sorting these labelled paragraphs generates a more precise list of similar examples. Following this approach enabled me to create subcategories that were organised into a hierarchical tree or 'word cloud' format, thus allowing me to visualise how the pieces fit together at a glance. In addition this method helps make explicit what ethnographers do in their heads all the time, namely sorting, comparing, searching for patterns, and building models. In some ways the software helps demystify pattern identification and analysis by clearly, articulating the coding, searching and sorting process. Database software also provides a systematic form of triangulation, helping to keep the ethnographer honest by providing direct access to the raw data in context and noting the frequency of items' occurrence almost instantly (Fetterman, 2010:93).

The video recordings of the classroom observations were selected and watched a number of times and then coded, based on the seven categories defined by the TPACK framework. The Atlas.ti software program was used for this purpose. The multiple viewing of video data allowed me to explore a layered approach, searching for subtle nuances that are hidden in the data,

and which only become visible after several viewings. It also allowed for observations of strategies that indicated how participants engaged in "reflective practice" (Schön, 1983) with each successive lesson. The purpose of the multiple viewing of video data was to listen to the nature of the conversations between the participant and the learners in the classroom and how these interactions were conducted during the course of the lesson. This process was also followed to identify dominant discourses in the responses of the participants in the transcribed semi-structured interviews. I began my analysis by categorising each discourse episode as Technology (T), Content (C), or Pedagogy (P). Furthermore since the coding categories were not mutually exclusive, each discourse segment could be coded in multiple ways, for example a discourse segment could be coded as Pedagogy and Technology (PT), Content and Technology (CT), Content and Pedagogy (CP), or even Content and Pedagogy and Technology (TCP).

These codes were not the only codes employed. From a methodological standpoint (Atlas.ti) codes serve a variety of purposes. They capture meaning in the data. They also serve as handles for specific occurrences in the data that cannot be found by simple text-based search techniques. Codes are used as classification devices at different levels of abstraction in order to create sets of related information units for the purpose of comparison (for example a concept such as "Coping Strategy"). The findings of this section of the data are discussed in Chapter 5.

4.8.1 The value and integrity of the data

Triangulation is critical in establishing data trustworthiness (McMillan & Shumacher, 1989:418). It is at the heart of ethnographic validity and involves testing one source of information against another to strip away alternative material and attempt to prove a hypothesis (Fetterman, 2010:94). Validity and reliability are enhanced by including triangulation in qualitative research (Maxwell, 1992:94). Triangulation is a powerful way of demonstrating concurrent validity, particularly in qualitative research (Campbell & Fiske, 1959). The role of triangulation in this study was to support validity and reliability and trustworthiness of the data collection and analysis and to integrate the results from the various instruments employed. These instruments include the following already mentioned devices: classroom observations; self-assessment questionnaires; semi-structured interviews; documentary data and the teacher generated artefacts.

4.8.2 Trustworthiness, validity and reliability

This study relies on valid, authentic and trustworthy methods of collecting and presenting information and interpreted understandings. Hammersley and Atkinson (1983:191) state that "data in themselves cannot be valid or invalid; what is at issue is the inferences drawn from

them". Maxwell (1992:284) supports this view by stating that 'validity' is not an inherent property of a particular method, but pertains to the data, accounts and/or conclusions, reached by using that method in a particular context for a particular purpose.

Notions of reliability and validity in case study research are difficult to conceptualise, much less quantify. As Peshkin (2000:5-10) remarks, "those in qualitative research who have become comfortable with subjectivity ... are reconciled to phenomena that they perceive, interpret, and construct and that they take as ambiguous, protean, and complex". When a methodological decision must be made in studying a case site, Stake (1998:238) says that "each researcher will make up his or her own mind" - unlike the experimental researcher whose decisions may be standardised. McMillan and Schumacher (2014:354) list ten strategies to enhance design validity. The framework below encapsulates my actions as the researcher in response to each strategy.

Table 4.1: Enhancing design validity

Strategy	Description of my intended action
Prolonged and persistent fieldwork	Data collection took place over eighteen months. The data analysis and triangulation ensured a match between findings and participant reality.
Multi-method strategies	Triangulation in data collection and analysis. In compliance, I used a variety of instruments to collect the data. Triangulation ensured obtaining convergent data using cross-validation.
Participant language; verbatim accounts	Obtain literal statements of participants and quotations from documents. Interviews were recorded in English and transcribed verbatim. Classroom observations were video-taped.
Low-inference descriptors	Detailed descriptions of explanations and situations were noted by means of a research journal which was kept for the duration of this study.
Multiple researchers	My testing for understanding during both data collection and review with my supervisors facilitated agreement on descriptive data collected.
Mechanically recorded data	Use was made of a video camera and audio recording devices during all field observations and interviews.
Participant researcher	Anecdotal records were kept in a digital diary for purposes of corroboration. Perceptions and assumptions that emerged from the transcriptions of recorded field observations have been interpreted and analysed to ensure understanding and intended meaning.

Strategy	Description of my intended action
Member checking	I checked informally with participants for accuracy during data collection. This checking was ongoing.
Participant review	Participants have been requested to review my synthesis of interviews in order to ensure an accurate representation.
Negative cases or discrepant data	I actively searched for, recorded, analysed and reported negative cases or discrepant data that are an exception to patterns or that modify patterns found in the data.

4.8.3 Enhancing design validity

Lincoln and Guba (1985:290) refer to the importance of trustworthiness in qualitative research. Trustworthiness refers to the researcher's interpretation of real-life data. Based on her interpretation of Guba's (1981) model, Krefting (1991:215) relies on credibility, applicability, consistency and neutrality as strategies to ensure trustworthiness in qualitative studies. Guba's (1981) model is based on the identification of four aspects of trustworthiness that are, relevant to both quantitative and qualitative studies: (a) truth value, (b) applicability, (c) consistency, and (d) neutrality. Based on the philosophical differences between qualitative and quantitative approaches, the model defines different strategies of assessing these criteria in each type of research. These strategies are important to researchers in finding ways to ensure rigor in their studies. The following responses in Table 4.2 relate to this study.

Table 4.2: Ensuring trustworthiness (Krefting, 1991:215)

Credibility	The use of more than one source of data and more than one data collection method; use of member checking and allowing participants' to review synthesis of interview data.
Applicability	Interpreting data in accordance with research questions; use of member checking and allowing participants' to review synthesis of interview data.
Consistency	Ensuring consistent compliance in terms of data collection methods; detailed descriptions of participants' sample, data collection methods and strategies for analysis.
Neutrality	Ensuring non-interference. Recording as truthfully as possible, raising additional questions where necessary.

The Technology Integration Assessment Instrument (TIAI) (Harris *et al.*, 2009:393-416) is a pedagogically inclusive instrument and reflects the key TPACK concepts of the conceptual framework in this study. The instrument's reliability and validity has been supported in two successive rounds of testing by Harris, Grandgenett and Hofer (2009) and has proved to be an excellent conduit for tracing the TPACK

development of the sample and includes the participants' integration of multi-media through the use of the appropriate technology applications; how this practice is communicated to the learners; how students are engaged in active learning; how creativity is encouraged; how learners collaborate with others; constructing a healthy learning environment, allowing students to control the process and product, providing flexible options for the varied needs of learners, providing positive reinforcement, involving critical thinking skills, and incorporating multiple intelligences (Forcier & Descy, 2005).

4.8.4 The researcher's role

Detailed or 'thick' descriptions and verbatim quotations are the most identifiable features of ethnographic field notes. Thick descriptions give context and cultural interpretation to an ethnographer's analysis (Fetterman, 2010:125). The chosen research method confirmed my position as the primary research instrument. As such I had to demonstrate my ability to distinguish between what is important and what is not. According to Gray (2009:12) research bias must be acknowledged and relevant strategies implemented to mitigate bias. This process involves self-awareness, understanding the power dynamics in the research process, co-creation of knowledge, and awareness of the implication of the shared knowledge. Therefore, I have adopted a reflexive stance throughout this investigation. MacMillian and Schumacher (2014:356) clarify that reflexivity is a broad concept that includes rigorous examination of one's personal and theoretical commitment in order to understand how they serve as resources for selecting a qualitative approach, framing the research problem, generating data relating to the participants and developing specific interpretations.

In this research I have made use of a digital diary to document my interactions and my informal discussions with the participants, as well as record my own reflections. These reflections provided an insight into personal issues experienced by the participants during the study. Personal problems that cropped up were related to emotional experiences such as the loss of loved ones and friends, and the incapacitating illness of close family members, which saw some participants withdraw from the research. When participants displayed emotional upheaval and turmoil in their private lives, I was compelled to be sensitive and allow the participants who were affected to recover, before approaching them again (see Chapter 6).

These 'waiting periods' frequently caused a delay in my observations of the particular participants. Pillow (2003:175) validates the following strategy and suggests that the researcher recognises 'the other' by capturing the essence of the informant or 'letting' them speak for themselves when they are ready. Paton (2002:66) states that reflexivity also involves discomfort as researchers seek to minimise predispositions through self-questioning and suggests that this questioning focus on several screens that the researcher uses for self, audience and participants. Another reflexive strategy is on positionality which assumes that

only texts in which researchers display their own positions (standpoints), or contextual grounds for reasoning can be considered valid research.

4.8.5 Ethical considerations

According to McMillan and Schumacher (2014:362) ethics deals with beliefs about what is right or wrong, proper or improper, good or bad. Ethical matters are concomitant with trustworthiness. Leedy and Ormrod (2005:101) explain that most ethical issues in research fall into one of four categories: protection from harm, informed consent, right to privacy, and honesty with professional colleagues. This research study was conducted in terms of the school's research policy. In the section that follows I mention issues that apply to this study and how I conformed to them.

I undertook to focus on the research in question and did not interfere in any manner that could jeopardise the *integrity* of data and the study as a whole. I also undertook to *communicate the objectives, nature and future use of findings* to participants' prior to commencement of data collection activities. *Informed consent* by participants was a prerequisite in the gathering of the data in this study; it included assurances of *confidentiality* and *anonymity* of the site and organisation. Participants were *not placed under duress* during this research project. Participants and other individuals were not compromised during the research process. The confidentiality of data obtained from participants, was meticulously protected. David *et al.* (2001:347-348) say researchers also need to inform the participants that they have the right to *withdraw* at any point in the research if they wish, this was complied with in a *letter of permission to withdraw* written to the participants.

4.9 Conclusions

This chapter has described the approach to the research study on Technology Integration in classroom practice I have focused on the elements and structure of design and methodology used in this research and have clarified the processes followed in collecting and analysing the data. I have also detailed why I have opted for a qualitative approach in which the choice of method was a multiple case study using the within-case and cross-case analysis approach. Multiple data sources employed in this study were explained in depth. I have elucidated the weaknesses, strengths and other limitations of the case study design followed for this study. I have also outlined my role as a participant observer and indicated how I conformed to the ethical considerations of valid research.

In the next chapter, I present the data from the various data sources and begin the process of analysing and interpreting the data.

CHAPTER 5

FINDINGS

5.1 Introduction

This research study set out to follow the trajectories of a sample of teachers who teach in the Foundation and Intermediate Phases at a primary school. The conceptual lens that was employed to drive the aims of this study was the TPACK framework of Mishra and Koehler (2006). Coinciding with this investigation was the installation of Interactive White Boards (IWBs) and other technology infrastructure in the classrooms of the participants at the research site. This situation provided an opportune time, firstly, to explore the development of individual teachers' digital competencies and, secondly, to track how teachers developed their TPACK as they became fluent in the integration of instructional technology to enhance their teaching.

Teachers' knowledge is complex by nature and is difficult to capture using a single instrument. Therefore, I have chosen to use multiple data sources "to investigate the research questions from various angles and perspectives" (Christensen & Prout, 2002:147). The demographic data collected from the sample of teachers shows that the research participants all have a minimum of a four-year post school leaving qualification, a prerequisite of the research site. These teachers were trained according to traditional pedagogic practices, at a time when ICTs were not yet prolific in classrooms. Hence, the technology-aligned staff development workshops, discussed in Chapter 4, were designed to motivate and prepare teachers to embed ICT in their teaching methodologies.

Lesson observations are known as 'learning walks' at the research site. These learning walks are an accepted practice at the school and normally happen unannounced. The principal, the deputy principals and other senior staff members arrive in classrooms to observe the interaction of teachers and learners during lessons. These observations are short in duration and provide a 'snap shot' of the level of learner engagement in a particular lesson. A number of these learning walks over the course of a term present an indication of the teacher's profile for personal development and growth. A rating scale is used to identify individual areas of deficiency and to set attainable targets for growth.

Subsequent to the staff development workshop, the learning walks now focus on evidence of teachers' technology integration. Data gathered is used to measure teachers' key performance areas. I had become aware that the participants in the study were confident and competent in their abilities, such as knowledge of their subject area, curriculum expectations and classroom

management. Shulman (1986:4) noted that PCK is a form of teacher knowledge which draws heavily upon individuals' knowledge of content, therefore, the researcher's knowledge of such content is an important prerequisite for this study.

Being familiar with the subject content of the dominant languages taught at the school as well as subjects such as Social Sciences, specifically with regard to the participants in the Foundation and Intermediate Phases, allowed me to make valid interpretations during the lesson observations and to later link these considerations to specific teaching strategies and technologies employed by the participants. All observations were unannounced, as I had made prior arrangements with the participants that I could only undertake 'learning walks' when my timetable allowed me to do so.

During these observations I found that participants were adequately prepared to teach. Lessons taught were stimulating and engaging for the learners. As mentioned in Chapter 2, this study follows a two-pronged line of enquiry to probe teachers' competencies in technology and the integration of technology into their classroom practices. The first line of enquiry explored teachers' knowledge of technology. It also examined how teachers' knowledge of subject content, pedagogy and teaching with technology, were characterised by a fluctuating relationship among these constructs, during the initial phase of incorporating technology into their teaching practice. This first line of enquiry is addressed by the first research question.

The second line of enquiry probes the practical adoption of new strategies, understanding and development of new knowledge or curriculum domain by the participants. This investigation is situated within the context of the classroom and explores the deployment of technology within the subject content, design of artefacts and application.

The current chapter presents the findings gleaned from the various datasets and is organised into the following sections:

Section 5.2: The research questions;

Section 5.3: A discussion of the findings from the various data sources: the self-assessment questionnaire; the classroom observations and the semi-structured interviews;

Section 5.4: Artefacts designed by the participants;

Section 5.5: A discussion of documentary data;

Section 5.6: A report on the case profiles of each of the four participants;

Section 5.8: Reflections on participant practices; and

Section 5.9: Conclusions to the chapter.

The key research questions that guided the research are set out below:

5.2 Research questions

- i. How can teachers acquire knowledge about instructional technologies to enhance their teaching?
- ii. Which factors impact on the development of teachers' TPACK?
- iii. How does the use of technology impact on traditional pedagogic practices?

The following sub-questions focused on the teachers' 'thinking and beliefs' about technology and were included to enable the researcher to understand how teachers' knowledge, beliefs and attitudes influence the decisions that they make when integrating classroom practice with technology:

- a) What are the factors that impact the sustainability of a technologically enhanced classroom practice?
- b) What kinds of decisions do teachers make when planning to integrate technology into their lessons?

The next section presents the findings generated from each of the data instruments.

5.2.1 Findings from the self-assessment questionnaires

Both self-assessment questionnaires were completed by only eight of the ten participants in the study (see Chapter 4). Although I requested in a sensitive manner numerous times from the two participants that I needed both the pre and the post questionnaires, they did not comply. For the two participants I only received the pre questionnaire. However, they participated in terms of all the other requirements of the study (see Chapter 5.2.4). The 46 survey items in the questionnaire assessed all seven constructs of the TPACK framework as set out in the literature in Chapter 2.2.1. The aim of the self-assessment questionnaire was to profile how the participants viewed themselves, both before the study and eighteen months later at the conclusion of the data collection process. In this way, areas of growth and expansion of the individuals' learning trajectories and the development of their TPACK could be identified.

The self-assessment instrument comprised various constructs of the framework and provided a means of reflection for each participant. These constructs, from items 1 to 42 (see Appendix C), facilitated the categorising and measuring of the sample teachers' knowledge, skills and understanding of technology as well as their 'thinking' when selecting technologies to combine with teaching approaches. The items in the questionnaire allowed the participants to give voice

to their own levels of skills development and competencies. The post questionnaire findings indicated a more informed perspective of the participants ICT skills development. As mentioned in Chapter 4, the assessment focused on how the participants measure their own levels of TPACK-technology implementation and integration in their classrooms and how their practice is shaped by their TPACK. TPACK emerges at the intersection of the three basic constructs (technology, pedagogy and content) as 'an intuitive understanding of teaching content with appropriate pedagogical methods and technologies' (Mishra & Koehler, 2006, Koehler & Mishra, 2008). I was also hoping to determine if levels of growth were evident within the timeframe between the completion of the two questionnaires.

The self-progress questionnaire (Schmidt *et al.*, 2009) became a lens with which to measure and understand how the participants viewed their own development, within the elements of the TPACK framework. Data was collected by employing the pre- and post- self-progress questionnaires (Schmidt *et al.*, 2009). The questionnaire, based on surveys developed by Archambault and Grippen (2009) and Schmidt *et al.* (2009) was adapted to reflect context of subjects and teacher specialisation. This tool afforded a useful way to satisfy the objectives of the study and could provide insight into the main research question. The questionnaire consisted of three sections. The first section focused on the participants demographic profile such as gender, age and subject specialisation. It is interesting to note that research undertaken by Mueller, Wood, Willoughby, Ross and Specht (2008:1523) suggests that teachers who integrate technology into their teaching do not differ from those who do not, in terms of gender, years of experience, past technical problems, or personal views about their work.

5.2.2 Permutations of TPACK and content knowledge

The category of questions inclusive of items 1 to 33 employed the five-level Likert scale response for questions to the participants as a self-report measure. The TPACK constructs on which the participants reported included Technological Knowledge (TK), Content Knowledge (CK) Pedagogical Knowledge (PK) together with 'sub-elements' or permutations. Questions relating to the content knowledge of Mathematics/Numeracy, English/Literacy, Social Sciences and Science were answered by participants.

The data obtained from this section indicate an upward or more positive rating by participants about their skills in the pre-questionnaires. The post questionnaire reveals a more cautious rating by the participants (see Appendix C) and can be interpreted as a more realistic rating. The use of e-Tools in the context of both staff training and the classroom presented different constraints and affordances for the participants, which possibly also explains the more cautious

rating in the post-questionnaire. A plausible explanation is that participants reported a more informed perspective on their ICT skills in the post questionnaire.

A subset of questions (items 34-42) about TPK (Technological Pedagogical Knowledge) in this section was adapted to explore the impact of the 'Designing an Online Teaching Event' on the participants TPK. Examples of questions include: *'I can choose e-Tools that enhance the teaching approaches for a lesson; I can choose e-Tools that enhance learners' learning for a lesson; The Designing an Online Teaching Event has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom and I am thinking critically about how to use technology (e-Tools) in my classroom'*.

In both pre- and post-questionnaires positive ratings by the majority of participants were noted, as they chose only the levels of 'agree' and 'strongly agree'. The focus in this section was on the choice of e-Tools to enhance lessons; to critically think about how to deploy technology in the classroom and how to adapt technology to different teaching activities; how to use strategies that combine content, technologies and teaching approaches; and then, finally, to provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at their school. Mishra and Koehler (2009:9) also point out that knowledge of a given discipline is critical to developing and selecting appropriate technological tools for educational purposes.

In Table 5.1 I have tabulated the choice of digital or e-Tools - that are predominantly used by the participants - under major category, minor category and the observable ICT forms. The table was populated from the data observations that emerged during the classroom observations.

Table 5.1: Forms of ICT relating to participants' choice of digital/e-tools (Adapted: Bertram & Waldrip, 2013)

Major category	Minor category	Observable ICT forms used by participants
Programs and software	Microsoft Office	<ul style="list-style-type: none"> • Power-point • MSWord
	Educational	<ul style="list-style-type: none"> • Mathematics (Maths)
		<ul style="list-style-type: none"> • Computers 4 Kidz
		<ul style="list-style-type: none"> • Wordshark & Numbershark
		<ul style="list-style-type: none"> • Interactive games (free online)
	Graphics editing	<ul style="list-style-type: none"> • Paint (Microsoft) program to create simple drawings • Flash (Adobe)
	Video/audio editing	<ul style="list-style-type: none"> • Windows moviemaker (MS video creating/editing software) • Audacity (recording & editing audio) • Photo Story (MS) (creates visual story from digital images) • Picasa • Podcasts
	Presentation	<ul style="list-style-type: none"> • Prezi (a cloud-based presentation)
Websites	Encyclopaedia	<ul style="list-style-type: none"> • Britannica (Web-based encyclopaedia)
	Websites (general)	<ul style="list-style-type: none"> • Starfall (Interactive Lit & Num activities) • Qwizdom teach (Smart board/IWB) • You Tube • Google • Wikipedia • Khan academy
ICT infra-structure and hardware		<ul style="list-style-type: none"> • Interactive whiteboard • Smart board • Interactive data projectors • Laptops • Data projectors • Flip camera • Videos • Webcams

5.2.3 TPACK (Technology, Pedagogy and Content Knowledge)

This category of questions, items 43 to 46, also employed the Likert scale response for questions from the participants' Pedagogical Knowledge (PK); Pedagogical Content Knowledge (PCK); Technological Content Knowledge (TCK); and Technological Pedagogical Knowledge (TPK). In this category participants had to rate their TPACK in each of the subjects mentioned.

Responses by participants revealed 'agree' and 'strongly agreed' ratings for responses on content knowledge, which is in line with high levels of teacher knowledge of content within the sample. This rating strongly aligns with the sample's well-developed PCK. Participants were confident about their content knowledge of subject specialisation and thus rated accordingly.

The graphic presentations below (Figures 5.1 to 5.4) depict the correlation analysis of the two questionnaires for Items 43 to 46. Each construct was rated on a five-point Likert scale. The graphs provide a visual picture and a richer understanding of the participants' initial high ratings in the first questionnaire. A more realistic rating of their emerging TPACK knowledge in the follow-up questionnaire became evident and indicate that participants had a more informed perspective on their ICT skills. Technology is notoriously in a state of flux and, therefore, constantly changing. By their very nature newer digital technologies - which are protean, unstable and opaque - present new challenges to teachers who are struggling to use more technology in their teaching, as noted by Papert (1980) and Turkle (1995). This fact might also account for the neutral stance of some participants.

The item questions included in the TPACK constructs are listed below with the corresponding graph depicting the sample's ratings:

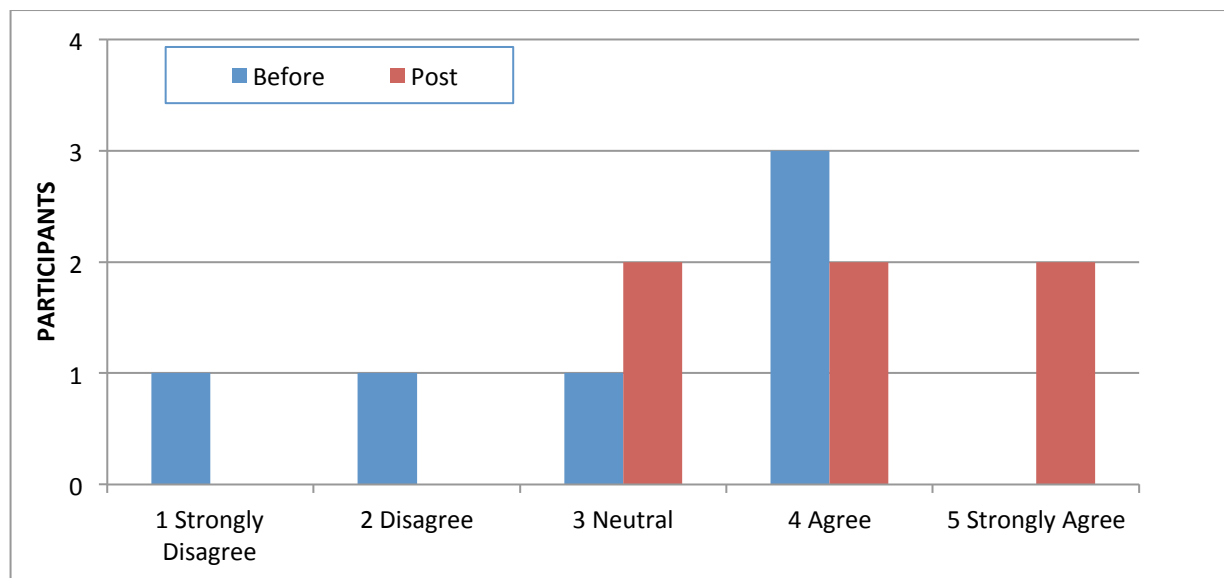


Figure 5.1: I can teach lessons that appropriately combine Mathematics, technologies and teaching approaches

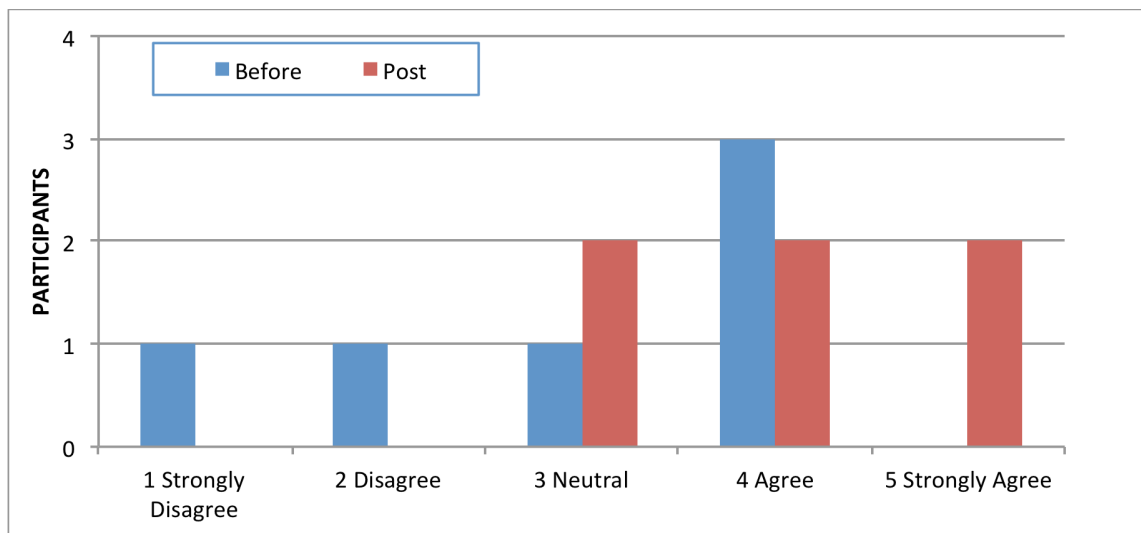


Figure 5.2: I can teach lessons that appropriately combine Literacy, technologies and teaching approaches

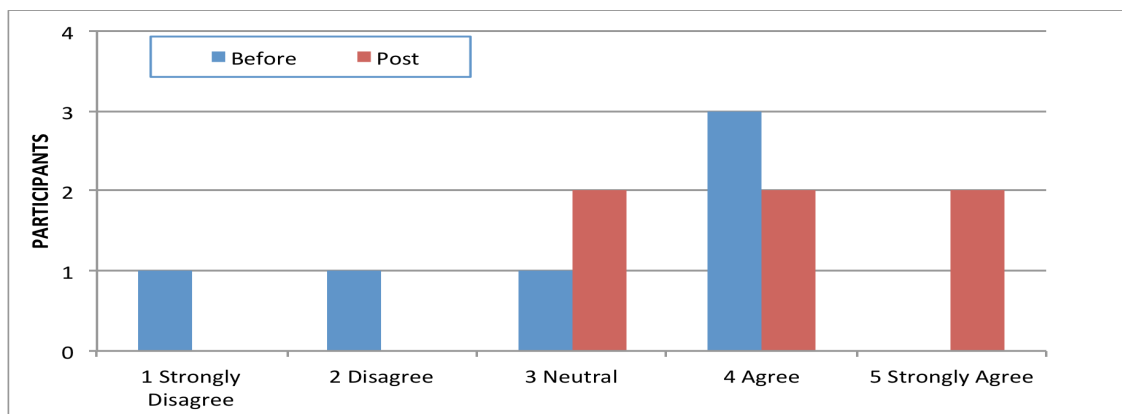


Figure 5.3: I can teach lessons that appropriately combine Science, technologies and teaching approaches

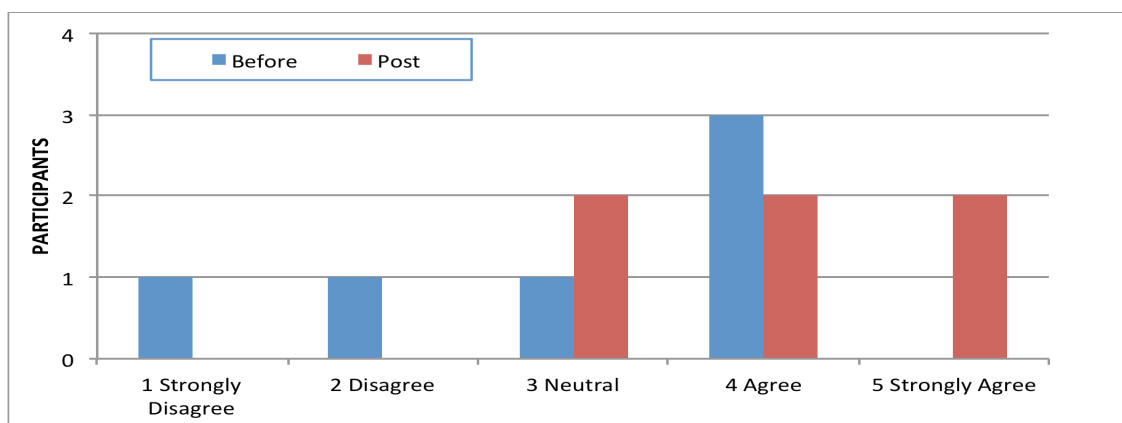


Figure 5.4: I can teach lessons that appropriately combine Social Science, technologies and teaching approaches

5.2.4 Models of TPACK by Phase partners

Items 47 to 54 measured models of TPACK by Phase partners and other senior teachers from the perspective of the participant. Time as a constraining factor was raised by most participants and mentioned as a possible reason why Phase partners are not able to demonstrate lessons. The findings in this section, which consisted of narrative responses, revealed that participants experienced modelling by Phase partners as unpredictable, or non-existent. In line with the literature, Putnam and Borko (1997:1223) allude to the 'situated practice' approach (see Chapter 2) in which teachers bring experiences from the classroom to staff development activities. The data clearly indicates that collaborative practices among participants still lack positive change as is reflected in the responses in the next paragraph. The demonstrations by Phase partners were mostly of a technical nature, involving how to use applications and software, and did not focus on pedagogy and its relation to technology integration. Lessons taught by Phase partners did not appropriately model the combining of subject content with e-Tools, teaching approaches and teaching strategies which advanced the pedagogical aims of a lesson.

Collaborative practices at the time of the research had not yet been cemented in a manner that enables colleagues to confidently approach others. Participants were beginning to realise that technology promotes new ways of working. Those driven by personal motivation continuously tried to refine how technology is implemented and delivered in their lessons. However, these participants were in the minority. After eighteen months of technology integration at the research site a participant from the Foundation Phase observed the following:

"I have not yet had an opportunity to observe a lesson by any one from my Phase. It will be good to be able to share our experiences with technology in our classrooms but, unfortunately, time must be made available for that."

Another participant narrated:

"I do share with my Grade partner but I feel that I do not get the same feedback. But I feel whatever I have to offer I can give back to the other teachers and it makes it exciting. Because you have figured out something and you can explain it to the teachers. It empowers you as a teacher."

5.2.5 Narrative responses related to specific episodes when ICT was demonstrated or modelled by the ICT instructor, Phase partners and participants

ICT instructor:

Participants were asked to describe a specific episode in which the *ICT instructor* effectively demonstrated or modelled combining content, technologies and teaching approaches in a classroom lesson (Item 55). Most responses related to a technical nature of support and did not include appropriate pedagogical strategies to benefit lesson activities. These responses came from the first survey. Participants were still at the beginning stages of becoming familiar with the functions of the interactive white boards. Many sessions were conducted to instruct participants on the functionalities of the interactive white boards. Most support sessions also focused on technical difficulties and 'trouble shooting' on how to calibrate and orientate the IWB in order to control the applications. In these early sessions the participants lacked the terminology to explain the difficulties that they were experiencing. The early experience of the participants with technology centred around technology as a substitution for, and an automation of, the manner in which lessons were taught previously.

The following are some of the comments that were made in response to the first survey by research participants:

"Last year (the ICT instructor) demonstrated the use of Excel spread sheets and merging, but this was not content-based for a specific learning area" (Intermediate Phase respondent).

"My ICT instructor effectively demonstrated the use of the IWB. No lesson was taught as such, but he also showed us how to use the Qwizdom Teach software that was installed on the board" (Foundation Phase respondent).

"My ICT instructor assisted me with the installation of free software and showed me how to search for videos and clips and how to download and save them for my lessons. These videos made my lessons interactive" (Foundation Phase respondent).

Phase partners:

The next narrative response (Item 56) asked participants to describe a specific episode in which one of the Phase partners effectively demonstrated or modelled combining content, technologies and teaching approaches in a classroom lesson. Responses by the participants were nuanced and indicated that lessons modelled lacked the undergirding pedagogy and that

the focus was on employing the software during Mathematics or English language lessons. The participants also related how the English lessons were demonstrated by using video as a tool to engage learners. Another participant responded thus: *"... we had a few model lessons demonstrated by our Maths teacher at school. He showed us how to use mathematics tools and where to find them on the Interactive Whiteboard"*. A third participant said, *"I did not observe a teacher modelling this"*.

Participants

Participants were asked to describe a specific episode (Item 57) where they effectively demonstrated or modelled combining content, technologies and teaching approaches in a classroom lesson. As these responses came from the follow-up questionnaire, there was greater emphasis on participants' understanding of authentic integration of technological tools to support lessons. The time lapse between the two questionnaires reflected the growth and acquisition of skills by the participants. Higher levels of confidence sparked changes in the participants' practice. The data of the follow-up survey also indicated that curriculum goals were now more aligned with technological tools. Technological tools were also more compatible with selected strategies. Participants with well-developed curricular understanding and content knowledge were able to illustrate a deeper understanding of the fit of technology with pedagogy.

A progression between responses in questionnaires 1 and 2 shows a clear shift from content to activity in the design of the lessons with the availability of the IWB. A constructivist approach was now more observable because there was a greater focus on learner engagement. A constructivist alignment provides the possibility of a shared dialogue within the dialogic space afforded by the IWB. Active learner engagement becomes possible with technologically enhanced instruction. Beetham and Sharpe (2007:2-3) contend that, "... Pedagogical activities require forethought and an explicit representation of what learners and teachers will do ...", they further argue that the pedagogy itself needs to be reconsidered in order to link technology and transformation.

A major focus of the research study was the collaboration between some of the participants and myself as the researcher (see Section 5.3.5). Two of the participants allowed me to observe their teaching only. One was very skilled, the other still in the early stages of technological integration in the classroom. These two participants abstained from completing the pre- and post- self-progress questionnaire. They granted me permission for all other aspects of the data collection process, such as lesson observations, semi-structured interviews and informal discussions from time to time. In line with ethical considerations set out in Chapter

4, I did not place undue pressure on these two participants when it appeared that they did not want to divulge information of a personal nature, such as professional qualifications.

5.2.6 A reflection on the classroom observations

Teaching and learning are altered in the classroom setting when technology is used. Bos (2011) purports that technological knowledge is in continuous flux and requires a deep and essential understanding, as well as a mastery of the use of technology for information processing, communication, and for problem solving to occur (see Chapter 2). As a participant observer, I was immersed in what was happening in the classrooms, when teachers were teaching and providing optimal learning experiences to the learners in their classrooms. With the exception of two participants, - alluded to earlier - my relationship with the rest of the sample became that of collaboration as the participants developed new classroom practices and built their TPACK. These participants also requested my support in planning lessons supported by technology. Sharing digital resources became part of this collaboration. The literature points to a willingness to apply new methods and strategies and a critical awareness that all technologies have affordances and constraints (Morsink *et al.*, 2011:4). Teachers were expected to deploy the IWBs during their teaching. The principal, during his class visits (see Chapter 4) would evaluate individual teachers on his daily and weekly learning walks (Appendix G). The scrutiny by the leadership prompted participants to start their lesson planning well in advance of classes to ensure that their newly acquired skills met with approval.

The IWBs (funded by corporate donors) were installed a few months prior to the commencement of this study. There was thus an outside expectation about the transformative nature of this new infrastructure. Literature by Wikan and Molster (2011:209) alludes to the outside expectation placed on teachers to use ICTs, rather than on how it might contribute to learner understanding (see Chapter 2). Many of the participants were learning to navigate the IWBs and the accompanying software. At the same time they were experimenting with different approaches to integrate technology in most of their lessons. As discussed briefly in Chapter 4, and in more detail in Chapter 6, the IWB is an example of the affordances of technology within a given context and purpose. Software packages such as Microsoft Office Suite were not designed for educational purposes, yet their applications have become popular in education due to their convenience and adaptability. Understanding the purpose of technology within a given context underpins the understanding of TPK (Mishra & Koehler, 2009:6).

The fluidity between various digital media and the subject being taught was experimental initially for many participants. At this stage most of the participants had a broad enough understanding of technology to effectively use a number of the e-Tools to enhance their lessons. Participants related how the structured staff development activities had contributed to

advancing their technological knowledge and skills. The knowledge and skills that most of the participants had already acquired cover the first three levels of the UNESCO ICT CFT (2011) framework, which includes the stages of ICT usage: *Emerging*: becoming aware of ICT; *Applying*: learning how to use ICT in subject teaching; *Infusing*: understanding how and when to use ICT (see Chapter 3). It was during the early stages of technology implementation and integration when participants were trying to find the balance between the curriculum goals and the use of technology that my role as a support person was established. I found myself participating in the lesson planning and sourcing of suitable technologically-based resources and corresponding IWB activities to consolidate the learning activity.

During the planning of their lessons, the participants needed to consider how their instructional strategies could be compatible with the technology selection. The most successful lessons observed were those in which there was a fit between the elements of content, pedagogy and technology. Each lesson presented a unique interplay of these three elements. Skilled teachers understood how to navigate these spaces created by the interplay of the elements. Participants had to set aside time to plan lessons and connect them to relevant e-Tools to enhance the lessons. Participants criticised the constraints of a content-laden curriculum and its rigid time frames as a barrier to their innovation with technology. The subjects taught by those participants in the Foundation Phase include Languages, Mathematics and Life Skills. The subject areas taught by the participants in the Intermediate Phase include English, Mathematics and Social Sciences. Planning to integrate technology should happen in all learning areas. The complexity of the interweaving of these elements plays out very differently for each subject area so that participants needed to continuously rethink their planning for technology integration (TI) in a lesson.

5.2.7 Findings from the classroom observations

The integration assessment instrument displayed in Table 5.2 was employed to assess participants' classroom teaching during the observations. This instrument (see Chapter 4) proved to be an excellent conduit for tracing and categorising the various aspects of the participants' technology integration. I found the instrument particularly valuable for providing structure to the observations. This allowed me to observe each of the participants in this manner. Each lesson was evaluated using the four-point sliding scale of the instrument for each criterion. The criteria included the following aspects: curriculum goals and technologies; instructional strategies and technologies; technology selection and fit (content, pedagogy and technology together).

Table 5.2: Technology Integration Assessment Instrument (TIAI) (Harris *et al.*, 2010)

Criteria	4	3	2	1
Curriculum Goals & Technologies (Curriculum-based technology use)	Technologies selected for use in the instructional plan are strongly aligned with one or more curriculum goals.	Technologies selected for use in the instructional plan are aligned with one or more curriculum goals.	Technologies selected for use in the instructional plan are partially aligned with one or more curriculum goals.	Technologies selected for use in the instructional plan are not aligned with any curriculum goals.
Instructional Strategies & Technologies (Using technology in teaching/ learning)	Technology use optimally supports instructional strategies.	Technology use supports instructional strategies.	Technology use minimally supports instructional strategies.	Technology use does not support instructional strategies.
Technology Selection(s) (Compatibility with curriculum goals & instructional strategies)	Technology selection(s) are exemplary, given curriculum goal(s) and instructional strategies.	Technology selection(s) are appropriate, but not exemplary, given curriculum goal(s) and instructional strategies.	Technology selection(s) are marginally appropriate, given curriculum goal(s) and instructional strategies.	Technology selection(s) are inappropriate, given curriculum goal(s) and instructional strategies.
"Fit" (Content, pedagogy and technology together)	Content, instructional strategies and technology fit together strongly within the instructional plan.	Content, instructional strategies and technology fit together within the instructional plan.	Content, instructional strategies and technology fit together somewhat within the instructional plan.	Content, instructional strategies and technology do not fit together within the instructional plan.

Overall results collected during the classroom observations revealed that the sample showed willingness and a preparedness to use technology in the classroom. The sample was eager to implement skills, knowledge and expertise acquired by integrating the 'hands-on' digital media activities that formed part of their digital portfolios during the Designing an Instructional Event Course. Lessons were observed in which the participants employed the Technology Integration Assessment Instrument (Harris *et al.*, 2010) which is a TPACK-based technology integration assessment (instrument (TIAI) (see Chapter 4). The TIAI guided the lesson observation of each participant. By using the TIAI to provide structure to the lesson observations, I was able to identify evidence of each participant's classroom practice and teaching strategies, and to gain a

greater understanding of content, planning and teaching, as well as the choice of digital tools. Each participant's lessons were evaluated using this instrument.

On each paper copy of the TIAI I would indicate the topic of the lesson, date and time, field notes and 'memos to self' (Denzin & Lincoln, 2008). I also selected for each criterion the appropriate scale from 1 to 4. When I started collecting the data for this study, the technology infrastructure in the classroom was still limited. Each participant had a laptop and had to reserve a data projector when needed.

The setting up of technological hardware before the lessons proved challenging for some participants. Hence, I was often requested to assist them with this task. Mostly, assistance would be required a day or so before trying to teach a technologically enhanced lesson. Support was needed in connecting the data projector to the laptop, as well as deciding where to place it so that learners could best view the content displayed on a screen. Retrieving saved activities and documents from folders to display on the white board often interrupted the flow of the lesson because participants sometimes used ineffective filing systems and archiving for online documents. Participants soon realised that when planning a lesson with technological support, it is important to save all relevant multi-media items in one folder which should be clearly labelled for easy access.

Such interruptions to the lesson, in order to find where a video clip was saved or as a result of sound problems or impaired Internet speed when trying to stream a video clip, resulted in the learners becoming playful during the wait and the participating teacher experiencing some pressure and anxiety. As teacher expertise became consolidated, confidence in skill levels more flexible and the constraints of technology better understood, the need for this type of technical support diminished. In the literature reviewed Dias (1999) iterates that technology integration becomes seamless when it extends and supports curriculum objectives and engages learners in meaningful learning.

The evaluation rubric allowed me to rate observable behaviour such as the pedagogical decision-making of the participant; the selection of instructional strategies and technology; compatibility of the technology with the curriculum objectives; and, finally, the 'fit' which amalgamates content, pedagogy and technology. According to Rodgers (2002:122) the pedagogical approach to integrate technology involves the judicious selection of technology as per the requirement of the content, framing objectives of learning and delineating the tasks and subtasks to be performed by the learners during the analyses of the videotaped lessons. These observations and field notes were used to comprehend and interpret participants' classroom practices and the strategies that they considered during the teaching of the lesson.

Participants who were less confident and skilled in the use of technology selected devices which automated methodologies they previously used for teaching. Harasim (2012:2) refers to these tendencies of teachers to merely integrate technology in traditional teaching modes and notes that teachers do not often reflect on how these trends shape their classroom practices. Such lessons were largely teacher-led and often lack learner participation. Muffoletto (2001:3) argues that, where possible, teachers avoid the "de-centring of the teacher as a voice of authority". Participants who sometimes used technology as merely a presentation tool, held strong views about *teaching* the lesson and transferring knowledge to the learners.

The aim of the participants was to cover as much curriculum content as possible during a lesson. Selwyn (2011:125) refers to this engagement of teachers with technology as the "passive delivery of information through interactive whiteboards (IWB) and the bounded system of virtual learning environments and managed learning systems". It was also observed that the participants were not yet exploring the full potential of the IWB as an artefact to support dialogic learning spaces (Nes & Wikan, 2013). I elaborate on the use of IWBs in Chapter 6. What was also observed was the link between the chosen digital-media activities and the lesson outcomes, as well as the participants' ability to consider and implement the requirements of the curriculum for a particular lesson. Participants who had a better grasp of the enactment of the curriculum, integrated technology to address challenges experienced by learners.

Examples were observed of participants in this study who successfully trialled technology applications to address language barriers experienced by learners when teaching language and literacy based-lessons. To achieve this outcome, some participants successfully employed the use of video as 'a hook' to engage learners. Videos were content-related, age-appropriate and considerations was given to the use of language accents that learners could relate to. The use of video was seen as a vivid and stimulating way to engage learners. Other participants employed web-based reading programs which enabled personalised reading levels and allowed learner progress to be tracked. Mishra and Koehler (2006:1025) view teaching as very complex and describe the knowledge of content, pedagogy and technology as central for developing good teaching.

Those participants who had acquired a strong pedagogical content knowledge (PCK) through many years of teaching were able to combine this strength with a sound selection of technology based activities to facilitate teaching and learning with technology. Their pedagogical goals were the focus of the lesson, rather than the technological innovation (Angeli & Valanides, 2009). The participants whose primary focus was pedagogical goals were well versed in their content area curricular outcomes. The data show that these participants were more likely to develop their own artefacts to support their teaching. I reflect on these artefacts in Section 5.4.

A summation of responses elicited by a question in the semi-structured interviews imparts the very personal views of some participants. This question relates to the different foci of each participant with regard to their choice of e-Tools. The exploitation of the Internet as a resource to develop learners in non-academic skills also resonates with participants. The question posed to participants focused on software applications or web-based applications that are utilised when planning for technology integration. One participant responded as follows:

"What I often do is use, especially in Social Science, I make use of clips found on the Internet-You Tube to show learners and also now that is what I can do with simply a data projector."

Another participant said:

"There are a lot of websites that I use regularly. I do have a number of resources now. There are so many things out there! There's story books. So I want to try and bring that into the classroom and see if they (children), if it won't help with focusing. I also use the yoga and meditation programs which I get on the Internet and also on You Tube. I do it every Monday. Mondays are so important if you want to centre and calm them (children) for the week."

5.2.8 Findings from the semi-structured interviews

The semi-structured interview responses by the participants were transcribed (Appendix E). Various themes emerged that indicated the fluidity of teachers' perspectives and understanding of technology integration and instructional technologies. Although the same format was followed with each participant, I was able to probe more deeply in certain instances to obtain additional information. The responses selected are from the four participants identified for the individual case profiles in Section 5.4.

From data analysis of the semi-structured interviews the themes identified are: professional development and policy; teacher knowledge; teacher beliefs and teachers' TPACK and technology as a tool to address barriers to learning. In section 5.3 I provide the themes that emerged from the semi-structured interviews and a brief summary of the findings on each question. (See Appendix K for the transcription of the participant responses to the semi-structured interview questions.)

5.2.9 Main themes identified from the analysis of the semi-structured interviews

5.2.9.1 Professional development and policy guidelines

It was evident from the participants' responses that the majority had no knowledge of, or were only vaguely familiar with ICT-related policies or the guidelines for teacher training and professional development in ICT. Respondents also reported that they only concentrate on policy that relates to academic matters. One respondent related, *"I am not an IT teacher, so I concentrate on academics only"*.

5.2.9.2 Teacher knowledge of technology

Participants acknowledged that before they joined the staff of the research centre they were unfamiliar with employing digital technologies in the classroom. Others used technology mainly for administrative purposes and, thus, their knowledge of technology is the result of trial and error. The majority of the participants acknowledged the influence of the staff development courses on their acquisition of technological knowledge and skills. One participant responded as follows:

"I made a deliberate decision to start getting to know technology, although I don't read up a lot about it. It is just finding my own way around technology."

Various themes emerged in response to the question regarding the considerations that are taken into account when planning lessons to include technology. These points included the importance of lesson outcomes, the need for lessons to be interactive and learner participation. Other considerations that emerged focused on maintaining learner focus and planning around learners' different learning styles.

5.2.9.3 Teacher beliefs about technology

In considering technology as a necessity for learner achievement, participants were all in agreement that technologically enhanced teaching can lead to learner achievement. There were no negative stances in terms of how teachers feel about the use of technology from the sample. *"Yes, I do, technology makes the lessons interesting and interactive."* Other participants mentioned the importance of learner access, and opportunities to extend learners through interactive multi-media lessons.

5.2.9.4 Teachers' motivation and deepening of TPACK

The participants' responses indicated a shift towards a development of a TPACK "mind-set" (Morsink *et al.* 2011:4, see Chapter 2.2.1). There was also an indication that participants could

relate the use of technology to lesson outcomes. They were willing to apply new methods and strategies which included technological tools. Some participants were aware of the advantages that technology offers. *"We have been using technology for the past year and the confidence they [learners] have gained, it is just amazing."*

Participants related to the ability of technology integration to develop learners' critical thinking skills in a positive manner. *"I think it can. It depends on the level of our children, what level they think on. But I think it can enhance their thinking and higher order skills."*

An awareness of technology as an enabler to foster the teaching of 21st century skills resonated with all the participants. Participants responded in an overwhelmingly positive manner to this question and related high levels of motivation amongst their learners. However an awareness of technological constraints was also raised, one of which was Internet speed. *"With the Internet being so slow I find that if I source certain things it takes longer."*

Technical difficulties also contributed to the constraints experienced and added to participants' frustrations. *"I actually downloaded some of my things, then my Laptop crashed and it had to be re-done. This new one was on the point of crashing and then he (administrator) had to install some other programmes."* Other constraints were related to the curriculum. *"... but I think this year with CAPS, I needed to put my head around CAPS and put my head around planning of my lessons and my Assessments, especially. I think that was a bit of a challenge for me this year."*

5.2.9.5 Technology as tool to address barriers to learning

Responses to the question of the learning needs and preferences of learners when integrating technology, highlighted the personal views of participants and how learner-centred their approaches are. Participants often viewed poor results of learners as a reflection of their teaching abilities. Although in the minority, one participant said, *"I must say, this year I probably have not adapted to the weaker learners, no, I haven't gone into a lesson preparation and thought that this will be for the weaker learners."* The majority of the participants considered that learners are diverse and have different learning styles and that this aspect, therefore, should be a consideration when planning lessons.

In Chapter 4 I listed and explained artefacts and documentary data as data instruments. In the next sections I present the data that emerged from these two final instruments.

5.3 Artefacts designed by the participants

One of the first indicators of exploring how the participants differed in their decision-making processes when integrating technology was evident when some of the participants designed their own digital artefacts. It became evident that as the participants designed these artefacts the 'thinking' behind this process was that the object should feed into their lesson planning and pedagogy. These participants were eager to ask for advice from peers and willing to apply new methods and strategies. I viewed this design process as indicative of a deeper contemplative practice by the individual participants. I was able to reflect on teacher 'thinking' and 'beliefs' about technology as well as 'strategic thinking', which incorporates knowing when, where and how to use digital technologies and other relevant multi-media in the classroom. Participants' motivation seemed to relate strongly to developing a TPACK-mind-set. This mind-set develops when there is an on-going commitment to learn more about technological tools and options to access technological expertise and advice of peers and others (Morsink, 2011:4). Examples of the artefacts the participants created were digital stories, in which the learners participated by assisting with the telling of the stories (audio) and in the drawing and storyboarding. The learners' drawings formed the visual background to the stories. Thereafter, the participant teacher would use an appropriate software application to compile and produce the story.

5.4 Documentary data

As mentioned in Chapter 4, the sample participated in a workshop as part of a skills and professional development initiative titled 'Designing an Online Teaching Event.' This workshop consisted of two phases and followed a blended learning model of instruction. The first phase was a traditional face-to-face session, which was conducted over a five-day period. This was followed by an online phase of four weeks. Participants were requested to complete and electronically submit a prototype assignment within an e-Learning platform. The documentary evidence of the results of the face-to-face workshop provided valuable insight to me because I could use it as a frame of reference for each of the participants, with regard to their attitudes towards technology integration.

The outline of the course (Appendix F) highlights the various aspects of the course design in which a 'Learning by Design' model was followed (Stoltenkamp, 2012). When these responses are closely analysed, one can conclude that the course had a significant impact on the individual participants' knowledge of technology. It clearly provided a vernacular for expression and what became more noticeable was a 'common language' that described and characterised their emerging digital literacy. The foundations of a 'TPACK mind-set' are evident when reading the narratives of the participants as they engaged in the various topics in the on-line forum.

Appendix F gives the outline for the course and Appendix G the rubric that was employed as a measuring instrument by the leadership of the school during their 'learning walks' to observe and rate the impact of the professional development on a shift of teachers' knowledge and teaching methodologies. Robertson and Sutherland (2009:215) suggest that when opening up the space for a wide range of new kinds of collaborations - between teachers themselves and between teachers and learners - we contribute to the knowledge about ICT and learning. "How, otherwise, might we keep pace with the very fast-changing nature of ICT innovations and how they mediate learning?" they ask.

5.5 Reporting on the case profiles of individual participants

In the following section the trajectories of four 'information-rich' participants are presented. I have introduced each participant's case with a narrative obtained from the documentary data discussed above. Data was generated during the interaction of participants in the 'Designing an Online Teaching Event' shortly before the commencement of this investigation. This data was collected in order to probe and to answer the sub-questions on the teacher's 'thinking' and 'beliefs' when teaching with technology.

I wanted to comprehend how teachers' knowledge, beliefs and attitudes influence the decisions that they make when integrating classroom practice with technology. Survey items from the self-report measure and the semi-structured interview questions addressed matters pertaining to considerations that are taken when planning lessons with technology. I looked at the participants' use of technological representations (i.e. multi-media, visual demonstrations) to demonstrate specific concepts in a content area. In each case I explore the participants' motivation for using technology with special focus on the main research questions. When teachers are thinking within the framework of TPACK, they are concurrently reflecting on their current knowledge while making decisions about content, pedagogy and technology.

5.5.1 The case of Annabel

Annabel is less experienced than the other participants in terms of years of teaching experience. She is an Early Childhood Development teacher responsible for teaching the Reception Year class. Her verbatim quote was transcribed thus: "*I wasn't clued up with technology and now that I have come here (research site) it has just broadened my knowledge about technology ...*" (see Appendix K).

Although she started out with a low-level of confidence in her technological abilities, she was eager to request pedagogical and collegial support in her efforts to integrate technology in her teaching. She continuously reached out to me as the researcher to assist her in the early

stages of her learning trajectory. She always requested one-on-one sessions. Table 5.3 outlines her first encounters and thinking around technology enhanced practices during the 'Designing an Online Teaching Event' course in a prototype lesson (see Appendix K for the complete prototype plan by participants as it emerged from the documentary data).

Table 5.3: Key features of prototype lesson: Annabel

Grade R teacher	Academic focus	Selection of e-Tools	Pedagogical motivation and measurable outcomes
Age group: 5 years	Pre-reading skills with focus on phonics and high frequency words	Digital photo story (MS). Creates story with images, audio and animation, animated powerpoint (MS).	Focus on high frequency words to support incidental reading and comprehension.

5.5.2 The case of Meredith

Meredith is an experienced teacher with almost twenty years of teaching experience. She has in depth knowledge of the curriculum and is able to lead a team of Foundation Phase teachers. She is known to her peers for her tenacity and ability to always create innovative and engaging lessons. In an unobtrusive manner, she started her journey with technology. She was one of the first participants to create accompanying artefacts to support her lessons and at the same time engage the learners at a deeper level as co-creators of knowledge. In her own words: "*I would love to say my lessons are 100% enriched with technology ...*" (see Appendix K).

Table 5.4: Key features of prototype lesson: Meredith

Grade 1 teacher	Academic focus	Selection of e-Tools	Pedagogical motivation and measurable outcomes
Age group: 5-6 years	English, Afrikaans, Numeracy and Life Skills	Animated powerpoint, digital photostory (MS), video clips, creating photo collages, own artefacts designed from learners' work.	Visual stimulation for learners to enhance memory. Assessing listening skills to support cognitive development.

5.5.3 The case of Yolanda

Yolanda has also been a Foundation Phase teacher for more than two decades. She is particularly creative and artistic, a skill which she employs to enhance her lessons. Initially she did not appear to be interested in using technology for lesson enhancement. The cycle of innovation and change at the research site has propelled her to embrace change. With a very motivated 'swim or sink approach' she acquired new skills and expertise and, in a short time,

this is what she had to say to me: *"I can't imagine my classroom without technology ... I would like to measure the impact of technology integration on my learners' literacy skills ..."* (see Appendix K).

Table 5.5: Key features of prototype lesson: Yolanda

Grade 2 teacher	Academic focus	Selection of e-Tools	Pedagogical motivation and measurable outcomes
Age group 7-8 years	English	Video clips, digital photo story (MS), designed own artefacts to illustrate lesson.	Listening to stories to extend vocabulary. Support conceptual understanding, and development of listening and speaking skills.

5.5.4 The case of Dorothea

Dorothea has also been a teacher for almost 20 years. She is creative by nature and a budding artist. She has shown a keen interest in technology at a personal level. A few months after the installation of her IWB, a systems breakdown thwarted her efforts to continue the momentum of technology integration with her Grade 3 learners. However, Dorothea was very motivated to work around this challenge and reverted to using a data projector and a laptop. She narrated the following:

After using the IWB non-stop ... then the life span of my projector lamp came to an end and it was over. Oh! I felt terrible! For like 6 months, and I nagged and nagged and nagged! Probe: So the IWB has become part of your instructional methodologies? "Yes, of course. They then gave me a replacement projector (one from the hall)" (see Appendix K).

Table 5.6: Key features of prototype lesson: Dorothea

Grade 3 teacher	Academic focus	Selection of e-Tools	Pedagogical motivation and measurable outcomes
Age group 8-10	English and Science	Video-clips, animated powerpoint, digital photostory (MS). Artefacts designed with learners.	Listening and speaking skills. Encouraging higher order thinking skills through questioning. Support of conceptual understanding through the development of listening and speaking skills.

5.6 A reflection on participants' practices

When a comparison is made among participants in this study, the individuality and uniqueness in approaches and performance in classroom practices are the most observable. The results

indicate a nuanced consideration when teachers plan with technology. The alignment with learning outcomes is dependent on factors such as the success of the lesson, previous successful use of a particular e-Tool and then re-teaching of concepts if learners have difficulty in grasping concepts. Due to the diverse nature of learner ability, it is sometimes necessary to re-teach concepts.

In the Foundation Phase, more than the Intermediate Phase, most teaching is teacher led. This practise is grounded within the traditional context of the Foundation Phase teacher. The teacher initiates and guides all activities during which 'mastery learning' is the focus, and the teacher emphasises 'knowing how' and 'knowing that' as traditional teaching methodologies. In Wertsch's (1998) socio-cultural approach, he distinguishes between the terms 'mastery' and 'appropriation'. Mastery is a traditional consideration of knowing how to do particular actions, whereas appropriation is characterised as 'making something one's own'.

Technology based activities are sometimes approached in a similar vein in a 'low-level' approach. Technology often is not yet fully utilised for its potential affordances. The methodology of teaching in the Foundation and Intermediate phases allows for a more dynamic interaction between the learners and the teacher. However, observations revealed that the participants prefer to remain tightly in 'control' of what could become an animated dynamic between teacher and learners. Participants are not yet ready for a classroom milieu in which technology can lead to much 'disruption' when learners immerse themselves through animated and lively responses to the sound, graphics and animation of, for example, a video watching activity. Reviewing the literature on Complexity theory (see Chapter 2) there is the notion that innovation happens at the 'edge of chaos'.

Sullivan (2009) claims that where emergent learning occurs in the classroom environment on the 'edge of chaos' learners had a sense of agency. In classrooms where learning was tightly bound, there was minimal learner agency and emergent learning was undetectable. The recorded video-taped lessons revealed that learners were naturally responsive and, at times, inadvertently responded with advice when the teacher experienced technical 'glitches'. This response was not popular with some of the participants who viewed such behaviour as disrespectful or inappropriate at times.

5.7 Conclusions

This chapter has presented the findings of this study. By researching the phenomenon from various angles, the data showed how the participants had started to embrace emerging technologies. Responses were varied and reflected individual progression in terms of how the participants developed skills, knowledge of technology and confidence in their abilities, and

depended largely on the participants' personal motivation. The data further illuminate how ICTs interact with existing pedagogies, classroom norms, and how they might change the possibilities for knowledge building and new forms of learning. The four case studies amplify Wertsch's idea of the learner-technology relationship (in which the participants are the learners) as one of 'a person-acting-with-mediational-means' to emphasise that a person's capabilities are potentially enhanced by working with technology. This finding explains that different kinds of technologies will benefit the enhancement of different classes of capabilities. The case studies selected outlined how the individual participants had started to optimise the affordances of technological tools for educational instruction. This outcome has mitigated the commonly held views that veteran teachers are afraid to employ technology in their teaching. Robertson and Sutherland (2009:2012) describe this 'epistemological diversity' as new ways of knowing and accessing the curriculum, and different ways of representing knowledge. In Chapter 6 I engage in a discussion based on the results of the study. I will explore the potential benefits of the UNESCO ICT-competency framework and the TPACK model - as guiding frameworks for teachers' ICT competencies and for developing a TPACK-mind-set.

CHAPTER 6

REFLECTIONS AND DISCUSSION OF FINDINGS

6.1 Introduction

In this chapter I reflect on the findings and conclusions that emerged from this study and their implications for continued technology integration at the research site. I begin with a synopsis of variables that emerged from the data analysis, such as sustainability of technology integration, and the sustained change in classroom practices of the participant teachers. I then discuss affordances of, and barriers to, technology integration at the research site. The TPACK (2006) conceptual framework as well as the UNESCO framework, ICT-CFT (2011) and its efficacies, will be discussed as frameworks that can be applied to sustain integration practices, in order to mitigate the impact of teacher attrition, and provide a structure to the continuous and sustainable integrated development of teachers' technology skills and deepening of teacher knowledge. A two-pronged line of inquiry was followed to investigate the research problem. Following on from the literature review on teacher competences in instructional technology, I illuminate the three scaffolds that emerged from the data. The first scaffold points to teachers' personal views on technology integration. The second scaffold underpins the importance of twinning the current curriculum outcomes with appropriate technological tools to modify lessons that are enhanced by technology. It appears that matters related to the sustainability and continued use of technology integration at the research site lean heavily on these two scaffolds. I engage in a discussion of the advantages of the IWB as a critical affordance in the primary classroom and its role in sustaining instructional practices with technology. The third scaffold is a long-term whole school technology vision for future directions at the research site and definitely links with the organisation's vision to foment growth and development for teachers.

The rest of the chapter consists of the following sections:

Section 6.2: Synopsis of variables that emerged from the data analysis;

Section 6.3: Sustaining the change in classroom practices: observations from the study;

Section 6.4: Examples of and barriers to technology integration;

Section 6.5: Critical aspects emerging from the data that influence participants' TPACK;

Section 6.6: The TPACK Framework (2006) and the UNESCO ICT Conceptual Framework for Teachers (2011); and

Section 6.7: Conclusions of Chapter 6.

6.2 Synopsis of variables that emerged from the data analysis

In this section I elaborate on the themes that underlie the three scaffolds that emerged during the data analysis.

6.2.1 Sustainability of technology integration at the research site

As iterated in Chapter 2, this study follows a two-pronged line of enquiry to probe teachers' developing competencies in technology and its integration in their classroom practices. The first line of enquiry investigated and explored teachers' knowledge of technology. The second line of enquiry probed the practical adoption and integration of new strategies within the classroom context.

The three scaffolds that emerged from the analysis of the data could have a significant influence on the long-term sustainability and growth of primary teachers' continued integration of technology into their classroom practices. These scaffolds attempt to answer the sub-questions (see Chapter 5) in terms of exploring the sustainability of a technologically enhanced classroom practice, and teachers' planning to integrate technology into their lessons.

6.2.2 Teachers personal views on technology integration

The first scaffold points to teachers' personal views on technology integration. Teachers' technological beliefs are influenced by their teaching philosophy (Norton, McRobbie & Cooper 2000:87). This study also acknowledges that teacher roles have changed and now involve a complex shifting of perspective from the "more-knowledgeable-other to the co-constructor" of knowledge (Sutherland *et al.*, 2009:6). This complex shift is not yet fully understood by all the participants in this investigation, as referred to in Chapter 5. Participants in the study were at different stages in their own trajectories and thus individual teachers' motivation and readiness to adopt new practices reflected each one's personal journey in terms of changing their teaching practice to that of technologically enhanced instruction. Huffman and Rickman (2004:282) postulate that a common problem is that ICTs are seen as the innovation. Innovation, they argue, needs to be the process that comes with ICTs' use and innovation potential. ICTs, therefore, need to become an element of the curriculum and the shift in ICT aligned instruction needs to take place in pedagogical practice. TPACK competencies and perceptions should be developed according to the motivation levels and initiatives undertaken by the individual participants. This scaffold was characterised overall by participants' trying out new ideas and examining good practice involving the employment of technological tools.

The findings as reported and narrated in the four case studies emphasise the individual 'thinking' and perspectives of each participant when they related how they plan with technology.

Professional development activities often involve risk-taking by the individual, while simultaneously fostering learning, adaptability and improvement. The data in this study demonstrate the relationship between professional development and teacher learning and how it impacts change and motivation to adopt new practices. Researchers (Hofer & Swan, 2008:179) concede that integration of technology is a very personal undertaking. Participants in this study all responded positively to the impact of the staff development that was designed to introduce the use of e-Tools and their applications in learning activities in the classroom.

Very often, as was also observed during this investigation, teachers' tend to be afraid of critique, especially by peers. The data confirms that collaborative practices of sharing with Phase partners to raise standards have yet to become common practice. The two most essential factors for understanding teachers' integration centre on teacher beliefs and attitudes. Teaching is not only a matter of skill and competencies. Kelly (1980) suggests, therefore, that when teachers adopt new classroom practices or when they consider changing their practices the following are important: the change must be feasible in terms of classroom practice; it must be perceived as relevant to the teaching and learning needs and, finally, it must be acceptable in terms of the teachers' underlying philosophy of education (see Chapter 2). The data in this study also illustrate the melding of teacher readiness as a critical factor in adopting new technologies.

6.2.3 Technology integration and curriculum delivery

The second scaffold suggests that technology enhanced lesson activities should be curriculum linked, alongside which a technology integration framework can act as a point of reference to guide the appropriate selection of technological tools. Starkey (2012:110) underscores this view when she points out that successful digital technologies in everyday teaching practice require relevant expertise on the part of the teacher. Such a curriculum needs to have flexibility in its application to allow teachers to tailor learning appropriate for the context, to be able to integrate concepts and skills across subjects and to take learners beyond mastery to the creation of knowledge from the concepts of skills being learnt. The participants in this investigation consistently related that the current curriculum constrained innovation and creativity due to its rigid and content-laden nature and, therefore, they viewed the curriculum as a barrier to technology integration. This situation often resulted in a disconnection during lesson planning, when consideration is given to the implementation of technology. During lesson observations and personal interaction with participants their lessons very often were characterised by the use of technology merely as a presentation tool.

In a curriculum in which technology is integrated, teachers need pliancy in its application to modify learning appropriate for the context, and to be able to integrate concepts and skills. For

some participants the selection of appropriate tools to complement lessons proved challenging, mainly because imbedding technology in lessons requires additional time spent on planning. Participants teach different lessons during the course of the school day and consequently, are, challenged by time and other factors related to pedagogical decision making. The use of technology might not fit content and instructional strategies within the intended lesson or teaching plan (Harris *et al.*, 2009:9).

The TPACK conceptual framework by Mishra and Koehler (2006) connects technology to curriculum and content and focuses on specific pedagogical and constructivist approaches. This framework looks at the significance of the three elements of the constructs (content, pedagogy and technology). Solutions for teachers lie in the ability to be malleable when navigating the spaces between the three elements and, most importantly, the interactions among these elements within a specific context. Mishra and Koehler (2006) confirm the inter-relatedness of these knowledge bases that exist in a state of equilibrium. Kuhn (1977:225) refers to this state as the 'essential tension', albeit in a different context.

TPACK then becomes the foundation for the effective teaching that underlies pedagogy. When participants in this study became more confident and fluid in their abilities, appropriation of software and its related features on the IWB, provided more differentiated opportunities for structuring lessons for learners who experienced barriers to learning.

This positive observation is supported in the data that emerged from Items 34-42 (TPK) which is one of the sub-elements of the permutations of TPACK (see Chapter 5.2.1). This scaffold has implications for teachers' planning practices because their own developmental levels show an efficiency to integrate technology for instructional purposes, a process that Dias (1999) identifies as seamless integration. Participants who had developed the necessary technological expertise were able to have a nuanced understanding of the interplay between the spaces within the three elements (see Figure 2.2 in Chapter 2, and Table 6.1 for the TPACK definitions).

Teaching with technology, however, is complicated, more so due to the ever changing nature of emergent technologies. The seven permutations of the framework define each of the knowledge constructs, and a brief definition of each permutation is given in Table 6.1. According to Mishra and Koehler (2006), TPACK stresses the connections and the continuous overlapping and interweaving of the constructs when teachers demonstrate their understanding of technology, pedagogy and content to produce effective discipline-based teaching with educational technologies. During the three-year phase of this research, two major staff development opportunities for staff were arranged to familiarise teachers with emerging technologies and to develop professional learning needs of teachers. A shift has been

observed in teachers' teaching approaches, away from a techno-centric slant to one with an increased ability to connect content with technology and pedagogy through constructivist methodologies. This research study can confidently claim that the majority of participants in the study embraced the change and continue to develop sound practices towards technologically enhanced instruction practices.

During the course of this investigation the participants, through an iterative process over time, demonstrated how they each developed a confident TPACK. As discussed in the sample characteristics, each of the participants already possessed a well-developed PCK and their content related knowledge was adequate. The manifestations of the development of technological knowledge and skills, as observed during the classroom practises of the participants, and explained in the case profiles, are explored in Chapter 5.

6.2.4 Whole school technology vision

The third scaffold is a long-term whole school technological vision for future directions. A vision of which, together with the school leadership, is negotiated within a consultative process. As far back as 2009 the research site embarked on a peer development process with outside stakeholders (Roos, 2009) to reflect on its learning vision based on the Principles of Learning (Resnick, 1983) (see Chapter 1.5.1). It is important to note that at this stage, some of the critical success factors were already in place, such as a supportive and diversified leadership and an existing commitment to make time for self-development.

A considerable spirit of innovation prevailed amongst a core of staff and the organisational climate was conducive. This learning vision proposed, based on the Principles of Learning, and in the context of striving towards innovation, additional perspectives on pedagogy and the use of technology. Key ideas from this learning vision are summarised as follows (based on the Principles of Learning [Resnick, 1998:89]) which underpin the teaching methodology at the school:

- Stimulating: engaging, fun, intriguing, enquiry, creative, innovative, interactive;
- Relevant: real-life, current, develop 21st century skills, 3Rs, practical, value-based;
- Rigorous: critical thinking, active reasoning, synthesis, deep understanding, developing 21st century skills; and
- Continuous: accessible, pervasive, progressive.

At the time (2009) this exercise served to increase the understanding of a group of lead teachers of what could happen in a 21st century classroom in an innovative school. These

workshops were the stepping-stones for exploring the critical success factors necessary to provide focus for the efforts to grow professionally. Following a cascade model, lead teachers on their return from these vision sessions were required to transfer knowledge to peers at school. Critical success factors use the lenses of people, processes and environment. The following factors were identified as instruments to enhance success:

- Strong and supportive leadership;
- Strong commitment to time and effort of professional and self-development;
- Recognition that self-development is a process and could take time - realistic expectations;
- Freedom to take risks, make mistakes in a supportive environment;
- Collaborative support amongst peers; and
- Connected environment with online access.

Undergirding this scaffold is the fact that the vision of the organisation is situated within an empathetic culture of teacher support which recognises sufficient interaction time. Most importantly, is sustained staff development which links the vision of technology integration with the curriculum, so that it reflects the continuous cycle of learning through staff development. This research study shows that technology could be a mechanism for changing instructional practices when used to deliver curriculum content. As such, the processes described above are cyclic, each introspection marks the start of another cycle in the development of new avenues of innovation.

Participant teachers continuously expressed the need for on-going training and one-on-one support. Sutherland *et al.* (2009:6) succinctly relate that pedagogical change that new technologies make possible, frequently challenge current practice and, therefore, lead to tensions. Furthermore, technology alters and 'disrupts' the social relationships in the classroom between learners, and between the teachers and learners, in ways that are challenging (as noted in Chapter 5). Many teachers do not seem to be ready for teacher-learner relationships in which the boundaries of the roles are blurred and no longer clearly defined in the knowledge-building process. This uncertainty is especially so, as confirmed by observations, in participants' classrooms during this research project. Hence, Barton (1997) asserts that teachers need to construct new roles for themselves and reconceptualise their practice.

6.3 Sustaining the change in classroom practices: Observations from the study

One of the major drivers of the participants' change in classroom practices was propelled by the staff development activity which recognised the need for participants' constructivist orientation to emerging technologies. The literature argues that the teacher becomes an important starting point in understanding change within the use of ICT in schools (Donnelly *et al.*, 2011:1469). What are the participants' views on changing practices? What might threaten sustainability to changes in classroom practice? These pertinent questions are important in the light of the unavoidable infrastructural changes made by the research site as part of the school's long term objectives to create capacity in line with its technology investment plans. Wikan and Molster (2011:209-218) allude to the need for teachers to supplement existing mainstream teaching with emerging technologies.

Alongside these structural changes was the provision of efficient teacher support through the vision of the organisation's supportive culture, as detailed in Chapter 4. The section on the research context in Chapter 1 outlines the technological infrastructure and the availability of broadband and, more recently, WI-FI infrastructure to aid the shift to embedding technological hardware in the classroom for learner engagement.

Technological infrastructure at the research site was employed to create an enabling and stimulating learning environment, which necessitated the need for teachers' own learning. Classroom observations of participants deploying newly installed digital infrastructure in the initial stages of this study noted the dynamic of learners and Teacher Assistants in classrooms, such as: the latter group possessing technological familiarity and showing intuitive knowledge when connecting the laptop cables to the IWB; the learners being eager to explore the touch functionality of the IWB; juxtaposed against the participant who no longer appeared to be the only 'knowledgeable other'.

In my view teacher attrition could be a possible threat, because new incumbents to the organisation might have shortcomings and lack the digital competences, skills and expertise that have already begun to characterise the participants' classroom practices. New incumbents' own teaching views and beliefs might not be supportive of technologically enhanced practices. Elen and Lowyck (1999:145-169) define teacher beliefs as a tacit set of unconsciously held assumptions regarding educational issues and processes such as teaching, learning, curriculum, schooling and knowledge. The new incumbents might not be the 'right fit' for the research site's vision. Zeidler (1997:483) suggests equipping such teachers with skills in the use of classroom technology, while Sutherland *et al.* (2001:213) argue that they need to be brought into the circle of knowledge production about their own practice. In this way one can deal with concerns of epistemology and methodology. There is a need, then, for continuous

professional teacher development to sustain this shift in teaching practices and induct new incumbents to the organisational culture. It is noted that teachers' predispositions towards teaching with technology vary. Ingvarson (2013:4) paints a negative picture of teachers' professional development in observing that:

There are many individually effective professional development programs and activities operating at school and systems levels, but the overall pattern of provision is brief, fragmentary and rarely sequential. The capacity of the profession to engage most of its members in effective modes of professional learning over the long term is weak.

The above observation illustrates the existence of both affordances and barriers to the adoption and integration of technology by teachers within classrooms.

6.4 Affordances of and barriers to technology integration

Conole and Dyke (2004:204) define affordances as "what uses ICT invites and facilitates, what it lends itself to and what it can do well". This definition refers to design functions and features of technology that can be exploited effectively and creatively for use in new settings (Hennessy, 2014:357). This study found that some participants still implement technology in limited ways and do not take full advantage of its potential. Other participants are given to bursts of innovation and creativity and then fall back into familiar patterns of teaching as dictated by the curriculum. Teacher change is often viewed as a barrier. Ottenbreit-Leftwich (2006) suggests that the following factors constitute both barriers and affordances: personal factors which relate to inner-drive, personal beliefs, commitment, confidence and previous success. Another factor, which is less personal, is academic support - the vision by the leadership of the school, together with a sustainable plan, is also a contributing factor to the positive affordances experienced. Other critical factors are access to professional development, availability of time, hardware, software and the Internet.

Interview data indicate that participants' views with regard to affordances of technology are slowly moving from a narrow view to one that is more embracing of technologies' potential. There is the realisation that digital technologies are associated with constructivist forms of learning. This understanding or epistemology of learning underpinned the course work for the participants during the staff development course. Selwyn (2011:26) claims that this approach positions learners at the centre of the learning process. Participants' own definitions for motivating how they employ technology are still fluid, because the use of most applications and digital tools is still experimental in order to gauge technology's success in learner engagement. Participants frequently still use technology as a mere presentation tool in existing instructional practises.

The Grade 3 participant teachers are more likely to find new innovative ways of changing their classroom practices. This situation might be because older learners engage and respond differently to learning activities. Artefacts designed by these participants attest to higher levels of confidence and greater willingness to exploit the affordances of technologies in the classroom. The Grade 3 participant teachers had also started to review previously planned lessons and were embedding such lessons with technology. The aim, as reported by the participants, was to create a data base/repository of digitally enhanced lesson resources to replace previously designed lessons in the teachers' digital archive, so that these resources could be selected for use at any time to review concepts or to support revision activities. An advantage of this process was that teachers could draw on their expertise and on developing TPACK to populate these databases. Such understanding of affordances was driven by individual participants' personal drive and motivation.

The review of the conceptual framework (TPACK, 2006) in the research literature clarifies the constructs or elements of content knowledge (CK) and technology knowledge (TK). In TK expertise in technical abilities and the application of multi-media tools are required. The review notes the complementary relationship with pedagogy to guide the Technological Knowledge (TK) (Ala-Mutka, 2011:15). TK, as a construct in the framework, encompasses modern technologies such as interactive whiteboards (IWBs) (see Chapter 2.2.1). (I briefly mention in the introduction to Chapter 5 that the installation of the IWBs coincided with the start of this investigation.) The challenges to integrate technology effectively remain numerous and have been well-documented in the research literature. Similarly, creating effective learning environments with technology remain elusive in terms of consistently successful technology integrated instruction by the teacher, accompanied by an equally consistent and successful learner experience.

The affordances of the IWB as an artefact can hardly be ignored in the primary classroom. The IWB has become the conduit for technology aligned teaching in the primary classroom. Critical observations by Haugsbakk (2011:249) in Chapter 2 of this study state that there is a need to theorise the relationship between tool and agent, in order to unpack this relationship's inherent potential and what is at stake when it is integrated in learning and teaching activities. In research by Asmawi (2007) (see Chapter 2) three categories of modalities of learning are linked to digital applications namely; visual: text, pictures, animation and video; auditory: sound and music; and tactile: physical interaction with the IWB. For Wikan and Molster (2013) the IWB is an artefact to support dialogic learning spaces in primary schools. Similar research by Hennessy (2014:33) focused on pedagogic strategies for orchestrating dialogue.

As an artefact, the IWB software allows teachers to create engaging generative learning objectives which offer interactive multimedia that are adaptable to different topics and provide task structure, as well as offering an opportunity for instant learner feedback. Findings from research by Higgins, Beauchamp and Miller (2007:213-226) conclude that the IWB offers significant advantages in terms of ease and speed of use and learner motivation. Participants in this study narrated similar views during the semi-structured interviews.

The participants highlighted the dynamic visual presentations and how lessons can be sequenced to include interactive activities that maintain learner interest. Participants also successfully utilised small group activities for exploration and expression. The interactive nature of the IWB allows learners to draw on the board and drag labels onto displayed images, annotate and link ideas or play flash games related to the topic. Affordances such as these maximise learner participation in the learning activity and reinforce new skills and vocabulary.

In conclusion, the IWB as an affordance makes available technologies that create excitement and motivation, capture learners' attention and offer a range of opportunities to cater for learning by learners with diverse abilities and, hence, a wide range of learning opportunities with the option to differentiate and extend learning through a variety of software features.

6.5 Critical aspects emerging from the data that influence participants' TPACK

Although TPACK as a conceptual lens is useful to describe teachers' knowledge of technology, it presents the researcher with many variations within different contexts, which is further complicated by the extent, quality and type of technology used. Much has been said about the TPACK teacher mind-set (Morsink *et al.*, 2011:4), but important questions that demand an answer relate to participants' digital competence, their pedagogical approaches and the embedded use of technology for learners. All these factors influence the enhancement of the teachers' TPACK. I elaborate on the critical aspects below.

- **Teachers digital competence**

Developing digital competence, as pointed out in Chapter 1, implies the ability to understand media and to be able to communicate with others using a variety of digital tools and applications. There is an assumption that teachers' digital competence requires a certain level of technical skill.

Developing digital competence, according to Ala-Mutka (2011:5), should be considered as a continuum from instrumental skills towards productive and strategic personal competence. These skills need to be developed continually with changing tools and practices that the

teacher selects and applies for integration. In the digital context, Ala-Mutka (2011:5) further argues that basic abilities to use digital devices and media should progress into critical and effective strategies for using these tools in tasks and learning. There is a need for teachers to view and to understand the development of learners' technological skills on a similar continuum as their own, albeit at a less sophisticated level and pace.

- **Technology integration and pedagogical processes**

The literature on knowledge of technology acknowledges its complex and ill-structured nature and volatility. When technology is combined with pedagogy, it further complicates teaching. Therefore, Mishra and Koehler (2009:9) argue that for successful teaching with technology it is necessary to continually create, maintain and re-establish a 'dynamic equilibrium' among all the elements. Keeping this view in mind, my observations in the classroom concentrated on noting the interplay of these elements, and how these coalesce in the delivery of a lesson that establishes the dynamic equilibrium proposed by the researchers. Initially, it was difficult to ascertain if a lesson created such an equilibrium because participants focused mainly on the technology itself and their skills in deploying this technology. The data in Chapter 5.3.2 point to the initial high rating by participants on their own knowledge of selected technologies shortly after they had been introduced to these applications and their teaching applications. As the study progressed the participants realised the complexity of maintaining 'equilibrium' between the content that was selected for a particular lesson, the fit with technology and the underpinning pedagogy.

Very often, the underpinning pedagogy was not very observable, so that there was a disconnect between the three elements that constitute the framework. On realising this imbalance, some participants would limit the technological tools and applications used in the lesson and focus on the 'work that needed to be covered', as was recounted by participants during my probes in the semi-structured interviews.

Many factors during the school day also impacted on the success a participant might have with an authentic technologically enhanced lesson, as opposed to a lesson where technology just automates certain aspects of the teaching. Harris, Mishra and Koehler (2009:395) conclude by saying:

Understanding that introducing new educational technologies into the learning process change more than the tools used - and that this has deep implications for the nature of content-area learning, as well as the pedagogical approaches among which teachers can select - is an important and often overlooked aspect of many technology integration approaches used to date.

The assessment of the effectiveness of classroom practises using adequate instructional materials that enhance learner motivation and facilitate pedagogical processes requires attention and even more so when technologically enhanced practices become part of newly adopted classroom habits. Technology integration is a recent development in the field of teacher education and classroom management. Pierson (2001:413) referred to technology integration practises as a function of expertise, in a similar study in which she investigated how teachers at various levels of technological expertise and teaching ability, used technology and how it related to their teaching practice. She highlighted in her findings that differences observed among the use of technology were associated with different levels of teaching expertise, a finding that has been ratified in this study. Pedagogical processes, in this context of technology integration, involve the skills of pedagogy, content and knowledge of the subject matter (Shulman, 1987). Effective classroom management, therefore, is effectively linked to PCK, which is the underpinning key conceptualisation of TPACK (2006). Sustained changes in classroom practice are also hinged on PCK.

- **Learners use of technology tools**

Cox *et al.* (2009) assert that the presence of technology, in the form of computers for use by learners, changes the dynamic of how learning and teaching can happen in the classroom. This study also identified disparities in teacher approaches, teacher motivation to sustain change, and teacher understanding of how changing knowledge practices require adaptations in instructional practices in teaching and learning. What is disconcerting about these findings is that, despite the desktop computers that are available for use by learners in the classrooms at the research site, teachers seldom plan computer based activities for learners which include independent or group exercises to aid learning, supplement or consolidate new information taught, and enable learners to produce activities that form part of their assessment. Rather, the learners' computers are used for drill and practice activities or to 'keep them busy' with out-dated gaming activities. Participants' professional learning was deficient in terms of how learners could become active participants in embedded classroom technology integration. Individual participants who valued collaborative practices and reflected on their own development, were more likely to promote the learning autonomy of learners through technology (James & McCormick, 2009:973-982).

In Chapter 1 I argue for the embedded practice of technology integration in the classroom (Mereku, 2011) whereby learner competences can be developed through digital activities. These exercises can relate to curriculum outcomes or 21st century skills. Sample learning activities are freely available via the Internet and include organising a digital story project or recording a school excursion using a digital camera and then presenting it to the class. This

argument for technology integration has implications for teachers and learners in terms of using technological applications for assessment of learners' acquired skills. Learning progress can be evaluated through annotated e-Portfolios linked to a database of learner progress (Starkey, 2012:71). Currently, at the research site, the deployment of hardware remains within the control of the teacher.

In Section 6.6 below I focus the discussion on the initial contemplation of the vision reflection cycles (see Section 6.1.2) that situate the teachers within the process of capacity building to integrate technology for instruction. I also put forward and motivate my proposal for the consideration of the two Frameworks discussed above as further drivers to sustain technology integration employing an integrated approach.

6.6 The TPACK Framework (2006) and the UNESCO ICT Conceptual Framework for Teachers (2011)

The research site has made adequate provisions for technology-related infrastructure during the past decade, (see Chapter 1) and forecasts its needs annually for ICT continued expansion, upgrading and related requirements, such as accompanying staff development activities. The current foci areas are: WI-FI hubs throughout the school; securing digital content; creating repositories of shared catalogued content which can be accessed offline; computers integrated into classrooms; software for online collaboration by staff and a learning portal for learners to retrieve and upload assessments. Notwithstanding this progressive approach, the school still lacks a well-designed staff development protocol for curriculum enhanced ICT integration. The research site committed itself to adopting technology for systemic change for school management and for streamlining of administrative purposes a number of years ago. At the time of writing a continued commitment is concerned with capacity building for staff and learners.

Commissioned research by Roos *et al.* (2008:26) in a document titled: *A framework for use of ICTs in schools: An options analysis (SAIDE)*, propose a number of integration models that schools could consider for developing ICT literacy. The research site here initially followed Option C: which is a segregated model (ICT Coordinator model) in which an ICT literacy teacher follows an integrated ICT and digital literacy curriculum which is CAPS (DoE, 2012) aligned and works on Microsoft (Computers 4 Kidz). The research site is now preparing to move to a more integrated approach, as set out in Option A. Option A outlines that ICT literacy is integrated with curriculum activities across the curriculum and facilitated by all teachers. The document acknowledges this option as the most desirable model for implement the policy on e-Education, but with a caveat that it requires time and effort on the part of the whole school.

Long-term professional development by all staff underpins this model. Initially unaware that such models had been proposed by the DoE in 2004, the school followed its own hybrid model which showed similar features and objectives.

Considerable time had elapsed, at the time of writing, since the promulgation of the DoE's policy on e-Education in 2004, as pointed out in Chapter 3. Independent schools, such as the research site, had planned their own digital future, together with business partners and other stakeholders, to meet similar objectives to those set out in the policy on e-Education (2004) (see Chapter 3.2). The data in Chapter 5 reveal that few participants were familiar with e-Education policy. In Chapter 1, I discussed the research context and drew attention to the site's technology capabilities and infrastructure, and its vision towards technologically enhanced teaching and supporting its teachers in this unavoidable ICT paradigm shift. As alluded to earlier in this discussion, when it is used to deliver curriculum content, technology could be a mechanism for changing instructional practices.

The process by which teachers are now integrating technology in their teaching is a complex one with many variables that impact its efficacy in the classroom. Mishra and Koehler (2006) claim that TPACK's conceptual framework for understanding the complexities of teachers' knowledge, proffers an integrated view of the knowledge base needed by teachers when using instructional technology. This acknowledgement also recognises that, in the absence of a development protocol at the research site to guide the developmental and learning processes of teachers. A reflection of the next cycle of staff development, the following frameworks should be considered. Based on an extensive review of the literature on frameworks to guide the understanding of teacher knowledge, I propose that both these frameworks, TPACK (2006) and the ICT Conceptual Framework for Teachers (2011) from UNESCO be implemented to guide staff development.

Hirsch (2013) argues that schools have to implement strategies that are less episodic and concludes that professional learning is more effective when it is a systemic and sustained internal process. Both frameworks mentioned above place a strong emphasis on the need for pedagogy, content, knowledge, skills and values to be combined with technology. These frameworks are undergirded by constructivist principles (see Chapter 2) "... which are both a learning theory and an epistemology" (Harasim, 2012:60). Constructivist learning theories aver that, how we perceive knowledge and the process of coming to know, shapes our educational practice.

In research carried out by Koh *et al.* (2013:185) it was noted that even experienced primary school teachers tend to be less confident of their 'constructivist orientations'. Consequently, these challenges should be considered when designing teachers' technology for professional

development. In Chapter 2, TPACK (2006) and its methodological underpinnings was discussed in depth and its origins, strengths and weaknesses were illuminated.

As mentioned previously in this study, TPACK (2006) represents the three main knowledge domains of teachers' knowledge, namely: content, pedagogy and technology. At the same time, this representation acknowledges the transactional nature of the main constructs when the various combinations push forward complex permutations for each individual context in which technology is integrated. The TPACK model reinforces the importance of integrating pedagogical skills in ICT. Providing a pedagogy-driven strategy to incorporate technology into educational process is the main objective of this framework (Chapter 2). Table 6.1 below briefly defines each of the constructs and their permutations. The TPACK (2006) model reinforces the importance of integrating pedagogical skills in ICT and views teaching as dynamic and complex, and sees technology as an influential factor.

Table 6.1: Definitions of knowledge constructs of Mishra & Koehler's TPACK model (adapted from Chai *et al.*, 2012)

Knowledge constructs	Definitions
Content knowledge (CK)	knowledge about the subject matter
Technological knowledge (TK)	knowledge about technologies
Pedagogical knowledge (PK)	knowledge about the process or methods of instruction
Technological content knowledge (TCK)	knowledge to represent the content or the subject matter with technology
Technological pedagogical knowledge (TPK)	knowledge of the existence, components, and capabilities of various technologies to be used in teaching
Pedagogical content knowledge (PCK)	knowledge of pedagogical strategies to teach specific content (subject matter)
Technological pedagogical content knowledge (TPACK)	knowledge of using technologies to teach and represent the subject matter

The rhetoric in the research literature and other anecdotal evidence indicate that it is undisputed that technology on its own does not lead to change, as posited by Wong *et al.* (2008). Another conceptual framework that is methodologically-grounded and has been employed to evaluate teachers' levels of technology integration is the SAMR-model developed by Puentedura (2011), which can also be considered as a lens to evaluate teachers' levels of TI. In a technologically-enhanced environment, Puentedura (2011) contends, classroom

teachers need to reflect on how technology integration leads to transformative and 'deep' learning (see Chapter 2 for a brief introduction of this concept).

The UNESCO framework, ICT-CFT (2011:3), is arranged in three successive stages of teachers' development. Stage 1 is Technological Literacy, which involves the use of ICT to enable learners to learn more efficiently; Stage 2 focuses on Knowledge Deepening, which enables the acquisition of in-depth knowledge of school subjects and how to apply this subject knowledge to real world contexts; Stage 3 is Knowledge Creation, which enables the creation of knowledge for the establishment of more harmonious and prosperous societies. The Framework (ICT-CFT, 2011:4) argues that teachers need to use teaching methods which are appropriate for evolving knowledge societies.

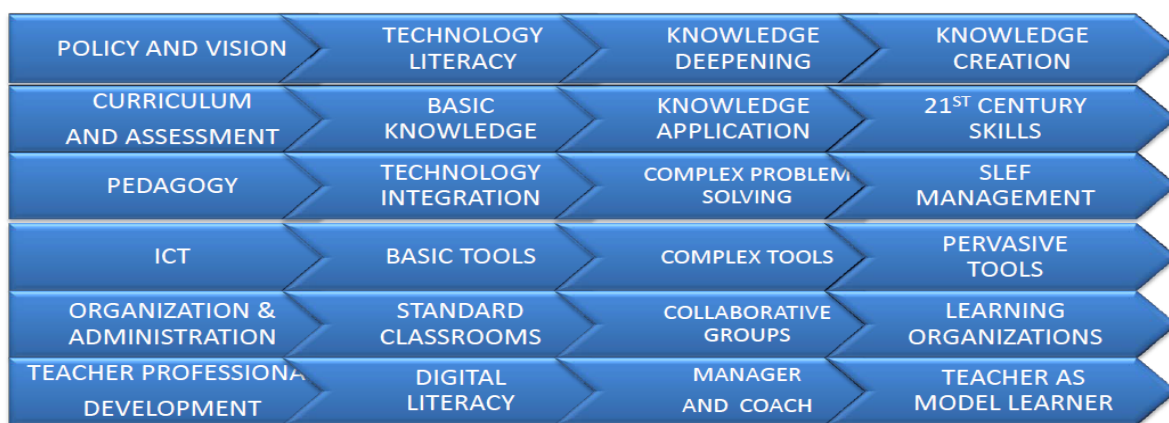


Figure 6.2: UNESCO ICT-CFT (2011) A reference framework (Consent by Miao, UNESCO, 2011:17)

The above framework offers the potential for teachers to develop full curricula for courses in ICT skills, and provides the basis for qualifications certifying that a teacher has acquired the Framework competencies. In addition, it is a potential tool for identifying gaps in teachers' skill levels and ascertaining the developmental stages of individuals as they progress, and can be employed as an evaluation instrument to measure levels of progress. This framework can be employed at an individual level to give structure to self-directed learning. It is equally suited for assessing groups of teachers who are directing their use of technology through professional development activities.

The TPACK (2006) and the UNESCO ICT-CFT (2011) are globally accepted benchmark frameworks. The objectives as set out, allow practising teachers to meet acquired minimum competences and standards with technology encompassing pedagogy. In contextualising this framework for primary school teachers, it can contribute in augmenting ICT levels during staff training workshops as an institutional strategy, as illustrated in Figure 6.3 below.

Shift of teachers' qualification: Pedagogical content knowledge (PCK) → Technological PCK (TPCK)

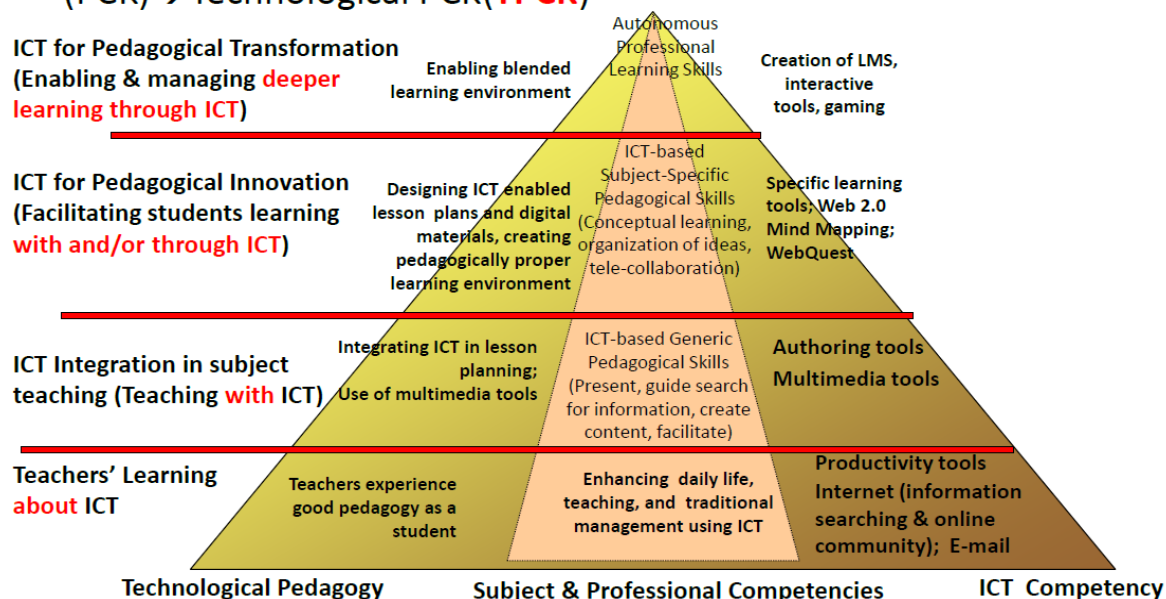


Figure 6.3: The shift of teachers' PCK to TPACK (Adapted from Miao, UNESCO, 2011:18)

Contextualising the UNESCO ICT-CFT (2011) to the research site ensures that there is quality and rigour in the site's ICT training programme for teachers. Figure 6.3 above is an example of a group of teachers' shift from PCK towards their Technological PCK, as illustrated in the findings of a study on Chinese pre-service teachers by Miao (2011:18), employing the UNESCO ICT-CFT (2011) module (see Appendix 2) in the framework which brings professional learning into focus. The structure for teachers' development depicts how the individual teacher starts learning about ICTs through a scaffolded curriculum which culminates in the acquisition of autonomous professional learning skills.

The UNESCO ICT-CFT (2011) framework is equally useful to facilitate in-service teachers' professional development on effective ICT-pedagogy integration (Miao, 2011). When contextualising the framework to the needs of an institution, teachers' TPACK or ICT qualifications (in the case of pre-service teachers) should be pivoted around pedagogy. Miao (2011:18) contends that teachers' ICT competency is not the determining factor for knowledge creation and knowledge deepening. He views policy environment and other enabling factors as more critical.

6.7 Conclusions

Beginning with a synopsis, I illuminated the scaffolds that emerged from the analysis of the data which conclude how factors, such as teachers' personal views, understanding how

technology links with curriculum and a shared whole school vision, contribute to issues of sustainability of technology integration at the research site.

A brief historical overview of the earlier visions of the school upon moving towards technologically enhanced teaching underscored critical success factors that were identified as contributing to the research site's on-going commitment towards CPTD. Researchers (Harris *et al.*, 2009:395) affirm that introducing new educational technologies into the learning process change more than the tools used, and point out that this process has deep implications for the nature of content-area learning, as well as the pedagogical approaches which teachers can select. According to the authors, this observation is an important and often overlooked aspect of many technology integration approaches used to date.

Affordances of artefacts such as the interactive white board (IWB) in the primary classrooms have shown some success in driving technology integration. However, the IWB's inherent potential as a support to dialogical learning spaces remains untapped. I reviewed critical aspects that contributed to the participants' TPACK trajectory. Teachers' TPACK accounts for the disparities in individual teachers' approaches to the use of technology in the classroom. Powerful evidence exists in the literature regarding the impact of professional development and the important role that it plays in changing teachers' teaching methods (Putnam & Borko, 2000:4). I conclude this chapter by arguing for the adoption of these frameworks. Based on an extensive review of the literature on frameworks to guide the understanding of teacher knowledge, I recommend that both the TPACK (2006) and the UNESCO, ICT Conceptual Framework for Teachers (2011) be considered to guide staff development at the research site. In Chapter 7 I explore the design of a Classroom Integration Model (CIM) which proposes a blended and integrated approach of technologically enhanced teaching in the Grade 3 English Home Language classroom.

CHAPTER 7

A CLASSROOM TECHNOLOGY INTEGRATION MODEL

7.1 Introduction

In this chapter I make suggestions for technology activities alongside the English Home Language Programme for Grade 3 (DoE, 2011). These suggestions are based on the findings presented in Chapter 5 and reflected on in Chapter 6. It is hoped that this classroom integration model (CIM) that I propose, can serve as a simplified framework for teachers in primary classrooms to select and combine appropriate technologies when teaching Literacy and Language based activities. It is about choices that teachers might make about technological tools for the processes of teaching and learning and the consequences of these choices. The framework outlines technological tools that align with curriculum outcomes, and guide teachers' choices to facilitate pedagogy-driven tools to stimulate learning. Technological activities for learners are linked to appropriate skills. Suggestions are made for technology-based learner activities. Such a model has the potential to provide the foundations for a blended and integrated approach of technologically enhanced teaching. This proposed model aims to provide structure regarding how teachers utilise the computers currently available for learner use at the research site. This chapter makes an argument for the nesting of, and an embedded approach to, ICT usage for the learner in the primary classroom that will foster the development of a conceptualisation towards a learner TPACK. The rest of the chapter is organised into the following sections:

Section 7.2: Teacher readiness and perceptions of learner engagement with computers; teacher strategies; contextualising multi-literacies; exploring digital literacy practices; curriculum supported ICT for learners;

Section 7.3: Evaluation of learners' use of technology;

Section 7.4: Motivation for a Classroom Integration Model (CIM); and

Section 7.5: Conclusions of Chapter 7.

7.2 Teachers' readiness and perceptions of learner engagement with computers

Proponents of technology integration into the learning environment have often envisioned technology that plays the same role within the classroom as it does within greater society. This is a vision that has not yet materialised in the context of poorly resourced schools (Mishra & Koehler, 2006:1017-1018). The availability of computer hardware and software has redefined

how teachers manage their classes. One of my research objectives was to focus on how primary practising teachers acquire this new domain of knowledge (ICTs) and how this acquired domain knowledge translates into embedded classroom practice. I also posed questions related to the impact of technology on traditional classroom pedagogic practices.

The availability of technology (in the form of computers for learner use) in the classroom has added a new role for the teacher, namely to plan and manage a computer integrated environment and to facilitate and guide the learning process through the utilisation of this environment. The Policy on e-Education (2004) refers to the gap, beyond access, in which teachers and learners should, "... create content of their own, and communicate and collaborate and integrate ICT into learning and teaching". However, it is noted that computer activities such as gaming, virtual worlds, multimedia and social networking, according to the views of some participants, might distract the learners and do not sit well alongside traditional literacy practices and curriculum outcomes. It was observed during the study undertaken at the research site that, due to these perceived distractions, participants are hesitant to allow learners access to the classroom computers.

This investigation has fore-grounded teachers' development of technology, pedagogy and content knowledge and how this shapes their classroom practices and their own learning trajectories. This focus acknowledges that teachers' classroom practice needs to filter down to how their acquired TPACK (2006), as a construct, influences the learner in a technologically enabled environment. Following on from my discussion in Chapter 3, teacher readiness in the literature suggests a developmental trajectory for teachers within which to develop their ICTs from entry, through adoption to the adaptation, appropriation and innovation levels, as set out in the Guidelines for Teacher Training and Professional Development in ICT (2007), as being the targets to achieve.

In this regard, Sawtelle (2008:12-15) posits that teachers should be familiar with the school's learning systems, "... using technology, Internet usage, wiki text, embedding of audio/video/simulations and edu-games". When participants reach the innovation or transformation levels as illustrated in the SAMR-model (Puentedura, 2011) one may assume that technology integration may lead to task redesign and the creation of new tasks through transformative and deep learning, while also leading to changes in the methodology of teaching and the learning process. This level of learning 'with and through' technology refers to the generative use of computers. Generative use encourages learners to generate knowledge and to practice skills that are linked to the curriculum (UNESCO, 2011:5).

Although the participants have developed awareness and confidence in alternative conceptualisations of teaching, data from the semi-structured interviews points to the need for

teachers to find strategies to engage learners' use of the computers that have been installed in the classrooms. On reflecting upon the participants' practises (see Chapter 5 and 6) within the context of the Foundation Phase teacher where the focus is on mastery learning, the use of technology by the learners is not yet prioritised. I, therefore, argue that the focus for staff development and support activities should now include teachers' understanding of technology integration practices which will extend to primary learners becoming active users of ICTs at the research site.

My own engagement with the participants in this investigation is characterised by the visual depiction, as presented in Figure 7.1. This adapted framework by Papa (2011:273) is based on Knowles's (1990) theory of how adults learn. Based on the fact that adults learn best through mentoring, suggestions are made that (adult) learner-centred strategies be used to support adult learning (Figure 7.1). Papa's framework (2011:253) views the following strategies as essential to how adults learn: reading and writing; auditory; visual and kinaesthetic. The methods of delivery in our continued mentoring sessions are illustrated in the visual representation below. Although the data collection for this investigation had terminated at the research site at the time of writing, my relationship with the participants continue to be one of mentoring and collaboration since they (the participants) completed the "Designing an Online Teaching/Instructional Event" course (Stoltenkamp, 2012) (see Chapter 4).

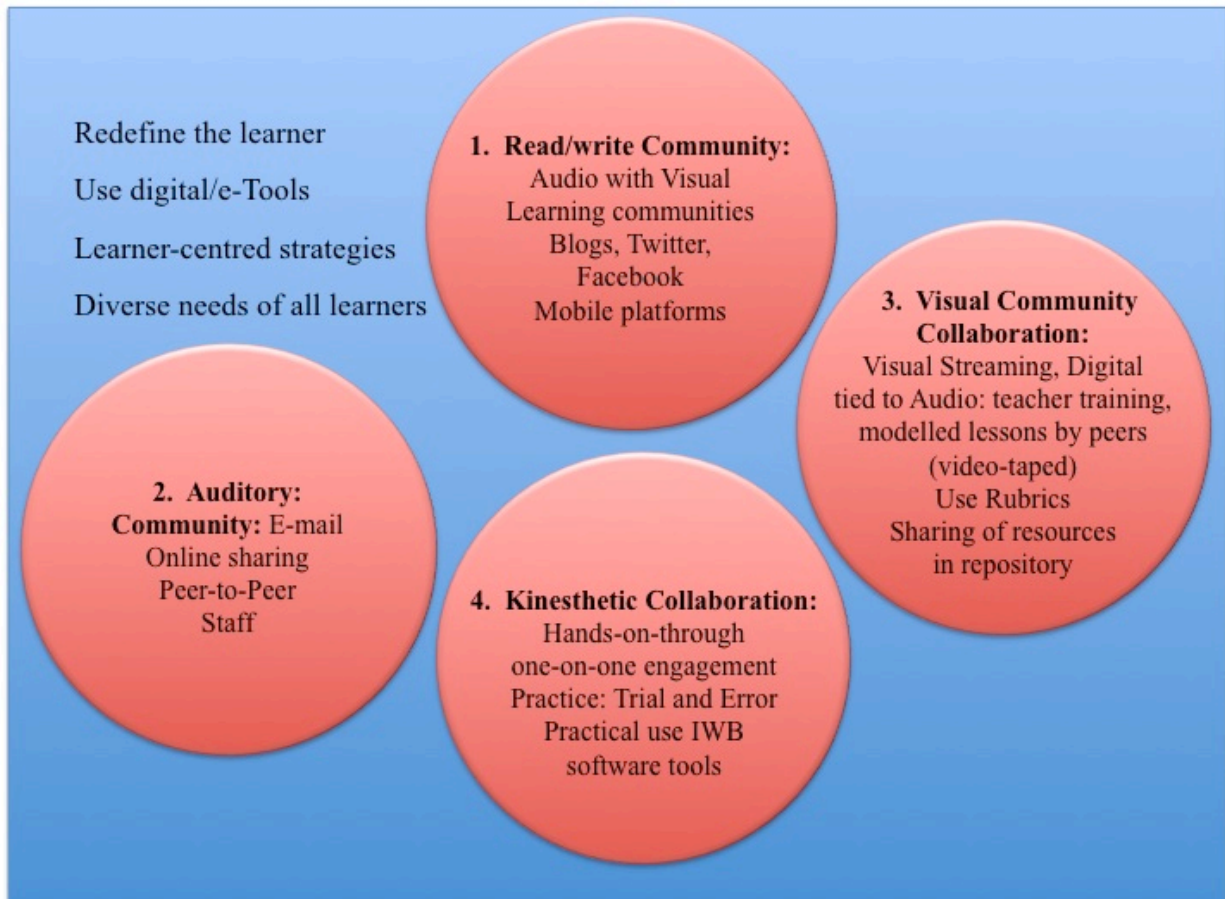


Figure 7.1: Explicit Learning and Technology Strategies (Adapted from Papa, 2011:273)

Upon reflecting on my relationship with the sample of participants, what resonates with me is what Fenwick and Edwards (2010:126) refer to as the "discretionary spaces: ... fragments of practice that are made up of good ideas or chance or crisis, because policy is only ever part of what teachers do".

7.2.1 Teacher strategies for learner engagement with technology

As mentioned previously, the next reflective cycle of the teachers' professional development process should be to consider strategies that can be employed to engage the learner in the classroom. These cycles of reflection could feed into the long term vision of the role of technology in the school, as alluded to in the discussion in Chapter 6 on the research site's cycles of introspection. The need for such reflection finds expression in the data from this research, as reported by participants. A further consideration pertains to how explicit learning and technological strategies for learners' (teacher and learners) ICT engagement can be developed (see Figure 7.1). This type of reflection becomes useful in Phase discussions with small groups of teachers (in their capacity as learners) that involve mentoring and collaborating

on classroom practice during the sharing of their individual and collective expertise. It is my contention that teachers (participants) need to shift their perspectives on how they can use strategies to engage learner activities with technology.

Schibei *et al.* (2008:313) reason that developing teachers in their classrooms would help them to find authentic connections that can be continually examined, both individually and in the larger community (Phase). These connections with technology should always support content and pedagogy. The lesson design process is not only about content, but also incorporates the constructs to support the content. The teacher thus ensures that the technology and resources are ready for learner use. Martinez and Harper (2008:64-69) suggest that learners may be of great use in this design process. They can make sure that instructive supports can be developed (i.e. presentations and videos).

7.2.2 Contextualising multi-literacies within emerging technologies

Wikan and Molster (2011:209-218) allude to the need for teachers to supplement existing mainstream teaching with emerging technologies (see Chapters 2 and 6). With regard to the use of technology to support literacy practices in the classroom Holum and Gahala (2001:3) write that digital technology has now expanded our understanding of literacy practices, and multi-literacies now refer to technological skills for communicating, investigating, accessing and using information, computing, thinking critically about messages inherent in new media, and understanding and evaluating data. As policymakers and teacher educators ponder what it means to be literate in a digital society, we are confronted with an array of definitions on digital and technological literacy (see also Chapter 1.3.2).

A broad definition of multi-literacies, as put forward by the *New London Group* in 1996 and as cited by Anstey and Bull (2006:23), explains multi-literacies as being cognitively and socially literate with paper, live, and electronic texts. Multi-literacies also refer to being strategic, that is, being able to recognise what is required in a given context, to examine what is already known and, then, if necessary, to modify that knowledge to develop a strategy that suits the context and situation. A multi-literate person must, therefore, be a problem solver and strategic thinker, that is, an active and informed citizen. Technologically mediated instruction, therefore, by definition, refers to multimodalities.

Davies and Merchant (2009) consider the advancement towards the use of digital tools in the classroom, and state that the understanding of digital literacy and traditional literacies reflects a tension (Figure 7.2 below). This tension arises between digital literacy as a set of skills and competencies on the one hand, and understandings that arise from socio-cultural and communicative practices, on the other (see Chapter 2).

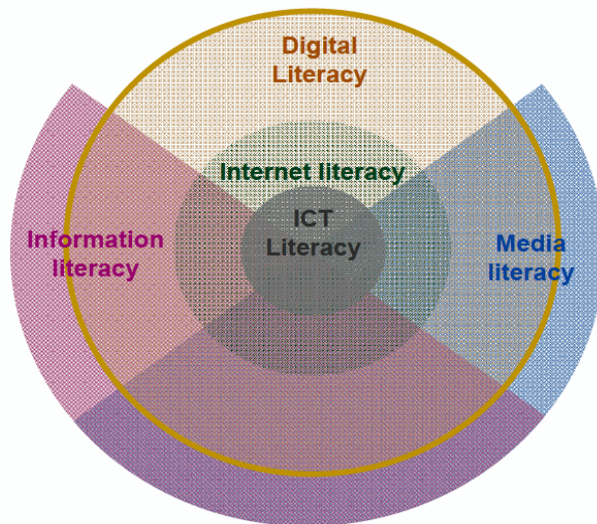


Figure 7.2: Digital literacy and other related literacies (Source: Ala-Mutka, 2011)

The diagram in Figure 7.2, sourced from the Digital Literacy literature, illustrates that Internet Literacy and ICT Literacy, Media Literacy and Information Literacy are 'partially' overlapping with what is called Digital Literacy. Digital Literacy, according to Ferrari (2012:16), is at the convergence of multiple literacies as synthesised in the diagram in Figure 7.2 (see Chapter 1). All of the above literacies contain a digital component and, in return, digital literacy is enriched by the new means and tools derived from technological surge and convergence. In search for an encompassing definition of digital literacy I was guided to the work of Gilster (1997), who coined the phrase, and advocates that it is:

[A] set of skills to access the Internet; find, manage and edit digital information; join in communications; and otherwise engage with an online information and communication networks. In simple terms, digital literacy is the ability to properly use and evaluate digital resources, tools and services and apply it to their lifelong learning process (Gilster, 1997:220).

Gilster (1997) identified four key competencies aligned to his definition of digital literacy, namely assembling knowledge; evaluating information; and searching and navigating in non-linear routes. Digital literacy, therefore, becomes an important entitlement for all young people in a digital world culture. Hague and Williamson (2009) reason that digital literacy empowers learners with skills, knowledge and an understanding that will help them be active in social, cultural, economic, civic and intellectual life, now and into the future. They further view literacy as transient by nature and that it is being influenced constantly by the innovation of new technologies. As new technologies have become embedded in popular culture, new avenues of communication influence the emergence of new vocabulary.

More than ever, the deictic nature of language has presented learners with the challenge of meaning-making. Programmes that foster the integration of technology in the classroom should consider the pedagogical underpinning of the subject. Selwyn (2011:23-24) extends this definition to include 'employability', and asserts that digital literacy should be considered an essential life skill for individuals as they grow up in an 'information society'.

Knowledge and information, according to Hague and Williamson (2009), are presented in different contexts and to different audiences (visual, audio, textual). Finding and selecting relevant information and critically evaluating it and re-contextualising knowledge is underscored by an understanding of the cultural and social context in which it takes place. Therefore, digital literacy provides individuals the opportunity to participate meaningfully and safely as technology becomes increasingly pervasive. In Chapter 6, Ala-Mutka (2011:5) argues that, in a digital context, basic abilities to use digital devices and media should progress into becoming critical and effective strategies for use of these tools in tasks and learning. There is a need for teachers to view and understand the development of learners' technological skills on a similar continuum as their own, albeit it at a less sophisticated level and pace.

7.2.3 Exploring learners digital literacy practices

The previous statement, therefore, finds reflection in my own assumptions and my personal research with Grade 3 learners in a technologically enhanced environment. I employed ethnographic observations to document my own reflective practice and work with my learners. At this stage of my discussion, I would like to explain that just prior to this investigation, more than 4 years ago, I was afforded the opportunity to teach small groups of learners in need of literacy support in a technologically enabled environment. The research site made one-on-one computing possible by equipping my classroom with desktop computers for each learner in my group (6) which are connected to the Internet via LAN and installed with MS Office Suite and other free MS tools. This embedded technological infrastructure propelled my further interest in harnessing learners' learning with technology.

My obligation to the research site is to ensure that outside stakeholders and funders are kept informed through regular written reports, and video footage, on how the use of technology in the classroom can be exploited to advance learner achievement at the research site. The completion of these reports is necessary for meeting outside expectations and maintaining a relationship with outside stakeholders, as alluded to in earlier chapters. Early on in my technologically enhanced teaching activities, I had to grapple with the tensions of understanding digital literacy as a necessary technical skill and a communicative practice while, simultaneously considering factors related to the safety of online environments for young learners. Burnett and Merchant (2011:41) purport that in the public imagination technology is

patterned by discourses of risk, surveillance, and rampant consumerism. (In the words of my learners "... *the Internet is a dangerous place ...*".)

- **Illustrating digital dimensions of literacy practices**

In my search for relevant literature on children's literacy learning through technology, I came across the work of Burnett (2010). Burnett (2010:247) identifies three loose categories of studies which position technology as: deliverer of literacy; site for interaction around texts; and medium for meaning-making. This positioning of technology has influenced my own research and thinking around engaging learners' meaning-making and sense-making through technology. Burnett (2010:247) cites the actor-network theory (Latour, 2005) as a lens to consider other ways that technology and children may be 'acting upon' literacy in educational settings through re-contextualising meanings from other domains.

My intent is not to debate the actor-network theory in this chapter but, rather, to illustrate that it has shaped my understanding of how digital practices within educational settings relate to other dimensions of children's literacy learning, and how young children can engage with text in new ways. This illustration also serves to explain that teachers' own technological instruction practices in the classroom can be linked to theory when they reflect on their own practices. It is hoped that this example might extend the participants' pedagogical insights. "Participating in self-study allows the teacher to focus on activities that are in direct response to the class. The teacher can define the rationale, schedule, flow of the classroom activities and the related research" (Shadow & Armfield, 2011:121).

My own experience of learners using digital tools demonstrates that children make meaning around new technologies. I promote a stance that they consider not only being passive consumers of what technology offers, but also become producers of knowledge. Initially, most of the learners' engagement around the computer focused on navigation and skills to consolidate prior-knowledge about their own competencies in terms of searching the Internet, reading information and making meaning of text. Such activities of learners 'acting with' technology can provide a new lens for looking at learners' literacy practices using digital tools and their understanding and engagement with multi-media texts. Not only do my own technological integration practices focus on learners who are seen as more advanced and independent in terms of their reading and literacy skills, I also teach learners who exhibit deficits in the dominant language and, therefore, are labelled 'struggling readers'.

- **Considering the diverse perspective of technology integration**

This perspective of diverse ability groups places the context of learners using technology in my small group engagements in polar opposites. In an after school programme I engage with small groups of 6 learners who have been included in a Literacy Extension Programme. We meet twice weekly. Activities that the learners engage in are all designed around digital productivity tools. The learners engage in digital story projects and are involved in the conceptual discussion of the theme, and then creating story boards and the final artefact which is accompanied by animations, music and voice audio and then, finally, generating the artefact.

Both groups of learners (Grade 3) are exposed to e-Tools such as MS Office productivity applications and Google Slides/docs, as well as Internet searches on various web browsers. They are also exposed to e-Books, including online web-based applications, online reading activities and literacy games. To a limited degree they are exposed to social-media, which is restricted to a 'Twitter' class page which is managed by myself. We exploit Twitter and its uses as a writing tool. Learners comment on current issues and we decide together which comments are 'tweeted'. It has been my experience that despite the diversity in abilities, the learners of this grade and age cohort engage with technology in a myriad of ways. Learner engagement is initially through trial-and-error. Less confident learners continuously request support from others in the work group. This is especially so when using productivity tools. I encourage this engagement of 'collaboration' and 'talk' as it forms the foundations of 'sharing knowledge'. Soon, learners become familiar with the computer as a learning tool, and then they engage on their own terms during sessions called 'own computer time'. Learners develop their own preferences in terms of what they want to do. These activities usually fall within the following range: watching a video clip on a topic of interest, web searches for a class project, looking at images of a sports fan, using drawing tools, creating an animated power-point, recording a reading activity to work on their fluency and then playing it back, and playing games to support literacy and numeracy activities.

Learners quickly become adept at navigating between browsers and search engines. Each learner has a folder in which class activities, group projects and individual projects are saved. Learners can work at their own pace on these activities. They are also given the opportunity to present their created digital stories, power-point presentations or e-Books to the group. During this process, there is a focus on language and literacy skills. A further focus is on editing and final production and sharing of the artefacts with others through a class presentation.

- **Changing classroom dynamics**

As elaborated on in the context of the research in Chapter 1, learners in Grade 3 at the research site have been engaged in mastering the basics of computer skills since Grade R. These learners, however, seldom have the opportunities to practice these acquired skills outside the computer lab. Using the lenses of teachers and learners, I began my own foray into technologically-enhanced instruction to explore technology as a tool to drive learners' literacy practices. It is my personal assertion, and which is highlighted throughout this investigation, that technology integration should not be viewed as a solution to 'fix' what is wrong in the classroom or with the learner or, indeed, to push up 'benchmark scores'. Hattie (2015:7-29), in a recent paper entitled, *What doesn't work in education: The politics of distraction*, undeniably sees these, among others (smaller class sizes; poverty; infrastructure; funding), as the politics of distraction and advocates for collaborative expertise of teachers to enhance teaching and learning.

With technological infrastructure becoming embedded within the classroom context at the research site, computer stations have become available in the classroom for use by the learners. In Chapter 6 I noted the shift towards embedding technological hardware - computers - for learner use in the classroom. In the literature on embedding technology in the classroom for use by learners, Cox *et al.* (2009) assert that the presence of technology in the form of computers for use by learners changes the dynamic of how learning and teaching can happen in the classroom (see Chapter 6.1.5).

Employing ethnographic observation in my own classroom research has influenced my selection of this methodology for this thesis investigation (see Chapter 4). It gave me the necessary perspective of the 'insider' as I developed my own TPACK mind-set (Morsink *et al.*, 2011:4) and came to the realisation that multi-literacies revolve around the concept of Content Knowledge, Pedagogical Knowledge and Technical Knowledge, as the TPACK (2006) framework suggests. The integration of these modes of knowledge allows for true technological integration and understanding within the classroom (Koehler & Mishra, 2006).

7.2.4 Curriculum supported positioning of ICT for learners

In previous chapters I have addressed issues pertaining to the research site in terms of its learning vision, leadership support, continuous professional development of teachers and support by outside partners and stakeholders, what remains to be discussed are practical considerations pertaining to strategies around curriculum and technology integration as a practice within the classroom for efficient curriculum delivery. This issue of practical integration has implications for the teachers' enactment of the dominant curriculum at any given time. In an

ideological assumption, the knowledge component (CK) of a democratic curriculum must be what Habermas (1972) has called 'emancipatory knowledge'.

This democratic approach to curriculum planning and delivery, then, has the merit of being concerned with ensuring that all learners have access to what is regarded as 'intrinsically worthwhile'; its 'concept of entitlement' is genuine rather than rhetorical. In a knowledge economy, digital divide theories address these troubling disparities in terms of access to ICTs (see Chapter 1). Viewed differently, such an approach falls short of offering a satisfactory basis for an appropriate curriculum for a democratic society, since it produces a form of curriculum which leads to stratification of society resulting in elitism and the consequent alienation of those who find themselves in the lower strata of such a society.

Constructivist approaches, as claimed by Selwyn (2011:26), position learners at the centre of the learning process (see Chapter 6). Reksten (2000:193) urges that technology and the use of the Internet not be separate or independent from the instructional disciplines offered at the school. Using examples from a study (Burnett, 2013:192) of primary pupils' interactions around digital texts, it is claimed that we must acknowledge the distinctiveness of the use of technology in classroom contexts but also see the spaces associated with those contexts as continually constructed, relational and heterogeneous. Burnett (2013) recognises this complexity and proposes the term 'classroom-ness' to help us better understand the barriers and opportunities associated with effective integration of new technologies in educational contexts. In research by Albion *et al.* (2010:303) it was found that there was a need to adapt the curriculum to incorporate greater use of ICT so that teachers are adequately prepared to work with ICT in their classrooms. Green and Hannon (2007:619) view ICT use and the generic characteristics of a 'group' of young children as most relevant, as teachers draw on existing knowledge and skills during these interactions. Which makes this task composite, with an almost infinite set of variable parameters, which suggests the need for some generalisations to reduce the complexity.

The e-Education Policy (DoE; ICT, 2004) views learning through ICTs as arguably one of the most powerful means of supporting learners to achieve the nationally-stated curriculum goals. Yet, the Curriculum and Assessment Policy Statement Grades R-3 for English Home Language under the general aims of the curriculum document, states that, "... learners are able to use science and technology effectively and critically ...". The document emphasises the traditional approaches to the integrated literacy programme only and seems to follow an out-dated vision of literacy education. Scant references to digital resources are made when the document mentions 'electronic texts'.

In its recommendation for texts and resources (DBE, 2011:79), only older technologies (CDs, tapes, DVDs and television) are mentioned in the document. The document lacks suggestions on how ICTs and, therefore, computers and related software can be used as productivity tools in the primary grades. There is no mention of how learners can employ technology to enhance reading, writing, speaking, listening and language-use to develop digital literacy skills. Its scope and sequence fail to link activities to objectives in the policy on e-Learning. However, the aim of this discussion is not to review the English Home Language Programme, but merely point out the absence of multi-media and digital tools/e-Tools as a resource and a tool in its recommendation of resources.

Responses by the teacher participants in the semi-structured interviews pointed to a need for a structured framework to guide the process for a learner-centred approach to technology-based projects, so that 'collaboration' between learners and teachers becomes reciprocal and that technology can be employed by learners for engagement and participation in learning activities.

This integration of technology in the classroom must be done in a purposeful and supportive manner. The technologies and the way they are used must support the curriculum goals and their enactment so that learners will benefit from the intended educational gains. Mishra and Koehler (2006) and Niess (2005) explain that technology as a learning tool, as opposed to a teaching tool, fundamentally changes the way teachers teach.

Each school is unique in its needs and goals and each class presents unique challenges. It becomes paramount, therefore, that each school should begin to develop a plan for the most appropriate and available technologies and how they should be used to suit the needs of the curriculum, teachers and learners. The school where this study was conducted has a sound strategic plan in place for the acquisition and replacement, as well as maintenance of technological infrastructure. It has also established partnerships with the private sector to ensure its continued sustainability (see Chapter 1). Although the advancement of technology integration to enhance the understanding of curricular content has permeated the daily activities, the research site lacks a well-designed technology integration model for the embedded use of technology by the learners in the primary classrooms.

Providing a framework for teachers to integrate technology, not only to create interesting tasks for learners, but to "... deepen their understanding and to take learners beyond recall, recognition and reproduction ..." (DoE; ICT, 2004) will move technology away from the periphery and the limited view that teachers currently have of its potential use as a teaching and learning tool. Various incentives for teachers to integrate technology in their daily activities and areas to facilitate change, experimentation and risk-taking are prioritised in the e-Education Policy (2004). While the policy on e-Learning acknowledges ICTs as a resource for curriculum

integration and a collaborative tool for teachers and learners, Jones and Moreland (2004:1), in their research, strongly advocate the building of a knowledge base for teachers to teach with technology.

While I was conducting this research study, I came to the realisation that those teachers who teach younger learners at the research site require a substantial amount of academic knowledge about language, literacy and numeracy development. This is more so, because Starkey (2012:111) states that integrating technology requires teachers to use digital tools for organisation and for teaching processes to enhance student learning, a route that necessitates on-going professional learning. Learners who are admitted to the school are from low SES and many have deficits in terms of acquiring the dominant language as well as in their developmental milestones.

It becomes a challenging task for teachers to enable all their learners to develop and understand the concepts being taught when they comprise such diverse levels of knowledge and deficits (Hogg, 2010:666). Hattie (2015:6) argues that the challenge for teachers is to ensure effective teaching. Poverty (low SES) should not be viewed as a barrier, but is frequently the reason given for low learner expectations and explanations of why they 'cannot teach these learners'. Admittedly, he adds, poverty does "make for a tough start." Fullan (2011:155) avers that, for change to occur we need to practice, and for successful learning-based action we need to make the 'adaptive leap' through reflective action on attitudes, behaviour and values. He further claims that teachers cannot make the adaptive leap in a technologically enhanced environment without building capacity, which is accountability-driven and situated within group learning with peers.

7.3 Evaluating technology use of learners

An increasing body of work by Stagg-Peterson and Clay (2012:140-142) and Honan (2010:179-193) investigates the tensions that teachers experience when they attempt to provide practical responses in terms of how children engage with digital literacies. Competing discourses around literacy and technology can make it difficult for teachers to respond to possibilities offered by digital texts within their Language and Literacy Programmes. There has to be a focus on continually reflecting on the practice needed for teachers to grow in the ever changing field of digital literacies (Papa, 2001:124). Similarly, evaluating the implementation of such technologies gives individual teachers an opportunity to measure the impact of technologies on the learning of their learners.

Roschelle *et al.* (2000:76-78) examined how computer technology can be used to motivate learners. Their research found that active engagement, participation in groups, frequent

interaction, gaining feedback and connections to real-world contexts enhanced how children learn while using computer-based applications. Within the context of this study the data indicates that the majority of participating teachers do not yet fully exploit the potential of classroom technologies (See Chapter 5). In my observations of the participants' teaching practices using technology I came to the following conclusions regarding the teachers' perspectives of learners' abilities.

Firstly, learners in the primary classes are not considered as possessing the necessary abilities and skills to utilise technology for educational purposes by the participants in this investigation. Yet, the learners at this school have been immersed in technology related activities twice weekly, from the time they are enrolled at the school at the ages of four and five. By the time that they have progressed to Grade 3, the majority of learners are skilled navigators and are familiar with the computer vernacular and understand its uses. Still, the participants viewed the use of technology merely as a means for teachers to deliver the curriculum.

Secondly, the Interactive White Board (IWB) as artefact (see Chapter 6) has the potential to support dialogic learning spaces in primary schools, as the research by Hennessey (2014:114) attests. Participants in this study are still in the process of deepening their understanding of exploiting its use as a space for discussion. The types of interaction with the board can impact the forms of dialogue that the teacher has with the learners. Ness and Wikan (2013) state that the IWB, more than other technologies, can be used by teachers to create spaces for discussion. The afore-mentioned authors have observed three types of activity when teachers use the IWB: technical, physical and conceptual.

- **Learner agency**

Technology use at the research site is still not embedded in a way that would allow learners to use its functionalities to engage in digital projects, therefore, its use and applications are one-sided and teacher-based. Infusing technology within the curriculum so as to enable learners to participate in technology-based activities will provide a different enactment and engagement with the curriculum. This immersion will draw on the learners' reserves of knowledge and help them 'gain a sense' of control and involvement with the learning processes.

Starkey (2012:68) propounds that, "making connections to a students' existing knowledge and experiences underpins the process of learning and would be considered as they contemplate what they are learning". In like manner, Borko and Putnam (1996:674) define learning by stating that: "learning is an active, constructive process that is heavily influenced by an individual's existing knowledge and beliefs and is situated in particular contexts". This definition is relevant in a digital age schooling system, which involves mastering and exploring the

boundaries of concepts and skills, and creating and sharing knowledge. The said authors note that being active and constructive requires the learner to have a level of agency within the learning process, rather than passively sitting, listening or reading words. It is this level of agency that I had hoped teachers would explore in the English Home Language Programme for Grade R-3, and expand to other subjects taught.

Key principles for the school leadership to consider should centre on the understanding and use of technology to enhance pedagogy and content, and to realise that technology is continually evolving. This implies that, as mentioned in earlier chapters, the curriculum should have flexibility in its application to allow teachers to adapt learning appropriate content, to be able to integrate concepts and skills across subjects and to take learners beyond mastering to the creation of knowledge from the concepts and skills being learnt. All the activities can be aligned and scaffolded within the curriculum outcomes in the English Home Language Programme Grades R-3 (DoE, 2011). The CIM in Table 7.1 is a simplified framework which links learner ICT competencies and skills to skills and outcomes in CAPS (DoE, 2011). Pedagogical practices should encourage the following learner-centred learning listed in CAPS (DoE, 2011): learners present to others; learners explore creativity; learners engage in deep thinking (no right answer); learning is interest-driven and characterised by autonomy/self-direction, responsibility and accountability for own learning. When learners collaborate with each other and engage in active learning the teacher becomes a facilitator in a resource and activity-rich learning environment. According to Green and Hannon (2007) there is a growing acknowledgement that children are part of the information society, because they are capable of using digital technologies in creative and innovative ways and are consumers of digital media. The potential of a classroom technology integration model and how technological access for learners can translate into 'learners' TPACK' is illustrated in Figure 7.3 below.

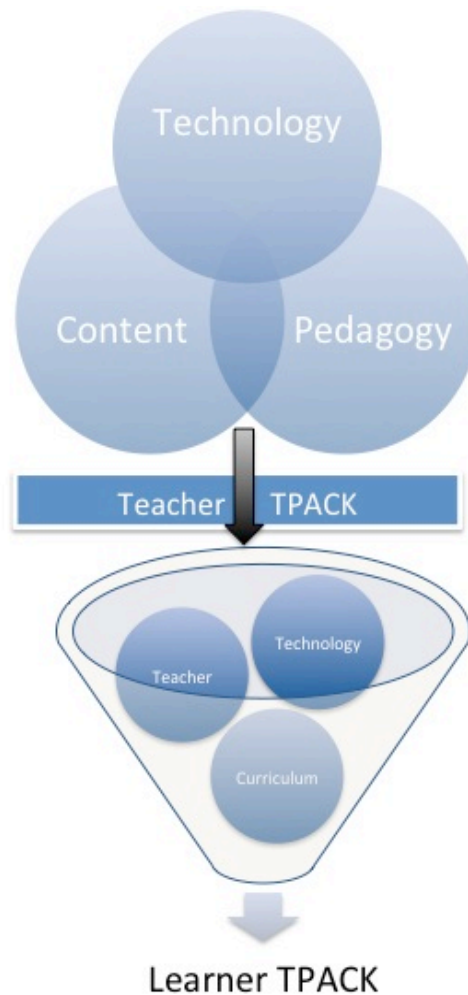


Figure 7.3: From teacher TPACK to learner TPACK

7.3.1 Learner access

Digital environments provide new opportunities to enable children to access, create and share multi-media resources and engage in collaborative and 'distributed learning' (Lankshear & Knobel, 2011; Davies & Merchant, 2009). How can learners access technology in the school context? It is important that teachers realise the use of ICT from a learner's perspective as the issue of equity is still minimally addressed. Teachers need to become flexible in how they manage learner activity on the available computers in the classroom.

It is suggested that teachers consider the available software for all areas of learning. Art programs can enable children to perform some skills which they cannot complete on paper, and the printouts can be very satisfying for children, particularly those with special needs. Learners can engage in making patterns digitally for using in a graphics area. Children-friendly websites can be saved to the 'favourites' folder list for easy access by learners to conduct website searches and online curated/vetted activities. Digital images can be uploaded and

used for story prompts and other literacy-related activities to enable discussion and vocabulary extension. Learners can use images to create a digital story using the available software, text, music and animation can accompany such stories. Learners can use word-processing to type up creative writing paragraphs, and to illustrate paragraphs with clip art, saved images or visual art.

Learners can also design their own interactive and animated power-point stories. Video Clips on a variety of themes and stories can be archived for learner use, including listening to stories, or consolidating concepts. Software for role play is freely available on the Internet. The teacher can place the computer in a role play area, this helps the area reflect children's lives today (for example as they are often positioned in doctors' waiting rooms and travel agencies). Real life uses of ICT involve asking questions such as: how do you use a computer in ways that reflect 'real life' uses? Free online children's reading and literacy websites make it possible to track learner's reading progress online.

Explicit strategies can be designed by the teacher to include the available software. The above are some examples of such strategies. Foci should point to integrated and cross-curricular technological instruction that takes advantage of the affordances of technology to become more learner-centred and promote the skills of collaboration and problem-solving relevant to real-world challenges, in order to prepare learners for a future with emerging technologies (Schrum & Levin, 2012:9).

7.4 The motivation for a classroom integration model (CIM)

The design for the CIM was propelled firstly by the paucity of such a curriculum-linked model at the research site. This model has emerged from my own engagement and experiences of teaching Grade 3 learners in a technologically enhanced environment. Secondly, its aim is to promote authentic technology integration, which is embedded within the English Home Language Programme for the Foundation Phase Grades R-3 CAPS curriculum (DoE, 2011). In addition, its further aim is to firstly guide and suggest appropriate technologies to accompany digital activities for learners. Secondly, the CIM aims to suggest strategies for the learners to participate actively and collaboratively in group-work. Due to the current lack of high-speed Internet connectivity to the computer stations in the classrooms, my approach to the design of this CIM needed to consider this limitation. However, plans are in place to connect these learner stations to the Internet, therefore, making effective use of what is available will make the transition smoother once the future plans for connectivity are fully realised.

The CIM model, as outlined below, focuses on similar skills that are taught by the ICT trainer for the Primary Grades (see Chapter 1) as set out in a technological skills curriculum which is

age and Grade appropriate. With or without Internet connectivity, the value of such a model will guide teachers towards an embedded and collaborative use of technology in the primary Language Programme.

The use of computers to support a broad range of teaching and learning purposes links directly with the roles of the teacher as learning mediator (role 1); as interpreter and designer of learning programmes and materials (role 2); as scholar, researcher and lifelong learner (role 4); as assessor (role 6) and as learning area/subject/discipline/phase specialist (role 7) (DoE, 2011).

The Policy on e-Education proposes various models of achieving learner ICT literacy, as mentioned in Chapter 6. The policy identifies option A as the most desirable option, and lists the following advantages when selecting this model, I only highlight the advantages that are applicable to this case study. Since these suggestions were made, the research site is now in the process of migrating from the computer lab model to an embedded and blended classroom model, where tablet computing is envisaged as the next step in its learning vision, based on option A's advantages which include that: Learners use ICT in meaningful contexts; learners develop 21st century skills and critical outcomes; whole school professional development aligns with this approach; and teacher skills align with DoE Guidelines for Teacher Training and Professional Development in ICT (2007) (see Chapter 3). The e-Education policy (DoE, 2004) further mentions a number of purposes for the ICT integration model by which learners' ICT literacy across the curriculum can be acquired (adapted from Roos, 2008:14):

- Information gathering fuels thinking and responses to challenge questions and tasks;
- Collaborating and communicating beyond the classroom with other learners who can add value to their learning process;
- Processing, transforming and producing/sharing information in individual and group activities;
- Using multimedia and digital content to deepen understanding; and
- Using ICTs to overcome barriers to learning associated with learning with special education needs.

Learner access should be designed around the four pillars outlined in the classroom integration model. The participants were already familiar with the skills and competencies sketched in the framework. These skills and competencies are taught by the ICT tutor. For the learner in Grade 3, these technologically-enhanced learner-centred activities should by no means be complex. Activities will reflect their abilities to apply skills that they have been introduced to and are familiar with. Some learners are less skilled than others and would need more modelling by the teacher from time to time. The following four areas are the main pillars for this model: Basic

operations and concepts; Productivity tools; Technology communication tools; and Technological research tools. These are summarised in Figure 7.1 below.

Table 7.1: Framework for the Classroom Integration Model (CIM)

E-Tools	Learner competencies and skills	Curriculum descriptors
Basic operations and concepts	Learners will demonstrate a sound understanding of the nature and operations of technology systems. Learners should be proficient in applications, which are taught in the ICT curriculum for Grades R-3. (Computers 4 Kidz) which include tools listed below.	Listening and speaking Reading and viewing Writing
Productivity Tools:	Learners demonstrate the use of technology tools to enhance learning, increase productivity and promote creativity. (e-Tools (not reliant on the Internet) include; Paint, MS Word, MS PPT, Collages, Audacity, Photostory3, Basic Mind maps, Access Dictionary, and Thesaurus from Word). Learners use productivity tools to collaborate in constructing technology-enhanced projects, prepare projects for projects for publication and other creative work. (Examples are story projects, animated power point presentations MS Word documents, etc.).	Listening and speaking: <ul style="list-style-type: none"> • Uses language imaginatively to tell stories • Tells a short story with simple plot and characters(record) • Makes oral presentations • Revision and consolidation of phonics activities (videos) • Mind maps to report story Reading and viewing: <ul style="list-style-type: none"> • Reads enlarged electronic texts (Guided & Shared) • Reads online books, listen to Audio books & Talking books • Listens to poems (Audio & visual Uses visual cues to talk about graphical text, pictures, charts & maps
Technology Communications Tools:	Learners use ICTs to collaborate, publish, and interact with peers and other audiences (blogging, wiki's, classroom webpage, class newspaper). Learners use a variety of media formats to communicate information and ideas effectively to multiple audiences. (Teacher, peers, other Grades) Examples are multi-media applications, text, images, audio, and digital video, storyboard tools). Teachers' own artefacts; learner artefacts.	Writing: <ul style="list-style-type: none"> • Writes a selection of short texts • Keeps a diary (digital) • Writes a simple book review • Writes a short newspaper article • Contributes to class story • Digital stories Interactive power point to present stories
Technology Research Tools:	Learners use technology tools to locate (Google search) using Boolean features, evaluate, and collect from variety of sources. Web sites, online data bases Learners use tools to report results. Learners learn to store and manage information and projects, how to retrieve and share (online).	Writing: <ul style="list-style-type: none"> • Use pre-writing strategies to gather ideas and information • Blog on class blog • Contribute to class Twitter page Store and manage writing activities in e-portfolio/folders

7.4.1 Monitoring and assessing primary learners' use of ICTs

It is important to create a core-software for young learners to view content that is age appropriate and contributes to the overall objectives of the lesson activity. Learners are increasingly exploring web-based activities by themselves. Learners, therefore, need to see the computer as a tool for learning and teachers need to scaffold learners' learning at the computer, always considering safety and explaining the value of digital citizenship. Keeping a learner-friendly desktop and interface encourages independence. While concepts and skills are explored in different ways, according to Starkey (2012:108), not all learners will create knowledge using each concept or skill they have mastered. The nature of knowledge and skill will be flexible and unpredictable, as discussed in the literature on the theory of Connectivism in Chapter 2. Starkey (2012) reports that this flexibility will allow the cohort to have divergent learning experiences, which caters for their specific learning needs.

7.5 Conclusions

As learners and teachers gain competence and confidence and remain motivated to use ICTs, it is inevitable that the use of digital tools will "become pragmatic and become just another resource, albeit a powerful one" (John & Wheeler, 2007:122). This chapter underpinned fostering the integration of classroom technology to enrich the learner's experience and participation through digital mediation. It was noted that there was a need for teacher-acquired TPACK to attend to digital skills and competencies of learners in order to meet the shift in literacy practice that embrace multi-literacies. It was also observed that continued professional development remains critical to ensure that teachers keep abreast of changes in effective use of new technologies and manage a flexible classroom curriculum that can accommodate the affordances of technology for learner usage.

Teachers should acknowledge that planning instruction must be content-based and that pedagogy should be facilitated by the alignment of the selected technological tool to mediate learning. In this chapter there was a need to seek a broad definition of multi-literacies to expand our understanding of the advancement of technology's impact on traditional views of literacy. In realising this understanding, teachers need to evaluate technologies that can facilitate learner competencies and skills in a technologically enabled environment.

Teacher readiness is an important consideration when teaching with technology. In this chapter I have sketched an info-graphic of my continuing mentoring relationship with the participants, considering how adults learn by drawing on the theory of adult learning (Knowles, 1990). The literature (Mishra & Koehler, 2006) cites mediating factors that influence how teachers integrate technology in their classrooms. Further, in this chapter I drew comparisons between my own

research and children's literacy practices using digital tools. In this respect, I highlighted influences of Burnett (2010) to illustrate children's literacy practices with technology.

This investigation has considered teachers' development of technology, pedagogy and content knowledge and how it shapes their classroom practices and their own learning trajectories. As issues around technology equity are marginal at the research site, teachers' acquired TPACK confidence needs to permeate towards the conceptualisation of a learner TPACK through constructs of technology and curriculum knowledge to foster such a learner TPACK in a technologically enabled environment. The next chapter draws the research to a conclusion by reflecting on the main findings, before it proceeds to make recommendations, which emanate from the study.

CHAPTER 8

CONCLUSIONS AND RECOMMENDATIONS

8.1 Overview of the study

This study aimed to explore how participant teachers gain knowledge about instructional technologies and how instructional technologies are deployed in their teaching. The teachers involved would then draw from this acquired knowledge and experience to intercede appropriately and effectively with technology to enrich curriculum outcomes. Factors such as self-efficacy and teacher motivation were explored through the lens of continuing professional teacher development (CPTD).

As an underpinning theoretical approach, I employed the TPACK model by Mishra and Koehler (2006) as a 'conceptual lens' with which to interpret and categorise the unique technological knowledge that teachers needed to develop and embed in their instructional practice so as to foster student learning. The TPACK (2006) framework connects technology to curriculum content and specific pedagogical approaches and describes how teachers' understanding of these three knowledge bases can interact with one another to produce effective discipline-based teaching with educational technology. With technological infrastructure being supplied within the classroom for access by learners, there was a further need to understand how the use of computer technology translates into embedded classroom practice, since the use of technology requires a learner-centred approach.

TPACK, as a multi-faceted seven-component framework, collided with traditional views of participants as the presence of technology in the primary classroom mandates that teachers become competent and skilled to deploy and harness technologies potential. Mishra and Koehler's (2006) framework focuses on the unique affordances of technology to transform content for the learner while maintaining the pedagogical advantage of deploying such technology in the classroom. This stance allowed me to capture and articulate the "interplay of the amalgam of knowledge" (Shulman, 1986:9) needed by the teacher in the classroom.

8.2 Conclusions from the findings

A critical conclusion arrived at early in the research was that professional development and collaboration in developing new methodologies drove and sustained teacher learning and innovation as the participants deepened their understanding and shared expertise.

Despite the technologically focused professional development activities in which staff regularly participate to develop knowledge and skills, there is still the question of what the curriculum requires. The participants in this investigation consistently related that the current curriculum constrained innovation and creativity due to its rigid and content-laden nature and, therefore, viewed the curriculum as a barrier to technology integration (see Chapter 6). Observations confirmed the complexities of adopting and implementing instructional technologies. Variables identified as characterising this complexity were individual perspectives about, and interpretations of the adoption process, made by the participants. As noted in Chapter 2.2.1, developing technology as the 'new' domain of knowledge or skill will impact on earlier embedded knowledge or pedagogy and how these elements are integrated. Taken together with the literature, the findings have been able to demonstrate the complexities of technology integration and innovation practices at the research site. I illuminate critical aspects below.

- **Pedagogic perspectives**

During the course of the investigation over which participants' trajectories ran, their pedagogic engagements with technology were challenged and reshaped as they were compelled to modify their existing teaching methodologies. It is aptly summarised in the literature (Cox & Graham, 2009:60-69; Inan & Lowther, 2010:137) that teachers tend to use technology in three ways: for instructional preparation; for instructional delivery; and as a learning tool. This observation was borne out in the data, as was discussed in Chapters 5 and 6. However, as the study progressed, the participants, who were starting to develop a more confident TPACK, also developed and demonstrated appropriately the use of technology as a learning tool, which indicated a clear shift in their pedagogical approach to technology. The evidence further suggests that the Heads of Departments appear to have devolved themselves in supporting participants to achieve pedagogical goals through ICTs, this focus is left to the individual teacher. There is no evidence to suggest collaboration between participants and senior teachers in evaluating a lesson to find if it meets pedagogical goals during the lesson planning and how it manifests when the lesson is presented. The focus appears to be on the innovation of employing technology to present a lesson.

- **Sustaining ICT-enhanced practices**

The need to sustain such a shift remains challenged by habits of old methodologies which are compounded by the constraints of a rigid curriculum. The study is significant and relevant for several reasons. Firstly, it offers an important contribution to the exploration of teachers' development and adoption of technological practices through professional development courses and the practical application and integration of this technology in the primary classroom. The study's theoretical importance lies in the finding that real change occurs in

classroom settings within a 'situative perspective', and that collaboration practices are an important driver of this process. Moreover, there is the added value in the realisation that teacher attitudes and motivation towards professional growth and professional development are key contributory factors to the practical implementation of technology integration in the classroom. The study also demonstrates that technology integration benefits the teacher as a learner, as well as the learners themselves. Furthermore, changing classroom practices confirm the complex and dynamic nature of teachers' knowledge, as pointed out in the literature.

Emerging from the study was the knowledge that teachers had to construct new roles for themselves and that participants who "... saw a direct link between the curriculum and technology ..." were more successful in how they linked pedagogy to technology (Rodgers, 2002). Participants in the sample with many years of experience and a firm grasp of the curriculum had a more nuanced understanding and could select a more appropriate fit between the technological tool and the curriculum outcome. This understanding by some participants justifies the thinking that technology integration (TI), underscored by the relevant pedagogy, leads to new knowledge and practise, and what is known as the 'TPACK mind-set' needed by teachers. The core of this new knowledge domain underlies truly meaningful and deeply skilled teaching with technology (Mishra & Koehler, 2008:23). The data also highlighted the notion of sustaining the adoption of new practices. I elaborated on the sustainability of technology integration practices in Chapter 6, and showed how integration is influenced by the affordances and barriers inherent in technological artefacts.

- **Constraints**

Apart from the affordances and barriers in the classrooms which were discussed in Chapter 6, further constraints have been identified in terms of the convergence of a leadership vision and teacher roles towards technological innovation. Lacuna identified pertain to the lack of a coherent conceptualisation of a technological plan which set out priorities based on attainment of targets and an action plan.

8.3 Reflections

Two lines of enquiry were followed in this investigation. The first line of enquiry investigated and explored teachers' knowledge of technology. The second line of enquiry probed the practical nature of technology integration in the classroom. The essence of the conclusions arrived at after analysis of the data, are encapsulated within the three scaffolds that emerged from the data and were reflected upon in Chapters 5 and 6.

- **Reconceptualising practices**

There is a broad consensus in the literature that teachers value support when starting to use technology. Teachers' development of pedagogical insights around the implementation and use of technology and the need to ameliorate their own conceptions around technology and its use in teaching, requires continuous support. Technological pedagogical knowledge (TPK) is an understanding of how teaching and learning can change when particular technologies are used in particular ways. This includes knowing the pedagogical affordances and constraints of a range of technological tools, as they relate to developmentally appropriate strategies for primary school learners. Although the participants in this investigation have made strides in their development of a confident TPACK, the recommendations are made so that teachers continue to deepen their own learning and to embed it in their instructional methodologies.

- **Developing a TPACK-mindset**

A particular focus, and one that had a significant influence on the shift in the participants' development of a TPACK Mind-set (Morsink, 2011:4) is the commitment to on-going professional development opportunities and reflections in mentoring sessions to drive improvement. A deepening of constructivist and cognitivist orientations encapsulates how teachers transform, organise and reorganise their previous knowledge for teaching, using technologies, and how this process shapes educational practice. Several researchers, such as Koh *et al.* (2013:185), found that primary school teachers, particularly those with more teaching experience, tend to be less confident of constructivist orientations. These challenges should be considered when designing teachers' professional development which is aimed at instructional technology. Therefore, continuous professional teacher development (CPTD) is needed. Structured in-house mentoring and training should incrementally mitigate constraints and the tendency to fall back into old routines.

- **Policy perspectives**

Enabling legislative and policy frameworks provided by various governmental departments (DoE ICT, 2003:2), and by UNESCO endorse the support of integrating ICT into teaching and learning in educational institutions. As newer technologies continue to emerge, and permeate all levels of society, the participants' trajectories should become more robust and mature. A relevant observation in this investigation is that teachers who had a well-developed pedagogy of the subject content had a more intuitive understanding of selecting appropriate technologies to enhance the lesson.

8.4 Recommendations

There are several ways in which the data from this investigation can be drawn together to make recommendations. I have decided to tie my recommendations to the identified scaffolds that emerged from the data analysis. I draw on the caveats by Roschelle, Pea, Hoadley, Gordin and Means (2000:76-101) that:

Promises of ICTs to transform education could not be realised without a focus on cultural aspects, namely curricular goals; compatibility with assessment; the need for teachers to collaborate and the critical importance of on-going pedagogical support.

The scaffolds from the data analysis are underpinned by an approach of the sustainability of a classroom practice enhanced by instructional technology integration through pedagogy. With this in mind I move on to suggest a few recommendations for the effective integration of ICTs in the primary school classrooms at the research site.

8.4.1 Teachers' personal views on technology integration

My first recommendation would link with the first scaffold which points to teachers' personal views on technology integration which centre on beliefs and attitudes, as well as on teacher readiness. Teacher beliefs and motivation are closely linked to self-efficacy, as pointed out in earlier chapters. Self-efficacy, as is the case in this study, is viewed through the lens of Bandura's Social Cognitive Theory (1997:3). Efficacy describes one's beliefs in their capabilities to organise and execute the courses of action required to produce given attainments. In addition, the organisation where this study was conducted also values high quality attributes when teachers are appointed to the organisation and is, therefore, comforted by the fact that appointees at the research site are all mostly exceptionally motivated and driven by high levels of attainment.

A strong culture of performance and success is encouraged through a holistic model which measures factors that drive efficacy within the organisation and its people.

The organisation, therefore, advocates data driven evidence to continually improve outputs at the school. Efficacy in collaborating with others, such as Phase partners when sharing expertise, has been identified as a gap in the data which seeks to be addressed. I would, therefore, propose that 'collaboration' as a sub-category be added to the evaluation scales on the Key Performance Areas of teachers' overall efficacy measures.

By encouraging collaboration, ongoing professional reflections and commitments can be addressed during the teacher and principal lesson evaluation discussions, should the need

arise. I addressed these, and matters related to teachers' personal pathways for professional growth, in my discussion in Chapter 4. The value attached to encouraging collaboration amongst teachers is a growing element in the literature as it represents one of the 21st century skills (Guo, Justice & Sawyer, 2011:961). These researchers further posit that collaboration may enable teachers to improve their management of difficult situations, connected to teaching children with low level engagement, thus supporting teachers' self-efficacy. This buy-in, of developing more engaged collaborative practices, will feed into the organisation's most recent vision directed towards embracing 21st century skills.

8.4.2 Technology integration and curriculum delivery

The second recommendation links with the second scaffold. This scaffold underpins the importance of how technological tools used to modify lessons should enable curriculum outcomes. According to Huffman and Rickman (2004:282), ICTs need to become an element of the curriculum and the shift in ICT should align with instructional needs to take place in pedagogical practice, a shift that is not easily attainable because, "it involves risk-taking by the individual as they foster learning, adaptability and improvement" (Hofer & Swan, 2008:179). We need to bear in mind that Starkey (2012:108) raises the debate in the literature on curriculum flexibility, because learning is unpredictable and cannot be explicitly stated as a prescriptive content outcome. Teacher expertise becomes an important element of integrating technology effectively into the curriculum (Sadik, 2008:487).

I would suggest a blended model in which the current curriculum can be delivered as a digital curriculum. The blended model approach, which I defined in Chapter 4, is one that combines fragments of traditional learning types with fragments of technology-enhanced learning (Kim, 2007:1-8). The blended approach incorporates multiple methods of instruction, which might be teacher or learner-led. The approach is available off-line or on-line in order to customise the learning experience of a group of diverse learners. Provisions can thus be made to accommodate flexibility, due to the unpredictable nature of technology, or compromised broadband speed. Such a blended model ensures that digital learning activities are aligned to the classroom curriculum and aids the learners' development of digital skills and competencies. There is a clear paradigm shift from content to activity. Oliver and Conole (2002:23-37) also see the following three elements as important characteristics in this blended model, namely, engagement, motivation and deeper understanding. Participants in this study had been involved in a blended model of e-Learning (see Chapter 4) within an LMS and were familiar with synchronous and asynchronous environments.

8.4.3 Whole school technology integration vision

The third scaffold is a long-term whole school vision for future directions. Vision is a complicated process, "and is an active multi-dimensional process, it is contextual, and lies within the needs of particular schools and communities" (Ylimaki, 2006:649). Positive factors pertaining to the vision were outlined in Chapter 6 and allude to the positive culture that already exists at the research site. The ideal situation would be a deepening of the "shared-vision based on the core values of participants and their hopes for the school, which ensures realisation. A commitment to a shared-vision provides coherence to programmes and learning practices" (Lambert, 2003:6). This shared-vision should be concretised within the strategic plan of the school. Tondeur (2015:24) includes the following additional steps in ICT-policy planning: gaining insight into teachers' vision on education; making an inventory of the actual use of technology; setting priorities based on attainment targets; considering new activities; and drawing up an action plan.

- The first aspect to be addressed within the context of this scaffold would be the continuing professional development of staff to raise the performance levels of teachers and learners and expand teachers' growth in terms of their technology integration practices. This process should be a coordinated effort between teachers and a technical expert who also understands curriculum matters (Technology Integration/Infusion Specialist).
- Regular dedicated blocks of time during the school term must be scheduled so that matters pertaining to technology integration practices can be addressed. The need for time was raised as a barrier by the participants in the study. Matters relating to mentoring, collaboration with peers and Phase partners, consulting teachers with technological expertise, time to plan with digital resources, becoming proficient in productivity tools, archiving and sourcing relevant materials, technical assistance; and having time to discuss with a colleague or Phase partner the value of a specific tool, software or hardware that might enhance a lesson, were cited as areas of concern.
- A second recommendation concerning staff development pertains to the notion that the leadership needs to become familiar with the provisions of the policy on e-Education (2004). Although not fully implemented, this policy becomes useful in terms of its intentions. Targets, as set out by the DoE (2011:14), are annually reviewed. I recommend that the leadership at the research site consider adopting or consulting globally recognised frameworks which can guide staff development. The following frameworks both place a strong emphasis on pedagogy, content, knowledge, skills and values being combined with technology and will fill the current void. Both are aligned

with constructivist principles. As outlined in Chapter 6, the UNESCO ICT Conceptual Framework for Teachers provides guidelines for planning with technology, teacher education programmes and training modules for use by individuals or groups (see Chapter 3 for a schematic outline of the developmental stages within each module, and Chapter 6 for a discussion of this model). This framework is equally useful to facilitate in-service teachers' professional development on effective ICT-pedagogy integration. The second framework that provides pedagogy-driven strategies to incorporate technology for instruction is the underpinning conceptual framework for this study, the TPACK-framework by Mishra and Koehler (2006). Definitions for the knowledge constructs within the framework describe the knowledge that teachers need (see Table 6.1 and Chapter 2 for a review of the TPACK (2006) model).

- Although the administration processes of the research site have been digitised for a number of years now, data that can be accessed from the current LMS only fulfil the role of ensuring that learner and staff records are kept. Furthermore, examination results are captured and reports are produced. There is a need for a more robust LMS so that the utilisation of this resource can promote cohesiveness within the school culture. Teachers should be able to use the LMS to assess learners, evaluate and record results of formative assessments and, most importantly, track learner progress and retrieve historic data of learner achievement (Schrum & Levin, 2012:110) to inform planning. The LMS can house a shared portal for resources and repository for training materials that can be accessed on-line and off-line by teachers. A robust LMS has discussion forums in which mutual learning can be extended to allow small groups of teachers to work virtually on a project through the sharing of ideas. Collaborative activities such as these are not bound by time and place. Finally, the LMS has the potential for feedback through purposefully generated surveys to determine further needs for staff development.
- The most appropriate way to encourage progress within the context of this research would be to redefine the position and job description of the current ICT tutor. There is a need for the creation of a specialist position, together with a team which includes technical support services to drive the vision of the organisation in terms of its technology integration vision and plan at the primary school. In the literature these role-players are referred to as Technology Integration Specialists or Technology Infusion Specialists. Other team members would include an onsite technology coach who can provide different methods of instruction for different technologies (Arns, 2008:12-15). Expertise of such a specialist, can curtail ill-conceived considerations to a minimum. Johnson *et al.* (2009) cited in research by Schrum and Levin (2012:61) reported on an

examination of the literature on the use of technology in schools and conclude that there is still a need for: formal instruction in new skills (information, technological and visual literacies); an awareness that learners have changed, but educational practices have not; more authentic learning experiences because these are infrequent; and integration into current structures of primary and secondary education which are less difficult.

- The Technology Specialist should be knowledgeable about curriculum and assessment policies (Booyse & Du Plessis, 2014:5) and demonstrate adaptability towards pedagogical knowledge with technology while considering curriculum deliverables. The specialist should understand the multiple domains (technology, pedagogy and content) that teachers need for teaching specific content at specific grade levels (Harasim, 2012:2) and the need for curriculum flexibility. This person would subscribe to a theory driven practice, firmly lodged within the Principles of Learning (Resnick, 1983) and the Revised Blooms' Taxonomy (Anderson *et al.*, 2001) which underpin the teaching methodologies at the research site, a conversation that I had in Chapter 1.
- The Technology Specialist would also need to understand 21st century curriculum and instruction methods to support teachers' training needs because the research site is leaning towards innovative practices. This specialist must be familiar with teacher roles and understand how professional learning communities, or communities of practice, can become mechanisms to promote collaborative practices. He/she would also need to understand that new learning should be sustained by theory and have a mastery of Educational Theory as it relates to differentiation and inclusivity.
- In view of classrooms that are equipped with computer hardware for use by learners, and as more hardware becomes integrated in classrooms, physical ergonomic issues are seldom considered. It is my contention that design changes around infrastructure and such concepts will ultimately impact the organisational culture. Re-designing classroom layout should tap into creative spaces for learners. Sound ergonomic practices should be encouraged. The classroom must, therefore, become a space that can be re-configured to accommodate various uses through multiple reconfigurations. The premise of educational ergonomics is context-specific, according to Smith (2001), which is defined as "that field of human factors concerned with the interaction of educational performance and educational design".
- The use of the IWB in the primary classrooms presents with under-utilisation of its potential. Limited use was deduced from classroom observations. IWBs, as cultural artefacts, can support dialogic learning spaces, as was discussed in Chapter 6. The

IWB has become a vehicle to bring technology into the primary classroom. For Wikan and Molster (2013) the IWB is an artefact to support dialogic learning spaces in primary schools. Similar research by Hennessy (2014:33-44) focused on pedagogic strategies for orchestrating dialogue. Staff development should focus on developing dialogue and dialogic pedagogy through well-selected resources that are stimulating, engaging and meaningful to learners. Linked with any level of IWB use is the need to also include some learner ownership of the board, arising from opportunities for focused cumulative, open-ended discussion in the whole class, in pairs, or groups to move forward the learning by the learners.

In summary, introducing new technologies into classrooms increase pressure on teachers to use these technologies so that this process positively impacts learner achievement. Factors that influence such decisions have been addressed in this investigation. These include: participant teachers' technological skills and knowledge development and acquired competencies; deployment of technology in classrooms; participants' beliefs, attitudes and 'thinking' about technological practices; and the influence of professional development on competencies and perceptions.

Furthermore, constraints and affordances of technologies for the participants were explored, as were related matters pertaining to maintaining sustainability of technology integration, learner access through computer hardware and how it can be exploited towards learner engagement, motivation and learning. Finally, there has been an attempt to explore the deepening of teacher knowledge through collaborative practices. It was found that there is a need for a shared-vision to realise fully the move towards the concretising of innovative practices within a strategic plan for technology integration.

8.5 Further research

Limited research has been undertaken on the classroom teacher's development and knowledge of ICTs in the South African context. With this realisation, and in considering the context of the research site, the following are identified as areas requiring further investigation:

- I. I alluded to a learner TPACK in Chapter 7. There is a need to explore how a learner TPACK can be developed by considering how variables such as curriculum and technology can contribute. This will stimulate further research around the concept of primary 'learners' TPACK' which can offer a new perspective of learners' engagement with technological tools as we theorise how the teacher might influence learner TPACK through the fusion of curriculum content and technology.

- II. Competency, attitude and support counted as some of the more influential factors as teachers gained knowledge of technological tools accompanied by relevant pedagogies. It was noticed that, as participants' knowledge and competencies increased, their practices aligned more along constructivist approaches. Further research is necessary to explore how teachers who lack constructivist orientations can be supported.
- III. There is a need for qualitative research on how to improve the effective use of ICTs through innovative methods, possibly incorporating a variety of ICT tools. These can be investigated as pilot studies. Such studies should be ongoing so that feedback can be obtained and methods modified to refine the teaching and learning processes through pedagogy driven strategies.
- IV. Literacy practices have changed due to the proliferation of digital tools, drawing attention to multi-literacies. There is a gap in the domestic literature on technology integration practices that explore this aspect of children's multi-literacies and the impact on language learning.
- V. The IWB brings technology into primary classrooms. Research is needed to explore its use as a tool to consider dialogic pedagogy in the primary classroom. Such research can contribute to debate about how the IWB is an artefact that can support dialogic learning spaces in primary schools.
- VI. Technology integration in primary classrooms falls short when assessing learner outcomes for learners with diverse abilities. Research in this area can contribute to how learners' digital artefacts can become alternative forms for learner assessment.
- VII. Learners' perceptions and use of digital tools are closely associated with the stimulation provided by video-games, which can entertain them for hours. Research is needed to determine how effective these features of digital games are in improving cognition and thinking strategies needed to stay on top of the game, and how gaming can be integrated in the curriculum to develop these thinking strategies.

8.6 Conclusions

In conclusion, this study aimed at tracing primary school teachers' technological, pedagogical and content knowledge development. A further aim was to understand how teachers' development of TPACK (2006) drives the TPACK-mindset to guide technology-enhanced teaching methodologies. TPACK (2006), as argued in the literature, refers to a teacher's knowledge of how to synchronise the use of subject knowledge with curriculum outcomes using emerging technologies to advance learners' conceptual understanding of subject matter.

Throughout the eighteen-month period that this investigation was in operation, I was able to immerse myself fully within the ecology of the classroom to examine the practices of 10 teacher participants, who were also my colleagues. I was able to gain a clearer understanding of the uniqueness of each participant and each one's engagement with technologically enhanced instruction.

Technology integration at the research site has been influenced mostly by contextual and school related factors. Decisions made in acquiring infrastructure have been fragmented, due to availability of funding. The impact of this has influenced decisions towards a more integrated approach. It is envisaged that this study will make a meaningful contribution to the research site (see Chapter 1), as current teachers continue to become competent and skilled users of emergent technologies and come to the realisation that learners, even in the primary grades, can benefit through regular and integrated access to digital technology.

The schematic outline in Table 8.1 below presents the critical success factors of the earlier visions of technology integration at the research site, starting with historical successes, and indicating critical factors that need attention at the research site. It is suggested that current critical factors that need attention should inform the strategic plan for future technology integration and implementation.

Table 8.1: Convergence of leadership vision and teacher roles towards technological innovation

➤ Historical Critical success factors	Present	Not present	Blending with teacher views	Non-blending with teacher views	To be reviewed
Strong and supportive leadership	✓		✓		
Commitment to CPTD	✓		✓		
Collaborative support	✓			✓	✓
Connected environment	✓				
➤ Recent Critical factors					
Design an Online Teaching Event	✓		✓		
21st Century Learning Design Course	✓		✓		
From Techno-centric to constructivist methodologies	✓		✓		
Interactive White Boards	✓		✓		✓
➤ Current Critical Factors					
Embedded and Blended Approach				✓	✓
Space re-design		✓	✓		✓
Policy Guidelines and implementations		✓		✓	✓
Digital Integrated Curriculum		✓		✓	✓
Technology Integration Specialist		✓	✓		✓

REFERENCES

References to unpagged online documents and articles are cited by paragraph, chapter or web link.

- Achinstein, B. 2002. Conflict among community: The micro-politics of teacher collaboration. *Teachers College Record*, 104(3):421-455.
- Afshari, M., Bakar, K.A., Luan, W.S., Samah, B.A. & Fooi, F.S. 2009. Factors affecting teachers' use of information. *Journal of Research and Technology in Education*, 2(1):77-104.
- Ager, A. 2013. Annual research review: resilience and child wellbeing-public policy implications. *The Journal of Child Psychology and Psychiatry*, 54, 488-500.
- Ala-Mutka, K. 2009. "Reviewing of learning in ICT-enabled networks and communities. *JRC Scientific and Technical Reports-EUR 24061 EN*. <https://jrc.ec.europa.eu/publications/pub.cfm?id=2139> [Retrieved: 8 March 2013].
- Ala-Mutka, K. 2011. Mapping digital competence: Towards a conceptual understanding. *JRC European Commission Institute for prospective technological studies. Luxembourg*.
- Albion, P.R., Jamieson-Proctor, R. & Finger, G. 2010. Auditing the TPACK confidence of Australian pre-service teachers: The TPACK confidence survey (TES). In C. Maddux, Gibson, D. & Dodge, B. (eds). *Research Highlights in Technology and Teacher Education 2010* (pp. 303-321). Chesapeake, VA: *Society for Information Technology in Teacher Education*.
- Anderson, L.W., Krathwohl, D.R., Airasian, P.W., Cruikshank, K.A., Mayer, R.E., Pintrich, P.R., Raths, J. & Wittrock, M.C. 2001. *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. Complete ed. New York: Longman.
- Angeli, C. & Valanides, N. 2005. Pre-service teachers as ICT designers: An instructional design model based on an expanded view of pedagogical content knowledge. *Journal of Computer-Assisted Learning*, 21(4):292-302.
- 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 & Education*, 52(1):154-168.
- Angeli, C. 2005. Transforming a teacher education method course through technology: Effects on pre-service teachers' technology competency. *Computers & Education*, 45(4):383-398.
- Angers, J. & Machtmes, K. 2005. An ethnographic-case study of beliefs, context factors, and practices of teachers integrating technology. *The Qualitative Report*, 10(4):771-794.
- Anst y, M. & Bull, G. 2006. Teaching and learning multi-literacies: Changing times, changing literacies. *The International Reading Association*.
- 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). <http://www.citejournal.org/vol9/iss1/general/article2.cfm> [Retrieved 28 August 28, 2011].
- Archambault, L.M. & Barnett, J.H. 2010. Revisiting technological pedagogical content knowledge: Exploring the TPCK framework, *Computers & Education*, 55(4):1656-1662. Doi: 10.1016/j.compedu.2010.07.009. [Retrieved 28 August 28, 2011].
- Arns, J. 2008. Staff development: Caf  Style. *Learning and Leading with Technology*, 36(3):12-15.
- Asmawi, R. 2005. Interactive whiteboard: A new dimension in teaching and learning. *Pendidikan Jilid*, 27:213-219.

- Azjen, I. 1985. From intentions to actions: A theory of planned behavior. In Kuhl, J. & Beckman, J. (eds). *Action-control: From Cognition to Behavior*. Heidelberg: Springer.
- Bailey, K.D. 1978. *Methods of Social Research*. Basingstoke: Collier-Macmillan.
- Balanskat, A., Blamire, R. & Kefala, S. 2006. The ICT Impact Report: A review of studies of ICT impact on schools in Europe. <http://ec.europa.eu/education/doc/reports/doc/ictimpact.pdf> [Retrieved: 11 April 2011].
- Ball, S.J. 2004. *The RoutledgeFalmer Reader in Sociology of Education*. New York: RoutledgeFalmer.
- Ball, S.J. 2008. *The Education Debate: Policy and Politics in the Twenty First Century*. Bristol: The Policy Press.
- Ball, S.J., Maguire, M. & Braun, A. 2012. *How Schools Do Policy. Policy Enactment in Secondary Schools*. New York: Routledge.
- Bandura, A. 1982. Self-efficacy mechanism in human agency. *American Psychologist*, 37(2):122-147. <http://www.uky.edu/~eushe2/Bandura /Bandura1982AP.pdf> [Retrieved: 4 April 2012].
- Bandura, A. 1997. *Self-efficacy: The Exercise of Control*. New York: W.H. Freeman and Company.
- Bandura, A. 1977. *Social Learning Theory*. New York: General Learning Press.
- Barker, B. 2010. *The Pendulum Swings: Transforming School Reform*. Stoke-on-Trent: Trentham Books.
- Barrett, H. 2006. Researching and evaluating digital storytelling as a deep learning tool. In Crawford, C. et al. (eds). *Proceedings of Society for Information Technology and Teacher Education International Conference 2006* (pp. 647-654). Chesapeake, VA: AACE.
- Barton, R. 1997. Computer-aided graphing: A comparative study. *Journal of Information Technology for Teacher Education*, 6(1):59-72.
- Basit, T.N. 2010. *Conducting research in educational contexts*. London: Continuum.
- Bassey, M. 1999. *Case study research in educational settings*. Buckingham: Open University Press.
- Beeson, M. W. 2011. *The Influence of Teacher Beliefs and Knowledge on Planning for Technology Integration in Technology-Rich Classrooms*. Published PhD dissertation. 2013. Greensboro: University of North Carolina.
- Beetham, H. & Sharpe, R. 2007. *Rethinking Pedagogy for a Digital Age: Designing and Delivery e-Learning*. London: Routledge.
- Bell, F. 2011. Connectivism: Its place in theory-informed research and innovation in technology-enabled learning. *The International Review of Research in Open and Distributed Learning*, 12(3):98–118.
- Bell, L. & Stevenson, H. 2006. *Education: Policy Process, Themes and Impact*. New York: Routledge.
- Belshaw, D. 2012. *The Essential Elements of Digital Literacies'* Open Beta Publishing Model. <http://doughbelshaw.com/blog/2009/12/30/openbeta-a-publishing-model/> [Retrieved: 15 November 2012].
- Bernstein, B. 1996. *Pedagogic and Symbolic Control and Identity*. London: Taylor & Francis.
- Bertram, A. & Waldrip, B. 2013. ICT for ICT's sake: Secondary teachers' views on technology as a tool for teaching and learning. *Australian Educational Computing*, 28(1):61-70.
- Bhattacharya, K. 2007. *Data Analysis Advanced Qualitative Methods A Student Handbook*. College of Education, University of Memphis: Ball Hall.

- Biggs, J. 1999. *Teaching for Quality Learning at University*. Buckingham: Open University Press.
- Bilbao-Osorio, B., Dutta, S. & Lanvin, B. (eds). *The Global Information Technology Report, 2013*. Geneva: World Economic Forum.
- Billet, S. 2010. Learning throughout working life: interdependencies at work. *Studies in Continuing Education*, 23(1):19-35.
- Blaikie, N. 2000. *Designing social research*. Cambridge: Polity.
- Blömeke, S. 2005. Teacher education-teacher performance-student achievement. *Perspectives of National and International Educational Research*. [Http//edoc.hu.berlin.de](http://edoc.hu.berlin.de) [Retrieved: 12 July 2011].
- Bogdan, R. & Biklen, S. 1998. *Qualitative Research for Education: An Introduction to Theory and Methods*. Needham Heights, MA: Allyn and Bacon.
- Bold, C. 2012. *Using Narrative in Research*. London: Sage.
- Booyse, C. & Du Plessis E. 2014. *Curriculum studies: Development, Interpretation, Plan and Practice*. Pretoria: Van Schaik Publishers.
- Borko, H. & Putnam, R.T. 1995. Expanding a teacher's knowledge base: a cognitive psychological perspective on professional development. In Guskey, T.R. & Huberman, M. (eds). *Professional Development in Education: New Paradigms and Practices*. New York: Teachers College Press.
- Borko, H. & Putnam, R.T. 1996. Learning to teach. In Berliner, D.C. & Calfee, R.C. (eds). *Handbook of Educational Psychology* (pp. 673-709). New York: Macmillan.
- Borko, H. & Putnam, R.T. 2000. What do views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher*, 29(1):4-15.
- Borko, H., Whitcomb, J. & Liston, D. 2009. Wicked problems and other thoughts on issues of technology and teacher learning. *Journal of Teacher Education*, 60:3.
- Bos, B. 2011. Professional development for elementary teachers using TPACK. *Contemporary Issues in Technology and Teacher Education*, 11(2):167-183.
- Bransford, J.D., Brown, A.L. & Cocking, R.R. (2000). *How People Learn: Brain, Mind, Experience and School*. Washington, DC: National Academy Press.
- Bridges.org, 2002: *Digital Divide Assessment of the City of Cape Town*, <http://www.bridges.org/capetown> [Retrieved: 2 March 2014].
- Brown, R., Noble, P. & Papa, R. 2009. *So you want to be a higher education administrator?* Lancaster, PA: Proactive Publications.
- Bruce, B. & Levin, J. 1997. Educational technology: Media for inquiry, communication, construction, and expression. *Journal of Educational Computing Research*, 17(1):79-102.
- Bruffee, K.A. 1999. *Collaborative learning: Higher education, interdependence, and the authority of knowledge*. 2nd ed. Baltimore, MD: Johns Hopkins University Press.
- Bruner, J. 1960. *The Process of Education*. Cambridge, Mass: Harvard University Press.
- Bruner, J. 1985. Models of the learner. *Educational Researcher*, 14(6):5-8. Published: American Educational Research Association.
- Bruner, J. 1996. *The culture of education*. Cambridge, Mass: Harvard University Press.
- Bruner, J.S. 1967. *On knowing: Essays for the left hand*. Cambridge, Mass: Harvard University Press.
- Bruning, R.H., Schraw, G.J. & Ronning, R.R. 1999. *Cognitive Psychology and Instruction*. Upper Saddle River, NJ: Merrill.

- Bryman, A. 2008. *Social Research methods*. 3rd ed. New York: Oxford University Press.
- Bull, G. & Garofalo, J. 2009. Personal fabrication systems: from bits to atoms. *Learning and Leading with Technology*, 36(7):10-12.
- Bull, P. 2009. Cognitive constructivist theory of multimedia design: A theoretical analysis of instructional design for multimedia learning. In Siemens, G. & Fulford, C. (eds). *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2009* (pp. 735-740). Chesapeake, VA: AACE.
- Burgess, J. 2006. Hearing ordinary voices: Cultural studies, vernacular creativity and digital storytelling. *Continuum: Journal of Media & Cultural Studies*, 20(2):201-214.
- Burnett, C. & Merchant, G. 2011. Is there a space for critical literacy in the context of new media? *English, Practice and Critique*, 10(1):41-57.
- Burnett, C. 2010. Technology and literacy in early childhood educational settings: A review of research. Hallam University Sheffield. *Journal of Early Childhood literacy*, 10(3):247-270.
- Burnett, C. 2013. 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.
- Calderhead, J. 1996. *Teachers: Beliefs and Knowledge*. In Berliner, D.C. & Chaffee, R.C. (eds). *Handbook of educational psychology* (pp. 709-225) New York: Simon Schuster Macmillan.
- Campbell, A., McNamara, O. & Gilroy, P. 2004. *Practitioner Research and Professional Development in Education*. London: Sage.
- Campbell, D.T. & Fiske, D.W. 1959. Convergent and discriminant validation by multi-trait-multi-method matrix. *Psychological Bulletin*, 56, 81-105.
- Carr, A.A., Jonassen, D.H., Litzinger, M.E. & Marra, R.M. 1998. "Good ideas to foment educational revolution: The role of systematic change in advancing situated learning, constructivism and feminist pedagogy." *Educational Technology*, 38(1):5-14.
- Cazden, C., Cope, B. & Fairclough, N. 1996. A pedagogy of multi-literacies: Designing social futures. *Harvard Educational Review*, 66(1):60-92.
- Centre for Innovative Educational and Communication Technologies (CIECT) University of the Western Cape. Designing an online teaching/instructional event. June (2012).
- Chai, C. S., Koh, J. H. L. & Tsai, C.C. 2010. Facilitating pre-service teachers' development of technological, pedagogical, and content knowledge (TPACK). *Educational Technology & Society*, 13(4):63-73. http://www.ifets.info/journals/13_4/7.pdf [Retrieved: 15 April 2015].
- Chai, C. S., Koh, J. H. L. & Tsai, C.C. 2011. Exploring the factor structure of the constructs of technological, pedagogical, content Knowledge (TPACK). *The Asia-Pacific Education Researcher*, 20(3):595-603.
- Chatti, M. A., Jarke, M. & Frosch-Wilke, D. 2007. The future of e-learning: a shift to knowledge networking and social software. *International Journal of Knowledge and Learning*, 3(4/5):404-420.
- Chigona, A. 2015. Teacher education students' domestication of ICTs for teaching and learning. In *Proceedings of Global Learn 2015* (pp. 240-247). Association for the Advancement of Computing in Education (AACE).
- Chigona, A., Chigona, W., Kayongo, P., Kausa, M. 2010. An empirical survey on domestication of ICT in schools in disadvantaged communities in South Africa. *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, 6(2):21-23.
- Chisholm, L. 2003. The Politics of Curriculum Review and Revision in South Africa. *Presented at the 'Oxford' International Conference on Education and Development, September 9-11 2003*.

- Chisholm, L. 2011. The challenge of South African schooling: dimensions, targets and initiatives. 2011 Transformation Audit: From Inequality to Inclusive Growth. South Africa.
- Christensen, P. & Prout, A. 2002. Working with ethical symmetry in social research with children. *Childhood: A Global Journal of Child Research*, 9(4):474-97. In Hartas, D. 2010. *Educational research and enquiry: Qualitative and quantitative approaches* (ed.). London: Continuum Publishing.
- Chui, G. 2000. Unified theory is getting closer, Hawking predicts, *San Jose Mercury News*. www.mercurynews.com. [Retrieved: 23 January 2000].
- Clarke, D.J. & Hollingsworth, H. 1994. Reconceptualising teacher change. In Bell, G., Wright, B., Leeson, N. & Geake, J. (eds). *Challenges in Mathematics Education: Constraints on Construction*, Vol. 1. Proceedings of the 17th annual conference of the Mathematics Education Research Group of Australasia (pp. 153-164). Lismore, NSW: Southern Cross University.
- Clarke, D.J. & Hollingsworth, H. 2002. Elaborating a model of teacher professional growth. *Teaching and Teacher Education*, 18(8):947-967.
- Cobb, V. 1999. *An International Comparison of Teacher Education*. Washington, DC: ERIC Clearinghouse on Teaching and Teacher Education.
- Cohen, L., Manion, L. & Morrison, K. 1994. *Research Methods in Education*. 4th ed. London: Routledge.
- Cohen, L., Manion, L. & Morrison, K. 2003. *Research Methods in Education*. 5th ed. London: Routledge.
- Cohen, L., Manion, L. & Morrison, K. 2011. *Research Methods in Education*. 7th ed. London: Routledge.
- Conole, G. & Dyke, M. 2004. Understanding and using technological affordances: A response to Boyle and Cook. *Research in Learning Technology*, 12(3):301-308.
- Conradie, D.P. & Roodt, J. 2004. Realities versus ideals with regard to E-learning in South Africa. *Human Sciences Research Council, South Africa*.
- Cordes, C. & Miller, E. 2000. *Fool's Gold: A Critical Look at Computers in Childhood*. College Park, MD: Alliance for Childhood.
- Coverdale, A. 2008. Future learning-scapes - e-Learning Conference, University of Greenwich, 2010. Presentation paper - Using and Social Media in Academic Practice (with LeRoy Hill).
- Cox, M.J., Niederhauser, D.S., Castillo, N., McDougall, A.B., Sakamoto, T. & Roesvik, S. 2013. Researching I.T in education. *Journal of Computer Assisted Learning*, 29, 474-486.
- Cox, S. & Graham, C.R., 2009. Diagramming TPACK in practice: Using an elaborated model of the TPACK framework to analyse and depict teacher knowledge. *TechTrends*, 53(5):60-69.
- Cresswell, J.W. 1998. *Qualitative Enquiry and Research Design: Choosing Among Five Traditions*. Thousand Oaks, Ca: Sage.
- Crockett, L., Jukes, I. & Churches, A. 2012. *Literacy is Not Enough: 21st Century Fluencies for the Digital Age*. Australia: HawkerBrownlow Education.
- Crotty, M. 1998. *The Foundations of Social Research*. London: Sage.
- Cuban, L. 1990. Reforming again, again, and again. *Educational Researcher*, 19(1):3-13.
- Cuban, L. 2001. *Oversold and underused: Computers in the classroom*. Cambridge, MA: Harvard University Press.

- Darling-Hammond, L. 2007. Evaluating No child Left Behind. www.thenation.com/doc/20070521/darling-hammond on November 2, 2009 [Retrieved: 16 September 2015].
- Davenport, T. & Prusak, L. 1998. *Working Knowledge: How Organizations Manage What They Know*. Boston: Harvard Business School Press.
- David, M., Edwards, R. & Alldred, P. 2001. Children and school-based research: "informed consent" or "educated consent"? *British Educational Journal*, 27, 347-365.
- Davies, J. & Merchant, G. 2009. *Web 2.0 for Schools: Social Participation and Learning*. Peter Lang: New York.
- Davis, A. 2004. Co-Authoring identity: Digital storytelling in an urban middle school. *THEN: Technology, Humanities, Education & Narrative*, 1(1):1. [http:// thenjournal.org/feature/61](http://thenjournal.org/feature/61) [Retrieved: 18 March 2012].
- Day, C. 1999. *Developing teachers: The challenges of lifelong learning*. London: Falmer Press.
- DBE see South Africa. Department of Basic Education.
- De Jong, O., Van Driel, J.H. & Verloop, N. 2005. Pre-service teachers' pedagogical content knowledge of using particle models in teaching chemistry. *Journal of Research in Science Teaching*, 42(8):947-964.
- De Vaus, D.A. 2001. *Research Design in Social Research*. London: Sage
- Deci, E. & Ryan, R. (eds). 2002. *Handbook of Self-determination Research*. Rochester, NY: University of Rochester Press.
- Delors, J. 1996a Choices for education: The political factor. In Delors, J. (ed.). *Learning: The Treasure Within*. France: UNESCO.
- Denzin, N.K. & Lincoln, Y.S. 2008. (eds). *The Landscape of Qualitative Research*. 4th ed. New York: McGraw-Hill.
- Denzin, N.K. 1989. *The Research Act: A Theoretical Introduction to Sociological Methods*. New York: McGraw-Hill.
- Dessoiff, A. 2010. Reaching digital natives on their terms. *District Administration*, 46(4):36-42. <http://www.districtadministration.com/toc/default.aspx?issuedate> [Retrieved: 4 January 2011].
- Dewey, J. & Bentley, A.F. 1949. *Knowing and the Known*. Boston: Beacon.
- Dextor, S., Anderson, R. & Becker, H. 1999. Teachers' views of computers as catalysts for change in their teaching practice. *Journal of Research and Computing in Education*, 31(3):221-239.
- DHET see South Africa. Department of Higher Education and Training.
- Di Blas, N., Fiore, A., Mainetti, L., Vergallo, R., Poalini, P. 2014. A portal of educational resources: providing evidence for matching pedagogy with technology. *Research in Learning Technology*. <http://dx.doi.org/10.3402/rlt.v22.22906> [Retrieved 29 July 2014].
- Dias, B.L. 1999. *Integrating Technology some things you should know*. ISTE - L&L 27 (3). <http://www.dirkdavis.net/cbu/etc520/resources/Integrating%20Technology.pdf> [Retrieved: 24 May 2012].
- Dias, L. B. (1999). Integrating technology: Some things you should know. *Learning and Leading with Technology*, 27(3):10-13.
- Digital storytelling Association. 2002. <http://www.dsaweb.org/01.associate/ds.html>. [Retrieved: 22 May 2012].
- DoE see South Africa. Department of Education.

- Donnelly, D., McGarr, O. & O'Reilly, J. 2011. A framework for teachers integration of ICT into their classroom practice. *Computers & Education*, 57, 1469-1483.
- Downes, S. 2005. An Introduction to Connective Knowledge. Proceedings of the International Conference held on June 25-26 2007. <http://www.downes.ca/cgi-bin/page.cgi?post=33034> [Retrieved: 12 April 2015].
- Dreyer, L. 2014. Teachers feel ill-equipped to cope in the classroom. University of Stellenbosch. *Cape Argus*, 29 December 2014.
- Dreyfus, H.L. & Dreyfus, S.E. 1986. *Mind over Machine*. Oxford: Basil Blackwell.
- Dreyfus, H.L. 1992. *What Computers Still Can't Do*. Cambridge, Mass: The MIT Press.
- Duff, S. 2014. The latest statistics on South African Internet Penetration. Published by Statistics SA. Pretoria. <http://blog.webafrica.co.za/general/latest-statistics-south-african-internet-penetration/> [Retrieved: 19 December 2014].
- Duffy, T.M. & Jonassen, D. (eds). 1992. *Constructivism and the Technology of Instruction*. Hillsdale NJ: Lawrence Erlbaum Associates.
- DuFour, R. & DuFour, R. 2010. *The Role of Professional Learning Communities in Advancing 21st Century Skills: Rethinking How Student Learn*. Bloomington: Solution Tree Press.
- DuFour, R. & Eaker, R. 1998. *Professional Learning Communities at Work: Best Practices for Enhancing Student Achievement*. Bloomington, IN: National Education Service.
- Eisenhart, M. A. & Howe, K. R. 1992. Validity in educational research. In LeCompte, M.D., Millroy, W.L. & Preissle, J. (eds). *The Handbook of Qualitative Research in Education* (pp. 644-680). San Diego, CA: Academic Press.
- Elen, J. & Lowyck, J. 1999. Metacognitive instructional knowledge: Cognitive mediation and instructional design. *Journal of Structural Learning and Intelligent Systems*, 13, 145-169.
- EMIS see South Africa. Department of Education.
- Erben, T., Ban, R. & Castaneda, M. 2009. *Teaching English Language Learners Through Technology*. New York: Routledge.
- Eriksen, B.A. 2011. *How to Bridge The Digital Divide? Global Studies Spring*. Roskilde University.
- Ernest, P. 1998. *Social constructivism as a Philosophy of Mathematics*. Albany, New York: SUNY Press.
- Erstad, O. 2010. Educating the digital generation. Exploring media literacy for the 21st century. *Nordic Journal of Digital Literacy*, 5(1):55-72.
- Ertmer, P. A. & Ottenbreit-Leftwich, A. T. 2010. Teacher technology change: How knowledge, confidence, beliefs and culture intersect. *Journal of Research on Technology in Education*, 42(3):255-284. [Retrieved: from <http://www.eric.ed.gov/PDFS/EJ882506.pdf>].
- Ertmer, P.A. 2005. Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research & Development*, 53(4):25-39.
- Evala, E. 2013. Online-offline system of evaluating teaching and courses for professional development. Proceedings of the 8th International Conference on e-Learning: ICEL (2013). Academia Conferences Limited, 2013.
- Evanciew, C.E.P. & Rojewski, J. W. 1999. Skill and knowledge acquisition in the workplace: A case study of mentor-apprentice relations in youth apprenticeship programs. *Journal of Industrial Teacher Education*, 36(2):24-54.
- Evoh, C. 2009. Collaborative partnerships and the application of ICTs in Secondary Education in South Africa. In Salmons, J. & Wilson, L. (eds). *Handbook of Research on Electronic Collaboration and Organizational Synergy* Volume I. New York: Information Science Reference.

- Fabry, D.L. & Higgs, J.R. 1997. Barriers to the effective use of technology in education: Current status. *Journal of Educational Computing Research*, 17(4):385-395.
- Fairclough, N. 2003. *Analysing Discourse: Textual Analysis for Social Research*. London: Routledge.
- Faraj, S. & Wasko, M.M. 2002. The web of knowledge: An investigation of self-organizing communities of practice on the net. Unpublished.
- Fenwick, T. & Edwards, R. 2010. *Actor-Network Theory in Education*. London: Routledge.
- Ferrari, A. 2012. *Digital Competence in Practice: An Analysis of Frameworks*. EU, Luxembourg: European Commission Joint Research Centre Institute for Prospective Technological Studies.
- Ferrari, A. 2013. *DIGCOMP: A Framework for Developing and Understanding Digital Competence in Europe*. EU, Luxembourg: European Commission Joint Research Centre Institute for Prospective Technological Studies.
- Fetterman, D.M. 2010. *Ethnography: Step-by-step*. 3rd ed. Stanford University: Sage Publications.
- Fisher, C. 2004. *Research and Writing a Dissertation for Business Students*. Harlow England: Pearson Education Limited.
- Flick, U. 1998. *An Introduction to Qualitative Research*. London: Sage.
- Forcier, R.C. & Descy, D.E. 2005. *The Computer as an Educational Tool: Productivity and Problem Solving*. Upper Saddle River, NJ: Pearson.
- Frazel, M. (2009). *Digital storytelling guide for educators*. Washington, DC: International Society for Technology in Education.
- Freeman, M., deMarras, K., Preissle, J., Roulston, K. & St. Pierre, E.A. 2007. Standards of evidence in qualitative research: An incitement to discourse. *Educational Researcher*, 36(1):25-32.
- Fullan, M. & Hargreaves, A. 1998. *What's Worth Fighting for in Your School? Working Together for Improvement*. Ontario: Open University Press.
- Fullan, M. & Stiegelbauer, S. 1991. *The New Meaning of Educational Change*. New York: Teachers College Press.
- Fullan, M. 1996. Leadership for change. In Leithwood, K., Chapman, J., Corson, D., Hallinger, P. & Hart, A. (eds). *International Handbook of Educational Leadership and Administration*. Dordrecht, Boston, London: Kluwer Academic Publishers.
- Fullan, M. 2007. *The New Meaning of Educational Change*. 4th ed. New York: Teachers College Press.
- Fullan, M. 2011. *Change Leader: Learning to Do What Matters Most*. San Fransisco: Jossey-Bass.
- Gagné, R.M. & Medsker, K. 1996. *The Conditions of Learning: Training Applications*. New York: Harcourt Brace and Company.
- Gall, M. & Breeze, N. 2005. Music composition lessons: The multi-model affordances of technology. *Educational Review*, 57(4):415-33.
- Gall, M., Lazarus, E., Tidmarsh, C. & Breeze, N. In Sutherland, R., Robertson, S. & John, P. 2009. *Improving Classroom Learning with ICT*. London: Routledge.
- Gay, L.R. & Airasian, P. 2003. *Educational Research: Competencies for Analysis and Applications*. 7th ed. New Jersey: Prentice Hall.
- Geddis, A.N., Onslow, B., Beynon, C. & Oesch, J. 1993. Transforming content knowledge learning to teach about isotopes. *Science Education*, 77(6):575-591.

- Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P. & Trow, M. 1994. *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Society*. Stockholm: Sage.
- Giddens, A. 1990. *The Consequences of Modernity*. Oxford: Polity Press.
- Gils, F. 2005. Potential applications of digital storytelling in education. In 3rd Twente Student Conference on IT, University of Twente, Faculty of Electrical Engineering, Mathematics and Computer Science, Enschede, February 17-18.
- Gilster, P. 1997. *Digital Literacy*. Indianapolis IN: Wiley Publishers.
- Giving Life to an Education Vision. *Financial Mail*. 1 December 2006. www.khanya.co.za.
- Glaser, B.G. & Strauss, A.L. 1967. *The Discovery of Grounded Theory*. Chicago, IL: Aldine.
- Glaser, R. 1984. Education and thinking: The role of knowledge. *American Psychology*, 39(2):93-104.
- Glatthorn, A. 1995. Teacher development. In Anderson, L.W. (ed.). *International Encyclopedia of Teaching and Teacher Education*. 2nd ed. London: Pergamon Press.
- Glesne, C. 1999. *Becoming Qualitative Researchers: An Introduction*. 2nd ed. New York: Longman.
- Global Information Technology Report. 2013. Growth and jobs in a hyper connected world. Geneva: World Economic Forum. INSEAD.
- Graham, C.R. 2011. Theoretical considerations for understanding technological pedagogical content knowledge (TPACK). *Computers in Education*, 57(2011):1953-1960.
- Gray, D.E. 2009. *Doing Research in the Real World*. 2nd ed. London: Sage.
- Gredler, M.E. 1997. *Learning and Instruction: Theory Into Practice*, 3rd ed. Upper Saddle River, NJ: Prentice Hall.
- Green, H. & Hannon, C. 2007. Their space for a digital generation. *Demos*. London. <http://www.demos.co.uk/publications/theirspace> [Retrieved: 20 January 2013].
- Griest, G. 1996. Computer education as an obstacle to integration and Internet working. *Learning and Leading with Technology*, 24(8):59-63.
- Grossman, P.L. 1990. *The Making of a Teacher: Teacher Knowledge and Teacher Education*. New York: Teacher College Press.
- Grundy, S. 1987. *Curriculum: Product or Praxis*. London: Falmer Press.
- Guba, E.G. & Lincoln, Y.S. 1994. Competing paradigms in Qualitative research. In Denzin, N.K. & Lincoln, Y.S. (eds). *The Handbook of Qualitative Research*. London: Sage.
- Guo, Y., Justice, M. & Sawyer, B. 2011. Exploring factors related to preschool teachers' self-efficacy. *Teaching and Teacher Education*, 27:916-918.
- Habermas, J. 1972. *Knowledge and Human Interests*. London: Heineman.
- Habermas, J. 1984. *The Theory of Communicative Action*. (Vol. 1) *Reason and the Rationalization of Society*. Translated by McCarthy, T. Boston, MA: Beacon.
- Hague, C. & Williamson, B. 2009. Digital participation, digital literacy and school subjects. A review of the policies, literature and evidence. Bristol: Future Lab. www.futurelab.org.uk/resources/documents/lit_reviews/DigitalParticipation.pdf [Retrieved: 15 August 2015].
- Hall, B.L. 1999. How to do ethnographic research: A simplified guide [On-line]. Available: www.sas.upenn.edu/anthro/CPIA/METHODS/ [Retrieved: 13 March 2012].
- Hammersley, M. & Atkinson, P. 1983. *Ethnography: Principles in Practice*. London: Tavistock.

- Hammersley, M. 1992b. *What's Wrong With Ethnography? Methodological Explorations*. London: Routledge.
- Hannon, J. & Bretag, T. 2010. Negotiating contested discourses of learning technologies in higher education. *Educational Technology and Society*, 13(1):106-120.
- Harasim, L.M. 2012. *Learning Theory and Online Technologies*. New York: Routledge.
- Hardy, J.V. 1998. Teacher attitudes toward and knowledge of computer technology. *Computers in the Schools*, 14(3-4):119-136.
- Hargreaves, A. & Fullan, M.G. 1992. *Understanding Teacher Development*. London: Cassell.
- Hargreaves, A. 1994. *Changing Teachers, Changing Times: Teachers' Work and Culture in the Post-modern Age*. New York: Teachers' College Press.
- Hargreaves, A. 2012. *Self Improving School System: Towards Maturity*. Nottingham: National College for School Leadership.
- Harrington, R.A. 2008. The development of pre-service teachers' technology specific pedagogy. *Dissertation Abstracts International-A*, 69(3). UMI No. AAT 3309570.
- Harris, J. 2005. Our agenda for technology integration: It's time to choose. *Contemporary Issues in Technology and Teacher Education*, 5(2)
<http://www.citejournal.org/vol5/iss2/editorial/article1.cfm>. [Retrieved: 25 May 2012].
- Harris, J., Grandgenett, N. & Hofer, M. 2010. Testing a TPACK-based technology integration assessment instrument. In Maddux, C.D., Gibson, D. & Dodge, B. (eds). *Research Highlights in Technology and Teacher Education 2010* (pp. 323-331). Chesapeake, VA: Society for Information Technology and Teacher Education (SITE).
- Harris, J., Grandgenett, N. & Hofer, M. 2012. Testing an instrument using structured interviews to assess experienced teachers' TPACK. In Maddux, C.D., Gibson, D. & Rose, R. (eds). *Research Highlights in Technology and Teacher Education 2012* (pp. in press). Chesapeake, VA: Society for Information Technology & Teacher Education (SITE).
- 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.
- Harris, J.B. & Hofer, M.J. 2011. Technological pedagogical content knowledge (TPACK) in action: A descriptive study of secondary teachers' curriculum-based, Technology-related instructional planning. *Journal of Research on Technology in Education*, 43(3):211-229.
- Hartas, D. 2010. (ed.). *Educational Research and Enquiry: Qualitative and Quantitative Approaches*. London: Anthony Rowe.
- Hattie, J. 2009. *Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement*. Oxford: Routledge.
- Hattie, J. 2015. *What Doesn't Work in Education: The Politics of Distraction*. London: Pearson.
- Hauge, T.E., Lund, A. & Vestol, J.M. 2007. *Teaching in Transformation: ICT, Activity, Design*. Oslo: Abstrakt Forlag.
- Haugsbakk, G. 2011. ICT in schools with teachers on the sidelines. Critical gaze on school foundation documents. In Hauge, T.E. & Lund, A. (eds). *Small Steps or Leaps. About Digital Conditions in Schools* (pp. 249-273). Oslo: Cappelen Academic.
- Heath, S.B. & Street, B. 2008. *On Ethnography: Approaches to Language and Literacy Research*. New York: Teachers College Press.
- Hennessy, S. 2014. *Bridging Between Research and Practice: Supporting Professional Development Through Collaborative Studies of Classroom Teaching with Technology*. Rotterdam: Sense Publishers.

- Henning, E. 2004. *Finding Your Way in Qualitative Research*. Pretoria: Van Schaik
- Hermans, R., Tondeur, J., van Braak, J. & Valcke, M. 2008. The impact of primary school teachers' educational beliefs on the classroom use of computers. *Computers & Education*, 51:1499-1509.
- Hernandez-Ramos, P. 2005. If not here, where? Understanding teachers' use of technology in Silicon Valley schools. *Journal of Research and Technology in Education. International Society for Technology in Education*, 38(1):39-64.
- Herrington, J., Oliver, R. & Reeves, C. 2003. Patterns of engagement in authentic online learning environments. *Australian Journal of Educational Technology*, 19(1):59-71.
- Hickman, L. 1990. *John Dewey's Pragmatic Technology*. Bloomington: Indiana University Press.
- Higgins, S., Beauchamps, G. & Miller, D. 2007. Reviewing the literature on interactive whiteboards. *Learning, Media and Technology*, 32(3):213-226.
- Hirsch, S. 2013. *Learning Forward*. Washington DC: National Education Association.
- Hitchcock, G. & Hughes, D. 1995. *Research and the Teacher*. 2nd ed. London: Routledge.
- Hmelo-Silver, C., Duncan, R. G. & Chinn, C. A. 2007. Scaffolding and achievement in problem-based and inquiry learning: A response to Kirschner, Sweller and Clar (2006). *Educational Psychologist*, 42(2):99-107.
- Hoepfl, M.C. 1997. Choosing qualitative research: A primer for technology education researchers. *Journal of Technology Education*, 9(1):47-63. <http://scholar.lib.vt.edu/ejournals/JCTE/v19n1/foster.html> [Retrieved: 6 June 2012].
- Hofer, M. & Swan, K.O. 2008. Technological pedagogical content knowledge in action: A case study of a middle school digital documentary project. *Journal of Research on Technology in Education (JRTE)*, 41(2):179-200.
- Hogg, L. 2010. Funds of knowledge: An investigation of coherence within the literature. *Teaching and Teacher Education*, 27(3):666-677.
- Holiday, A. 2002. *Doing and Writing Qualitative Research*. London: Sage.
- Holum, A. & Gahala, J. 2001. Critical issue: using technology to enhance literacy instruction. *Educational Research and Improvement*. Oak Brooke: Washington, DC.
- Honan, E. 2010. Mapping discourses in teachers' talk about using digital texts in classrooms. *Discourse: Studies in Cultural Politics of Education*, 31(2):179-193.
- Hope, W.C. 1997. Resolving teachers' concerns about microcomputer technology. *Computers in the Schools*, 13(3-4):147-160.
- Hopkins, D. 2008. *A Teachers Guide to Classroom Research*. Maidenhead: McGraw-Hill: Open University Press.
- Howell, C. & Lundall, P. 2000. Computers in schools. Project coordinators of the national survey. Bellville: University of the Western Cape.
- Hsieh, J.J.P., Rai, A. & Keil, M. 2008. Understanding digital inequality. Comparing Continued Use Behavioral Models of the socio-economically advantaged and disadvantaged. *MIS Quarterly*, 32(1):97-126.
- Hu, C. & Fyfe, V. 2010. Impact of a new curriculum on pre-service teachers' Technical, Pedagogical and Content Knowledge (TPACK). In *Curriculum, Technology & Transformation for an Unknown Future*. Proceedings ascilite Sydney 2010 http://www.ascilite.org.au/conferences/sydney10/Ascilite%20conference%20proceedings%202010/Chun_Hu-concise.pdf. [Retrieved: 4 April 2015].

- Huberman, M. 1992. Teacher development and instructional mastery. In Hargreaves, A. & Fullan, M. (eds). *Understanding Teacher Development*. London: Cassell.
- Huffman, S. & Rickman, W. 2004. Technology planning: The simple model. *Educational Technology* 44(4):36-40.
- Imbizo for African Youth, 2001. Transcription of remarks at the Imbizo in honour of African youth attending the ITU telecom 2001. Youth Forum.
<http://www.thepresidency.gov.za/pebble.asp?reid=2737> [Retrieved: 18 March 2012].
- Inan, F. & Lowther, D. 2010. Factors affecting technology integration in K-12 classrooms: a path model. *Education Tech Research Dev*, 58:137-154.
- Ingvarson, L. 2013. *Professional certification: Promoting, and Recognising Successful Teaching Practices*. Paper presented at the Sustaining Teachers' Professional Growth Cambridge Seminar.
- Innovative Teaching and Learning (ITL). Microsoft Partners in Learning. WWW. itlresearch.com. [Retrieved: 15 June 2015].
- International ICT Literacy Panel. 2007. Digital Transformation. A Framework for ICT Literacy: ETS. http://www.ets.org/Media/Tests/Information_and_Communication_Technology_Lit. [Retrieved 11 November 2013].
- International Telecommunication Union. 2007. Telecommunication: *ICT Markets and Trends in Africa*. http://www.itu.int/ITU-D/ICT/statistics/material/af_report07.pdf [Retrieved: 10 March 2012].
- International Telecommunication Union. 2013. *Measuring the Information Society*. www.itu.int/en/ITU-D/Statistics/Pages/publications/mis2013.aspx [Retrieved: 10 December 2013].
- International Telecommunication Union. 2015. *Market and Regulatory Trends in the ICT sector*. In Trends in Telecommunication Reform 2015. <http://www.itu.int/en/Pages/default.aspx> [Retrieved: 4 July 2015].
- Isil, K.Y., Hattice, F.O., Kilicer, K., Ahmet, N.C. Birinci, G. & Adile, A.K. 2011. The development, validity and reliability of TPACK-deep: A pedagogical content knowledge scale. *Computers & Education*, 58:964-977.
- Isreal, M. & Hay, I. 2006. *Research Ethics for Social Scientists: Between Ethical Conduct and Regulatory Compliance*. London: Sage.
- ITU see International Telecommunication Union.
- Jacobsen, M. 2001. Building different bridges: Technology integration, engaged student learning, and new approaches to professional development. Paper presented at AERA 2001: What we know and how we know it, the 82nd Annual Meeting of the American Educational Research Association, Seattle, WA, April 10-14.
- James, C. R., Dunning, G., Connolly, M. & Elliott, T. 2007. Collaborative practice: A model of successful working in schools. *Journal of Educational Administration*, 45(5):541-555.
- James, M. & McCormick, R. 2009. Teachers learn how to learn. *Teaching and Teacher Education*, 25:973-982.
- Jansen, J.D. 1998. Curriculum reform in South Africa: A critical analysis of outcomes-based education. *Cambridge Journal of Education*, 28(3):321-331.
- John, P.D. & Sutherland, R. 2004. Teaching and learning with ICT: New technology, new pedagogy? *Education, Communication & Information*, 4(1):101-107.
- John, P.D. & Wheeler, S. 2007. *The digital classroom. Harnessing technology for the future*. Fulton Publishers.

- Johnson, K. (ed.). 2005. *Expertise in second language learning and teaching*. Palgrave MacMillan: New York.
- Johnson, L., Levine, A., Smith, R. & Smythe, T. 2009. *The 2009 Horizon Report: K-12 edition*. Austin, Texas: The New Media Consortium. <http://www.nmc.org/pdf/2009-Horizon-Report-K12.pdf> [Retrieved: 26 August 2015].
- Jonassen, D.H. (ed.). 2004. *Handbook of Research on Educational Communications and Technology*. 2nd ed. Mahwah, NJ: Lawrence Erlbaum Associates.
- Jonassen, D.H. & Carr, C. 2000. Mind tools: Affording multiple knowledge representations in learning. In S. P. Lajoie (ed.). *Computers as Cognitive Tools, Vol. 2: No More Walls* (pp. 165-196). Mahwah, NJ: Lawrence Erlbaum Associates.
- Jonassen, D.H. 1994. Technology as cognitive tools: Learners as designers. *Instructional Technology Forum*, paper #1. <http://it.coe.uga.edu/itforum/paper/1/paper1.html>. [Retrieved: 26 November 2011].
- Jones, A. & Moreland, J. 2004. Enhancing practicing primary school teachers' pedagogical content knowledge in technology. *International Journal of Technology and Design Education*, 14:121-140.
- Joyce, B. & Showers, B. 1988. *Student Achievement Through Staff Development*. New York: Longman.
- Joyes, G. & Chen, Z. 2006. An Activity theory approach to the exploration of tutor's perceptions of effective online pedagogy. Paper presented at the 23rd annual ascilite conference: Who's learning? Whose technology? Sydney.
- Katz, I.R. 2004. Assessing information and communications technology literacy for higher education. Paper presented at the Annual Meeting of the International Association for Educational Assessment, Philadelphia, Pa.
- Kawooya, D. 2004. Universal access to ICT and lifelong learning: Uganda's experience. *New Library World*, 105(1206/1207):423-428.
- Kaya, Z., Özdemir, T.Y., Emre, G. & Kaya, O.N. 2011. Exploring pre-service information technology teachers' perception of self-efficacy in web-technological pedagogical content knowledge. 6th International Advanced Technologies Symposium (IATS' 11), 16-18 May, Elazig, Turkey.
- Keane, T., Keane, W.F. & Blicblau, A.S. 2013. The use of educational technologies to equip students with 21st century skills. X world Conference on Computers in Education, July 2-5, 2013, Torun, Poland.
- Keating, T. & Evans, E. 2001. Three computers in the Back of the Classroom: Preservice Teachers' Conceptions of Technology integration. Paper presented at the Society for Paper code: 2145 Information Technology & Teacher Education International Conference 2001, Chesapeake, VA.
- Kebede, G. 2004. The information needs of end-users of Sub-Saharan Africa in the digital information environment. *International Library and Information Review*, 36(3):273-279.
- Keengwe, J., Onchwari, G. & Wachira, P. 2008b. The use of computer tools to support meaningful learning. *Association for the advancement of computing in Education Journal*, 16, 77-92.
- Kelle, U. & Laurie, H. 1995. Computer use in qualitative research and issues of validity. In Kelle, U. (ed.). *Computer-aided Qualitative Data Analysis* (pp. 19-20). London: Sage.
- Kelly, A.V. 1980. *Curriculum context*. London: Paul Chapman Publishing.
- Kelly, A.V. 1983;1999. *The Curriculum. Theory and Practice*. 4th ed. London: Paul Chapman Publishing.

- Kelly, A.V. 2009. *The Curriculum: Theory and Practice*. Thousand Oaks California: Sage.
- Killen, R. 2007. *Teaching Strategies for Outcomes-based Education*. 2nd ed. Cape Town: Juta.
- Kim, W. 2007. Toward a definition and methodology for blended learning. *Workshop for Blended Learning 2007*. (pp. 1-8). http://www.cs.cityu.edu.hk/~wbl20007/WBL2007_Proceedings_HTML/WBL2007_Proceedings.pdf [Retrieved: 8 January 2013].
- King, N. & Horrocks, C. 2010. *Interviews in Qualitative Research*. Sage: London.
- Kirkwood, A. & Price, L. 2005. Learners and Learning in the 21st Century: What do we know about students' attitudes and experiences of CiT that will help us design courses? *Studies in Higher Education*, 30(3):257-274.
- Kitchens, J. 2009. Situated pedagogy and the situationist international: countering a pedagogy of placeness. *Educational Studies*, 45:240-261.
- Klopfer, E. 2008. *Augmented Learning: Research and Design of Mobile Educational Games*. Cambridge MA: MIT Press.
- Klopfer, E., Osterweil, S., Groff, J. & Haas, J. 2009. *Using the Technology of Today in the Classrooms of Tomorrow: The Instructional Power of Digital Games, Social Networking Simulations and How Teachers' Can Leverage Them*. The Education Arcade. Massachusetts Institute of Technology. Creative Commons.
- Knowles, M.S. 1980. *The Modern Practice of Adult Education: From Pedagogy to Andragogy*. New York: Cambridge Books.
- Knowles, M.S. 1990. *The Adult Learner: A Neglected Species*. Houston, TX: Gulf.
- Koehler, M. 2003. *Technological Pedagogical and Content Knowledge*. [Http://www.tpck.org/](http://www.tpck.org/) [Retrieved: 18 December 2011].
- Koehler, M.J. & Mishra, P. 2005. Teachers learning technology by design. *Journal of Computing in Teacher Education*, 21(3):94-102.
- Koehler, M.J. & Mishra, P. 2005. What happens when teachers design educational technology? The development of technological pedagogical content knowledge. *Journal Educational Computer Research*, 32(2):131-152.
- Koehler, M.J. & Mishra, P. 2008. Introducing TCPK. In AACTE Committee on Innovation and Technology (eds). *Handbook of Technological Pedagogical Content Knowledge (TPCK) for Educators* (pp. 3-29). New York: Routledge.
- Koehler, M.J. & Mishra, P. 2009. What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education*, 9(1). [Http://www.citejournal.org/vol9/iss1/general/artical1.cfm](http://www.citejournal.org/vol9/iss1/general/artical1.cfm). [Retrieved: 18 May 2015].
- Koehler, M.J., Shin, T.S. & Mishra, P. 2012. In Ronau, R.N., Rakes, C.R. & Niess, M.L. *Educational Technology, Teacher Knowledge and Classroom Impact: A Research Handbook on Frameworks and Approaches*. Hershey PA: Information Science Reference.
- Koh, J.H.L., Chai, C.S. & Tsai, C. 2013. Demographic factors, TPACK constructs and teachers' perceptions of constructivist-orientated TPACK. *Journal of Educational Technology and Society*, 17(1):185-196.
- Kolodner, J.L., Camp, P. J., Crismond, D., Fasse, B., Gray, J., Holbrook, J., Puntambekar, S. & Ryan, M. 2003. Problem-based learning meets case-based reasoning in the middle-school science classroom: Putting Learning by Design™ into practice. *Journal of the Learning Sciences*, 12(4):495-547.
- Köning, J. & Ertmer P.A. 2012. *Teachers' Pedagogical Beliefs*. Germany: Waxmann, Verlag.
- Konopasek, Z. 2008. Making thinking visible with ATLAS.ti: Computer-assisted qualitative analysis as textual practices. *Forum: Qualitative Social Research*, 9(2):Art.12.

- Kopcha, T.J. & Sullivan, H. 2007. Self-presentation bias in surveys of teachers' educational technology practices. *Educational Technology Research and Development*, 55(6):627-646.
- Kotter, J.P. & Cohen, D.S. 2002. *The Heart of Change: Real-Life Stories of How People Change Their Organisations*. Boston: Harvard Business School Press.
- Kraak, A. 1998. Competing education and training policy discourses: A systemic versus unit standards framework. In Jansen, J. & Christie, P. (eds). *Changing Curriculum: Studies on Outcomes-Based Education in South Africa*. Kenwyn: Juta.
- Kramer, D. 1999. *OBE Teaching Toolbox: OBE Strategies, Tools and Techniques for Implementing Curriculum 2005*. Cape Town: Juta.
- Krefting, L. 1991. Rigor in qualitative research: the assessment of trustworthiness. *American Journal of Occupational Therapy*, 45(3):214-221.
- Kress, G. 1989. *Linguistic Processes in Sociocultural Practice*. Oxford: Oxford University Press.
- Kress, G. 2000. *Multimodality*. In Cope, B. & Kalantzis, M. (eds). *Multiliteracies: Literacy Learning and the Design of Social Futures* (pp. 182-202). New York: Routledge.
- Kruger, J. 2012. A design-based research approach implementing a palette of educational technologies to foster 21st century skills. Proceedings ascilite 2012 paper presented 25-28 November, Wellington, New Zealand (pp. 519-528).
- Kuhn, T. 1977. *The Essential Tension*. Chicago, IL: The University of Chicago Press.
- Kuhn, T.S. 1977 [1959]. The essential tension: Tradition and innovation in scientific research. In T.S. Kuhn (ed.). *The Essential Tension: Selected Studies in Scientific Tradition and Change* (pp. 225-239). Chicago & London: Chicago University Press.
- Lam, Y. 2000. Technophilia vs. technophobia: A preliminary look at why second-language teachers do or do not use technology in their classrooms. *Canadian Modern Language Review*, 56(3):390-420.
- Lambert, J. 2006. *Digital storytelling: Capturing Lives Creating Community*. 2nd ed. Digital Diner Press, Berkeley: California.
- Lambert, L. 2003. *Leadership Capacity for Lasting School Improvement*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Landauer, T.K. & Dumais, S.T. 1997. A Solution to Plato's Problem: The Latent Semantic Analysis Theory of Acquisition, Induction and Representation of Knowledge. <http://lsa.colorado.edu/papers/plato/plato.annote.html> [Retrieved: 10 December 2013].
- Lankshear, C. & Knobel, M. (eds). 2008. *Digital literacies: Concepts, Policies and Practices*. New York: Peter Lang Publishing.
- Lankshear, C. & Knobel, M. 2011. *New Literacies: Changing Knowledge and Classroom Learning*. 3rd ed. Buckingham: Open University Press.
- Lave, J. & Wenger, E. 1999. *Situated Learning: Legitimate Peripheral Participation*. Cambridge, England: 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, 575-614.
- Leedy, P.D. & Ormrod, J.E. 2005. *Practical Research*. 8th ed. Upper Saddle River, New Jersey: Pearson Education.
- Lefebvre, S., Deaudelin, D. & Loisel, J. 2006. ICT implementation stages of primary school teachers: The practices and conceptions of teaching of teaching and learning. Paper presented at the Australian Association for Research in Education National Conference, Adelaide, Australia.

- Lenhart, A. 2002. Barriers to Internet Access: From the Non-user and New User Perspective. Paper presented at the Association of Internet Researcher, Conference 3.0, Maastricht, Netherlands, October 14.
- Lester, J. & Paulus, T. 2011. Accountability and public displays of knowing in an undergraduate computer-mediated communication context. *Discourse Studies*, 13(6):671-686.
- Levin, T. & Wadmany, R. 2006. Teachers' views on factors affecting effective integration of information technology in the classroom: Developmental scenery. *Journal of Technology and Teacher Education*, 16:233-263.
- Lieberman, A. & Miller, L. 2007. Transforming professional development: Understanding and organizing learning communities. In Hawley, W.D. & Rollie, D.L. (eds). *The Keys to Effective Schools: Educational Reform as Continuous Improvement*. 2nd ed. (pp. 99-116). Thousand Oaks, CA: Corwin.
- Lima, J. A. 2001. Forgetting about friendship Using conflict in teacher communities as a catalyst for school change. *Journal of Educational Change*, 2(2):97-122.
- Lincoln, Y.S. & Guba, E.G. 1985. *Naturalistic Inquiry*. Newbury Park: Sage.
- Lofland, J., Snow, D., Anderson, L. & Lofland, L.H. 2006. *Analyzing Social Settings: A Guide to Qualitative Observation and Analysis*. Belmont, CA: Wadsworth/Thomson.
- Lund, A. & Hauge, T.E. 2011b. Technology in use - Some lessons about change in schools and teacher professional development. *Nordic Journal of Digital Literacy*, (4):204-206.
- Lundall, P. & Howell, C. 2000. *Computers in Schools: A National Survey of Information Communication Technology in South African Schools*. Johannesburg: Shereno Printers.
- Ma, A.K.F., O'Toole, J.M. & Keppell, M. 2008. An investigation of student teachers' attitudes to the use of media triggered problem based learning. *Australasian Journal of Educational Technology*, 24(3):311-325. <http://www.ascilite.org.au/ajet/ajet24/ma.html>
- MacManus, R. & Porter, J. 2005. Web 2.0 for designers. Digital Web Magazine.
- Magnusson, S., Krajacik, J. & Borke, H. 1999. Nature sources and development of PCK for science teaching. In Gess-Newsome, J. & Lederman, N.G. (eds). *Examining PCK: The Construct and its Implications for Science Education* (pp. 95-120). Boston: Kluwer Academic Press.
- Malderez, A. & Bódoczky, C. 1999. *Mentor Courses: A Resource Book for Trainer-Trainers*. New York: Cambridge University Press.
- Margerum-Lays, J. & Marx, R.W. 2003. Teacher knowledge of educational technology: A case study of student/mentor teacher pairs. In Zhao, Y. (ed.). *What Should Teachers Know About Technology? Perspectives and Practices* (pp. 123-159). Greenwich, CO: Information Age Publishing.
- Marshall, C. & Rossman, G.B. 1999. *Designing Qualitative Research*. Thousand Oaks, CA: Sage.
- Martin, A. & Grudziecki, J. 2006. DigEuLit: Concepts and Tools for Digital Literacy Development. *ITALICS (Innovations in Teaching and Learning in Information and Computer Sciences)*, (4):246-264.
- Martinez, S. & Harper, D. 2008. Working with tech-savvy kids. *Educational Leadership*, 66(3):64-69.
- Mason, J. 1996. *Qualitative researching*. London: Sage.
- Mason, J. 2006. Mixing methods in a qualitatively driven way. *Qualitative Research*, 6(1):9-26.
- Maxwell, J. A. 2004a. Re-emergent scientism, postmodernism, and dialogue across differences. *Qualitative Inquiry*, 10(1):35-41.

- Maxwell, J.A. 1992. Understanding validity in qualitative research. *Harvard Educational Review*, 62(3):279-298.
- Maxwell, J.A. 2004b. Using qualitative methods for causal explanations. *Field Methods*, 16(3):243–264.
- Mbeki, T. 2001. Imbizo for South African Youth, Transcription of remarks at the Imbizo in honour of the African Youth Attending the ITU Telecom Africa 2001 Youth Forum. <http://www.thepresidency.gov.za/pebble.asp?reid=2737> [Retrieved: 8 April 2013].
- 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.
- McLaughlin, M. & Talbert, J. 2001. *Professional Communities and the Work of High School Teaching*. Chicago: University of Chicago.
- McMillan, J.H. & Schumacher, S. 2014. *Research in Education: Evidence-based Enquiry*. 7th ed. London: Pearson.
- McMillan, J.H. & Schumacher, S.S. 1989. *Research in Education*. 2nd ed. Glenview: Scott, Foresman.
- McMillan, J.H. & Schumacher, S.S. 1997. *Research in Education: A Conceptual Introduction*. New York: Longman.
- McMillan, J.H. & Schumacher, S.S. 2001. *Research in Education: A Conceptual Introduction*. 5th ed. New York: Longman.
- Meadows, D. 2003. Digital storytelling: Research-based practice in new media. *Visual Communication*, 2(2):189-193.
- Mercer, N., Hennessy, S. & Warwick, P. 2010. Using interactive whiteboards to orchestrate classroom dialogue. *Technology, Pedagogy and Education*, 19(2):195-210.
- Mereku, K.D. 2011. *The Role of ICTs in Marginalized Schooling Contexts*. Winneba, Ghana.
- Merriam, S. 1998. *Qualitative Research and Case Study Applications in Education*. 2nd ed. San Francisco: Jossey-Bass.
- Mertens, D.M. 2005. *Research Methods in Education and Psychology: Integrating Diversity With Quantitative and Qualitative Approaches*. 2nd ed. Thousand Oaks: Sage.
- Miao, F. 2011. ICT Competency Framework for teachers (ICT-CFT) and Institutional Strategy for Teacher Training on ICT-pedagogy. <http://www.unesco.org/new/en/unesco/themes/icts> [Retrieved: 16 November 2014].
- Microsoft partners in learning. 21st Century Learning Design. Innovative Teaching and Learning. SRI International.
- Miles, M.B. & Huberman, A.M. 1994. *Qualitative Data Analyses: An Expanded Sourcebook*. Thousand Oaks, CA: Sage.
- Mishra, P. & Koehler, M. 2009. What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education*, 9(1). <http://www.citejournal.org/vol9/iss1/general/article1.cfm> [Retrieved: 15 October 2013].
- Mishra, P. & Koehler, M. J. 2006. Technological pedagogical content knowledge: A framework for teacher knowledge. *Teacher's College Record*, 108(6):1017-1054.
- Mishra, P. & Koehler, M.J. 2003. Not "what" but "how": Becoming design-wise about educational technology. In Zhao, Y. (ed.). *What Teachers Should Know About Technology: Perspectives and Practices* (pp. 99-122). Greenwich, CT: Information Age Publishing.
- Moore, A. 2004. *The Good Teacher*. New York: Routledge.

- Morsink, P., Hagerman, M., Heinitz, A., Boyer, D., Harris, R. & Kereluik, K. 2011. Professional development to support TPACK technology integration: The initial learning trajectories of thirteen fifth- and sixth-grade educators. *Journal of Education*, 191(2):3-16.
- Motshekga, A. (presenter) 2009. Final Report of the Task Team for the Review of the Implementation of the National Curriculum Statement. DoE: Pretoria
<http://education.pwv.gov.za> [Retrieved: 27 April 2014].
- Mouton, J. 2005. *How to Succeed in your Master's & Doctoral Studies*. Pretoria: Van Schaik Publishers.
- Mouza, C. 2011. Promoting urban teachers' understanding of technology, content and pedagogy in the context of case development. *Journal of Research of Technology in Education*, 44(1):1-29.
- Mueller, J., Wood, E., Willoughby, T., Ross, C. & Specht, J. 2008. Identifying discriminating variables between teachers who fully integrate computers and teachers with limited integration. *Computers & Education*, 51:1523-1537.
- Muffoletto, R. 2001. *Education and Technology: Critical and Reflective Practices*. Cresskill NJ: Hampton Press.
- Murdoch, G. 2002. Rethinking communication exclusion. In: *Digital divide: A collection of papers from the Toshiba/BECTA digital divide seminar*. 19 February. British Educational Communications and Technology Agency, Coventry.
- Murray, M. 2008. Narrative psychology. In Smith, J.A. (ed.). *Qualitative Psychology: A Practical Guide to Research Methods*. 2nd ed. London: Sage.
- National Center for Education Statistics. 2005. Internet access in U.S. public schools and classrooms: 1994-2003 (No. NCES 20005-15). Washington, DC: U.S. Department of Education.
- Nes, K. & Wikan, G. 2013. Interactive whiteboards as artefacts to support dialogic learning spaces in primary schools. *International Journal of Media, Technology and Lifelong Learning*, 9(2).
- Newhouse, P. 2002. *Literature Review: The Impact of ICT on Learning and Teaching*. Perth, Western Australia: Department of Education.
- Niacker, S. 2013. Underperformance in the schooling system: The need for improved planning that focuses on the key policy challenges. In Sayed, Y., Kanjee, A. & Nkomo, M. (eds). *The Search for Quality Education in Post-Apartheid South Africa. Interventions to Improve Learning and Teaching*. South Africa: HSRC Press.
- Nias, J. 2005. Why teachers need their colleagues: A developmental perspective. In Hopkins, D. (ed.). *The Practice and Theory of School Improvement* (pp. 223-237). Dordrecht, The Netherlands: Springer.
- 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.
- Niess, M.L. 2011. Investigating TPACK: Knowledge growth in teaching with technology. *Journal of Educational Computing Research*, 44(3):299-317.
- Niess, M.L. 2012. Teacher knowledge for teaching with technology: A TPACK lens. In Ronau, R.N., Rakes, C.R. & Niess, M.L. *Educational Technology, Teacher Knowledge and Classroom Impact: A Research Handbook on Frameworks and Approaches*. Thousand Oaks: Sage.
- Nkomo, M., Sayed, Y. & Kanjee, A. 2013. Policy debates and issues: Context, contests and contradictions. In Sayed, Y., Kanjee, A. & Nkomo, M. (eds). *The Search for Quality Education in Post-Apartheid South Africa. Interventions to Improve Learning and Teaching*. South Africa: HSRC Press.

- Nkula, K. & Krauss, K.E. 2014. The integration of ICTs in marginalized schools in South Africa: Considerations for understanding the perceptions of in-service teachers and the role of training. South Africa, Grahamstown: Rhodes University.
- Norman, D.A. 2002. *The Design of Everyday Things*. New York: Basic Books.
- Norton, S., McRobbie, C.J. & Cooper, T.J. 2000. Exploring secondary mathematics teachers' reasons for not using computers in their teaching: Five case studies. *Journal of Research on Computing in Education*, 33(1):87-109.
- Nummedal, S.G., Benson, J.B. & Chew, S.L. 2002. Disciplinary styles in the scholarship of teaching and learning: A view from psychology. Disciplinary styles in the scholarship of teaching and learning: *Exploring Common Ground*, 163-179.
- Oberg, A. & Underwood, S. 1992. Facilitating teacher self-development: Reflections on experience. In Hargreaves, A. & Fullan, M.G. (eds). *Understanding Teacher Development* (pp. 162-177). New York: Teacher College Press.
- OECD 2010. Assessing the Effects of ICT in Education Indicators, Criteria and Benchmarks for International Comparisons: Indicators, Criteria and Benchmarks for International Comparisons Office of Technology Assessment. 1995. Teachers and technology: Making the connection, Washington, DC: U.S. Government Printing Office.
- Ohler, J. 2006. The world of digital storytelling. *Educational Leadership*, 63(4):44-47.
- Oliver, M. & Conole, G. 2002. Assessing and enhancing quality using toolkits. *Journal of Quality Assurance in Education*, 8(1):32-37.
- Ottenbreit-Leftwich, A.T. 2007. Expert technology-using teachers: visions, strategies and development. Unpublished dissertation. West Lafayette: Purdue University.
- Pahomov, L. 2014. *Authentic Learning in the Digital Age: Engaging Students Through Enquiry*. Alexandria, Virginia: ASCD.
- Papa, R. (ed.). 2011. *Technology Leadership for School Improvement*. London: Sage.
- Papert, S. 1980. *Mindstorms: Children, Computers and Powerful Ideas*. New York: Basic Books.
- Parasuraman, A. & Colby, C.L. 2001. *Techno-ready Marketing: How and Why Your Customers Adopt Technology*. New York, NY: The Free Press.
- Parasuraman, A. 2000. Technology Readiness Index (TRI). A multiple-item scale to measure readiness to embrace new technologies. *Journal of Service Research*, 2(4):307-320.
- Park, S. & Oliver, J.S. 2007. Revisiting the Conceptualisation of Pedagogical Content Knowledge (PCK): PCK as a conceptual tool to understand teachers' as professionals. Published online: Springer Science and Business Media B.V.
- Park, S. 2014. Trajectory from Portraying toward Assessing Pedagogical Content Knowledge (PCK): Drives, dilemmas, and directions for future research. Paper presented at University of Cape Town. 11 August 2014.
- Parks, S., Huot, D., Hamers, J.H. & Lemonnier, F. 2003. Crossing boundaries: Multimedia technology and pedagogical innovation in a high school class. *Language Learning & Technology*, 7(1):28-45.
- Partnership for 21st century learning. 2007. Framework for 21st century learning. <http://www.21stcenturyskills.org>. [Retrieved: 26 July 2014].
- Patton, M.O. 2002. *Qualitative Research and Evaluation Methods*. 3rd ed. Thousand Oaks: Sage.
- Pedersen, E. 1995. The art of teaching. *Forum*, 33(1) <http://exchanges.state.gov/forum>. [Retrieved 17 February 2008].

- Pelgrum, W.J. & Anderson R.E. 1999. *ICT and the Emerging Paradigm for Life Long Learning: A Worldwide Assessment of Infrastructure, Goals and Practices*. Amsterdam: International Association for the Evaluation of Educational Achievement.
- Pelgrum, W.J. & Voogt, J. 2009. School and teacher factors associated with frequency of ICT use by mathematics teachers; country comparisons. *Educ INF Technology*, 14, 293-308.
- Peshkin, A. 2000. The nature of interpretation in qualitative research. *Educational Researcher*, 29(9):5-10.
- Pfeffer, J. Sutton, R.I. 2006. *Hard Facts, Dangerous Half Truths and Total Nonsense: Profiting from Evidence-Based Management*. Boston: Harvard Business School Press.
- Pierson, M. 2001. Technology integration practice as a function of pedagogical expertise. *Journal of Research on Computing in Education*, 33(4):413-430.
- Pillow, W. 2003. Confession, catharsis, or cure? Re-thinking the uses of reflexivity as methodological power in qualitative research. *International Journal of Qualitative Studies in Education*, 16(2):175-179.
- Pinnock, A.J.E. 2011. *A Practical Guide to Implementing CAPS: A Toolkit for Teachers' Schools Managers and Education Officials to Use to Assist in Managing the Implementation of a New Curriculum*. Alexandra: NAPTOSA.
- PISA. 2006. *Education at a glance 2006*. Highlights. www.oecd.org/edu/skills-beyond-school/ [Retrieved: 13 March 2011].
- Popkewitz, T.S., Tabachnick, B.R. & Zeichner, K. 1979. Dulling the senses: Research in teacher education. *Journal of Teacher Education*, 30(5):52-60.
- Prensky, M. 2001. Digital natives, digital immigrants. *On the Horizon*, 9(5):1-5.
- Prensky, M. 2008. The courage to change: Guiding teachers to the new paradigm. *Educational Technology*, 48(3).
- Priestley, M., Edwards, R., Priestley, A. & Miller, K. 2012. Teacher agency in curriculum making: Agents of change and space for manoeuvre. *Curriculum Inquiry*, 42(2):191-214.
- Pritchard, A. 2004. Introducing new students to ICT: Giving a purpose to it all. *Active Learning in Higher Education*, 5(3):248-262.
- Puentedura, R. 2006. Transformation, technology, and education. <http://hippasus.com/resources/tte/> [Retrieved: 4 April 2015].
- Punt, L.F. 2011. Internal school moderation in the national curriculum statement: An application on Grade 10 and 11 tourism in District North schools of the Western Cape Education Department. Published PhD Thesis. Cape Town: Cape Peninsula University of Technology.
- Putnam, R.T. & Borko, H. 1997. Teacher learning: Implications of new views of cognition. In Biddle, B.J., Good, T.L. & Goodson, I.F. (eds). *The International Handbook of Teachers and Teaching* (pp. 1223-1296). Dordrecht, The Netherlands: Kluwer.
- Putnam, R.T. & Borko, H. 2000. What do new views of knowledge and thinking have to say about research on teacher learning? *Educational Researcher*, 2(1):4-15.
- Raines, C. 2002. Managing millennials. *Generations at work*. <http://www.generationsatwork.com/articles/millennials.htm> [Retrieved: 8 February 2012].
- Rakes, G. & Casey, H. 2002. An analysis of teacher concerns toward instructional technology. *International Journal of Educational Technology*, 3(1). <http://www.ed.uiuc.edu/ijet/v3n1/v31articles.html> [Retrieved: 2 March 2012].
- Rautenbach, W.L. 1991. Technological education for development in South Africa. Proceedings on Relevant Technological Education in South Africa: Cape Town.

- Reksten, L.E. 2000. *Using Technology to Increase Student Learning*. Thousand Oaks, CA: Corvin.
- Resnick, L.B. & Hall, M.V. 1998. Learning organizations for sustainable education reform. *Daedalus*, 127(4):89-188.
- Resnick, L.B. 1983. Toward a cognitive theory of instruction. In Paris, S.G., Olson, G.M. & Stevenson, H.W. (eds). *Learning and Motivation in the Classroom* (pp. 5-38). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Reynolds, A. 1992. What is competent beginning teaching? A review of the literature. *Review of Educational Research*, 62(1):1-35.
- Reynolds, M.E. 2009. The effect of context on teachers' ability to innovate with information and communications technologies in secondary schools. Published PhD Thesis, University of Pretoria.
- Richardson, V. & Anders, P. 1990. 'The role of theory in descriptions of classroom reading practices'. Research paper presented at American Educational Research Association and Annual Meeting.
- Richardson, V. 1996. The role of attitudes and beliefs in learning to teach. In Sikula, J. (ed.). *Handbook of Research on Teacher Education*. New York: Macmillan.
- Robertson, S. & Sutherland, R. 2009. From 'should be' and 'can be' to 'will be': Reflections and new directions on improving learning with ICT. In Sutherland, R., Robertson, S. & John, P. *Improving Classroom Learning with ICT*. New York: Routledge.
- Robin, B. 2005. *Educational Uses of Digital Storytelling. Main Directory for the Educational Uses of Digital Storytelling*. Instructional technology Program. University of Huston. <http://www.coe.uh.edu/digital-storytelling/default.htm> [Retrieved: 16 March 2012].
- Robin, B. 2008. The educational uses of digital storytelling. <http://www.coe.uh.edu/digitalstorytelling> [Retrieved: 21 October, 2012].
- Roblyer, M.D. & Edwards, J. 2000. *Integrating Educational Technology into Teaching*. 2nd ed. New Jersey: Prentice Hall.
- Rodgers, P.L. 2002. *Designing Instructions for Technology - Enhanced Learning*. New York: Idea Group Publishing.
- Roos, G. 2009. Report on 6i process investigation workshop held at Christel House, Cape Town.
- Roos, G., Bialobrzaska, M., Barlow-Zambodla, A. & Butcher, N. 2008. A framework for use of ICTs in schools: An options analysis. South African Institute for Distance Education. Braamfontein: South Africa. <http://www.saide.org.za> [Retrieved: 18 January 2012].
- Rorty, R. 1979. Epistemological issues of interviewing. In Kvale, S. 2008. *Doing Interviews*. London: Sage.
- Roschelle, J., Singleton, C., Sabelli, N., Pea, R. & Bransford, J. 2008. Mathematics worth knowing, resources worth growing, research worth noting: A response to the national mathematics advisory panel report. *Educational Researcher*, 37(9):610-617.
- Roschelle, J.M., Pea, R., Hoadley, C.M., Gordin, D.N. & Means, B.M. 2000. Changing how and what children learn in school with computer-based technologies. *The Future of Children*, 10(2):76-101.
- Rosenblatt, L.N. 1978. *The Reader, the Text, the Poem: The Transactional Theory of Literary Work*. Carbondale, IL: Southern Illinois University Press.
- Rosenkvist, M. 2010. *Using Student Test Results for Accountability and Improvement: A Literature Review*. Paris: OECD Education Working Papers. Doi: 2200559291.

- Rosenthal Tolisano, S. 2010. <http://www.globallyconnectedlearning.com> [Retrieved: 2 April 2012].
- Rowan, B., Jacob, R. & Correnti, R. 2009. Using instructional logs to identify quality in educational settings. *New Directions for Youth Development*, 121:13-31.
- Rubenstein, G. 2006. The New Drill. *Edutopia, February*. <Http://edutopia.org>. George Lukas Educational Foundation. [Retrieved: 14 March 2014].
- Ruthven, K. 2013. Frameworks for analysing the expertise that underpins successful integration of digital technologies into everyday teaching practice. American Educational Research Association. University of Cambridge. Paper presented.
- Ryan, G. 1999. Measuring the typicality of text: Using multiple coders for more than just reliability and validity checks. *Human Organization*, 58:313-322.
- Sadik, A. 2008. Digital storytelling: A meaningful technology-integrated approach for engaged student learning. *Educational Technology Research and Development*, 56:487-506.
- Sahin, I. 2009. Validity and reliability of educational Internet use self-efficacy beliefs scale (in Turkish). *Selcuk Universitesi Sosyal Bilimler Enstitusu Dergisi*, 21:459-471.
- Sanders, W.L. & Horn, S.P. 1998. Research findings from the Tennessee Value-Added Assessment System (TVAAS) Database: Implications for educational evaluation and research. *Journal of Personnel Evaluation in Education*, 12(3):247-256.
- Savage, J. 2006. Ethnographic evidence: The value of applied ethnography in healthcare. *Journal of Research in Nursing*, 11(5):383-393.
- Savin-Baden, M. 2000. *Problem-based Learning in Higher Education: Untold Stories*. Buckingham: SHRE and Open University Press.
- Savin-Baden, M. 2008. From cognitive capability to social reform? Shifting perceptions of learning in immersive virtual worlds. *ALT-J: Research in Learning Technology*, 16(3):151-161.
- Sawtelle, S.M. 2008. Does this really work? *Learning and Leading with Technology*, 33(8):12-15.
- Sayed, Y. & Kanjee, A. 2013. An overview of education policy change in Post-Apartheid South Africa. In Sayed, Y., Kanjee, A. & Nkomo, M. (eds). *The Search for Quality Education in Post-Apartheid South Africa. Interventions to Improve Learning and Teaching*. South Africa: HSRC Press.
- Sayed, Y. 1997. The concept of quality in education: A view from South Africa. In Watson, K.S., Modgil, S. & Modgil, C. (eds). *Education Dilemmas: Debates and Diversity* (Vol. 4). London: Cassell.
- Sayer, A. 1992. *Method in Social Science. A Realist Approach*. London: Routledge.
- Scardamalia, M. & Bereiter, C. 2003. Knowledge building. In Guthrie, J.W. (ed.). *Encyclopaedia of Education*. 2nd ed. New York: Macmillan.
- Schatzman, L. & Strauss, A. 1973. *Field Research*. Englewood Cliffs, NJ: Prentice Hall.
- Schibei, R., MacCullum, J., Cumming-Potvi, W., Durrant, C., Kissane, B. & Miller, E. 2008. Teachers' journeys towards critical use of ICT. *Learning, Media and Technology*, 33(4):313-327.
- Schmidt, D.A., Baran, E., Thompson A.D., Koehler, M.J., Mishra, P. & Shin, T. 2009. Technological Pedagogical Content Knowledge (TPACK): The development and validation of an assessment instrument for pre-service teachers. *Journal of Research on Technology in Education*, 42(2):123-149.
- Schön, D.A. 1983. *The Reflective Practitioner*. New York: Basic Books.

- Schrum, L. & Levin, B.B. 2009. *Leading 21st Century Schools: Harnessing Technology for Engagement and Achievement*. California: Corwin.
- Schunk, D.H. 2000. *Learning Theories: An Educational Perspective*. 3rd ed. Upper Saddle River, NJ: Prentice Hall.
- Seely-Brown, J. & Duguid, P. 1998. Organizing knowledge. *California Management Review*, 40(3):90-111.
- Selfe, C. 1990. Technology in the English classroom: Computers through the lens of feminist pedagogy. In Handa, C. (ed.). *Computers and Community: Teaching Composition in the Twenty-First Century* (pp. 118-139). Portsmouth, NH: Boynton/Cook.
- Selwyn, N. 2011. *Education and Technology: Key Issues and Debates*. New York: Continuum Publishing Group.
- Shadow, W. & Armfield, J. 2011. Planning, designing, implementing, and evaluating technology. In Papa, R. (ed.). 2011. *Technology Leadership for School Improvement*. London: Sage.
- Sharratt, M. & Usoro, A. 2003. Understanding knowledge-sharing in online communities of practice. *Electronic Journal on Knowledge Management*, 1(2):187-196.
- Shulman, L.S. 1986. Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2):4-14.
- Shulman, L.S. 1987. Knowledge and teaching: foundations of the new reform. *Harvard Educational Review*, 57(1):1-22.
- Shultz, K. 2009. *Rethinking Classroom Participation: Listening to Silent Voices*. New York: Teachers College Press.
- Siemens, G. 2004. Connectivism: A learning theory for the digital age <http://www.elearnspace.org/Articles/connectivism.htm> [Retrieved: 28 March 2012].
- Siemens, G. 2006. Knowing Knowledge, Lulu.com. [Retrieved: 28 March 2012].
- Silverman, D. 1993. *Interpreting Qualitative Data: Methods for Analyzing Talk, Text and Interaction*. London: Sage.
- Simons, H. 2009. *Case Study Research in Practice*. London: Sage.
- Simonsen, L.M. & Dick, T.P. 1997. Teachers' perceptions of the impact of graphing calculators in the mathematics classroom. *Journal of Computers in Mathematics and Science Teaching*, 16(2-3):239-268.
- Simpson, M. & Tuson, J. 2003. *Using Observations in Small Scale Research: A Beginners Guide*. Revised ed. Glasgow: University of Glasgow, the SCRE Centre.
- Skinner, E. & Hagood, M.C. 2008. Developing literate identities with English language learners through digital storytelling. *Reading Matrix*, 8(2):12-38.
- Slavin, R.E. 1987. Mastery learning reconsidered. *Review of Educational Research*, 57(2):175-213.
- Slavin, R.E. 1996. Reforming state and federal policies to support adoption of proven practice. *Education Researcher*, 25(9):4-5.
- Smith, T.J. 2001. Educational ergonomics: educational design and educational performance. Paper presented at the International Society for Occupational Ergonomics and Safety. Fairfax, VA.
- So, H.J. & Kim, B. 2009. Learning about problem based learning: Student teachers integrating technology, pedagogy and content knowledge. *Australasian Journal of Educational Technology*, 25(1):101-116. <http://www.ascilite.org.au/ajet/ajet25/so.html> [Retrieved: 12 April 2014].

- South Africa. 1996. *South African Schools Act, 1996 (Act No. 84 of 1996)*. Government Gazette, Vol. 566, No 35617. Pretoria: Government Printer.
- South Africa. 1996. *Telecommunications Act, 103 of 1996*. Government Gazette. Vol, 455. No 28839. Pretoria: Government Printer.
- South Africa. 1998. *Further Education and Training Act, 1998 (Act. 98 of 1998)*. Government Gazette, Vol. 401, No 19429. Pretoria: Government Printer.
- South Africa. 2011. Department of Basic Education and Higher Education and Training. *Integrated Strategic Planning Framework for Teacher Education and Development in South Africa 2011-2025*. <http://www.dhet.gov.za/> [Retrieved: 8 April 2014].
- South Africa. Department of Basic Education. 2011. *Curriculum and Assessment Policy Statement. English Home Language Grades R-3*. Pretoria: Government Printer.
- South Africa. Department of Basic Education. 2012. *The Regulations Pertaining to the National Curriculum Statement Grades R-12*. Government Gazette 36041, 28 December. Pretoria: Government Printer.
- South Africa. Department of Education. 2003. *Draft White Paper on e-Education: Transforming Learning and Teaching Through Information and Communication Technologies (ICTs)*. Government Gazette, 26 August 2004. Department of Education. Pretoria: Government Printer.
- South Africa. Department of Education. 2003. *Draft White Paper on e-Education: Transforming learning and teaching through ICT*. Pretoria: Government Printer.
- South Africa. Department of Education. 2003. *Education Management Information Systems (EMIS)*. Department of Education. Pretoria: Government Printers.
- South Africa. Department of Education. 2004. *White Paper on e-Education: Transforming Learning and Teaching Through Information and Communication Technologies*. Department of Education. Pretoria: Government Printer.
- South Africa. Department of Education. 2006. *National Policy Framework for Teacher Education and Development in South Africa*. Government Gazette. Department of Education. Pretoria: Government Printer.
- South Africa. Department of Education. 2007. *Guidelines for Teacher Training and Professional Development in ICT*. Department of Education. Pretoria: Government Printer.
- South Africa. Department of Education. 2007. *The National Policy Framework for Teacher Education and Development in South Africa*. Government Gazette. Department of Education. Pretoria: Government Printer.
- South Africa. Department of Education. 2008a. *The Design of the Continuing Professional Teacher Development (CPTD) System*. Pretoria: Government Printer.
- South Africa. Department of Education. 2011. *Action Plan to 2014: Towards the Realisation of Schooling 2025. Department Of Basic Education*. Pretoria: Government Printer.
- South African Institute for Distance Education (SAIDE). *A Framework for Use of ICTs in Schools: An Options Analysis*, Authors Roos, G., Bialobrzaska, M., Barlow-Zambodla, A. & Butcher, N. 2008. Braamfontein: South Africa. <http://www.saide.org.za> [Retrieved: 18 January 2012].
- Spiro, R.J., Feltovich, P.J., Jacobson, M.J. & Coulson, R.L. 1991. Knowledge representation, content, specification, and the development of skill in the situation specific knowledge assembly: Some constructivist issues as they relate to cognitive flexibility theory and hypertext. *Educational Technology*, 31(9):22-25.
- Stagg-Peterson, S. & Clay, J. 2012. Assumptions and practices in using digital technologies to teach writing in middle-level classrooms across Canada. *Literacy*, 46(3):140-146.

- Stake, R. 1998. *Case studies*. In Denzin, N.K. & Lincoln, Y.S. (eds). *Strategies of Qualitative Inquiry* (pp. 86-109). Thousand Oaks, CA: Sage.
- Starkey, L. 2012. *Teaching and Learning in the Digital Age*. New York: Routledge.
- Stenhouse, L. 1970. Some limitations of the use of objectives in curriculum research and planning. *Paedagogica Europaea*, 6:73-83.
- Stenhouse, L. 1985. Case study methods. In T. Husen & Postlethwaite, T.N. (eds). *International Encyclopedia of Education*. 1st ed. (pp. 640-6). Oxford: Pergamon.
- Stigler, J.W. & Hiebert, J. 1999. *The Teaching Gap: Best Ideas From the World's Teachers for Improving Education in the Classroom*. New York: The Free Press.
- Stoltenkamp, J. 2012. Designing an online teaching/instructional event. Blended Learning Programme, designed by the *Centre for Innovative Educational & Communication Technologies (CIECT)*. Bellville: University of the Western Cape.
- Strauss, A. & Corbin, J. 1990. *Basics of Qualitative Research*. Newbury Park, CA: Sage.
- Street, B. 2003. What's new in 'new' literacy studies? Critical approaches to literacy and theory. *Current Issues in Comparative Education*, 5(2):77-91.
- Sullivan, J.P. 2009. Emergent learning: the power of complex adaptive systems in the classroom. Paper presented at the complexity and research in teacher education conference. Scotland: University of Aberdeen.
- Summak, M., Baglibel, M. & Samancioglu. 2010. Technology readiness of primary school teachers: A case study in Turkey. *Procedia Social and Behavioral Sciences*, 2:2671-2675.
- Sutherland, R. & Triggs, P. 2009. A holistic approach to understanding teaching and learning with ICT. In Sutherland, R., Robertson, S. & John, P. *Improving Classroom Learning with ICT*. New York: Routledge.
- Sutherland, R., Robertson, S. & John, P. 2009. *Improving Classroom Learning with ICT*. New York: Routledge.
- Technology Integration Frameworks for the K-12 Curriculum, Hanover Research 2013. Washington. <http://hanoverresearch.com/evaluation/index/php> [Retrieved: 12 April 2014].
- Thompson, A. & Mishra, P. 2007-2008. Breaking News: TPCK becomes TPACK! *Journal of Computing in Teacher Education*, 24(2):4-14.
- Thomson, P. 2007. Whole school change. A review of the literature. London: Creative Partnerships.com [Retrieved: 7 April 2012].
- Tondeur, J. 2015. Educational research and innovation: the case of technology integration <http://ugent.academia.edu/JoTondeur> [Retrieved: 4 June 2015].
- TPACK., see Mishra & Koehler and Koehler Mishra.
- Trucano, M. 2005. *Knowledge Maps: ICT's in Education*. Washington, DC: InfoDev/World Bank. <http://www.infodev.org/en/Publication.8.html> [Retrieved: 6 July 2013].
- Tuli, F. 2010. The basis of distinction between qualitative and quantitative research in Social Science: Reflection on Ontological, Epistemological and Methodological perspectives. *Ethiopian Journal of Education and Science*, 6(1).
- Turkle, S.1995. *Life on the Screen: Identity in the Age of the Internet*. New York: Simon & Schuster.
- Turner, B. 1990. *Theories of Modernity and Postmodernity*. London: Sage.
- Turner, M. 1996. *The Literary Mind. The Origins of Thought and Language*. Oxford University Press.

- UNESCO. 2002. *Information and Communication Technologies in Teacher Education: A Planning Guide*: 2002. unesdoc.unesco.org/images/0012/001295/129533e.pdf [Retrieved: 15 November 2014].
- UNESCO. 2002. *The Dakar Framework for Action*. <http://www.unesco.org/education/wef/en-conf/dakfram.shtml> [Retrieved: 15 November 2014].
- UNESCO. 2003. *ICT in education: Using ICTs to upgrade the quality and reach of education in Asia and the Pacific*. <http://www.unescobkk.org/education/ict/online-resources/e-library/programme-updates/ict-in-education-2003/> [Retrieved: 15 November 2014].
- UNESCO. 2008. *ICT Competency Standard for Teachers; Policy Framework*. UNESCO: Paris.
- UNESCO. 2008. *The Millennium Development Goals Report*. http://www.un.org/millenniumgoals/MDG_Report_2008_ENGLISH.pdf [Retrieved: 15 June 2014].
- UNESCO. 2011. *ICT Competency Framework for Teachers*. Version 2. Paris:/UNESCO%20ICT%20COMPETENCY%20FRAMEWORK%20FOR%20TEACHERS%202011.pdf [Retrieved: 27 July 2014].
- Van Dijk, E. M. & Kattmann, U. 2007. A research model for the study of science teachers' PCK and improving teacher education. *Teaching and Teacher Education*, 23(6):885-897.
- Van Driel, J., Verloop, N. & De Voss, W. 1998. Developing science teachers' pedagogical content knowledge. *Journal of Research in Science Teaching*, 35, 673-695.
- Vasilachis de Gialdino, I. 1992. Ontological and epistemological foundations of qualitative research. *Forum: Qualitative Social Research*, 10(2):30.
- Vaughn, S., Schumm, J.S. & Sinagub, J. 1996. *Focus Group Interviews in Education and Psychology*. Thousand Oaks: Sage.
- Verhagen, P. 2006. Connectivism: A new learning theory? <http://elearning.surf.nl/e-learning/english/3793> [Retrieved: 8 March 2015].
- Voogt, J. & Roblin, N.P. 2010. 21st century skills. Discussienota. Enschede, The Netherlands: University of Twente.
- Voogt, J., Fisser, P., Roblin, N.P., Tondeur, J. & Van Braak, J. 2012. *Technological Pedagogical Content Knowledge - A Review of the Literature*. Enschede, The Netherlands: Department of Curriculum Design and Educational Innovation, University of Twente.
- Voogt, J.M. & Odenthal, L.E. 1999. Met Het Oog Op De Toekomst. *Een Studie Naar Innovatief Gebruik van ICT in het Onderwijs*. Enschede, The Netherlands: University of Twente.
- Vygotsky, L.S. 1978. *Mind and Society: The Development of Higher Mental Processes*. Cambridge, MA: Harvard University Press.
- Warschauer, M. 2006. *Laptops and Literacy: Learning in the Wireless Classroom*. London: Teachers' College, Columbia University.
- Wei, R. 2009. China's radio and TV universities: Reflections on theory and practice of open and distance learning. *Open Learning*, 25(1):45-56.
- Weller, M. 2011. *The digital scholar: How technology is transforming scholarly practice*. New York: Bloomsbury Publishing.
- Welsh, J., Harmes, J.C. & Winkelman, R. 2011. Florida technology integration matrix. *Principal Leadership*, October. http://www.setda.org/c/document_library/get_file?folderId=300&name=DLFE-1380.pdf [Retrieved: 16 August 2015].
- Wenger, E. 1999. *Communities of Practice: Learning, Meaning, and Identity*. Cambridge, UK: Cambridge University Press.

- Wertsch, J.V. 1985. *Culture, Communication and Cognition: Vygotskian Perspectives*. Cambridge: Cambridge University Press.
- Wertsch, J.V. 1991. *Voices of the Mind. A Socio-Cultural Approach to Mediated Action*. London: Wheatsheaf.
- Wertsch, J.V. 1998. *Mind As Action*. New York: Oxford University Press.
- Wilken, G. & Molster, T. 2011. Norwegian secondary school teachers and ICT. *European Journal of Teacher Education*, 34(2):209 -218.
- Williams, P. 2008. Leading schools in a digital age: A clash of cultures. *School Leadership and Management*, 28(3):213-228.
- Williamson, G. 2014. Technology in classrooms: Aiding learning barriers or a barrier to learning? SAnonnet Pulse. <http://www.ngopulse.org/article/technology-classrooms-aiding-learning-barriers-or-barrier-learning> [Retrieved: 8 November 2014].
- Wilson-Strydom, M. & Thomson, J. 2005. Understanding ICT integration in South African classrooms. http://www.cet.uct.ac.za/pie/WilsonStrydom_etal.htm [Retrieved: 11 March 2012].
- Winn, W. & Snyder, D. 1996. Cognitive perspectives in psychology. In Jonassen, D.H. (ed.). *Handbook For Research For Educational Communications and Technology* (pp. 112-142). New York: McMillan.
- Wolcott, H.F. 1975. Criteria for an ethnographic approach to research in schools. *Human Organization*, 34:111-127.
- Wong, E.M.L. & Li, S.C. 2008. Framing ICT implementation in the context of education change: A multilevel analysis. *School Effectiveness and School Improvement*, 19(1):99-120.
- Yin, R.K. 2003. *Case Study Research: Design and Methods*. 3rd ed. Thousand Oaks CA: Sage.
- Yin, R.K. 2009. *Case Study Research: Design and Methods*. 4th ed. Thousand Oaks CA: Sage.
- Yin, R.K. 2014. *Case Study Research: Design and Methods*. 5th ed. London: Sage.
- Ylimaki, R.M. 2006. Toward a new conceptualization of vision in the work of educational leaders: Cases of visionary archetype. *Educational Administration Quarterly*, 42(4):620-651.
- Yuksel, P., Robin, R.B. & McNeil, S. 2011. In Benson, S.D. (ed.). *Educational Uses of Digital Storytelling Around the World. International Conference of Information Technology and Teacher Education*. Nashville: AACE.
- Zeidler, D. 1997. The central role of fallacious thinking in science education. *Science Education*, 81, 483-496.
- Zhao, Y. 2003. What teachers need to know about technology? Framing the question. In Zhao, Y. (ed.). *What Should Teachers Know About Technology?* (pp. 1-14). Greenwich, Conn.: Information Age Publishing.
- Zuga, K.F. 1996. Reclaiming the voices of female and elementary school educators in technology education. *Journal of Industrial Teacher Education*, 33(3):23-43.

Appendix A

LETTER OF PERMISSION TO CONDUCT RESEARCH

Chamellé René de Silva
P.O. Box 44982
Claremont
7735

4 July 2012

Madam/Sir

Request to conduct research

I am presently enrolled at the Cape Peninsula University of Technology as a part-time postgraduate doctoral student in the Faculty of Education and Social Sciences. The research is in fulfilment of the D.Ed. I am requesting from XXXXX South Africa to grant me the necessary permission to conduct my research at the school.

The title of my research project is:

Technology integration: tracing in-service primary teachers' technological, pedagogical and content knowledge development: an ethnographic case study.

The research will make use of Ethnographic case study research to answer the research questions. The key research instruments that will be employed to collect the data are:

Interviews with staff members who will be approached to be participants in this investigation.

Classroom Observations (of participants)

Self-assessment questionnaires

Digital artefacts of Participants

Documentary data from Creating and Online Teaching Event course.

The research will be beneficial to the school as it may also provide teachers with a new philosophical and realistic perspective underscored by constructs of pedagogy on the integration of technology into the curriculum that may result in a shift in the utilization of technology. The policy framework for e-Education (DoE, 2003) refers to the significance of e-Education, and foregrounds how new models of learning are radically changing our conception of learning. It furthermore envisages a transformed teaching and learning environment, where the shift is an inclusive, integrated practice where learners work collaboratively, develop shared practices, engage in meaningful contexts and develop creative thinking and problem-solving

skills. My research therefore is framed against this background and is a timely one, as 2013 is mentioned for the achievement of the policy goals.

The following ethical safeguards will be observed and implemented by the researcher:

Informed consent in writing will be obtained from the management of XXXXX South Africa.

The right to privacy, and honesty with professional colleagues will be observed.

I undertake to focus on the research in question and will not interfere in any manner that may jeopardise the integrity of data and the study as a whole.

I undertake to communicate the objectives, nature and future use of findings to participants' prior to commencement of data collection activities.

Participants' will not be placed under duress during the research project.

Informed consent by participants will be a prerequisite in the gathering of the data in this study, this will include assurances of confidentiality and anonymity of the site, organisation, other, participants and individuals will not be compromised during the research process.

A copy of the final research report will be given to XXXXX South Africa.

Should you need to contact my supervisors, they are:

Dr Stanley Adendorff (adendorffS@cput.ac.za) and Dr Agnes Chigona (ChigonaA@cput.ac.za)

I trust that this information will allow you to make an informed decision with regard to my request.

Thanking you

Chamellé De Silva

Student Number: 209226218

Appendix B

LETTER OF PERMISSION TO PARTICIPANTS

September 2012
Chamellé René de Silva
P.O. Box 44982
Claremont
7735
Chamelledesilva@gmail.com

Dear Participant

Consent to be included in a research sample

I am presently enrolled at the Cape Peninsula University of Technology as a part-time postgraduate student in the Faculty of Education and Social Sciences. I am conducting research for my doctoral thesis.

Please read the following before signing the form.

Formal title: Technology integration: tracing in-service primary teachers' technological, pedagogical and content knowledge development.

The study purpose:

An overall objective of this study is to gain insight into teachers' development of technology, pedagogy and content knowledge (TPACK) and how this acquired domain knowledge might impact on their classroom practice and innovation through technology integration.

Research procedures:

Should you agree to participate in this study, you will be asked to participate in a semi-structured interview and complete a self-progress questionnaire. I will also conduct classroom observations, which will be by mutual agreement and arrangement. Video/audio-taping of field observations are envisaged. Artefacts designed by you, will be included in the analysis of the data.

Possible benefits:

It may provide teachers with a new philosophical and realistic perspective underscored by constructs of pedagogy on the integration of technology into the curriculum that may result in a shift in the utilisation of technology.

Lead to understanding the alignment of the content of the subject and supporting the aims of the curriculum by choice of the technology application.

Become competent teachers who use ICTs to enhance teaching and learning.

Create knowledge and information by adapting, applying, designing, inventing, and authoring information.

The policy framework for e-Education (DoE, 2003) refers to the significance of e-Education, and foregrounds how new models of learning are radically changing our conception of learning. It furthermore envisages a transformed teaching and learning environment, where the shift is an inclusive, integrated practice where learners work collaboratively, develop shared practices, engage in meaningful contexts and develop creative thinking and problem-solving skills.

Ethical considerations:

The following ethical safeguards will be observed and implemented by the researcher:

Informed consent in writing will be obtained from the management of XXXXX.

The right to privacy, and honesty with professional colleagues will be observed.

I undertake to focus on the research in question and will not interfere in any manner that may jeopardise the integrity of data and the study as a whole.

I undertake to communicate the objectives, nature and future use of findings to participants prior to commencement of data collection activities.

Participants will not be placed under duress during the research project.

Informed consent by participants will be a prerequisite in the gathering of the data in this study, this will include assurances of confidentiality and anonymity of the site, organisation, other, participants and individuals will not be compromised during the research process.

A report of the final research will be shared with the school/organisation.

Should you need to contact my supervisors, they are:

Dr Stanley Adendorff (adendorffS@cput.ac.za) and Dr Agnes Chigona (ChigonaA@cput.ac.za)

I trust that this information will allow you to make an informed decision with regard to my request.

Thanking you

Chamellé De Silva

I _____ (*Please print name in full*).

Have read the contents of the above letter of request and am satisfied with my understanding of the nature of the study, the nature of my participation and possible benefits and ethical considerations. My questions about the study have been answered. I agree to the research procedures as outlined above. I hereby voluntary consent to my participation in the research investigation described in this letter of consent.

.....
Name of participant

.....
Signature of participant

.....
Date

.....
Place

Chamellé de Silva
Name of researcher

.....
Signature

Appendix C

SELF-ASSESSMENT QUESTIONNAIRE

Thank you for taking time to complete this questionnaire. Please answer each question to the best of your knowledge. Your thoughtfulness and candid responses will be greatly appreciated. Your individual name or identification number will not at any time be associated with your responses. Your responses will be kept completely confidential.

DEMOGRAPHIC INFORMATION

1. e-mail address

2. Gender

Female

Male

3. Age range

30-35

35-40

45-50

50+

4. Major

Early Childhood Development (ECD)

Foundation Phase (Primary Education)

Other

5. Subject specialisation

Early Childhood Education

English

2nd Language

Health

Special Needs Education.

Mathematics

Music

Science-Basic

Social Science

Other

6. Phase specialisation

3 years

4 years

Foundation Phase (FP)

Intermediate Phase (IP)

Senior Phase and GET

Other

7. Have you designed a successful Online Teaching/Instructional event for your subject area?

Yes

No

8. Have you completed both the face-to-face and Online Phases of this event?

Yes

No

9. Are you able to identify e-tools for your subject and its pedagogical value?

a. Yes

b. No

Technology is a broad concept that can mean a lot of different things. For the purpose of this questionnaire, technology is referring to digital technology/technologies. That is, the digital tools we use such as computers, laptops, iPods, handhelds, interactive whiteboards, software programs/e-Tools etc. Please answer all of the questions and if you are uncertain of, or neutral about your response you may always select "Neither Agree or Disagree"

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly agree
TK (Technology Knowledge)					
1. I know how to solve my own technical problems.					
2. I can learn technology easily.					
3. I keep up with important new technologies.					
4. I frequently play around the technology.					
5. I know about a lot of different technologies.					
6. I have the technical skills I need to use technology.					
CK (Content Knowledge)					
Mathematics/Numeracy					
7. I have sufficient knowledge about Mathematics/Numeracy					
8. I can use a Mathematical way of thinking.					
9. I have various ways and strategies of developing my understanding of Mathematics.					
Social Sciences					
10. I have sufficient knowledge about Social Sciences.					
11. I can use a historical way of thinking.					
12. I have various ways and strategies of developing my understanding of Social Sciences.					
Science					
13. I have sufficient knowledge about Science.					
14. I can use a scientific way of thinking.					
15. I have various ways and strategies of developing my understanding of Science.					
Literacy					
16. I have sufficient knowledge about Literacy.					
17. I can use a literary way of thinking.					
18. I have various ways and strategies of developing my understanding of Literacy.					
PK (Pedagogical Knowledge)					
19. I know how to assess learner performance in a classroom.					
20. I can adapt my teaching based-upon what learners currently understand or do not understand.					
21. I can adapt/differentiate my teaching style to					

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly agree
different learners.					
22. I can assess learners' learning in multiple ways.					
23. I can use a wide range of teaching approaches in a classroom setting.					
24. I am familiar with common learner understandings and misconceptions.					
25. I know how to organise and maintain classroom management.					
PCK (Pedagogical Content Knowledge)					
26. I can select effective teaching approaches to guide student thinking and learning in Mathematics.					
27. I can select effective teaching approaches to guide student thinking and learning in Literacy.					
28. I can select effective teaching approaches to guide student thinking and learning in Science.					
29. I can select effective teaching approaches to guide student thinking and learning in Social Sciences.					
TCK (Technological Content Knowledge)					
30. I know about technologies that I can use for understanding and doing Mathematics.					
31. I know about technologies that I can use for understanding and doing Literacy.					
32. I know about technologies that I can use for understanding and doing Science.					
33. I know about technologies that I can use for understanding and doing Social Sciences.					
TPK (Technological Pedagogical Knowledge)					
34. I can choose e-Tools that enhance the teaching approaches for a lesson.					
35. I can choose e-Tools that enhance learners' learning for a lesson.					
36. The Designing an Online Teaching event has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.					
37. I am thinking critically about how to use technology (e-Tools) in my classroom.					
38. I can adapt the use of the technologies that I am learning about to different teaching activities.					
39. I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn.					
40. I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom.					
41. I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school.					

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly agree
42. I can choose technologies/e-Tools that enhance the content for a lesson.					
TPACK (Technology Pedagogy and Content Knowledge)					
43. I can teach lessons that appropriately combine Mathematics, technologies and teaching approaches.					
44. I can teach lessons that appropriately combine Literacy, technologies and teaching approaches.					
45. I can teach lessons that appropriately combine Science, technologies and teaching approaches.					
46. I can teach lessons that appropriately combine Social Sciences, technologies and teaching approaches.					
Models of TPACK (Phase partner)					
47. My Phase partners appropriately model combining content, e-Tools and teaching approaches in their teaching.					
48. My Phase partners appropriately model combining Literacy content, technologies in their teaching approaches.					
49. My Phase partners appropriately model combining Science content, technologies in their teaching approaches.					
50. My Phase partners appropriately model combining Social Sciences content, technologies in their teaching approaches.					
51. My HOD's appropriately models combining content, technologies and teaching approaches in their teaching.					

	25% or less	26% - 50%	51% - 75%	76%- 100%
Models of TPCK				
52. In general, approximately what percentage of your Phase partners have provided an effective model of combining content, technologies and teaching approaches in their teaching?				
53. In general, approximately what percentage of your colleagues at the Senior Phase have provided an effective model of combining content, technologies and teaching approaches in their teaching?				
54. In general, approximately what percentage of the GET Phase teachers have provided an effective model of combining content, technologies and teaching approaches in their teaching?				

Please complete this section by writing/typing your responses in the boxes.

55. Describe a specific episode where the ICT instructor effectively demonstrated or modeled combining content, technologies and teaching approaches in a classroom lesson. Please include in your description what content was being taught, what technology was used, and what teaching approach(es) was implemented.

56. Describe a specific episode where one of your Phase teachers effectively demonstrated or modeled combining content, technologies and teaching approaches in a classroom lesson. Please include in your description what content was being taught, what technology was used, and what teaching approach (es) was implemented. If you have not observed a teacher modeling this, please indicate that you have not.

57. Describe a specific episode where you effectively demonstrated or modeled combining content, technologies and teaching approaches in a classroom lesson. Please include in your description what content you taught, what technology you used, and what teaching approach (es) you implemented. If you have not had the opportunity to teach a lesson, please indicate that you have not.

Adapted from:

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).[http:// www.citejournal.org/vol9/iss1/general/article2.cfm](http://www.citejournal.org/vol9/iss1/general/article2.cfm) [Retrieved 28 August 2011].

Koehler, M. J., Mishra, P. & Yahya, K. 2007. Tracing the development of teacher knowledge in a design seminar: Integrating content, pedagogy, and technology. *Computers and Education*, 49(3):740-762.

Koehler, M. J. & 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.

Schmidt, D.A., Baran, E., Thompson, A.D., Mishra, P., Koehler, M.J. & Shin, T. S. (2009). Examining pre-service teachers' development of technological pedagogical content knowledge in an introductory instructional technology course. In I. Gibson, R. Weber, K. McFerrin, R. Carlsen & D.A. Willis (Eds.), *Society for Information Technology and Teacher Education International Conference book, 2009* (pp. 4145-4151). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE).

Copyright of Journal of Research on Technology in Education is the property of International Society for Technology in Education and its content may not be copied or emailed to multiple sites or posted to a list service without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.

Schmidt, Baran, Thompson, Koehler, Mishra & Shin (2009).

Researchers are free to use the TPACK survey, provided they contact Dr. Denise Schmidt (dschmidt@iastate.edu) with a description of their intended usage (research questions, population, etc.), and the site locations for their research. The goal is to maintain a database of how the survey is being used, and keep track of any translations of the survey that exist.

Permission granted to use images from power point presentation: UNESCO ICT Competency Framework for teachers (ICT-CFT) and Institutional Strategy for Teacher Training on ICT-pedagogy (Miao, Fengchun. 2011) f.miao@unesco.org (Permission granted on 15 July 2015).

Appendix D

TECHNOLOGY INTEGRATION ASSESSMENT INSTRUMENT (TIAI)

Classroom observation: Technology integration assessment instrument

Criteria	4	3	2	1
Curriculum Goals & Technologies (Curriculum-based technology use)	Technologies selected for use in the instructional plan are strongly aligned with one or more curriculum goals.	Technologies selected for use in the instructional plan are aligned with one or more curriculum goals.	Technologies selected for use in the instructional plan are partially aligned with one or more curriculum goals.	Technologies selected for use in the instructional plan are not aligned with any curriculum goals.
Instructional Strategies & Technologies (Using technology in teaching/ learning)	Technology use optimally supports instructional strategies.	Technology use supports instructional strategies.	Technology use minimally supports instructional strategies.	Technology use does not support instructional strategies.
Technology Selection(s) (Compatibility with curriculum goals & instructional strategies)	Technology selection(s) are exemplary, given curriculum goal(s) and instructional strategies.	Technology selection(s) are appropriate, but not exemplary, given curriculum goal(s) and instructional strategies.	Technology selection(s) are marginally appropriate, given curriculum goal(s) and instructional strategies.	Technology selection(s) are inappropriate, given curriculum goal(s) and instructional strategies.
"Fit" (Content, pedagogy and technology together)	Content, instructional strategies and technology fit together strongly within the instructional plan.	Content, instructional strategies and technology fit together within the instructional plan.	Content, instructional strategies and technology fit together somewhat within the instructional plan.	Content, instructional strategies and technology do not fit together within the instructional plan.

Harris, J., Grandgenett, N. & Hofer, M. (2009). Instructional planning activity types as vehicles for curriculum-based TPACK development. In Maddux, C. D. (Ed.). *Research highlights in technology and teacher education 2009* (pp. 99-108). Chesapeake, VA: Society for Information Technology & Teacher Education (SITE).

This is a "pedagogically inclusive" instrument that reflects key TPACK concepts and that has proven to be both reliable and valid in two successive rounds of testing. The instrument's inter-rater reliability coefficient (.857) was computed using both Intra class Correlation and a score agreement (84.1%) procedure. Internal consistency (using Cronbach's Alpha) was .911. Test-retest reliability (score

agreement) was 87.0% (Harris, Grandgenett & Hofer, (2009). Two approaches focus TPACK development within teachers' planning. Roblyer and Doering (2010) recommend TPACK self-assessment as the first step in each stage of instructional decision-making. Harris and Hofer (2006; 2009) draw upon research about teachers' planning practices to suggest a learning activities-based approach to selecting and combining curriculum-keyed teaching/learning strategies and complementary educational technologies. We are pleased to place this instrument into the public domain via a Creative Commons (attribution, non-commercial) license, and encourage consideration of its use for both research and professional development. We invite our readers to share their experiences with and perceptions of the rubric using the electronic mail addresses listed below.

judi.harris@wm.edu

ngrandgenett@mail.unomaha.edu

mark.hofer@wm.edu

Appendix E

SEMI-STRUCTURED INTERVIEW QUESTIONS TO PARTICIPANTS

Interview questions for semi-structured interviews with participants

Thank you for allowing me to interview you today. My questions will focus on your own development of becoming fluent with technology and the decisions that you make when you integrate technology in your teaching. I am recording today's interview for accuracy. This interview is confidential and you will not be identified.

Are you familiar with the policy on E-education (2004) or the guidelines for teacher training and professional development in ICT (2007)?

Could you briefly explain how your own knowledge of technology has developed, and was this a deliberate decision by you to become au fait with technology?

Are you comfortable teaching with technology? Why? Why not?

Do you think that integrating digital media or ICT's can become part of your instructional methodologies or current classroom practice? How?

Were you more motivated to use technology for teaching after the Online Teaching event?

And before?

Do you consider technology in the classroom as a necessity for learner achievement?

When you plan your lessons to include technology, what are the important considerations that you make?

Do you think that your lessons are enhanced by the integration of technology? Explain how.

Can you describe how the learners are engaged when your lessons are supported by technology?

How do you think it influences student learning and motivation?

Do you adapt the technology selection to the specific learning needs and preferences of your learners?

Do you think that technology software applications can be utilised to foster higher order thinking and problem solving skills? Or any of the other 21st century skills? (Critical thinking and problem solving, Communication, Collaboration?)

- Creativity?

What barriers or obstacles have you encountered during the installation of your interactive whiteboard, and how were these addressed?

Which software applications or web -based applications do you utilise mainly when you plan with technology integration?

Do you think that the technology applications that you select are mostly aligned with your learning area/curriculum?

Are you motivated to use technology more often to enhance your teaching? What percentage of your lessons are technology enhanced?

When you plan a new lesson, when do you think about technology activities?

Do you still prefer traditional resources for lessons?

How do you utilise the computers' for the learners' in the classroom?

Are there any matters that have not been discussed in this interview that you feel are relevant?

Appendix F

'DESIGNING AN ONLINE TEACHING/INSTRUCTIONAL EVENT'

This workshop consisted of two phases, and followed a blended learning model of instruction. The first phase was a traditional face to face session which was conducted over a five day period. It was followed by an online phase of four weeks. Participants were requested to complete and submit a prototype assignment electronically within an e-Learning platform. The documentary evidence of this workshop provided valuable insight to me as I could use it as a frame of reference for each of the participants' in sample with regard to their attitudes towards technology integration. The outline of the course highlights the various aspects of the course design which followed a 'Learning by Design' model (Stoltenkamp, 2012)

Online phase: 02 - 27 July 2012

The participant will be expected to actively engage in the following activities in order to receive a Certificate of Competence for the Designing and online teaching/instructional event.

A. Discussion

Week 1: ending 06 July 2012: Socialisation and familiarisation

Discussion forum topic 1: Identify your target audience and state how they will influence the development of your online course.

Week 2: ending 13 July 2012: Information exchange

Discussion forum topic 2: Develop measurable outcomes aligned to assessment task and content. Present it in your instructional strategy.

Week 3: ending 20 July 2012: Maintaining substantive discussion

Discussion forum topic 3: Discuss the selection of communication e-Tools for your course and relate it to social constructivism.

Week 4: ending 27 July 2012: Assessment

Discussion forum topic 4: Discuss the selection of online assessment e-Tools to enhance your traditional teaching methodologies

The learner/participant will be expected to engage in four (4) discussion topics for the period 02-27 July 2012.

B. Assignment: design your online teaching event

Submit an assignment (electronic format i.e. Word), within the eLearning platform (in assignment tool section). It should be approximately four (4) pages.

The assignment will include the following elements:

1. Rationale of the prototype

Highlight the need for the online environment for your specific discipline

2. e-Tools selected

Discuss the selection of e-Tools and its pedagogical value



Appendix G



ASSESSMENT RUBRIC TO EVALUATE TEACHER KNOWLEDGE


Educator:
 Date:

ICT competency standards for teachers

Module	Requirements	Teacher Ability			
		Excellent	Good	Average	Weak
Microsoft Excel Spreadsheets requires the candidate to understand the concept of spreadsheets and to demonstrate an ability to use a spreadsheet to produce accurate work outputs	Teachers shall be able to: Enter data into cells and use good practice in creating list (Class list)				
	Create Mathematical and logical formulas using standard spreadsheet functions				
	Create and format charts (graphs) to communicate information meaningfully				
Microsoft Word Word Processing requires the candidate to demonstrate the ability to use a word processing application to create letters and documents	Teachers shall be able to: Create and edit documents that will be ready to share and distribute				
	Prepare documents for mail merge operations				
	(Empty requirement cell)				
Microsoft Outlook Internet and Communication	Teachers shall be able to: Be aware of network etiquette and security consideration when using e-mail				
	Be aware of ways to enhance productivity when working with e-mail software. Organise and manage e-mail				
	(Empty requirement cell)				
Module	Requirements	Teacher Ability			
		Excellent	Good	Average	Weak
Microsoft PowerPoint requires the candidate to understand the concept of presentations	Teachers shall be able to: Sequence information				
	Presentation includes all material needed to give good understanding of the topic				

and to demonstrate the ability to create slides to produce powerful presentations	Graphics support the topic of the presentation				
YouTube - alternative learning tool  YouTube is a video-sharing website	Teachers shall be able to:				
	Download You tube videos				
	Embed YouTube videos into PowerPoint presentations				
Photo story 	Teachers shall be able to:				
	Create a visual story from digital photos				

Module	Requirements	Teacher Ability			
		Excellent	Good	Average	Weak
iWisoft video convertor  iWisoft Free Video Converter is not only a video converter, but also a professional video editor. With it you can easily crop, trim, merge videos, add text and picture watermark, change brightness, contrast, gamma, adjust sound volume	Teachers shall be able to:				
	Easily convert video/audio between all popular formats. use video editing functions, like cropping, trimming, merging, adding watermark, subtitle etc				
Audacity 	Teachers shall be able to:				
	Record live audio.				

<p>Audio editor for recording, slicing, and mixing audio.</p>	<p>Cut, copy, splice or mix sounds together</p>				
	<p>Change the speed or pitch of a recording</p>				
<p>Podcasting</p> 	<p>Teachers shall be able to:</p>				
	<p>Produce a podcast show with music</p>				

Appendix H

QUESTIONNAIRE ASSESSING TEACHERS AFTER DESIGNING AN INSTRUCTIONAL EVENT

XXXXX SCHOOL TEACHER-EDUCATOR QUESTIONNAIRE: IMPACT OF 'DESIGN COURSE'

The Centre for Innovative Educational and Communication Technologies (CIECT) at the University of the Western Cape designed and developed a blended learning course for teacher-educators, namely:

Designing an Instructional Event. Educators from XXXXX School engaged in the Programme (2 phases during the period, June-August, 2012).

The CIECT team at UWC, is currently embarking on research regarding the impact of the Programme - related to teaching-and-learning practices. We hereby kindly request your participation as an educator.

Please complete the following survey (only 5 questions which can be completed in approximately 15 minutes). Research ethics will be observed. Hence, all information provided, will be treated with confidentiality.

Instructions: Complete and re-send questionnaire - options:

Complete paper-based questionnaire, scan and email questionnaire to ciect.uwc@gmail.com

OR

Complete an online Google Survey. Click on the following link and complete online: <http://tinyurl.com/k5ckbux>. **This survey is automatically updated in real-time and available via mobile phones as well.**

Do you make use of the resources provided to you during the Design Course? Please tick accordingly (tick next to all stipulated resources - if you have made use of more than one).

Resources		Yes	No
Open Source Software/PLE's	Picasa		
	Photo Story 3 for Windows		
	Iwisoft		
	A-tube (video download and screen casting)		
	TagCrowd/Tagzedo		
	Google Drive		
	Narrated Power point		
Documentation	Instructional strategy		
	Planning document		
	Web design principles		
	Rubric prototype		
Learning Theories	Theories of Learning and its impact on eLearning		

If **yes**, briefly explain **why and how** you are making use of these resources?

If **no**, briefly explain **why you are not** making use of the resources?

Did you require extra IT support when making use of the resources, after engaging in the training Programme?

Yes	
No	

I integrate ICTs to enhance my teaching-and-learning practices, because ...?

I am coerced to make use of ICTs	
It is integrated into the curriculum of my discipline	
I was motivated after the 'Design Workshop' offered by CIECT	

Prior to your engagement in this 'Design Programme', did you make use of e-Tools to enhance your teaching practices (especially those e-Tools provided to you during the training Programme?).

If your answer was **no**, please explain why you did not make use of e-Tools to supplement current teaching-and-learning practices?

Appendix I

THE SEMI-STRUCTURED INTERVIEWS AND A SUMMARY OF CASE RESPONSES (SEE CHAPTER 5.3.1)

5.3. Professional development and policy

Question: Are you familiar with the policy on E-education (2004) or the guidelines for teacher training and professional development in ICT?

The case of Annabel: *"I am, I have actually managed to work through it, but I am getting there, I am getting there".*

The case of Meredith: *"I haven't ventured into reading anything about that because I only concentrate on my academic policies. So with regard to IT, I am not an IT teacher, I haven't endeavoured to read anything at all".*

The case of Yolanda: *"No, actually I am not, I should most probably familiarise myself with it".*

The case of Dorothea: *"I have read somewhere on the E-classroom website something about the policy".* **Probe:** The policy on E-education was gazetted in 2004 and stipulates that all learners in the GET and FET phases should become digitally capable by 2013. *"Will they probably extend it? So I have heard about it, and I have read here and there about it. I think I noticed it on the E-classroom Website. We should become e-schools".*

Three other participants from the sample had the following responses:

Participant 5: *Is that a national thing? No, I don't think that I have actually read it. I am not familiar with it".*

Participant 6: *"No, Ma'am".*

Participant 7: *"No, not".*

5.3.2 Teacher knowledge

Question: Could you briefly explain how your own knowledge of technology has developed, and was this a deliberate decision by you to become au fait with technology?

The case of Annabel:

I must say that when I started at this school, I wasn't clued up with technology and now that I have come here. (research site) It has just broadened my knowledge about technology how important it is for the little ones. It just captures them. It was not done intentionally, but I must say that it came to no harm. So I must say it has really changed my life as a teacher because I find

that I have more time on my hands and I can explain things better by using technology.

The case of Meredith:

Hmm, my experiences of technology is just via trial and error, hmm exploring the computer, using all of my free time the computer during breaks and in the morning. The session in the morning is very useful, then we have faster connectivity. I do a lot of exploring, discover things, use it, then I don't use it for a long time, then I forget where I found it.

The case of Yolanda:

Yes, definitely, I think technology is just all over, and just taking over the world, that if you don't aufait yourself with technology, then you will actually be left behind. So I made a deliberate decision to start getting to know technology, although I don't read up a lot about it. It is just finding my own way around technology.

The case of Dorothea:

Yes most definitely, because digital technology is the future and whether we like it or not it is going to become part of the children's lives. More so than our lives. We use it not, like on a daily basis, but now and again, but they are going to grow up one day using it as part of life.

Question: When you plan your lessons to include technology, what are the important considerations that you make?

The case of Annabel:

I think about outcomes that I want to achieve and what I want the children to understand and also things that they are not familiar with in their daily lives. I try to source that from the internet and actually show them what I am currently talking about.

The case of Meredith:

I like the fact that it needs to be interactive, I wouldn't want the children to just sit like they watching TV, so that there is some sort of communication between themselves, the teacher, their peers and whatever programme. The sad thing is that not everyone can go to the board all at once, if we do group work it gives them more opportunities to do that. I think our children excel, even the children that are hyperactive they would sort of settle down and participate in the lesson.

The case of Yolanda:

Well, I think when I plan a lesson things must excite them. When I choose my lesson, it is for the opening. It must be something that grabs their attention in the beginning, then I know that they won't lose their focus during the lesson.

The case of Dorothea:

When I plan a lesson, I think of the children in their different styles, their learning styles. That's how I approach it, because I have so many children who are not...you know...I have got more visual learners than auditory learners' and children who like to see things in my class, the learners' who sit still are in the minority. So I have to be very graphic and creative and all that.

5.3.3 Teacher beliefs

Question: Do you consider technology in the classroom as a necessity for learner achievement?

The case of Annabel: *"I strongly do believe that because the kids each one get a chance to do part of it and we giving the children the opportunity to actually interact you know in a friendly way".*

The case of Meredith: *"Oh absolutely, I think our children are visual learners, more so now than 20 or 30 years ago, and I think it is imperative that we do use it and if have the opportunity to use it then we should extend ourselves".*

The case of Yolanda: *I think it is, especially in the Foundation Phase, because our children learn by what they see. Everything is there for them. It does not matter what subject matter you are teaching, you can go to the internet and make it available for them to see. It is just so easily available".*

The case of Dorothea: *"Yes, I do, technology makes the lessons interesting and interactive".*

5.3.4 Teachers' TPACK

Question: Do you think that technology software applications/e-Tools can be utilised to foster critical thinking and problem solving skills, or any of the other 21st century skills-communication, collaboration and creativity?

The case of Annabel: *" Most definitely, yes I do I must say I do, they(Grade R) have picked up such a lot in the time we have been doing the technology for the past year, and the confidence they have gained. It is just amazing".*

The case of Meredith:

Oh yes, there are more opportunities for that and I have discovered that I can level the lessons for that. We (Grade 1) start at a lower level and sort of move toward the higher end questioning which excite some of the children and it does not leave out anybody. If I just stick to one level lesson then some of the children might be bored.

The case of Yolanda: *" I think it can. It depends on the level of our children, what level they think. But I think it can enhance their thinking and higher order".*

The case of Dorothea:

*Yes, definitely, there are certain children that are on that level. They always would ask me questions and I would normally just show them something that they are asking about. They would put the questions to me. So it is like a different way, instead of me just asking the questions. **Probe: So if you introduce your lesson for example with a video clip, more learners' would ask questions, whereas before they would have just been silent.** Yes, normally when using books, we would read and I would focus them on a picture. And I would say, what does this picture say? But with technology and something on the big screen, some children are just so clever, that they will ask me questions that I would not even think about. They pick up things in the background, like something on a wall or under the table or something like that. **Probe: It is an immediate response, because they see it at that moment and look for the relevance to the lesson.** Yes.*

Question: Are you motivated to use technology more often to enhance your teaching? What percentage of your lessons are technology enhanced?

The case of Annabel:

I am very motivated. I try to find the time to source information which is quite difficult for me. We need contact time with the children and the day is quite long. With the internet being so slow I find that if I source certain things it takes longer. I must say without the technology I don't see it would be possible in today's age and time you need to move along with technology.

The case of Meredith:

I would love to say my lessons are 100% enriched with technology, but I think this year with CAPS, I needed to put my head around CAPS and put my head around planning of my lessons and my Assessments, especially. I think that was a bit of a challenge for me this year. So I would probably sadly say maybe 65% of my lessons - I have used technology, not fully, not interactive.

You know the Smart Board might go on everyday and I might have my worksheets displayed on there. Then I am using it as a data projector. I need to maybe next year use it as an IWB, not just to display information.

The case of Yolanda: *"I am motivated to use it, I must admit the obstacle that I obviously have is time, because I need time to research it. But I do feel more motivated to use it".*

The case of Dorothea:

Well, it is about 20%. I would love to have it 50%, if I could get like Tablets into the classroom, it would be lovely. But I use the IWB daily and use the Internet. Probe: Do you use the software that is embedded in the IWB (Whizz Teach)? Not every day. Probe: Have you explored all the applications that you can make use of in your lessons? It will save you a lot of time searching for relevant applications to support your lessons. I actually downloaded some of my things, then my Laptop crashed and it had to be re-done. This new one was on the point of crashing and then he (administrator) had to install some other programmes, then I lost my links, you know how you save it in your favourites folder. Now I don't know where to get them.

5.3.5 Technology as tool to address barriers to learning

Question: Do you adapt the technology selection (multi-media) to the specific learning needs and preferences of the learners?

The case of Annabel: *"I do consider it, and that's why I start with basics first and as I move from the basics, I will try to integrate things that are more advanced for children who are more advanced. I will start with basic things and then move up".*

The case of Meredith: *"I have too, because all children learn differently".*

The case of Yolanda: *"I must say, this year I probably have not adapted to the weaker learners, no, I haven't gone into a lesson preparation and thought that this will be for the weaker learners, I think at this stage it was just for the class in general".*

The case of Dorothea: *"Yes, I do, because I consider the different learning styles of the learners'."*

Appendix J

PROTOTYPE LESSON DISCUSSIONS FROM DOCUMENTARY DATA OF THE DESIGN AND ONLINE TEACHING/INSTRUCTIONAL EVENT (2012)

Documentary data: The case of Annabel

My target audience is the pre-school learners. Learners are not exposed to technical equipment at home. With Grade R being the foundation for future learning, it is important that the classroom is structured in such a way for them to want to come and learn. When using technology in my class I find it more stimulating and interesting for the learners as they engage in discussion. From experience I have found that young learners are able to grasp concepts more easily by visual stimulation. My e-Tools I would use to assess my young learners are the following; PowerPoint presentations- This is such a helpful tool as I am able to extract pictures from the internet. This is very important for my visual learners. They will be able to see and discuss what is presented to them. I would be able to use it as an interactive assessment. Digital photo story - I would make up a photo story having pictures relating to the topic. This would lead to incidental reading as I would put in the High Frequency Words relating to the picture. Learners would be evaluated on the beginning sounds of the words.

Documentary data: The case of Meredith

*My target audience is the Grade 1 learners who are between 6-8 years old. My academic focus is English, Afrikaans, Maths and Life Skills .The minority of my learners are digitally savvy being exposed to computers, PlayStation and cell phones, but the majority is technically stunted and many more are visual or auditory learners! For this reason I am excited to catapult them into the exciting audio/visual experience of face-to-face learning. Despite the fact that I do not have an interactive white-board, (**Interactive white boards were installed soon afterwards**) my learners have been exposed to a data projector and Power point presentations. The children were in awe at the visuals and showed a renewed interest in the lesson. E-learning opened up a host of exciting tools in which to immerse my learners; exposing them to an exciting new experience. I intend to design interactive Power point presentations instead of using the chalkboard or written worksheet. The visual stimulation will enhance memory. Digital photo stories using their original*

written stories will test listening skills. Downloaded You-tube clips will be used to enhance Power point lessons or for storytelling, and to assess reading and listening skills. I will use PICASA to create collages of learners, their academic experiences and their work and create Podcast for Orals, Music, recitations - kids would love to hear themselves and others. MCQ type questions could be used for basic operations and phonics if all resources are in place. As an educator, it is incumbent on me to facilitate the cognitive growth of my learners by guiding, supporting, advising, encouraging them as their learning is accessed through the use of technology and the exposure to E-Learning Tools. I will strive to apply pedagogical value by using the following e-tools to supplement the traditional face-to-face approaches. I am confident that this online teaching event will motivate and inspire all learners. It certainly has inspired me!

Documentary data: The case of Yolanda

My target audience will be seven to eight year old learners which will form part of my Grade 2 class. Our language of instruction is English and yet many of our learners' home language is Isi-Xhosa or Afrikaans, so they find it difficult to express themselves in the language of instruction. I would download stories from YouTube because learners will find this more exciting than listening to me reading them a story. By often listening to stories and poems will help with vocabulary extension. Sometimes learners find it difficult to grasp a concept and because learners at that age are visual learners, I would make use of a digital story to explain the concept and learners can then see it develop from beginning to end. They will then get a better understanding of the concept. In Grade two learners are encouraged to write short stories and to illustrate their stories. Learners will be very proud if we showcase one of their stories using a digital story.

I will use the different e-Tools that will not only enhance my teaching but it will make learning more exciting and interactive for my class. To introduce learners to the expectation of the lesson I will do a narrated PowerPoint presentation that will include a picture for discussion which can be reviewed over a period of time. By straying away from the traditional teaching methods, the learners' attention will be captured and their interest will be increased. Learners will explore the picture and through effective and direct questioning they will come to a conclusion. Children are constantly developing their

listening and speaking skills and it forms a very important part of a child's learning. I see story telling as an important part of a Foundation Phase child's development so I will download stories from YouTube. For our lesson, learners will also be able to see that each story has a different beginning.

Digital Story Telling can also be used where learners can create a story of their class story (collaborative task) and share it with the other Grades."

Documentary data: The case of Dorothea

My target audience will be Grade 3 learners who are between the ages of 8 and 10. Some of them (1/5 of my class) repeated either Grade 1 or 2. I therefore have a complete mixed ability group with learners progressing on either Grade 1, 2 or 3 level. This is a big challenge for me as the educator as my lessons must be prepared in such a way that it caters for all their needs. Language is another barrier since learners' Home Languages are different from their Language of Teaching and Learning, which is English. Some learners are frustrated at times and I feel visual pictures and voice audio could be used to assist with this. My learners have been exposed to the interactive whiteboard and this has greatly enhanced my teaching and learners greatly enjoy being actively involved in lessons in this way.

Learners will influence the development of my course by how they respond to each stage of it. I would certainly have to make changes to the course according to their understanding and learning. I would only add new technology when all learners are ready to receive it because some learners take a long time to understand and take in new areas of learning. On the other hand this new way of learning would have them excited, waiting for more! I will make use of the following e-Tools. YouTube: Learners take part in whole group discussion after watching a short clip on the view of Earth from Space. This will give me an opportunity to test their Listening and Speaking Skills. (English) I would encourage interaction by questioning individuals. (Encourage high order thinking) PowerPoint Presentation: After watching this presentation (Stars and Planets), I would encourage learners to do their own research further using DBE workbooks and other reading materials during Library periods. Formal Assessment will be conducted after enough information has been gathered. Learners will receive a rubric beforehand, explaining exactly what they will be assessed on.

Picasa: Assessment: Social Interaction (Group activity). Learners will be divided into groups (houses). They will be given a camera and taken outdoors to take about ten pictures per group of things found only on Planet Earth. These pictures will be made into a collage using Picasa and screened on our Whiteboard. A Self- Assessment Rubric will be given to each group. 😊😐😞 (Group needs to tick smiley face; this will give me an idea if they found this activity enjoyable or not).

Digital Story: Group Activity: Groups must come up with their own story about: "I am an alien on planet ...". After story is written down they must draw their own illustrations. These stories will be uploaded on Digital Story and voice recordings could be added, giving each child in the group an opportunity to read a page. Assessment: English (Listening and Speaking; Reading and Viewing) Life Skills: Art; Personal Development.

Since Most of these e-Tools are new to them, it would take some time and careful planning to be successful. The plan is to introduce them over a long period so learners can easily identify each one and their value.

Appendix K

EXTRACTS FROM RELEVANT SECTIONS OF THE POLICY ON E-EDUCATION (2004): TRANSFORMING LEARNING AND TEACHING THROUGH ICT

Chapter Four: The Policy Framework

- 4.1 The following key elements underpin the use of ICTs in teaching and learning without constraining the teachers, learners and learning organizations in creativity, problem-solving and innovation. It encourages them to be fully engaged and participative in the teaching and learning process within an outcomes-based approach. This is dependant upon policy reforms, both within education and within other sectors e.g. the finance and telecommunications sectors.

Equity

- 4.2 The use of ICTs in education always involves choices about resource allocation. The drive for additional resources results from prior access to information and resources. The technically able and well equipped can often make more compelling cases for re-equipping than those who have poor or no resources. Technology tends to amplify advantage.
- 4.3 It is for this reason that the principle of equity should inform our approach and provide an alternative basis for supplying access to information and the allocation of resources. Equal access and equal competence must be the objective of our education system.
- 4.4 A technology baseline will therefore be developed to address the issue of equity.

Access to ICT infrastructure

- 4.5 The impact and effectiveness of ICTs rest on the extent to which end-users (learners, teachers, managers and administrators) have access to hardware, software and connectivity. For e-Learning to be successful, learners must have regular access to reliable infrastructure.

Capacity building

- 4.6 ICTs are most effectively applied when viewed as integral to teaching and learning by both learners and teachers. ICT integration supports outcomes-based education, which encourages a learner-centred and activity-based approach to education and training. Any ICT integration requires that teachers engage in rethinking and reshaping their engagement with the curriculum.
- 4.7 Many teachers have grown up in environments with limited electronic technology, and thus find the adaptation to working with ICTs more difficult than their learners do. A programme that urgently addresses the competencies of teachers to use ICTs for their personal work, in their classrooms, must be developed. This will require extensive staff development and support. Thus, ICTs will be central to the pre-service training of recruits and the ongoing professional development of practising teachers.

Chapter Five: Strategic Objectives

ICT professional development for management, teaching and learning

Every teacher, manager and administrator in General and Further Education and Training must have the knowledge, skills and support they need to integrate ICTs in teaching and learning.

- 5.1 The Department of Education must develop a national framework for competencies for educators (teachers, managers and administrators), and the use of ICTs as flexible tools for teaching and learning must be integrated into pre-service and in-service training. This will include legal and ethical issues, evaluation of software and the use of ICTs to address learners who experience barriers to learning. This will require creating an appropriate accreditation within the National Qualifications Framework, revising the Norms and Standards for Educators, and reviewing Department of Education in-service training policies and programmes to enable teachers to understand and use ICTs appropriately.
- 5.2 Standards for professional competency in ICT utilisation will consider the following competencies within an outcomes-based paradigm:
 - entry - computer literate, able to use computers and teach learners to use computers;
 - adoption - able to use various technologies, including the computer, to support traditional management, administration, teaching and learning;
 - adaptation - able to use technology to enrich the curriculum and use integrated systems for management and administration;
 - appropriation - able to integrate technology into teaching and learning activities, and use integrated systems for management and administration within a community context; and
 - innovation - prepared to develop entirely new learning environments that use technology as a flexible tool, so that learning becomes collaborative and interactive. Technology is integrated as a flexible tool for whole-school development.

The challenge is for managers and teachers to operate with higher competencies, without falling too much back on the initial ones.
- 5.3 The Department of Education will collaborate with the Education, Training and Development Practices SETA to access the skills levy for in-service ICT training programmes.
- 5.4 Each school will have a dedicated teacher outside the normal staffing ratio to manage ICT facilities and champion the use of ICTs in the school community. This teacher will receive the necessary training and support in learner focused approaches to learning and ICT in an outcomes-based paradigm.

PHASE I

ENHANCE SYSTEM-WIDE AND INSTITUTIONAL READINESS TO USE ICTs FOR LEARNING, TEACHING AND ADMINISTRATION

BUILD AN EDUCATION AND TRAINING SYSTEM TO SUPPORT ICT INTEGRATION IN TEACHING AND LEARNING

- Dedicated expertise is appointed and developed at different levels of the system for the planning, management, support, monitoring and evaluation of ICTs.
- Ongoing support to managers is provided at different levels of the system.
- Provinces are collaborating and pool ICT resources where appropriate.

BUILD TEACHERS' AND MANAGERS' CONFIDENCE IN THE USE OF ICTs

- Every teacher and manager has the means to obtain a personal computer for personal use, administration and preparation of lessons.
- Every teacher and manager has access to basic training in the use of ICTs.
- Technology incentives for institutions and teachers to use ICTs are installed through the "Most Improved Schools Award" programme and other schemes.
- A set of case studies and examples is available to teachers and managers on how to integrate ICTs in management, teaching and learning.

BUILD A FRAMEWORK FOR COMPETENCIES FOR TEACHER DEVELOPMENT IN THE INTEGRATION OF ICTs INTO THE CURRICULUM

- Norms and Standards for Educators are revised to include ICT use and integration.
- All pre-service teacher training in higher education institutions includes basic ICT literacy and basic ICT integration into teaching and learning.
- Teachers have access to in-service training on how to integrate ICTs into teaching and learning.
- Teachers have access to ICT technical support training.
- Institutional managers have access to in-service training on how to integrate ICTs in management and administration.
- Provincial managers are trained in ICT integration to offer support to institutions.

ESTABLISH AN ICT PRESENCE IN INSTITUTIONS

- Every institution has a computer and software for administrative purposes.
- 50% of all institutions have access to a networked computer facility for teaching and learning.
- All of the above institutions have legal software and use the software.
- ICT facilities are being used effectively to facilitate ICT integration into teaching and learning.
- ICT facilities are safe.

INSTITUTIONS ARE USING EDUCATION CONTENT OF HIGH QUALITY

- Institutions are using educational content that is developed according to set national norms and standards.
- Institutions have access to an updated database of evaluated content resources and are able to select content for their usage.
- Institutions have access to educational content on the Educational Portal "Thutong".

INSTITUTIONS ARE CONNECTED, ACCESS THE INTERNET AND COMMUNICATE ELECTRONICALLY

- 50% of institutions are connected to the Educational Network.
- Networks are safe and information security is monitored.
- Institutions use electronic means to communicate with provincial offices.
- All institutions have access to an e-Rate.

COMMUNITIES SUPPORT ICT FACILITIES

- SMMEs are developed and trained to provide technical support to institutions.
- Communities have access to ICT facilities and services, and in return provide assistance in sustainability of the intervention.

PHASE II

SYSTEM-WIDE INTEGRATION OF ICTs INTO TEACHING AND LEARNING

TEACHERS AND MANAGERS INTEGRATE ICTs INTO MANAGEMENT AND THE CURRICULUM

- 50% of teachers are trained in basic ICT integration into teaching and learning.
- Teachers have access to ICT technical support training.
- 80% of institution managers integrate ICTs in management and administration.
- Provinces support ICT integration into the curriculum.
- Research and evaluation inform developments and directions in ICT integration.

ICTs ARE WIDELY PRESENT IN INSTITUTIONS

- 80% of all institutions have access to a networked computer facility for teaching and learning.
- All of the above institutions have use legal software.
- ICT facilities are safe, effective, designed to facilitate ICT integration into teaching and learning, and in working condition.
- All institutions with ICT facilities have a dedicated teacher to manage the facility and to champion the use of ICTs in the institution.

INSTITUTIONS ARE USING EDUCATION CONTENT OF HIGH QUALITY

- The Educational Portal "Thutong" provides access to resources in all learning areas in GET and all subjects in FET.
- Institutions use the Educational Portal to communicate, collaborate and access content resources.
- Institutions have access to digital libraries.
- Teachers are producing digital content of high quality and making it available to other teachers.

INSTITUTIONS ARE CONNECTED, ACCESS THE INTERNET AND COMMUNICATE ELECTRONICALLY

- All institutions are connected to the Educational Network.
- Networks are safe and information security is monitored.
- Institutions use electronic means to communicate with provincial offices.
- All institutions have access to an e-Rate.

COMMUNITIES SUPPORT ICT FACILITIES

- SMMEs provide technical support to institutions.
- Community involvement supports institutions to sustain ICT facilities.

PHASE III

ICTs INTEGRATED AT ALL LEVELS OF THE EDUCATION SYSTEM - MANAGEMENT, TEACHING, LEARNING AND ADMINISTRATION

- All departments of education use ICTs seamlessly in planning, management, communication and monitoring and evaluation.
- All learners and teachers are ICT capable.
- ICTs are integrated into teaching and learning in all institutions.
- All teachers integrate ICTs into the curriculum.
- All institutions have access to a networked computer facility for teaching and learning that is safe, effective, designed to facilitate ICT integration into teaching and learning, and in working condition.
- All institutions use educational software of high quality.
- All institutions use the Educational Portal for teaching and learning in an outcomes-based education fashion.
- Communities are integrally involved in e-institutions.
- ICT interventions are informed by research.

DECLARATION OF LANGUAGE EDITING (1)



FACULTY OF EDUCATION AND SOCIAL SCIENCES
DEPARTMENT OF RESEARCH

MOWBRAY CAMPUS
P O Box 13881
MOWBRAY, 7705
Tel: +27 21 680 1572
Fax: +27 21 680 1504
Email: kwendac@cput.ac.za

07 September 2015

To whom it may concern

Language editing of D.Ed Thesis

I hereby confirm that I have language-edited the thesis: **Technology Integration: Tracing In-Service Primary Teachers' Technological, Pedagogical and Content Knowledge Development**, submitted by the candidate Chamelle de Silva.

Thank you

Dr C. M. Kwenda

A handwritten signature in dark ink, appearing to be "C. M. Kwenda", is written over a horizontal line.

DECLARATION OF LANGUAGE EDITING (2)

The DEd thesis by Ms Chamellé René de Silva,
(in the Faculty of Education, Cape Peninsula University of Technology)

has been edited by

Dr Barbara Basel

D.Litt. University of Pretoria, MA Potchefstroom University, BA UNISA
Executive Member of English Academy of Southern Africa
Lecturer in English Literature, Linguistics and Communication at Midrand
Graduate Institute. Cape Town Campus.
Academic Editing – MBA Theses, MEd Theses, Master’s in Graphic
Design Thesis,
External Examiner for MEd Thesis.

1 Six Oaks,
5, Adelaide Road
Plumstead
Cape Town 7800
Tel :021 761 4289
Cell: 082 6511659
barbara.basel@gmail.com

Barbara Basel

11 October 2015