

INNOVATIVE TEACHERS' PEDAGOGICAL EFFICACY IN THEIR USE OF EMERGING TECHNOLOGIES

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Submitted in partial fulfilment of the requirements

for the degree

Philosophiae Doctor (Computer Integrated Education),

in the

Department of Mathematics, Science and Technology Education

Faculty of Education

University of Pretoria

2011

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Charcoal drawing on cardboard: Diek Grobler 2006

Dedication

To Soar, Stride, Stroll and Inspire

The Batchelor and Kotzenberg family values are encapsulated in the pages of this document.

Humanity

Integrity

Perseverance

Humour

Resilience

Balance

Acknowledgements

Prof. Marlien Herselman – for her unwavering support and guidance throughout this journey. Her dedication has helped me to arrive at the destination.

Prof. John Traxler – for the inspiration and being a role model and mentor from afar.

Prof. Billy Fraser – for conceptualising and framing this journey.

Prof. Johannes Cronje – for prompting me to start this journey.

Dr. Adele Botha - my gratitude for being a friend and a research companion on the treacherous journey started 7 years ago and the pact we made to be *believing mirrors* for each other.

Declaration

1. I understand what plagiarism is and am aware of the University's policy in this regard.
2. I declare that this thesis is my own work. Where other people's work has been used (either from a printed source, Internet or any other source), this has been properly acknowledged and referenced with departmental requirements.
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Publications

Botha, A., & Batchelor, J. (2011). Mobile Learning. In K. Van Wyk (Ed.), *Teaching and elearning in South African Schools* Macmillan (in press).

Batchelor, J. (2010). *Liberating Learning: Innovative Pedagogical Practices in Africa*. Paper presented at the eLearning Africa: 5th International Conference on ICT for Development, Education and Training, Lusaka, Zambia.

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Kriek, L., Matthee, M., Lotriet, H., & Batchelor, J. (2010). Comparing the Emancipatory Value of two South African Mobile learning Projects. Paper presented at the MLearn2010, Malta, Greece.

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Summary

Innovative teaching is, in essence, the art of breaking down barriers which prevent educators from preparing learners for the gruelling demands of the 21st century by exploiting the affordances of emerging Information and communications technologies (ICT) to enhance their teaching and learning strategies. The resulting new educational practice can affect roles, learning situations, patterns of interaction, learning spaces, strategies and theories as well as modes of assessment (Mioduser, Nachmias, Tubin, & Forkosh-Baruch, 2002a). The problem addressed in this study is that of innovative teacher knowledge construction and its context. The role of educational technologies in teaching and learning has evolved and changed dramatically over time but little is understood of how this knowledge manifests itself in their practice and how it is replicated and shared in practice. Pioneering, innovative teachers have developed personal theories that may potentially inform future practice once articulated and disseminated. This study sets out to deepen our understanding of how new knowledge is created in practice by innovative teachers and how this knowledge manifests itself in teaching and learning with emerging ICT. The consequent collaboration between researcher and participant teachers can act as a reconciliatory measure between practice and theory.

The literature reviewed draws on tenets from socio-cultural theory, critical philosophy, emerging technology and teaching and learning theory and aims to construct rational foundations to assist in the articulation of new theories which, in turn, will better our understanding of this new emerging pedagogical practice. A post-modernistic interpretive prism views the research investigation through the work of teachers qualified as finalists in the Microsoft Innovative Teachers Forum Awards (ITFA) competition. This annual competition recognises and connects innovative teachers who share a common interest in the enhancement of teaching and learning through the use of technology. Data collecting instruments include meta-data consisting of educational multimedia artefacts, virtual classroom tours (VCT's), document analysis, innovative teacher workshops and interviews. The data were qualitatively analysed using Straussian Grounded Theory Method to articulate a substantive theory which aims to better our understanding of knowledge creation when innovative teachers use emerging technology to enhance their teaching and learning. The resultant substantive theory's three core components comprise moral cohesion; innovation negotiations in context; and responsive

governance as essential to innovative teachers' pedagogical efficacy when they engage with emerging technologies.

Innovative teachers' perception of the professional burden they carry along with their bricoleur attitude allude to them using whatever means and whatever is at hand to equip learners with the skills required to make them contributing members of their community and the information society. Strategies for the constant renewal of pedagogical practices and the need for reflexivity included the appropriation of learners' personal devices for learning where their disposition had to be carefully managed in accordance with ethical considerations and their various capabilities. Innovative teachers are powerful change agents within their school environments and in this regard a certain amount of freedom could be offered to innovative teachers to further explore their own practice whilst at the same time tasking them with additional responsibilities in growing organisational capabilities. Innovative teachers use their increased status and power within their schools to actively lobby for policy changes through participating in advisory committees and assisting in the drafting of documents that hold strategic, ethical and practical implications for the exploitation of emerging technologies within their schools.

Keywords

Emerging technologies

Information Communication Technology

Innovative teachers

Pedagogy

Grounded Theory

Technology integration

Pedagogical efficacy

Information society

Organizational learning

Table of Contents

Dedication	iii
Acknowledgements.....	iv
Declaration.....	v
Summary	viii
Keywords.....	ix
CHAPTER 1. INNOVATIVE TEACHING	1
1.1 Introduction	1
1.2 Background information	2
1.3 Problem statement	7
1.4 Motivation for this research study	8
1.5 Research questions	12
1.6 Research process presented	15
1.6.1 Paradigms or worldviews.....	16
1.6.2 Research philosophy	17
1.6.3 Research design	22
1.6.4 Research approach.....	23
1.6.5 Research strategy.....	25
1.6.6 Data Collecting Methods.....	31
1.6.7 Data Analysis Techniques.....	35
1.7 Study development phases.....	40
1.8 Constraints	41
1.9 Ethical considerations	42
1.10 Anticipated benefits and significance of the contribution	44
1.11 Map of thesis.....	44

1.12	Summary	46
CHAPTER 2. TO ESTABLISH THEORETICAL SENSITIVITY.....		49
2.1	Introduction	49
2.2	The framework of the study	49
2.3	The technosphere: Emerging technologies	53
2.3.1	Modes of curriculum delivery	54
2.3.2	Summary of technosphere: Emerging technologies.....	59
2.4	The ecosphere: Professional and organisational learning.....	59
2.4.1	A chronological view of teaching and learning theories.....	60
2.4.2	Principles of learning.....	63
2.4.3	ICT in Education. Where did it all start?	65
2.4.4	Summary of ecosphere: Professional and organisational learning	67
2.5	Sociosphere: Critical philosophy.....	69
2.5.1	Cultural-historical context.....	69
2.5.2	The information society	70
2.5.3	Summary of sociosphere: critical philosophy	74
CHAPTER 3. DATA SET AND ANALYSIS PROCEDURES		77
3.1	Introduction	77
3.2	Why Grounded Theory?.....	78
3.2.1	Learning by doing Grounded Theory	79
3.2.2	Limitations of Grounded Theory	80
3.2.3	Which one to choose?	80
3.2.4	Application of grounded theory in this study	85
3.3	Some background information to this research.....	86
3.4	Data gathering considerations.....	87
3.4.1	Preparing data for analysis	87
3.4.2	Sampling.....	88
3.4.3	Purposive sampling.....	88
3.4.4	Theoretical sampling.....	89
3.5	Data Capturing	90

3.6	Research documents.....	91
3.6.1	Virtual classroom tour (VCT).....	93
3.6.2	Posters and leaflets.....	96
3.6.3	Multimedia artefacts.....	99
3.6.4	Interviews.....	100
3.6.5	Video recorded formal structured interviews	101
3.6.6	Unstructured interviews	103
3.6.7	Impromptu informal conversational pieces.....	104
3.6.8	Innovative teacher workshops.....	105
3.7	Data analysis	109
3.7.1	Key analytical strategies to follow when doing Grounded Theory research	110
3.7.2	Use of memos	118
3.7.3	Constantly capturing thoughts in informal memos	119
3.8	Emerging categories presented	122
3.9	Summary	124
CHAPTER 4. SOCIOSPHERE.....		129
4.1	Introduction	129
4.2	Sociosphere: Critical philosophy.....	131
4.3	Professional burden	132
4.3.1	African renaissance	134
4.3.2	Stewardship	139
4.3.3	Ethical considerations	144
4.4	Teacher as Bricoleur.....	151
4.4.1	Teacher disposition.....	153
4.4.2	Teacher training	160
4.5	Moral Cohesion	163
4.6	Summary	166
CHAPTER 5. TECHNOSPHERE		168
5.1	Introduction	168
5.2	Technosphere: Emerging technologies.....	169

5.3	Technology implications	171
5.3.1	Availability and distribution	174
5.3.2	Technology appropriation.....	181
5.3.3	Mobile technology	185
5.4	Innovation strategy	191
5.4.1	Innovation process.....	193
5.4.2	Learner disposition.....	200
5.4.3	Managing expectations.....	209
5.5	Reflexive pedagogy	211
5.5.1	Curriculum issues	215
5.5.2	Unprecedented initiative	219
5.5.3	Assessment quandary	222
5.6	Innovation negotiations in context.....	225
5.7	Summary	231
CHAPTER 6.	ECOSPHERE	233
6.1	Introduction	233
6.2	Ecosphere: Professional and Organisational learning	234
6.3	Skills transfer.....	235
6.3.1	Self empowerment	237
6.3.2	Capacity building.....	239
6.3.3	Teachers chart their own development path	244
6.4	Organisational change	246
6.4.1	Hierarchal movement	249
6.4.2	Incentives for change.....	250
6.4.3	Lobby for change.....	251
6.5	Teachers leave	252
6.6	RESPONSIVE GOVERNANCE	254
6.7	Summary	257
CHAPTER 7.	CONCLUSIONS AND REFLECTIONS	258
7.1	Introduction	259

7.2	Research presentation	259
7.3	New insights: Theory development	261
7.3.1	Summary of findings: Sociosphere.....	262
7.3.2	Summary of findings: Technosphere	263
7.3.3	Summary of findings: Ecosphere	265
7.3.4	Construction of the substantive theory	266
7.3.5	Substantive theory: Possible practical implementation	271
7.3.6	Methodological contribution	271
7.4	Reflections.....	272
7.4.1	Making sense of methodology.....	272
7.4.2	Delayed methodological mastery	274
7.4.3	Regarding coding.....	275
7.4.4	Theoretical saturation.....	276
7.4.5	Mastering the software during data analysis	276
7.5	Judging the credibility of Study.....	279
7.5.1	Credibility	279
7.5.2	Transferability	280
7.5.3	Dependability	280
7.5.4	Confirmability.....	281
7.6	Writing sequence of the study.....	282
7.7	Personal reflection: Comments on the pragmatic side of this research	283
7.8	Limitations and restrictions of the study	285
7.9	Possible future research	286
7.10	Concluding remarks	287
	References	289
	Appendix A – Ethical Clearance Certificate.....	313
	Appendix B – Letter of permission from Microsoft South Africa.....	314
	Appendix C - Interview questions	315
	Appendix D – Example of the information contained in a VCT	316
	Appendix E – Examples of transcribed structured video interviews	320

List of Tables

Table 1-1: The intellectual puzzle for this study	15
Table 1-2: Philosophical Assumptions with Implications for Practice (Originally adapted from Guba and Lincoln 1988 by Creswell 2007)	21
Table 1-3: Fundamental principles for conducting interpretive studies (Klein & Myers, 1999, p. 72).....	38
Table 2-1: Major Learning Theory Perspectives (Christensen, 2001, p. 4)	62
Table 2-2: Teaching Principles Summary and Descriptions (Callaghan, 2008 p. 93)	64
Table 2-3: Overview of pedagogy in the industrial versus the information society (Voogt and Pelgrum, 2005, p. 158)	71
Table 2-4: Three approaches to the information society	72
Table 2-5: Overview of literature review	74
Table 3-1: Key differences in Grounded Theory Method approaches (Onions, 2006, p. 3)	83
Table 3-2: Set of common criteria in doing GT as suggested by Charmaz (2006) matched to actions taken in this study	85
Table 3-3: Data categories	90
Table 3-4: Data gathering and instruments used during the research process.....	92
Table 3-5: Contents of slides of a Virtual Classroom Tour.....	94
Table 3-6: interview questions posed to the semi-finalist in the World Wide Innovative Teachers Forum Awards (WWITFA) Hong Kong, 2008	102
Table 3-7: Samples of data sources generated through the workshops	105
Table 3-8: Stages in the analytical process as adapted from Coyne (2009, p. 17)	114
Table 3-9: Codes structured and organised to reflect the emergent core categories	123
Table 4-1: Research puzzle for moral cohesion	129
Table 4-2: Codes assigned to different data collection instruments during analysis	130
Table 4-3: <i>Moral cohesion</i> as the emerging core category with expanded theme <i>professional burden</i> highlighted for discussion	132
Table 4-4: Code of professional ethics (ACET, 2007, online)	148
Table 4-5: Coping strategies to address ethics as adopted by innovative teachers in their use of emerging technologies.....	150
Table 4-6: <i>Moral cohesion</i> as the emerging core category and related expanded theme <i>teacher as bricoleur</i> highlighted for discussion	151
Table 4-7: External elements influencing the proximal zone of enactment (Spillane, 1999).....	156
Table 4-8: Type of relationships between sub themes of Moral Cohesion	165
Table 5-1: Research puzzle for Innovation negotiations in context	168

Table 5-2: <i>Innovation negotiations in context</i> as the emerging core category with the expanded theme of <i>technology implications</i>	170
Table 5-3 Perspectives for Technology Use in Education (Voogt and Knezek, 2008a p.15).....	172
Table 5-4: Various classroom environments with differing levels of access to computers.....	177
Table 5-5: <i>Innovation negotiations in context</i> as emerging core category with the theme <i>innovation strategy</i> highlighted for discussion.....	191
Table 5-6: <i>Innovation negotiations in context</i> as emerging core category with <i>reflexive pedagogy</i> expanded and highlighted for discussion	210
Table 5-7: Implications of the demands of the global knowledge economy for youth in terms of required skills and learning strategies (Anderson, 2008).	212
Table 5-8 Educational outcomes required for the 21st Century (derived from: Anderson, 2008)	214
Table 5-9: Before and after evaluation of their practice: Ramanijafy Hortense Liliane	216
Table 5-10: Comparison between traditional and innovative teaching practices revealing <i>next practice</i> tendencies.....	229
Table 6-1: Research puzzle for the ecosphere	233
Table 6-2: <i>Responsive Governance</i> as the emerging core category with expanded theme <i>skills transfer</i> highlighted for discussion	235
Table 6-3: Pauline Skosana reflects on the benefits that her innovative teaching has brought to her school and community noting changes in teacher and learner perceptions	238
Table 6-4: Approaches to in-service training	243
Table 6-5: <i>Responsive governance</i> as emerging core category with expanded theme <i>organisational change</i> highlighted for discussion	245
Table 6-6: The core disciplines of systems thinking applied to innovative teachers and their schools ...	247
Table 6-7: Components of the innovative organisation (Tidd, et al., 1997)	255
Table 7-1: Criteria for judging research quality from a more qualitative perspective (Trochim, 2001, p. 162)	279

List of Figures

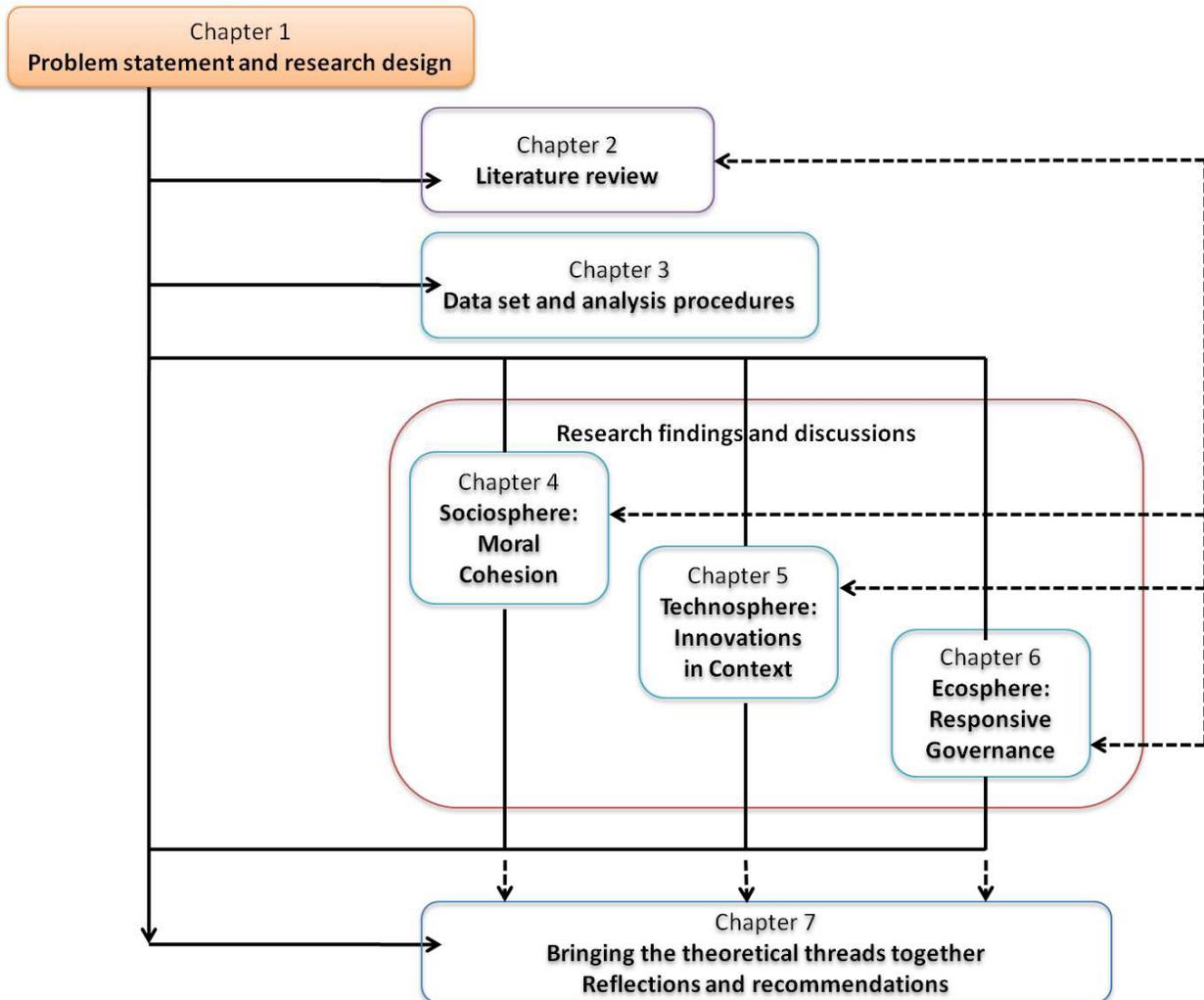
Figure 1-1: The Research Process 'onion' derived from (Saunders, et al., 2000, p. 85)	16
Figure 1-2: Philosophical assumptions (Myers, 1997)	18
Figure 1-3: Plotting the study situated within in the interpretive sociology quadrant (Burrell and Morgan, 1979).	20
Figure 1-4: Inductive and deductive reasoning.....	24
Figure 1-5: Key stages in grounded theory development (adapted from Harwood, 2002, p.67)	27
Figure 1-6: The researcher's involvement with the participants during the course of the study	34
Figure 1-7: Hermeneutic cycle	36
Figure 1-8: Post-structural system of interpretation (Demetrios, 2006).....	37
Figure 1-9: Research phases	40
Figure 1-10: Thesis outline.....	45
Figure 2-1: Framing the literature review of this study.....	51
Figure 2-2: mLearning framework (GSMA, 2010)	57
Figure 2-3: ICT spectrum (Anderson, 2010, p 13)	66
Figure 3-1: An example page of a Virtual Classroom Tour.....	94
Figure 3-2: South African finalists in the Worldwide Innovative Teachers Awards Forum in Hong Kong 2008. From left to right: Jacqueline Batchelor, Peter de Lisle, Saretjie Musgrave and Thamsanqa Makhatini	97
Figure 3-3: Poster entry from 2008 displaying codes	98
Figure 3-4: Pamphlet used as supporting material to an ITFA entry with relevant codes	98
Figure 3-5: Multimedia curriculum aligned artefacts for mobile use	99
Figure 3-6: A visual model of the coding process in qualitative research (Creswell, 2005, p. 238)	110
Figure 3-7: ATLAS.ti Text-Structure Text Process.....	111
Figure 3-8: Coding options in ATLAS.ti.....	112
Figure 3-9: The Grounded Theory analytical process from Warburton 2005 (adapted from Harwood 2002, P. 76).	113
Figure 3-10: Generating codes from a primary document	116
Figure 3-11: A framework for analysing Grounded Theory studies (Urquhart et al, 2010, p 366).....	117
Figure 3-12: Sample of researcher's paper based memos.....	119
Figure 3-13: Map of the Grounded Theory process of this research.....	121
Figure 3-14: Map of research findings to be discussed in subsequent chapters.....	126
Figure 4-1: Expanded emerging theme: <i>Professional burden</i>	133
Figure 4-2: Handwritten reflection from a workshop participant in the 2009 Microsoft Innovative Teachers Forum Awards.	135

Figure 4-3: Classroom on the outskirts of a rural village painted in the colours of the South African flag	136
Figure 4-4: Unused school computer centre	137
Figure 4-5: Zero tolerance for bribery - poster by Chris Gatsi, 2010	142
Figure 4-6: Expanded emerging theme: Teacher as Bricoleur.....	153
Figure 4-7: Reform of classroom teaching (Spillane, 1999).....	156
Figure 4-8: Poster section of the <i>Children who cares</i> project.....	159
Figure 4-9: Building theory: <i>Moral cohesion</i> as emerging core category with expanded themes	164
Figure 4-10: Interrelationship diagram of Moral cohesion.....	165
Figure 5-1: Expanded emerging theme: Technology implications	174
Figure 5-2: The M Learner.co.za displayed on a mobile phone.....	1
Figure 5-3: Innovation strategy as sub theme with expanded categories.....	192
Figure 5-4: Learning process in the virtual art gallery: Anywhere art (Rae Gagiano).....	197
Figure 5-5 Innovation Process (OPM, 2008)	198
Figure 5-6: Process relevant to exploitation and exploration learning adapted form Argyris and Schön's (1978).....	199
Figure 5-7: Screenshot of blogpage	1
Figure 5-8: Expanded emerging theme: Reflexive pedagogy	215
Figure 5-9: Poster section from <i>Anywhere Art</i> by Rae Gagiano	218
Figure 5-10: Building theory: <i>Innovation in Context</i> as emerging core category with expanded themes.....	225
Figure 5-11: Innovative teaching process and project planning.....	228
Figure 6-1: Expanded emerging theme: Skill transfer	237
Figure 6-2: Classroom 27 km from Ligbron.....	1
Figure 6-3: Senge's disciplines of systems thinking	246
Figure 6-4: Expanded emerging theme: Organisational change	248
Figure 6-5: Building theory: <i>Responsive Governance</i> as emerging core category with expanded themes	254
Figure 7-1: Research phases revisited	261
Figure 7-2: Visual synopsis of research findings	267
Figure 7-3: The visual map of building theory	268
Figure 7-4: Substantive theory of innovative teachers' knowledge manifestations when using emerging technologies to achieve pedagogical efficacy.....	270
Figure 7-5: Snippets of code	1
Figure 7-6: Ordered codes	278

What something is, as it is, we call its essence or nature. The origin of something is the source of its nature. The question concerning the origin of the work of art asks about the source of its nature. On the usual view, the work arises out of and by means of the activity of the artist. But by what and whence is the artist what he is? By the work: for to say that the work does credit to the master means that it is the work that first lets the artist emerge as a master of his art. The artist is the origin of the work. The work is the origin of the artist. Neither is without the other.

– Martin Heidegger (1971)

Taken from “*The Freirean Legacy*”(Slater, Fain, & Rossatto, 2002)



CHAPTER 1. INNOVATIVE TEACHING

“The circumstances, conditions and the very status of knowledge, learning, teaching and researching are currently in a state of profound upheaval under the double impact of rapid and far-reaching technological changes and the massive assault on longstanding narratives of foundation and legitimation.”

Lankshear, Peters and Knobel (2000, p. 17)

1.1 INTRODUCTION

The purpose of this study is to generate a substantive theory that describes how innovative teachers' tacit knowledge manifests when they engage with emerging technologies to achieve pedagogical efficacy in a developing context. This study focuses on articulating the tacit knowledge teachers possess when they implement new strategies in their teaching and learning and how it manifests itself in their specific teaching and learning contexts. The substantive theory is based on the experiences of teachers participating in the annual *Microsoft Innovative Teachers Forum Awards* later to be known as the *Partners in Learning Program*.

This study evolved from the researcher's own involvement in the field of innovative teaching practice with the focus on teacher training and upliftment. The researcher's teaching career, that spanned a period of 25 years mainly in the field of sciences, provided many opportunities to guide and mentor fellow teachers in the integration of ICT in their own day-to-day teaching and learning practice. These interactions included informal instances of engagement as well as more formal workshops mainly in the Eastern Cape and Gauteng regions of South Africa. Observations done during this productive period affirmed the notion that teachers acquire a unique set of skills of a very practical nature over time when engaging with new technologies. Teachers further experience difficulty in articulating their tacit knowledge coherently enough to affect significant change in their own schools.

The process of knowledge building takes place on a predominantly instinctive level and it is through a journey of reflection and engaging with like-minded colleagues that teachers manage

to articulate, formalise and share their practical tacit knowledge with others. A direct result of explicating their understanding of their practical knowledge is that they continue to renew and grow their own practice and consequently this brings about greater change.

This study focuses on the latter context, of new tacit knowledge and further explores the phenomenon of teachers capitalising on the disruptive nature of emerging technology to introduce new and innovative pedagogies within their own contexts.

1.2 BACKGROUND INFORMATION

Cohen (1987, p.153) argues: *“Technology is an old educational enchantment.”*

Technological enhancement continues to resonate through time and change. This preoccupation dates back to the early days of the first printing machines when the promise of increased circulation of printed media held particular appeal to the field of education. The wider distribution of school texts would reduce the need of memorising everything and aid the spread of knowledge to a wider audience. New technologies of instruction emerged rapidly with the advent of paperback books, radio and later film. The age of the television and the microcomputer followed shortly thereafter. Early research conducted in the area of educational technology was of an evangelical nature, singing the praises and virtues of technologies and their attributes and affordances. Over time, information has become more widely accessible and this modern trend continues with the ability to publish uncensored material and media. Today ubiquitous computing penetrates every aspect of our life with the promise of learning – anywhere and anytime (Kukulaska-Hulme & Traxler, 2005; Vavoula & Karagiannidis, 2005).

Teaching and learning did not remain entirely unaffected by the changing times. Technological thinking followed psychological thinking and computer programmers rooted their instructional design in the learning theory of their time. Behavioural theories formed the basis for the first innovative teaching machines with the drill and practice techniques in the late 1970 and early 1980. In these instances the relationship between a learner's actions and response did not acknowledge the cognitive learning process (Burton, Moore, & Magliaro, 1996).

In response to limitations observed in behavioural theories, the cognitive theory came into being as an extension to the behavioural theory with activities which focused on introspection and the development of the mind (Winn & Snyder, 1996). The field of educational technology evolved to include computer based training (CBT), multimedia and content packaging such as the CD-rom. Computer programming became less of a specialized field and instructional designers entered the programming fray creating training and learning material. The early 1990 saw the start of internet-based training (IBT) with the corresponding constructivism orientation supporting the notion that knowledge construction in an active process (Duffy & Cunningham, 1996). This gave way to the e-learning phenomenon in the late 1990 and early 2000 which was informed by the socio-constructivist learning theory where knowledge is constructed in collaboration with others and learning is supported with software content that was mainly licensed and readily and cheaply available. In the last few years there has been a move towards free and open content held in large repositories. An example of this is the Digital Learning Africa Online resources for Educators and Students in Africa available online at <http://digitallearningafrica.org/>. Contemporary learning theory is moving in the direction of distributed cognition where knowledge must be shared to be constructed in the sphere of massive electronic gaming (Leadbeater, 2008).

Web 1.0¹, has given way to Web 2.0², with Web 3.0³ in the design process with practitioners already engaged in a collaboration process defining its parameters. The initial development of the Internet offered users an avenue to source information and this later came to be known as Web 1.0 and it can be simply defined as a read-only medium. Only authorized developers and writers could contribute to this form of knowledge where a few select individuals decided on the quality and the quantity of knowledge available. This eventually gave way to Web 2.0 principles that can be defined as a read and write medium (Thompson, 2007). No longer is it the prerogative of a few individuals who understand the programming language to determine the content, but anyone with access to a computing device spanning all connected instruments can

¹ Web 1.0 - Web 1.0 refers to the state of the World Wide Web before the Web 2.0 craze, and included most websites in the period between 1994 and 2004

² Web 2.0 - A term that refers to a supposed second generation of Internet-based services. These usually include tools that let people collaborate and share information online.

³ Web 3.0 - "Web 3.0" has been introduced to hypothesize about a future wave of Internet innovation comprising services that might be called "the intelligent web".

participate in the creation of knowledge. Connecting with each other through social networking tools is bringing about a fundamental shift in how learning is auctioned and it is profoundly impacting current trends in teaching and learning practice (Dillon, 2004; Oblinger & Oblinger, 2005) .

Additional opportunities for co-operation amongst individuals sharing common interests and skills are created through crowdsourcing techniques. Users can band together to build and share knowledge and create collaboration opportunities for tasks that are too complicated to undertake alone. The emphasis here is on mass innovative participation and collective creativity (Leadbeater, 2008). Problems are broadcasted to the web and an open call for solutions announced. Users responding to the call are known as the crowd, submitting their solutions in the form of online communities. Together these communities review the submitted solutions and decide upon the most promising ones. The crowd does not only share in the labour but also in the rewards when contributing to the collective (Daren, 2008). Distributed cognition is a form of community involvement which is still deemed too advanced for our current pedagogical practice or teaching ecology.

Pedagogy for this study is seen to be when a teacher follows an instructional strategy that brings about the acquisition of knowledge, or the use of teaching techniques that influence learning. Therefore, effective teaching entails principles that promote student learning and identifies that which students gain by doing problems, using content and criteria directed toward learning. Anderson (2004) views the concept of efficacy in its relation to pedagogy as a dynamic construct that includes an entire range of content, skills and performances that may be deemed desirable in achieving learning. He notes that pedagogical efficacy is to be treated as an attribute of a group and is not to be treated as self-efficacy that is commonly used in psychology. The resultant transformative direction for education is described as pedagogical efficacy. The active construct of pedagogical efficacy shapes the concept of innovation in relation to other pedagogical strategies. Anderson (2004) deems any kind of creative departure from the traditional methods as innovative, however, in the context of this study innovative teachers are seen as teachers that design, develop and implement changes to their everyday teaching and learning practice through the use of emerging technologies and thus act as agents of change within their particular

environments. The rapid advance in technology and the multitude of devices with differing capabilities require a continuous renewal in education and this only serves to emphasise the quandary teachers experience when they incorporate technologies in their classrooms.

In an effort to address the rapid development of new technology solutions, the 2010 World Economic Forum Global Agenda Council invited a select group of scientists and forward thinkers to draft a definition of emerging technologies in the domain of the natural sciences. The selected group members established the Emerging Technology Governance Council that highlighted the following points to be considered when dealing with emerging technology concepts:

- They are technologies which arise from new knowledge, or the innovative application of existing knowledge;
- They lead to the rapid development of new capabilities;
- These technology concepts are projected to have significant systemic and long-lasting economic, social and political impacts;
- They create new opportunities for and challenges to addressing global issues; and
- They have the potential to disrupt or create entire industries.

The above points are not only pertinent to the world of natural science but cross over into the world of learning as they require a rapid response from educational systems to develop new capabilities. The implications of increased technological advances affect human development in various ways. Not only is our view of learning impacted but also the part teachers need to play within their own pedagogical practice to accommodate the innovation process when considering the use of the emerging technologies.

As emerging technologies relevant to education are rooted in the domain of the social sciences, it is difficult to restrict the inquiry to technological tools only. Veletsianos (2010) urges academics and practitioners of the learning sciences to marry concepts, ideas, theories and approaches to learning with the use of these technological tools. He views emerging technologies, concepts,

innovations and advancements as tools to be utilized in diverse educational settings to serve varied education-related purposes. Veletsianos, in his groundbreaking work (2010, p. 17) makes the following 5 points regarding emerging technologies:

1. May or may not be new technologies.
2. Could be described as evolving organisms that exist in a state of “coming into being.”
3. Experience hype cycles.
4. Satisfy the “not yet” criteria of (a) not yet being fully understood and (b) not yet being fully researched or researched in a mature way.
5. Potentially disruptive, but their potential is mostly unfulfilled.

Knowledge construction with the use of these emerging technologies thus considers the embryonic stages of concept development and corresponding research to support new fields of interest. Our understanding of knowledge construction and the role of educational technologies is constantly changing. Somekh (2007, p. 160) captured the implications of technological advancement to education by stating: “As they become more easy to access, these new tools change the very fabric of the culturally patterned ways in which we undertake scholarship and work”. Consequently the field of pedagogy has become complicated and teaching with technology has been labelled a wicked problem (Mishra & Koehler, 2006). Nevertheless, this wicked problem is not without solutions as teachers at the cusp of the early adoption curve are starting to experiment and engage creatively in contemporary activities to explore temporary solutions in their practice resulting in a new set of challenges to solve. Pioneer teachers and early adopters are responding to the challenges in that they are transforming their teaching practices. They are the agents of change and therefore often regarded as being responsible for the innovations they champion (Fluck, 2003). Being an innovative teacher which forms part of the focus of this research thus means having the critical knowledge to deal with a teachable moment, effectively applying it in the process of designing and implementing instruction with the use of emerging technologies. The challenge remains to learn from these teachers and their innovative solutions and to utilise their new practices to build capacity in the education profession.

1.3 PROBLEM STATEMENT

The trend persisted for many years to prepare future teachers with as much knowledge as possible before going into practice (Ben-Perez, 1995). A disconnect has developed between what has been learnt during teacher training and the actual teaching practice. Teachers were equipped with mainly theoretical knowledge and their practical expertise subsequently became fragmented with little connection to their classroom experiences. This model of expert-knowledge, where knowledge was often provided by a few subject matter experts, dominated the education domain for many decades. As teachers moved from their pre-service training environments and engaged in the profession of teaching, they started to expand their knowledge and began to question formal teaching and learning theory (Korthagen & Kessels, 1999). The tension created between known *theory* of teaching and learning and the actual *practice* of it in the classroom, offered opportunity for new knowledge creation (Jorgensen, 2001).

Terms such as *theory* and *practice* are frequently used in the education space; however, they are rarely accompanied by a thorough analysis of the range of meanings they carry. Carr and Kemmis (1986) regard *theory* as a source of principles that can be applied in practice as a matter of professional judgment which can be developed at the wisdom of practitioners. In the context of this study the meaning of *practice* can be defined as the “conversion of knowledge into action to transform life” (MacLaren, 2000, p. 20) and *theory* as an organised system of accepted knowledge that applies in a variety of circumstances to explain a specific set of phenomena (Malara & Zan, 2002). Therefore, the notion carries forward that *practice* holds the capacity to transform, and it is up to *theory* to find and explain the generalities embedded within these practices across differing conditions. Teacher knowledge is fluid and even though theory and practices constantly engage with each other, knowledge remains anchored in the tenets of expanding our understanding of knowledge awareness and knowledge creation. Teachers’ knowledge reflect in the intellectual richness of their practical experience and Shulman comments that “practitioners simply know a great deal that they have *never tried to articulate*” (Shulman, 1987, p. 12). Literature suggests that teachers hold personal theories, cognitive constructs and guiding principles which determine their instructional decisions and technology integration (Churchill, 2006). These decisions are often made without one being able to justify

oneself to others and Rosiek and Atkinson (2005) surmise that these tacit insights will need to be translated into accessible forms to make them publicly available.

Thomas Kuhn (1996) mentions the work of Polanyi in which scientists' success is said to depend on tacit knowledge acquired through practice. He continues by explaining that tacit knowledge cannot always be articulated explicitly. Polanyi's straightforward explanation of tacit knowledge as "that we know more that we can tell" is confirmed by Winn and Snyder (1996, p. 115) and can appear intuitive, making tacit knowledge difficult to measure.

It is the task of the teacher to grapple with these disruptive forces and to grow their learners with the tools at their disposal to acquire the skills needed to navigate the 21st century. Teachers do not articulate these new practices and consequently their actions are not well understood by their colleagues or transferred to differing teaching and learning contexts.

Integrating ICT in education is a complex issue which takes on many forms with different purposes. It can range from replicating existing educational practices through digital media with technology as tools, to transforming education to bring about new learning goals, new teacher knowledge and skills development which results in innovative pedagogies (Law, 2008). Manifestations of new knowledge and the cognition of the innovative teacher in the process of adopting new practices form the pivotal point of this study.

Eraut (2003) calls for the relations between theory and practice and their actions, context and outcomes to be clarified and Thornton (2006) requests that a comparison needs to be made between existing theories and new theories to determine whether they can better explain a phenomenon to further theoretical progress. The aim of this constant comparison is to improve the fit between *fact* and *theory* and this equally applies to *practice* and *theory*. Thus, the purpose of this study is to provide a theory of how innovative teachers' tacit knowledge manifests when they engage with emerging technologies to achieve pedagogical efficacy in a developing context.

1.4 MOTIVATION FOR THIS RESEARCH STUDY

In the early 1990s Selfe (1990) called for a theoretical perspective to examine the impact of Information Communication Technologies (ICT's) in education and warned against the

continued viewing of cases in isolation. He encouraged a systematic analysis to give our everyday classroom efforts direction and meaning. Sixteen years later Mishra and Koehler (2006) supported this call and suggested using good case studies, detailed examples of best practice and the design of new tools for learning to build greater understanding in the field of education and technology use in schools for teaching and learning purposes. Only once this has been accomplished can unified theoretical and conceptual frameworks be created that would allow researchers to develop and identify themes and constructs that would apply across diverse cases and examples of practice.

Bridget Somekh cautions that without evidence of new ways of doing things, speaking primarily towards ICT in education, a “distinct lack of imagination can result in fossilised patterns” being reinforced (Somekh, 2007, p. 160). These patterns refer to embedded cultural orientations and structures of power and authority involved in drafting policy and putting practice into effect. This resonates with a warning from De Bono:

“Culture is concerned with establishing ideas. Education is concerned with communicating those established ideas. Both are concerned with improving ideas by bringing them up to date. The problems arise when new information can only be evaluated through an old idea. Instead of being changed the old idea is strengthened and made ever more rigid” (1970, p. 9).

Researchers should not neglect to focus on episodes of changing pedagogical practice to suit the *tools of our time* with a proliferation of new technologies and ideas that impact current teaching and learning theory. Instead of strengthening existing theories, our calling as researchers is to seize the opportunity to amend the *fossilized patterns* by expanding and amending existing teaching and learning practices.

Somekh (2007) identifies the lack of fully technology integrated schools as a very real hurdle standing in the way of understanding how knowledge is constructed with ICT in teaching and learning. She argues that it is only in scenarios where technology has permeated every part of the human activity that the impact in the changing cognitive process can be studied. Offering an alternative perspective, this research study would argue that fully technology integrated schools

are not required and cognitive growth manifest with the sharing of available technologies. The South African reality is that there is an apparent lack of computers in classrooms (Blignaut & Howie, 2009), however, the availability of a multitude of untethered digital devices gives rise to different types of innovations. Innovative teachers exploit a host of ICT tools and their affordances, which have become almost ubiquitous to their teaching and learning. These teachers display exemplarily understanding of innovative pedagogy and use it to transform their processes of learning (Plomp, Anderson, Law, & Quale, 2009).

Litchfield, Dyson, Lawrence and Zmijewska (2007, p. 591) argue that there is an urgent need for a body of knowledge about learning and teaching principles and strategies which can inform teachers wishing to utilise innovative technologies. This knowledge store can also inform and guide the development of policy and pedagogical approaches about emerging mobile devices. Introducing emerging technologies into the classroom can have an impact on traditional teacher and learner roles, learning situations, patterns of interaction, learning spaces and assessments (Mioduser, et al., 2002a).

For the past 15 years the domain of ICT have supported learning environments has been studied. Voogt and Knezek (2008a) find it unfortunate that despite this long history, ICT have found their way to so few innovative teachers. Developing a theory for the innovative use of technology in education is difficult as it requires a detailed understanding of complex relationships that are contextually bound. In employing ICT in the classroom, whether it be through e-learning or m-learning instances, Conole et al. (2004) encourage a more theoretical approach in designing learning events with the intent of enabling practice to reflect an underpinning theory.

The International Association for Evaluation of Educational Achievement (IEA) Second International Technology in Education Study (SITES) module 2 projects recently gave birth to a new research field. This emerging research area was aptly called the Emerging Pedagogical Practices Paradigm (Kozma, 2003). During the study schools were selected based on their innovative pedagogical practices using technology (IPPUT). The data collected during this study informed and helped sculpt the parameters of this emerging field.

Personal tacit knowledge is created by experienced practitioners who test information through practice, reflect on its worth and then either integrate it into their actions and thoughts or reject it (Jarvis, 1999). This valuable learning process of knowledge creation aligns with the three intellectual traditions of the Emerging Pedagogical Paradigm (EPPP) namely:

- Lifelong learning which leads to autonomous learning;
- Constructivism, emphasising collaborative learning, and real-world projects with authentic assessments where students accept responsibility for their own learning and
- Information literacy, especially gathering data and analysing information.

Up to now the EPPP has addressed many requirements posed by the knowledge society, but there is much more work to be done in the full range of ICT knowledge-based skills. Little is understood about the ICT conceptualisation of the teacher who is not yet integrated into this paradigm. Essential skills such as deep understanding, critical thinking and high-performance learning still need to be fully understood in their relation to ICT use in the classroom and beyond.

Theory has to follow practice to enable the growth and maturation of a study field which is still in its infancy. Theory can offer coherent explanations of learning activities and practice. This is why it is time to move away from largely practice based models and start to generate theories that cover the use of emerging technologies in teaching and learning and in particular, how these can contribute to the field of Emerging Pedagogical Practice Paradigm from the teachers' perspective.

Selwyn (2002) reports on numerous attempts to introduce theoretical perspectives to an education technology audience without much success. His findings indicate an avoidance and mistrust to advance theoretical approaches when formulating research direction on the role of new technology in education. He redirects prospective research to seek out a more balanced angle and to move away from the more utopian outlook as characterised by research agendas. The reticence to reflect on negative, or less successful aspects of educational technology, has long been seen as a fundamental restriction in the field. More recently Selwyn (2010) calls for

the adoption of a more objective perspective in the academic engagement with educational technology and encourages the asking of awkward questions in order to highlight both the advantages and disadvantages of engaging ICT in education. He requests a change in the framing of educational technology research to reflect a more theoretical perspective in the formulation of research questions.

This call to advance theoretical perspectives to deepen our understanding of ICT usage in education resonates with this research study's proposed desire to uncover and illuminate the complexities in the field of knowledge creation with emerging technologies. Teachers are central to this challenge in their attempts to incorporate ICT in their everyday teaching and learning and confront the tensions between theory and practice on a daily basis. Accordingly, the research endeavour is to investigate the way in which innovative teachers develop and implement their novel knowledge in relation to their choices and justify their use of emerging technologies in their everyday practice for teaching and learning purposes.

1.5 RESEARCH QUESTIONS

In the current literature the voice of the innovative practitioner teacher is barely audible. This voice is rich in practice and experience and can aid us in our understanding of the best practice models. Innovative teachers offer an unique perspective on the use of emerging ICT in their everyday practice and can inform contemporary teaching and learning theories. Therefore, the ultimate aim of this research is to understand more clearly the relationship between practice, practical knowledge and theory in relation to emerging technologies. Investigating innovative teachers' personal theories and practice based models can pave the way for developing meta-theories to inform future practice.

The following primary research question was formulated to guide and frame the inquiry:

How does tacit knowledge manifest when innovative teachers engage with emerging technologies to achieve pedagogical efficacy?

In order to answer the main research question a set of sub-questions were initially formulated but they were changed as the study progressed. The initial questions were:

- I. What are the characteristics and affordances of new and emerging ICT that are used by innovative teachers and what are they doing to succeed in their use of ICT to change their teaching and learning practice?
- II. What personal theories/ beliefs/ practical knowledge do they exercise and how do they draw on existing theory in their innovative uses of ICTs in their teaching and learning?
- III. What other contextual factors influence knowledge building and innovative practices contributing to their success?
- IV. How are patterns of teaching and learning changing in the face of ICT integration both in and out of the classroom and what can policy-makers and other teachers learn from these innovations to inform future practice?

The initial sub-questions were found to be inadequate and too narrow in their focus to fully explain the phenomenon and they were revisited once the literature review delivered a framework appropriate to thinking about the factors that might influence innovative teachers when they conceive and act on their new tacit knowledge. The framework presented in Figure 2-1 (*cf.* Section 2.2) considers how people interact with their natural world, with other people and with the artificially man-made technical world. Innovative teachers are subjected to all three areas of influence and Gardiner (Gardiner, 1989) identifies these influences as the technosphere, ecosphere and the sociosphere. The initial data that was collected was analysed using this framework and yielded the main themes around which the final sub-research questions were formulated. The purpose of the sub-questions was to reveal the relevance of contexts and practice within a school environment.

Given the differing circumstances within which teachers innovate and the reflexive adaptation of their own practice within their work environment, the progressive *invivo* sub-questions that were revealed during data structuring aided the researcher in understanding how innovative teachers articulate their tacit knowledge in their quest for pedagogical efficacy.

The sub-questions are:

1. What role does moral cohesion play within the sociosphere of the innovative teacher?
2. How do teachers negotiate innovation within the technosphere context?
3. How do structures of governance respond to the innovative teacher within their ecosphere?

This study therefore needs to be appreciative of the relative role of the innovative teacher within the community; the pedagogical aspects that influence innovation and the way in which a school responds to an active innovative teacher within their midst. Thus the researcher endeavours to examine and better understand how the innovative teachers' knowledge manifests itself within their context.

Consequently the purpose of this study is to provide a theory on how innovative teachers' tacit knowledge manifest when they engage with emerging technologies to achieve pedagogical efficacy in a developing context. Emerging from the above purpose, the following objectives were set:

- To investigate personal convictions; social structure and relationships within the wider community that can hold sway over the innovative teacher;
- To describe areas of teacher innovation and engagement when using emerging technologies in their practice and
- To consider the response of governance structures when harnessing the skills of the innovative teachers within the school environment.

This research will therefore describe the phenomenon where teachers innovate within their own practice and employ emerging technologies to extend their pedagogy within the South African context.

The intellectual puzzle is presented in Table 1-1 below and contains the main research question, as well as the research objectives with matching formulated subsidiary research questions.

Table 1-1: The intellectual puzzle for this study

Research Question	Objective	Subsidiary research questions
How does tacit knowledge manifest when innovative teachers engage with emerging technologies to achieve pedagogical efficacy?	1. To investigate personal convictions; social structure and relationships within the wider community that can hold sway over the innovative teacher.	1. What role does moral cohesion play within the sociosphere of the innovative teacher?
	2. To describe areas of teacher innovation and engagement when using emerging technologies in their practice.	2. How do teachers negotiate innovation within the technosphere context?
	3. To consider the response of governance harnessing the innovative teachers within the school environment.	3. How do structures of governance respond to the innovative teacher within the ecosphere?

1.6 RESEARCH PROCESS PRESENTED

In the previous section, the background and the motivation for this study were presented along with the research problem and research questions. This section will put forward the research methodology including aspects of the research philosophy, design, approach, and the strategy employed in this study.

Using the self-styled 'research onion' model as proposed by Saunders, Lewis and Thornhill (2000, p. 85) Figure 1-1 below represents the research design for this study. This model symbolizes the research design as an onion, consisting of various layers, namely the research philosophy, design, approach, strategy, data collection methods and analysis techniques. According to this model, data collection and analysis forms the heart of the research design around which all the other layers are structured. The choices made in each layer influence and to an extent predetermine the options and decisions for the next layer. The onion needs to be

considered in totality before any research is undertaken in order to ensure synergy between the various layers.

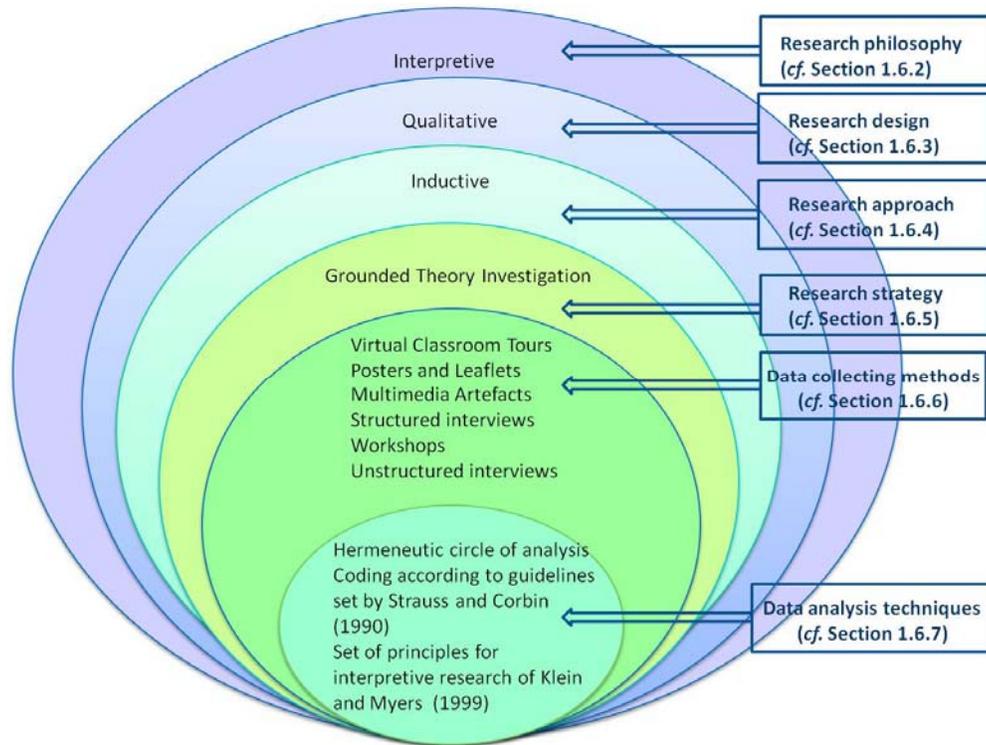


Figure 1-1: The Research Process 'onion' derived from (Saunders, et al., 2000, p. 85)

In subsequent sections, each layer of the research union is peeled away and discussed starting with the outer-most layer and moving closer to the heart of the onion. The first aspect to be investigated is the research philosophy which encapsulates the researcher's considerations as regards the development of knowledge. This first layer will therefore influence the subsequent research process.

1.6.1 Paradigms or worldviews

This research study adopts a post-modernistic approach and leans heavily on the tenets of Paolo Freire's (1974) consciousness-raising pedagogy and the communicative ethics that emerge from Jürgen Habermas (1987). Post-modernism has been described as a *thorn in the flesh* and can be viewed as a "prism which refracts multiple images of *reality*, reflects complexity, and fractures certainty" (Atkinson, 2003, p. 39). Her conjecture is that a post-modernistic approach may raise

more questions before, during and after research than provide answers and therefore it allows researchers the opportunity to rethink assumptions about focus, methodology and interpretations. Atkinson (2002) acknowledges the contradictions and uncertainties inherent to all research and describes post-modern text as refusing to *tidy up*, pointing to a set of characteristic features as follows:

- Resistance towards certainty and resolution.
- Rejections of fixed notions of reality, knowledge or method.
- Acceptance of complexity, lack of clarity and multiplicity.
- Acknowledgement of subjectivity, contradiction and irony.
- Irreverence for traditions of philosophy or mortality.
- Deliberate intent to unsettle assumptions and presuppositions.
- Refusal to accept boundaries or hierarchies in ways of thinking.

Atkinson regards post-modernism not as a method, but as a way of becoming entangled in research. It is neither comfortable nor predictable, but it is productive and provocative.

1.6.2 Research philosophy

Research philosophy concerns itself with the development of knowledge and informs the practice of research. Epistemology, according to Leedy and Ormrod (2005), refers to the assumptions about knowledge and how it can be obtained. In qualitative studies, research can be defined as interpretive, positivist and critical as illustrated in Figure 1-2 below.

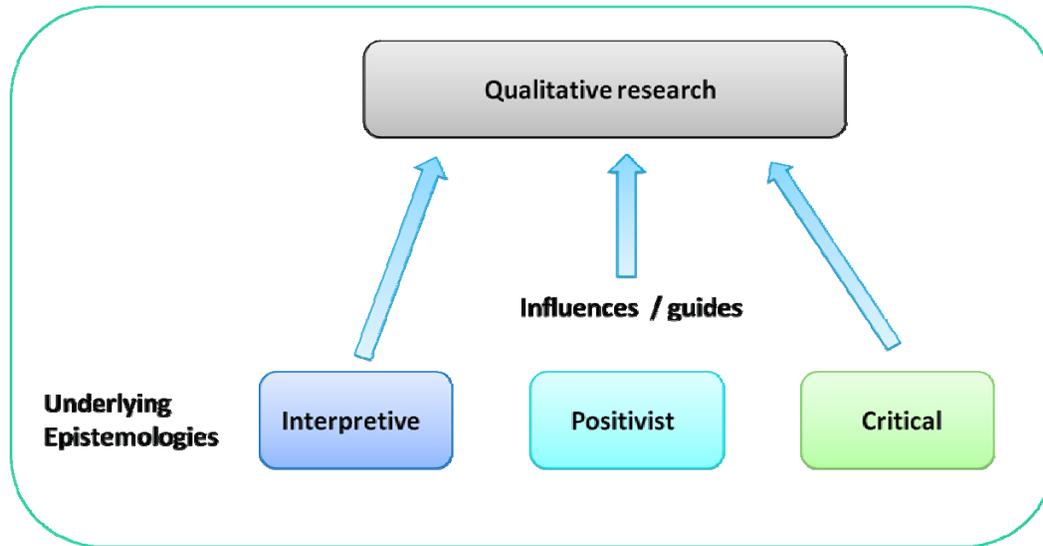


Figure 1-2: Philosophical assumptions (Myers, 1997)

Positivist research strives for objectivity, measurability, predictability, the constructions of laws and rules of behaviour and the attribution of causality (Saunders, et al., 2000). Reality is seen to be independent of the researcher and can be tested through hypothesis and theory.

The critical perspective is explicitly prescriptive and judges what behaviour in a social society should be like while seeking to empower the disempowered and to redress inequality in an effort to provide democracy to all members of society (Leedy & Ormrod, 2005). The intention of critical theory is to be transformative and, within the field of education, to interrogate the relationship between school and society and how schools perpetuate or reduce inequalities and the ideological interests they serve. Critical philosophy emphasises the practical over the theoretical and even though there is a persistent dialogue between theory and practice; the two cannot be separated from each other as they are intertwined and influence each other (Nichols & Allen-Brown, 1996).

The interpretivist perspective entails the study of social phenomena including mental states which are not embodied in physical form. This perspective is in contrast to the field of natural sciences where scientists use physical entities and construct their own theoretical constructs to explain and interpret the natural world (Mack, 2010). Social scientists study a world that has already been interpreted by the research participant within it and they have to make sense of it in

a new way (Swann & Pratt, 2003, p. 204). Cohen, Manion and Morrison (2000, p. 21-22) ascertain that Interpretive studies possess a set of particularly distinguishing features namely:

- People are deliberate and creative in their actions; they act intentionally and construct meanings in and through activities.
- People actively construct their social.
- Situations are fluid and changing rather than fixed and static; events and behaviours evolve over time and are richly affected by context.
- Events and individuals are unique and cannot be generalized.
- A view that the social world should be studied in its natural state, without manipulation by the researcher.
- Fidelity to the phenomenon being studied is fundamental.
- People interpret events, contexts and situations, and act on the basis of those events.
- There are multiple interpretations of, and perspectives on, single events and situations.
- Reality is multi-layered and complex and
- Many events are not reducible to simplistic interpretation; hence *thick descriptions* are essential rather than reductionism.

In Figure 1-3 below, Burrell and Morgan's (1979) present four quadrants which can be used to consider different sociological paradigms when conducting research. They present *interpretive* researchers to believe the world of human affairs is interconnected and commit themselves to explaining why society functions in a cohesive manner. In contrast researchers approaching the subject matter from the *radical humanist* perspective critically assess the status quo and highlight issues of radical change. *Functionalists*, on the other hand, view the social world as consisting of concrete artefacts and relationships that can be identified, studied and measured through natural sciences from an objectivist point of view. *Radical structuralists* focus on structural relationships

in the social world and view the social world from an ideographic perspective, focusing on overthrowing the limitations of existing social structures.

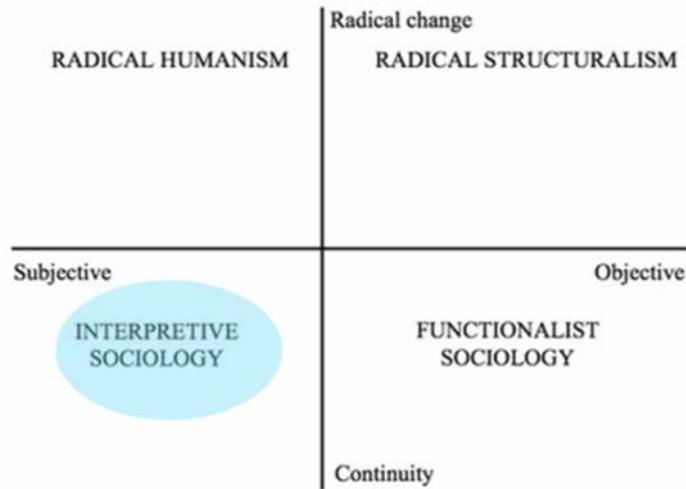


Figure 1-3: Plotting the study situated within in the interpretive sociology quadrant (Burrell and Morgan, 1979).

The choice of utilising the interpretive research approach in this study rests with the attempts to explore situated personal experiences and, in particular, to investigate professional practice. This approach explicitly expects the researcher to engage in the act of *interpreting* from the beginning of the research process to the end and thus it allows for opportunities to offer illuminating insights into contextualised customs and actions in the real life experiences of research participants (Radnor, 2002). Critics of interpretivist research maintain that researchers can never give a completely accurate account of another individual’s reality and therefore they must make their own assumptions clear before engaging in any subjective interpretations (Cohen & Crabtree, 2006). This notion is supported by Creswell who recommends that one makes these assumptions explicit in the writing of a study. He states:

“These assumptions consist of a stance toward the nature of reality (ontology), how the researcher knows what she or he knows (epistemology), the role of values in the research (axiology), the language of research (rhetoric), and the methods used in the process (methodology).” Creswell (2007, p.16)

In adopting an Interpretivist research philosophy, the basic set of beliefs that guide the study are made explicit and reflected in Table 1-2 below. This table is taken from Creswell (2007, p. 18) who based his work on that of Guba and Lincoln (1988).

Table 1-2: Philosophical Assumptions with Implications for Practice (Originally adapted from Guba and Lincoln 1988 by Creswell 2007)

Assumption	Question	Characteristics	Implications for Practice
Ontological	What is the nature of reality?	Reality is subjective with multiple dimensions, as seen by participants in the study.	Researcher uses quotes and themes in the words of the participants and provides evidence of differing perspectives.
Epistemological	What is the relationship between the researcher and that being researched?	Researcher attempts to lessen the distance between her/him and that being researched.	Researcher plays a dual role of participant and researcher and collaborates during workshops. The researcher has an integral understanding of the experience under investigation and holds an insider's view that is accepted within the innovative teachers' forum. The researcher, having met with some of the participants during facilitation workshops, is subsequently engaged in data collection exercises.
Axiological	What is the role of values?	Researcher acknowledges that research is value laden and that biases are present.	Because of the interpretive nature of the study the researcher's presence is apparent in the text and s/he admits that stories voiced represent an interpretation and presentation of the author as much as the subject of the study. The intertwining of both the researcher and the participants' material is a valuable voice to previously unheard opinions and perspectives as regards knowledge issues and processes pertaining to teaching and learning with emerging ICT.
Rhetorical	What is the language of research?	Researcher writes in a literary, informal style using the first person voice and uses qualitative terms and limited	Researcher uses an engaging style of narrative, the first-person pronoun and employs the language of qualitative research. Terms as defined by participants and invivo coding is used to reflect that phrasing is of primary importance and therefore a glossary list is avoided and unfolds naturally within the parameters of the study.

Assumption	Question	Characteristics	Implications for Practice
		definitions.	
Methodological	What is the process of research?	Researcher uses inductive/deductive logic, studies the topic within its context and uses emerging theory grounded in the data.	Qualitative studies are characterised as inductive, emerging and shaped by the researcher's experience in working with the data. Research questions can change throughout the study if required to better the understanding of the unfolding research problem (Creswell, 2007, p.19). This subsequently has an incidental effect on the data capturing strategy that needs to be amended to account for the new direction. During data analysis the researcher is guided by the data to develop an increasingly detailed knowledge of the topic being studied. Researcher works with particulars (details) before generalizations, describes in detail the context of the study and continually revises questions from experiences in the field.

1.6.3 Research design

Seeing that this study is concerned with the perspectives of innovative teachers in their practice of employing ICT in their teaching and learning, a qualitative research approach is followed. The main purpose of qualitative research is to describe, understand and interpret human or social phenomena (Hayes, 2004). The researcher proceeded with an investigation that allowed for in-depth probing and therefore the study provides sufficient space for personal reflection and contains a rich description of the individual teachers' consciousness as well as my perspectives as researcher.

Qualitative researchers draw their data from multiple sources including a variety of people, objects, textual materials, and audiovisual and electronic records. All qualitative approaches have two things in common namely that they focus on phenomenon occurring in natural settings and they study these occurrences in all their complexity. This approach can also be described as "exploring the world from the perspectives of the cultural insiders" (Hatch, 2002, p. 65). Qualitative research methods are designed to get them close to their participants and may require

some form of active involvement with their research participants. The focus of their research is often multifaceted and in their investigations they attempt to uncover and portray all the layers central to the phenomenon. Qualitative researchers may also use multiple forms of data in an effort to help them explain their research question and it is noted that data collected early in a study often influences the subsequent data collection strategies. Therefore qualitative studies are characterized by an emergent design (Leedy & Ormrod, 2005, p. 133, 143).

Qualitative researchers believe the strength of their methodology is the ability of the researcher to interpret what he sees as integral to the understanding of the phenomenon. Qualitative studies are characterised as inductive, emerging and shaped by the researcher's experience in working with the data (Leedy & Ormrod, 2005). The researcher therefore becomes the instrument through which all data was selected and filtered. Furthermore the data analysis is more subjective in nature and the dataset is scrutinized for patterns that reflect concept formation. It is thus of paramount importance for researchers to articulate their own predisposition and to clarify any preconceived ideas or notions of knowing surrounding the area of study, thereby revealing alternative perspectives (Creswell, 2009; DeMarrais, 2004). In this regard the use of bracketing interviews to articulate the preconceived notions of the researcher in relation to the inquiry is an integral instrument in the arsenal of the researcher and can increase the rigor of the process (Finlay, 2008). Research questions can change throughout the study if required to better the understanding of the unfolding research problem (Creswell, 2007, p. 19). This subsequently has an incidental effect in the data capturing strategy that needs to be amended to account for the new direction. During data analysis the researcher is guided by the data through interpretation and analysis to develop an increasingly detailed knowledge of the topic being studied.

1.6.4 Research approach

When applying logic to reasoning in research, there are two basic approaches namely inductive or deductive research. Deductive reasoning moves from the general to the specific and is known as the top-down approach. In contrast, inductive reasoning moves from a narrow angle to a wider perspective and begins with the observation of specific instances and then draws inferences

about larger and more general phenomena (Trochim, 2006). The difference in approaches is illustrated in Figure 1-4 below.

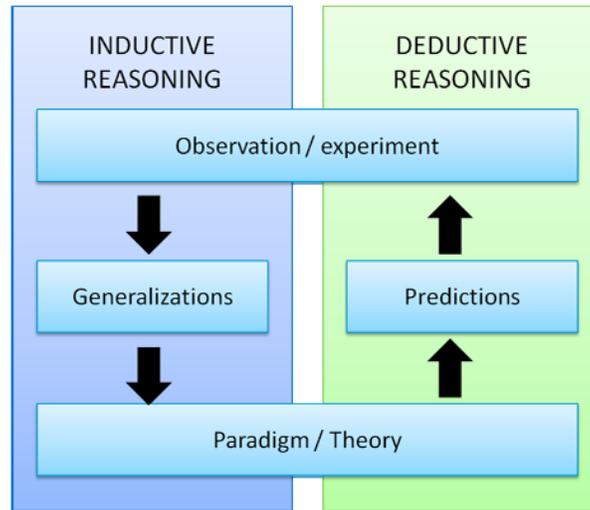


Figure 1-4: Inductive and deductive reasoning

Inductive reasoning is more open-ended and exploratory in nature and contrasts with deductive reasoning which is more concerned with testing or confirming a hypothesis. Another consideration to take into account is the aspect of time. The process of deductive reasoning can be completed in a relatively quick time and it is also quite predictable. It can thus be actioned according to set schedules. In contrast inductive reasoning is protracted and proceeds at a much slower pace due to the much longer period it takes to collect and analyse the data. This process proceeds at a much slower pace and ideas emerge gradually. The path of deductive research is seen as a lower-risk strategy whereas research dependent on inductive reasoning carries a greater risk as the researcher cannot guarantee that useful data patterns and theories will emerge from the collected data (Saunders, et al., 2000).

This study follows the inductive path of reasoning in an attempt to explain the phenomenon where innovative teachers use emerging technologies to improve their practice. The researcher took cognisance of the reservations connected to inductive research and steps were taken to mitigate the perceived risks through a carefully considered research strategy.

1.6.5 Research strategy

A research strategy is a clear plan of how to go about answering the research questions. Because qualitative research is a collection of several forms of inquiry there is no single method of doing qualitative research and the process requires a degree of flexibility which is imperative to the study. Grounded Theory was selected as the most appropriate method to investigate the research question as it has the ability to generate descriptive and explanatory accounts of teachers' contemporary innovative uses of ICT in their teaching and learning practice. Grounded Theory, as a research method, is particularly suited to study situated interactions and meanings as related to the social context in which they occur. This method lends itself to identifying components critical to the processes under investigation and to formulate a resulting theory grounded in the data. The net outcome of Grounded Theory research is that it contains a central phenomenon, describing the causal and intervening conditions along with the consequences (Dunican, 2005).

1.6.5.1 Grounded Theory

According to Trochim (2001) Grounded Theory can be viewed as an extremely well-considered explanation for some experience of interest. Patton (2004) takes the view that it discovers and conceptualizes the essence of complex interaction. It is helpful to this process when existing theories about a phenomenon are inadequate or nonexistent or when grey areas exist and need greater clarification or require deeper understanding. The generated grounded theory can be explained in words and is usually presented with much of the contextually relevant detail collected. The self-defined purpose of developed Grounded Theory is to begin with data and use it to develop a theory about phenomena or a process. Data were generally collected in the field rather than taken from research literature and ideas are based on the notion that the researcher is informed and ready to make decisions about individual pieces of data. The researcher is thus ready to recognise the "plausible relationships proposed among concepts and sets of concepts" (Strauss & Corbin, 1994, p. 278).

1.6.5.2 The history of Grounded Theory

There are three discernable Grounded Theory designs with each one emphasising different facets of the grounded theory (Creswell, 2005). The **systematic design** of Strauss and Corbin favours prescriptive procedures and preselected codes that make explicit the relationship amongst categories in the axial coding phases. The **emerging design** of Glaser prefers theory to emerge from the data in the generation of categories that can be compared in the explanation of basic social processes. Charmaz (2006) stresses a more **flexible approach** emphasising the use of active codes to best capture the experiences of the participants and focus on their views, values and beliefs rather than gathering facts and describing acts.

Key stages in grounded theory development, as illustrated in Figure 1-5 below, provide a schematic representation of the main events and publications through which this theory evolved into three distinctly different designs. These designs emerged as a response to inadequacies experienced within practice and valuable feedback from peers. Each of these designs had their own advocates and a lively debate ensued in the form of publications as a riposte to delivered criticism. These publications were used as a vehicle to refine and deepen the understanding of the specific approach within the academic circles.

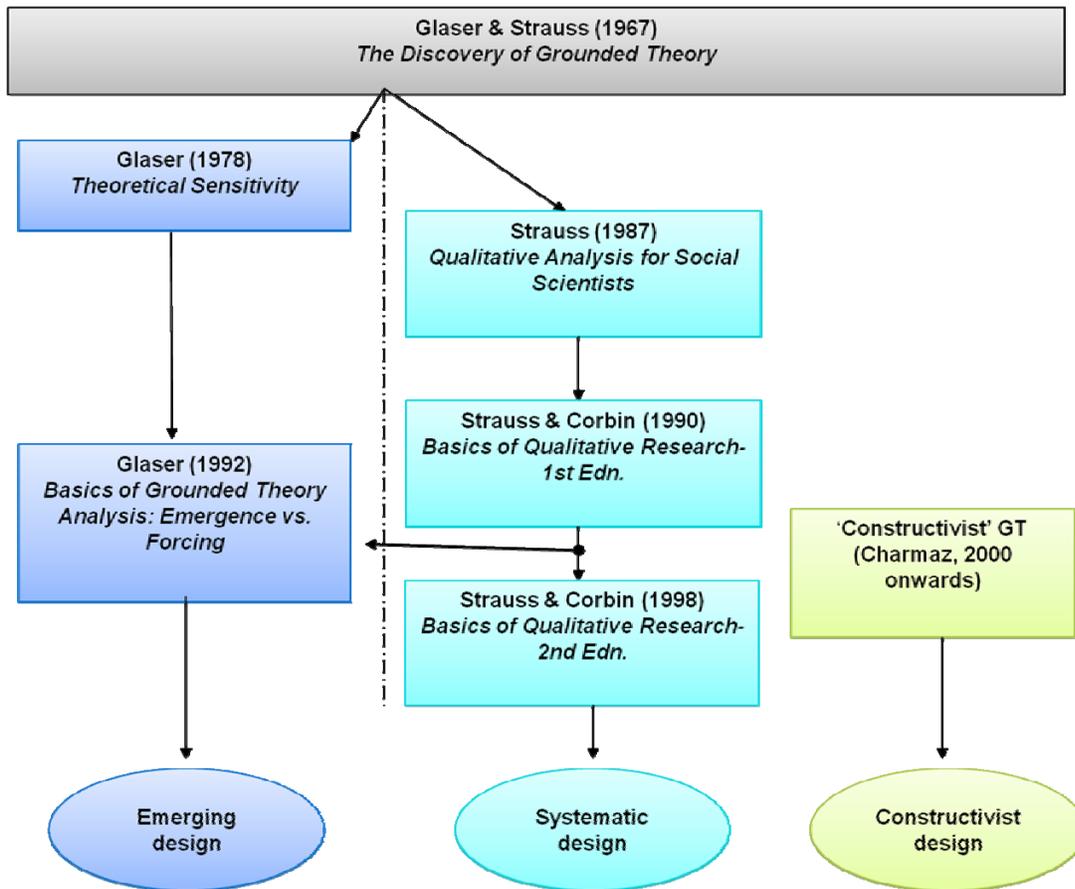


Figure 1-5: Key stages in grounded theory development (adapted from Harwood, 2002, p.67)

Grounded Theory is a qualitative research approach that was originally developed by two sociologists Barney G. Glaser and the late Anselm L. Strauss in the 1960s to be used in the field of nursing. This theory was developed in response to a need to better understand phenomena in healthcare and to articulate a theory which would make certain medical concepts accessible to others. Glaser and Strauss received wide acclaim for their method and were inundated with requests by others to learn more about their research methods. They responded by writing a pioneering book detailing their grounded theory procedures in the *Discovery of Grounded Theory* (1967). Both authors subsequently authored several books to better explain their early methods. It is at this point where their philosophical orientation separated. Glaser (1978, 1992) stayed true to the earlier methodological versions and expanded the stance of letting theory emerge freely from data.

In contrast, Strauss (1987) progressed a more regulated form of grounded theory teaming up with Corbin (1990, 1994) and suggesting a more prescriptive code for analysing data. This approach to grounded theory is popular within educational research circles and is associated with a rigorous approach to data analysis. It aims to ultimately present a visual picture of the generated theory.

This systematic approach drew extensive criticism from Glaser (1992) for he felt the approach would not allow theory to emerge from the data and therefore limit the research to describing acts rather than conceptualize new patterns in the data. Entering the field at a much later stage Charmaz (1990, 1994, 2006) advanced her own approach namely the *constructivist* method as she felt both Glaser and Strauss were too inflexible in their procedures. Charmaz (2003) argues that grounded theory methods evolve in different ways depending on the perspectives of the researcher and that by exploring the underlying ontological and epistemological perspectives one can help researchers acknowledge the limits of their studies.

Two critical factors for consideration when employing a Grounded Theory study is to select the type of Grounded Theory Method (GTM) and to decide whether to conduct a literature review at the start of the research process (Avis, Pauw, & Van der Spuy, 1999; Mavetera & Kroeze, 2009). Both these issues are highly contentious and are vigorously debated in the academic community. For the purposes of this study a Straussian GTM was selected as the researcher found it to be a far more structured approach when considering the methods proposed by Glaser or Charmaz. This method also provides an opportunity for the creation of a framework prior to collecting data and it further provides guidelines to the analytical procedure of data examination. Further motivation as to the choice of this theory is provided in Section 3.2.3.

Integrating literature in the initial stages of a Grounded Theory inquiry is controversial and has divided academics in their approach to research. The early integration of literature has given rise to much confusion especially for those novice researchers new to the Grounded Theory and wishing to embark on their own research journey (Mavetera & Kroeze, 2009; Pidgeon & Henwood, 1997). Notwithstanding contradictory statements and in spite of different opinions

relating to the literature review, there is nonetheless agreement that the Grounded Theory remains an intensive and rigorous method of research (Mcghee, Marland, & Atkinson, 2007).

Proponents of the Classic Grounded Theory (CGT) believe that conducting a literature review prior to entering the field of study as a violation of the basic premise of the CGT. The literature review can potentially dull theoretical sensitivity which can then result in the researcher overlooking key aspects of the emergent categories. Glaser and Holton (2004) also warn that a review can become futile if the area under survey proves to be of less relevance than the researcher originally deemed. This violates the basic premise of the Grounded Theory and valuable time would be wasted. Creswell (2003) suggests that literature should only be consulted once the independent theory starts to emerge. He takes a strong stand against an extensive literature review before core categories start emerging pertaining to the phenomenon under investigation.

Opposing the blank slate idea of Glaser and Strauss (1967), Avis (1999) is of the opinion that if a particular research field and topic are of interest to a researcher then s/he would already have preconceived ideas and values about the field of study and will enter the research field along with these impressions. Dey (1999) recommends entering the study field with an open mind and not an empty head. He thus deems an awareness of the literature as a crucial prerequisite in order to identify the dearth of existing knowledge. This pre-knowledge also helps the researcher to ascertain what areas of concern could be appropriate for further investigation and to view the literature as part of the dataset to be incorporated in the dissemination of the findings. Cutcliffe (2000) warns against restricting access to existing knowledge as it will limit the understanding of the phenomenon and the interplay that occurs between researcher knowledge, values, beliefs and data. This interplay adds to the rich descriptions of emerging substantive theories. Gasson (2004) proposes to acknowledge the influences of literature and to make use of the accumulative tacit knowledge of the researcher. Urquhart and Fernandez (2006) supporting Glaser and Strauss (1967) declare the notion of entering the research field with a blank slate as a myth and Thomas and James (2006) suggest that it is impossible to free oneself from preconceptions, not only in the entering of the field but also during data collection and analysis.

Leedy and Ormrod (2005, p. 141) suggest the use of literature to provide a rationale and a context for a study where Diaz and Andrade (2009, p. 46) encourage researchers to take previous experiences into account and draw from existing literature to structure a preliminary theoretical framework. This framework should then be utilised as a *sensitizing device* that can be elaborated on and modified by actual findings in the field. Tan (2010, p. 102) describes theoretical sensitivity as “the researcher’s knowledge, understanding, skills and ability to see data with analytical depth, be aware of the subtleties of meaning of data, generate concepts from the data, relate the concepts, and develop theory”. The main consideration is to continuously stay open to underlying issues that may provide disconfirming evidence to existing data and therefore extend emerging theory (Ng & Hase, 2008).

Lakatos (1970), the acclaimed philosopher of science, offers a reflection of scientific discovery in general:

“... for classical empiricists the right mind is *tabula rasa*, emptied of all content, freed from all prejudice of theory. But it transpires from the work of Kant and Popper – and from the work of the psychologists influenced by them – that such empiricist psychotherapy can never succeed. For there are and can be no sensations unimpregnated by expectations and therefore there is no natural demarcation between observational and theoretical propositions” (Lakatos, 1970, p. 99).

Taking all of the above into account the researcher, for the purpose of this study, decided to use the relevant literature to construct an initial literature framework in an effort to become more sensitized to the research domain before entering the field. Henceforth, literature is used to contextualise the space in which innovative teachers create new knowledge in their teaching and learning, resulting in transformed pedagogies. Literature frames the study of the phenomenon and sets boundaries for further discussions specifically in activities mediated with the use of emerging technologies in a developing world context. Literature will also be reviewed continuously throughout the data collection and dissemination process in a constant comparative analysis as concepts and finally theory start to emerge from the data set. Thus literature will be added to theory as it emerges throughout the study.

1.6.6 Data Collecting Methods

The context of the inquiry is limited to the participants in the Microsoft Innovate Forum Awards, an annual international competition which seeks teachers to enter their innovative projects in their use of ICT in their own teaching and learning (*cf.* Section 4.3). In this context, innovative teaching refers to a constant engagement in activities which stimulate learning in creative new ways that stretch beyond the limits of the classroom and traditional teaching methods. Great emphasis is placed on context, collaboration and content throughout the competition. The Microsoft Initiative, called *Partners in Learning*, <http://africa.partnersinlearningnetwork.com> works with governments, ministries of education and other key stakeholders in more than 100 countries. This annual competition receives support from the highest offices of government. The innovative attributes of the teachers and their finalist status in the Microsoft Innovate Teachers Forum Competition determined their consideration for this study.

The target group of this study was the participants to the annual Microsoft Innovate Teachers Forum competition. This study spanned the period from 2007 up to 2010. Even though some of the entrants left the teaching profession in this time, they were still approached to reflect on their entries into the competition.

Microsoft Innovative Teachers Forum is an annual competition that is presented at Microsoft Head Office in Johannesburg every year. All the competition entries are whittled down to 20 finalists by 10 judges who hail from a wide variety of backgrounds and interest. Judges come from diverse areas such as academia, government, independent consultants and industry.

All the competition finalists gather for 2 days to exchange ideas and share best practice examples of using technology in the classroom. Four winners are announced at a prize giving ceremony where the deputy minister of education usually does the honours. Winners are chosen in the following categories: community, content, collaboration and a peer review award. This competition has been running since 2005 with the local winners participating in the annual World Forum held on a different continent each year. Capitals hosting past events include Atlanta – USA(2006), Helsinki – Finland (2007), Hong Kong – China (2008), and Salvador – Brazil (2009), Cape Town – South Africa (2010). South Africa has been very successful in the

past on the world stage, winning one or more of the categories every year. This underscores the fact that there is a prevalence of local teachers exploring innovative ideas and practices in the use of ICT in education.

For the duration of this competition, there is time to view and engage with the teacher participants. This time together is used to exchange ideas with each other in unstructured and structured sessions. Initially the competition was only one day long but the participant teachers felt the time allocated for informal engagement with each other contributed greatly to their exchange of ideas and they requested additional time to be added to future competitions in order to enhance the opportunity for face to face deliberations and discussions. The organisers supported this notion and extended the competition to include another full day during which teachers could engage with each other in their transfer of skills. This change in the program allowed the researcher additional access to all other participants which accounts for more than 50 of the most innovative teachers in our country.

1.6.6.1 Sampling methods

Two different methods of sampling were used during this study and they are discussed in greater detail in Section 3.4. “Initial sampling in grounded theory is where you start and theoretical sampling directs you where to go” (Charmaz, 2006, p. 100). Initial sampling was used to present a point of departure through purposive sampling followed by theoretical sampling that allowed for elaboration and refinement. In this study theoretical sampling was applied in accordance with grounded theory methodology. In other qualitative research settings, theoretical sampling means gathering data until the same pattern reoccurs pointing towards empirical themes. In contrast, grounded theory employs theoretical sampling to develop emerging theoretical categories in an effort to construct conceptual categories (Creswell, 2009).

During the initial sampling phase, selection criteria were established before entering the field and it included entries in the form of virtual classroom tours (VCT). Artefacts such as reflective video, photographic images and materials produced during the period of competition were also considered for analysis. Subsequent theoretical sampling targeted specific teacher participants in the competition who displayed the needed knowledge and skills to inform the study further. In

subsequent sessions, workshop activities and focus group discussions were used as a means to gather more definitive data (*cf.* Section 3.6, Table 3-4).

With relevance to this study the following data sources were used in constructing a theory towards better understanding the practice of the innovative teacher in their quest to incorporate ICT into their classrooms: Data sets include Virtual Classroom Tours (VCT), multimedia artefacts, structured interviews, semi-structured interviews, observations, focus group interviews, reflective research diaries, expert reviewers and workshop events.

1.6.6.2 Role of the Researcher

Over the years of conducting this study the role of the researcher changed gradually from being a participant in the early days of this study to participant-researcher for a lengthy period and finally to researcher in the latter part of the study. This study is not entirely participatory in nature but the approach is consistent to building intellectual capacities and enabling people to articulate their own thought processes and thereby enhancing their own knowledge base so that they can pursue independent actions (Collins, 1998; Tilakaratna, 1990). The investigative process is viewed as educative and emancipatory in that it stimulates the development of self-knowledge for the participants as well as the researcher in fair exchange of knowledge where all are seen as experts. The evolving role of the researcher was fully acknowledged by the participants. A visual guide to the researcher's involvement during the course of this study is presented in Figure 1-6 below.

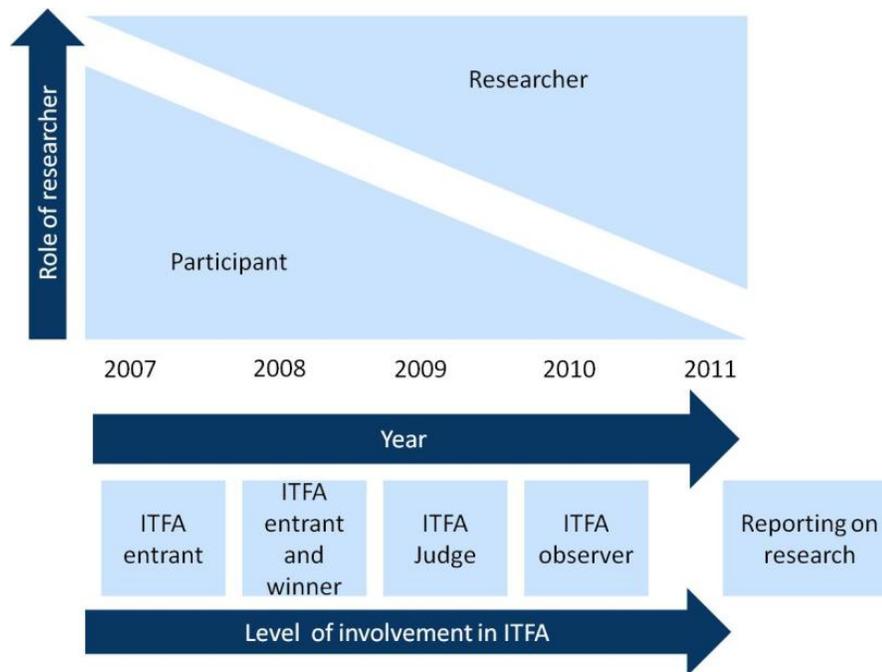


Figure 1-6: The researcher's involvement with the participants during the course of the study

Although the researcher originally participated in the competition as an entrant in 2007, the participatory nature of the involvement is acknowledged and viewed as providing additional opportunity to immerse oneself in the research field. Gradually, in time this role shifted to reflect levels of achievement within the competition as reflected in 2008 when the researcher won the content category and participated in the worldwide event in Hong Kong. During this time the researcher developed a deeper understanding of the complexities involved in articulating the new knowledge attained and disseminating it for a wider audience. The researcher changed roles in 2009 moving away from interacting so closely with fellow teachers to become part of the judging panel giving further insight into the application of judging criteria in selecting entrants. In 2010 the researcher adopted the role of observer during the competition and subsequently engaged with participants after the fact with follow up interviews.

Entries to this competition are rich in visual material including multimedia artefacts, illustrations and images as well as text based evidence of learning practice including lesson plans and learning artefacts. Learning contexts are well defined and motivating factors and influencing

parameters richly described resulting in rich pickings for analysis. Comments and criticism from judges on each entry is posted on the competition website to inform future practice and entrants to the competition. Once the initial coding was completed and some of the concepts started to develop the focus turned to unedited, in-competition candidate structured video interviews that were made available on request by the organisers of the competition. In these interviews the participants reflect on their entries and elaborate on their personal views, teaching strategies and the future of instruction and criteria guiding their selection of educational technology in the design of blended learning events. Post competition radio interviews and transcripts were also obtained. The analysed data from this interview phase was used to refine the sub-research questions and formulate additional research objectives leading to further theoretical sampling.

Teachers that attended the workshops organised by Microsoft were also targeted as part of the theoretical sample as prescribed in GTM. My quest during this time was therefore to interact with and observe teachers in an exchange of ideas during formal and informal sessions. In addition to the data collected via the entries and the interviews and interactions during the workshops, the sampling turned to the actual competition event.

Qualitative data analysis software ATLAS.ti was used for its capacity to handle and organise the large amounts of data that was collected throughout this study. The upgraded version of the software package 6.1 was very useful and capable of treating documents in pdf format, successfully handling multimedia recordings and graphic illustrations.

1.6.7 Data Analysis Techniques

Analysis of data consists of taking the data apart to determine individual responses before putting it together again in an effort to summarise it. Interpreting data involves exploring the general sense of the data before identifying patterns as they emerge before drawing them together in themes in an effort to answer the particular research questions (Creswell, 2005). This study requires a flexible method of analysis based on interpreting data and hence the choice to analyse data by means of hermeneutics.

Hermeneutics can be viewed as a philosophical approach to human understanding and therefore finds itself as part of the interpretative research family, but it can also be considered as a method of analysis, in the understanding of data that has become obscured in some way (Bleicher, 1980; Radnitzky, 1974). The act of interpreting is not only restricted to the researcher but is also the responsibility of the reader of the research findings as documented in this study.

Abulad (2007) recognises the existence of a hermeneutic cycle that guides the process of gaining a deeper understanding. The hermeneutic circle presented in Figure 1-7 below, presupposes the researcher appreciates how understanding can be developed. As new data emerge, new insights form resulting in a continuous circle ensuring that meaning and biases are eliminated in data analysis. Phases of analysis, synthesis and realisation form part of each individual loop typical of a hermeneutic cycle before the researcher moves on to the next iteration.

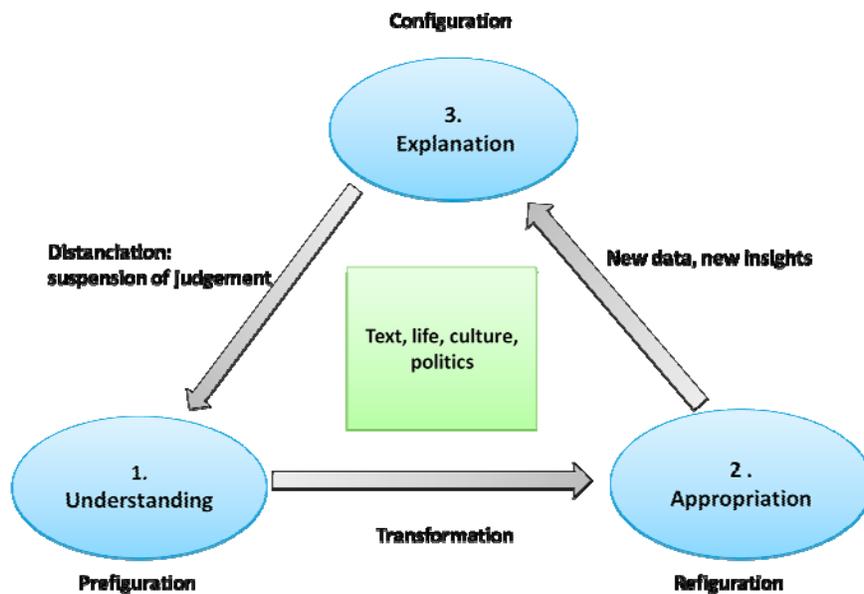


Figure 1-7: Hermeneutic cycle

This cycle extends to include interactions between the researcher and the participants which establishes the need for a dialectic interaction until a shared understanding is reached where the researcher can choose to revisit earlier encounters in search of greater clarity (Klein & Myers, 1999).

Within the realm of hermeneutics we see a diversity of approaches. Demeterio (2001) categorizes these approaches into five hermeneutic systems namely: romanticist, phenomenological, dialectical, critical and post-structural hermeneutics. Each one of these presents a unique system, conception of subject and object, goal and interpretive act which is either truth or meaning.

Among the group of five hermeneutic systems, there is no *best system*, as each has its own advantages and disadvantages. To select the best system for this study, it is necessary to look closely at the particular research problem that needs to be explored. This research study makes use of the post-structural hermeneutics system that draws upon several of the other interpretive systems such as the romanticist, phenomenological, dialectical and critical systems. Hermeneutics is the most powerful instrument that can be applied in this study as it not only explores the parameters of textuality, but also the institutional, social and political structures which define the relationships between truth, meaning and power. Other post-modern interpretive theories, such as feminism, also fall within the cadre of this type of hermeneutic system. Figure 1-8 below illustrates a post-structural hermeneutic system of interpretation.

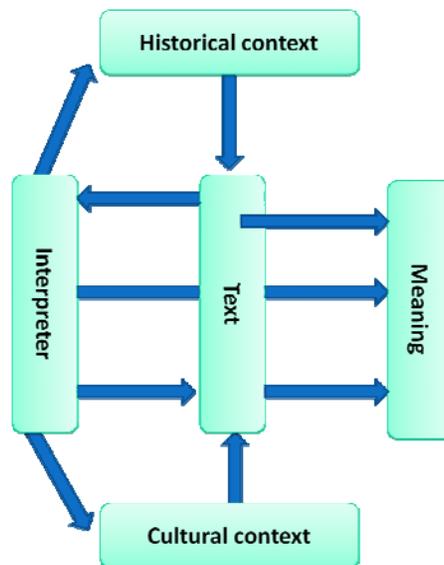


Figure 1-8: Post-structural system of interpretation (Demetrius, 2006)

Multiple arrows originate from the interpreter which suggests that s/he takes into account historical and cultural contexts when considering data analysis in the process of meaning

making. With regard to this study the data were not only limited to text in the form of interview transcripts and other textual documentation as depicted in Figure 1-6 above, but also include multimedia artefacts and observations. Artefacts can contain a myriad of meanings and it is up to the researcher to engage and carefully consider the cultural historical context before ascribing specific meaning to it. To this end Klein (1999, p. 72) proposes a set of principles which can be used to conduct and evaluate interpretive case research based on the philosophical perspective of hermeneutics and which mostly apply to studies of an interpretive nature. Table 1-3 below indicates these principles and how they have been applied to this research study.

Table 1-3: Fundamental principles for conducting interpretive studies (Klein & Myers, 1999, p. 72)

Fundamental principle for conducting and evaluating interpretive studies.	How and where they are applied in this study.
1. The Fundamental Principle of the Hermeneutic Circle. This principle suggests that all human understanding is achieved by considering the interdependent meaning of parts and the whole that they form. This principle of human understanding is fundamental to all the other principles.	During data analysis the data were initially fractured into units when coding before restructured into related concepts. This technique was applied in the data analysis in Chapters 4, 5 and 6.
2. The Principle of Contextualization. Requires critical reflection of the social and historical background of the research setting so that the intended audience can track the emergence of the situation under investigation.	Inter-relatedness between codes was established after taking the individual contexts into account and this is reflected in the construction of themes and sub-themes. Contexts are richly described.
3. The Principle of Interaction Between the Researchers and the Subjects. Requires critical reflection on how the research material (or "data") was socially constructed through the interaction between the researchers and participants.	The role of the researcher is initially that of participant and evolves over time to participant-researcher as reflected in Section 1.6.7.
4. The Principle of Abstraction and Generalization. Requires relating the idiographic details revealed by the data interpretation through the application of principles one and two (listed above) to theoretical, general concepts that describe the nature of human understanding and social action.	An attempt is made towards generalization in establishing the interrelatedness of concepts and categories into emerging themes.
5. The Principle of Dialogical Reasoning. Requires sensitivity to possible contradictions between the theoretical preconceptions guiding the research design and actual findings ("the story told by the data") with subsequent cycles of revision.	There is an ongoing comparative analysis between emerging data concepts and existing literature in an effort to reconcile data concepts.
6. The Principle of Multiple Interpretations.	Disconfirming evidence was sought to

Requires sensitivity to possible differences in interpretations among the participants which are typically expressed in multiple narratives or stories of the same sequence of events being studied.	illuminate the findings and added additional dimensions to the interpretations.
7. The Principle of Suspicion. Requires sensitivity to possible “biases” and systematic “distortions” in the participants’ narratives.	The voice of the researchers forms an integral part of this investigation and is supported in the grounded theory method.

In addition to the above principles, researchers are not only encouraged to document all their findings, but to also provide a logical reason for their decision making in ascribing meaning when engaging in hermeneutics. The act of interpreting is not only restricted to the researcher but is also the responsibility of the reader of the research findings as documented in this study. The creative spirit of the interpreter is lost if he/she becomes too mechanical in their interpretation. The same idea applies to the reader of this research text that is also engaged in an interpretive act. Abulad (2007) elaborates:

“... hermeneutics is the art of interpretation. Because it is an art, we are hereby not constructing a set of fixed and rigid guidelines for a valid interpretation of a text. In a way, method kills the art, especially since art requires a creative spirit. Each creation is a free process whose source is the interplay of faculties unique to each artist. The author thus follows a procedure which cannot be mechanically reproduced inasmuch artwork and interpretation. An interpreter follows his or her own inspiration, and mechanical rules are hereby out of the question. The encounter of both reader and text is an event that one can neither foresee nor define. Here are two worlds that fuse, even collide, in a way that creates a world that surpasses even the author’s expectation such that the text now takes a life of its own” (Abulad, 2007, p. 22).

The flexibility of analysing the data through the use of hermeneutics and not by means of a mechanistic process offered the researcher the opportunity to develop her thought processes along a natural path.

1.7 STUDY DEVELOPMENT PHASES

In the previous section, the *research process* was presented in terms of *the research design* and the *data collection strategy* that would best enable the researcher to investigate the tacit knowledge innovative teachers hold when engaging with emerging technologies and in doing so answer the main research question. This section will put forward the phases describing how the research was accomplished.

This study was divided into phases to accomplish the final deliverable of presenting a substantive emerging theory on the pedagogical efficacy of innovative teachers in their use of emerging technologies as reflected in Figure 1-9 below.

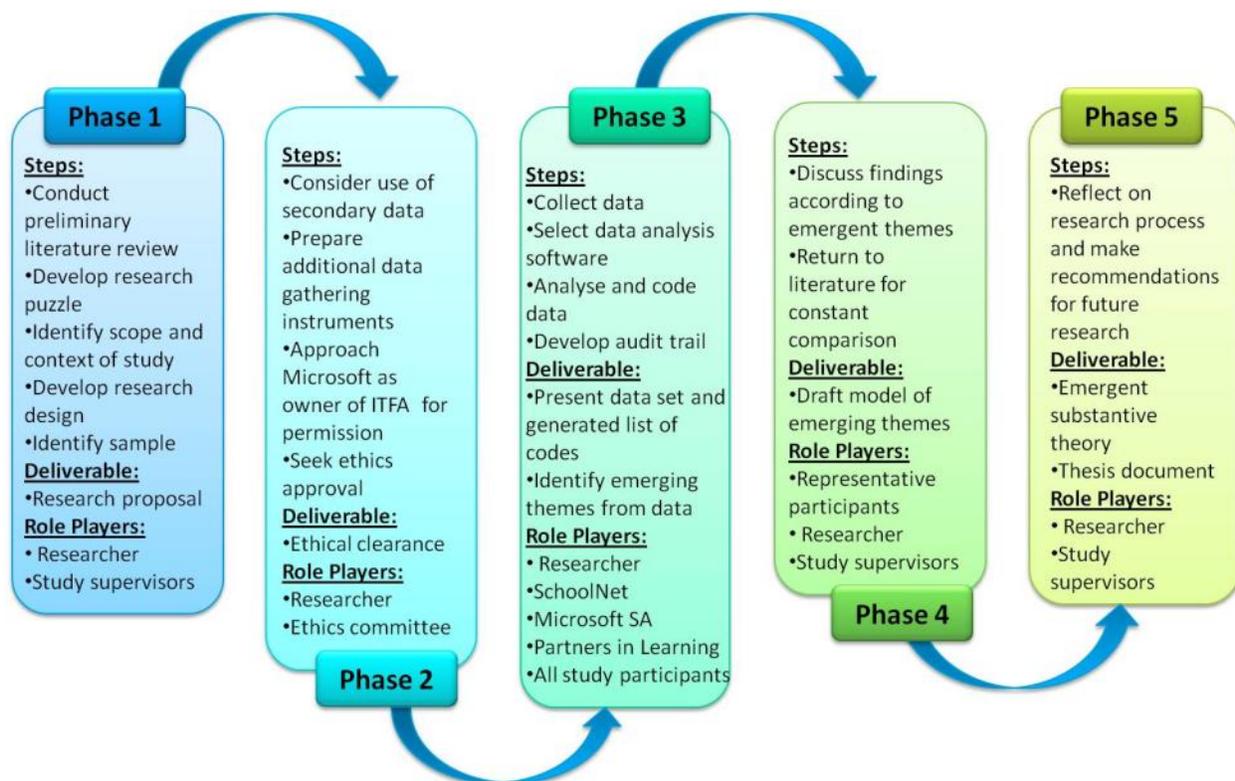


Figure 1-9: Research phases

The *first phase* concerned itself with defining the research interest. Once an initial literature review was conducted, the initial research puzzle was designed and formulated. This phase

culminated in the successful defence of the research proposal pertaining to this study at faculty departmental level.

Phase two centred around the preparation of data collection instruments and additional documentation in compliance with ethic standards as set out by the ethics committee of the University of Pretoria. Documentation required for ethical consideration included letters of permission from Microsoft South Africa as well as letters of informed consent to participant teachers and school principals. Appendix A contains the ethical clearance certificate and Appendix B the relevant letters to organisations and participants.

Phase three focussed on data collection and analysis. Secondary data were obtained from SchoolNet South Africa and these competition entries were initially coded to help direct further purposive sampling. Upon analysis of additional data, other themes started to emerge driving further data collection and analysis to the point of theoretical saturation.

During *phase four* of the research the emergent themes were presented and discussed. Literature was revisited and used as a constant comparative mechanism to help develop an emergent theory and tentative model.

Finally, *phase five* put forward a substantive theory that emerged during the study and this phase also reflects on the research process.

1.8 CONSTRAINTS

There is always the possibility of bias and subjectivity being fellow competitors vying for the same accolades, however, all forms of data are considered relevant in a Grounded Theory study. Initially, fulfilling the role of participant researcher was of considerable value as it added an interpretive nature to the study which provided an insider's view into the thought processes of the innovative teachers. Another limiting factor to consider is that competition entries can be skewed to reflect the positives and not the negatives of the entered projects as they may not go into the required depth in their description. The last aspect to consider is that fellow competitors might not be as forthcoming during peer judging and that they may hedge some information for formal competition judging. This only proved to be the case in the first year of this study as the

role of the researcher changed to other capacities including those of participant, observer and judge in subsequent years (*cf.* Section 1.6.6.2).

1.9 ETHICAL CONSIDERATIONS

Maintaining good ethical practice is pivotal to gaining the respect of participants and the research community. A sound ethical foundation also endows the study with legitimacy in the eyes of other research institutions and fellow practitioners. It is therefore imperative to adhere to prescribed standards and to gain the informed consent of participants in advance. The researcher, however, responsible for all possibilities at all times and sometimes ethics have to be negotiated in situ as unforeseen circumstances arise (Tisdale, 2004).

This study subscribes to the Kantian approach to ethics. This approach is based on the rational abilities of humans to regulate their engagement and therefore to determine principles that respect autonomous actions and decisions. The principles are forged regardless of whether our own convictions and values are in conflict with those of others (Tisdale, 2004), however, in this study there were no unusual ethical considerations as learners and vulnerable participants were not actively involved in the study. The rights of minors were therefore not infringed upon in any way. The ethical clearance certificate for the scope of this study is attached in Appendix A.

There are three main ethical issues which needed consideration in this study:

1. Permission from the organisers of the Microsoft Innovate Teachers Forum competition to conduct research presented in Appendix B.
2. An informed consent form was obtained from all teachers prior to engagement.
3. Protecting the identity of the learners as visible in images during construction of Virtual Classroom Tours (VCT's).

As most of the data, in the form of multimedia artefacts and digital documents, is available in the public domain, the only data needing verification was the interview transcripts and the workshop data.

According to Hatch (2002) teachers have relatively little power or status and often see themselves as being secondary to an educational researcher as they may feel coerced into participating in studies that school principals have already agreed to. Consequently they may feel inclined to refuse individuals which they perceive to be “experts” in the field. To overcome these reservations it was essential for the researcher to be sensitive to the educators’ potential vulnerability. Full disclosure of research intentions eased their concerns and clear undertakings were given to release them from the study if they so requested.

In the context of this study, the teachers involved are less vulnerable as they are well respected in their own communities and recognised as leaders in their particular fields. The added recognition of *finalist status* in such a competition ensured equal footing between the researcher and the participants. It is also worth noting that they were initially self-assured enough to enter the competition of their own volition.

The following principles were kept in mind when conducting grounded theory research:

- *Informed consent.* Participants and organisations involved were informed as to the role of the researcher and the objectives of the investigation. Where written consent could not be obtained from relevant authorities the data were limited to what was made accessible through the Microsoft databank and in the open domain.
- *Voluntary participation.* As part of the initial purposive sample and subsequent theoretical sample some teachers resigned from the teaching profession subsequent to entering the annual Microsoft Innovative Teachers Forum Awards. These teachers pursued careers in other sectors, including higher learning and the private sector, having demonstrated their potential on a wider platform. These participants were asked to continue their participation in the research in their private capacity.
- *Analysis and reporting.* This research strives for academic rigour in its reporting and a full disclosure of all methods and techniques used during data analysis is given.
- *Researcher’s role.* The role of the researcher as researcher-participant was communicated to all role players before data gathering commenced.

- *Researcher bias.* Because of the interpretive nature of the study and the premise of *all is data* underpinning the Grounded Theory Method, the beliefs, value system and pre-existing ideas and concepts held by the researcher are articulated and used as data in the form of a structured interview and research memos written whilst analysing and coding data.

This research strictly complies with all guidelines as prescribed by the University of Pretoria in order to protect the rights of all parties concerned. This process ensures that the research is conducted in a fair and just manner according to guidelines set out by Marshall and Rossman (2006). The results were subjected to reflection from peers and supervisors and published in peer reviewed conferences and journals and discussed in workshop formats.

1.10 ANTICIPATED BENEFITS AND SIGNIFICANCE OF THE CONTRIBUTION

Teachers in South Africa are generally viewed as a dispirited workforce and have long suffered under the banner of incompetence as a result of learners' low pass rates. Within the broader context of teachers' dismal performance, the innovative teacher offers a glimmer of hope and their practice is worth exploring in pursuit of realistic and best practice guidelines for a developing context (Souter, 2011).

This study in educational research illuminates the complexities within the South African context and contributes on a theoretical, practical and methodological level to the educational domain. Throughout this study the focus has remained the examination and articulation of the tacit knowledge innovative teachers hold and to make recommendations regarding teacher training and development in order to foster a culture of innovation amongst practitioners. The substantive theory is presented visually using text and diagrams where necessary. The benefits of this research are not limited to the theoretical but also include comments on the evolving nature of GTM specifically when applied in an educational setting (*cf.* Chapter 7).

1.11 MAP OF THESIS

Even though the research was conducted in phases, this study is structured in chapters to conform to conventional ways of thesis presentation. The research phases and chapters do not

correspond directly. This research study is documented in eight chapters. Figure 1-10: Thesis outline below reflects the structure and captures the main components of this study.

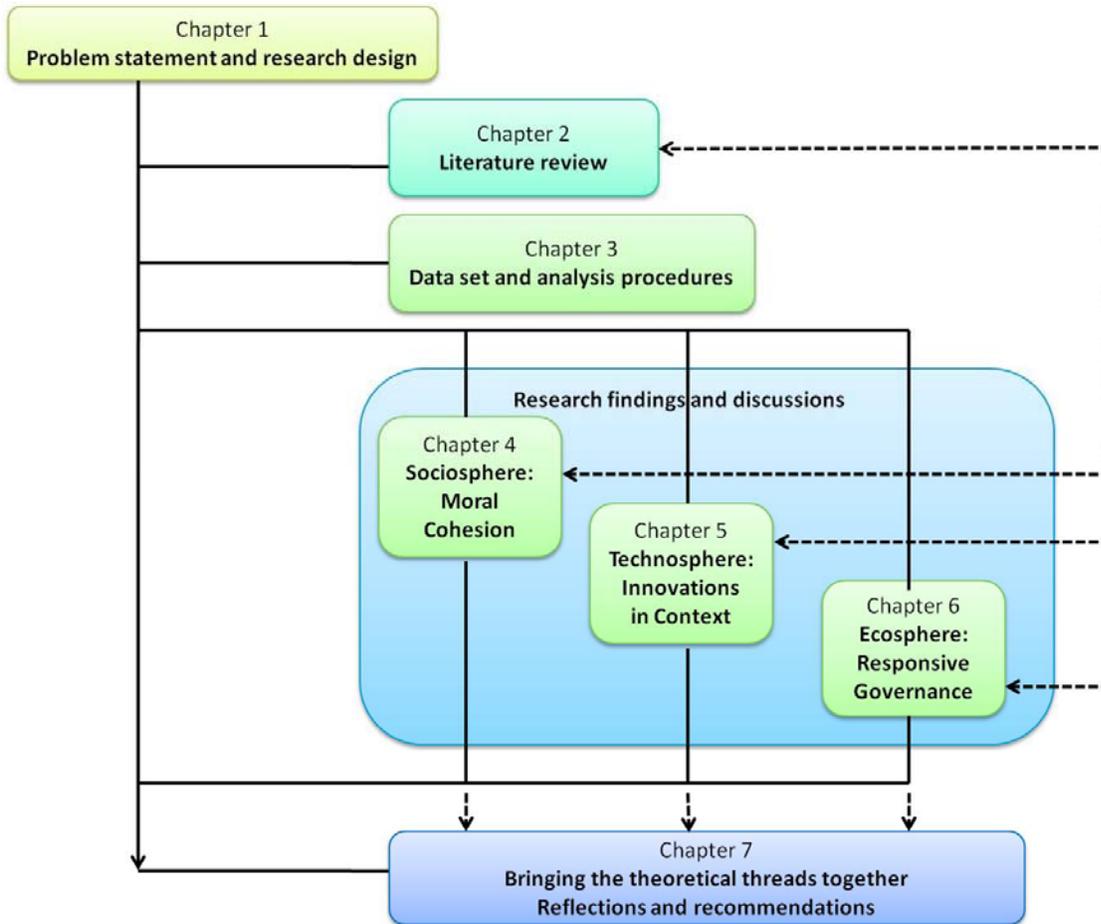


Figure 1-10: Thesis outline

Chapter 1 provides an overview of the research background and purpose statement leading to the formulation of several research questions. This Chapter also gives the philosophical underpinnings of this research, an outline of the research design and the historical backdrop and evolution of the Grounded Theory Method (GTM). Chapter 1 further provides reasons for selecting the Straussian GTM to investigate the phenomenon under scrutiny. Knowledge gaps are identified which in turn leads to the formulation of the research puzzle.

Chapter 2 reviews the literature and examines contemporary studies for details of the processes that may be at work when innovative pedagogical activities are developed and new knowledge articulated when teachers use emerging ICT in school classrooms.

Chapter 3 details the research process, the implementation strategy for the study as well as the dataset. Incidents of theoretical sampling, as demanded from the unfolding data, crystallize as categories and themes start to emerge.

Chapter 4 addresses the first sub-research question which is the role of the innovative teacher within the sociosphere. This Chapter also presents the initial formulations of categories. The main theme of moral cohesion is disseminated.

Chapter 5 focuses on the second-sub research questions that explore the pedagogical shift within the technosphere. The Chapter also articulates further developments of the emergent theory relating to teachers' innovative practices using ICT. The emerging theme of innovation in context is examined.

Chapter 6 presents the findings of the last sub-research question and centres around the implications for organisational change related to aspects of governance. This Chapter completes the last phase of the emergent theory development.

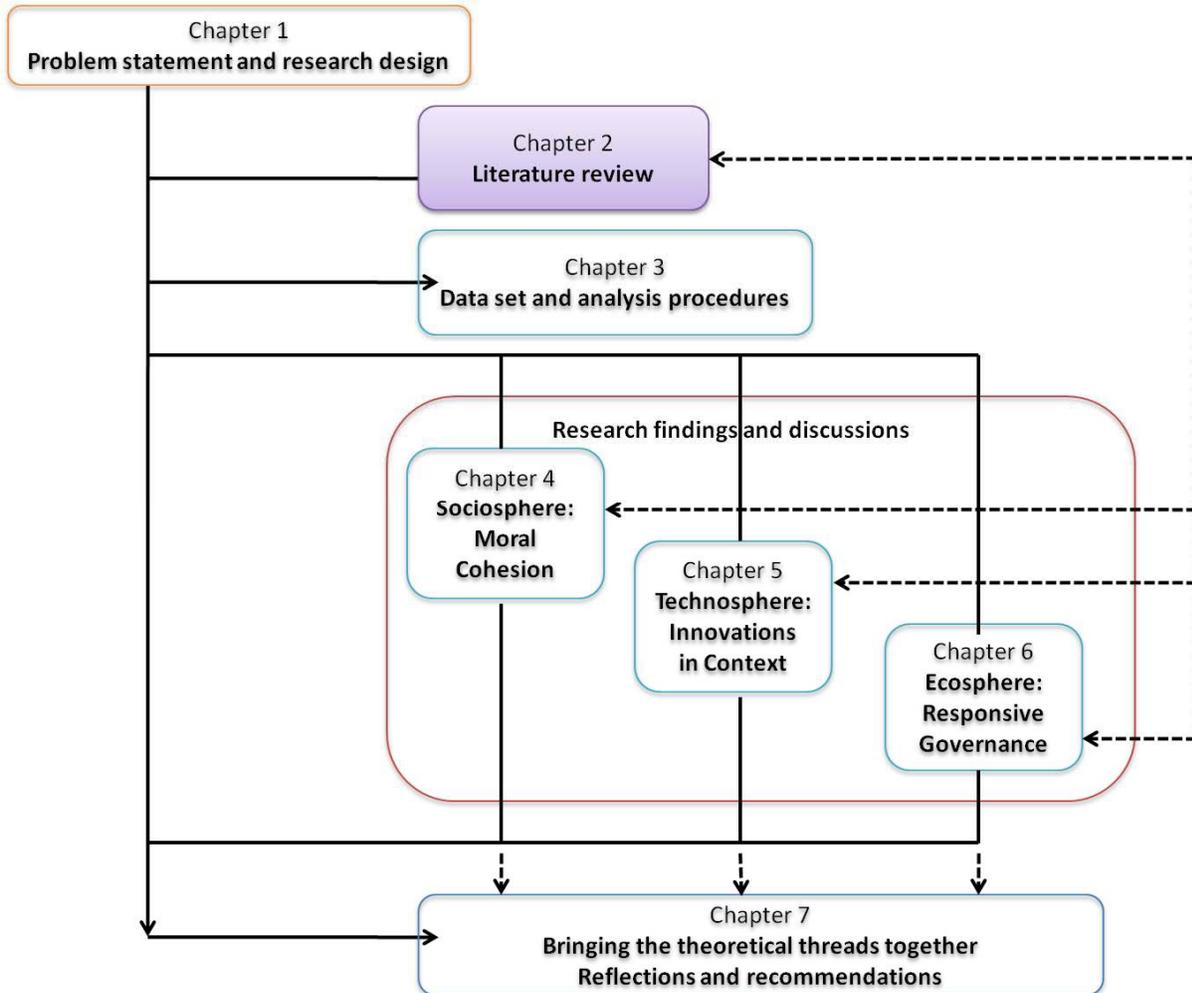
Chapter 7 attends to the subsequent substantive theory as developed in this study in an effort to answer the main research question and demonstrates how data and literature were used to develop and illuminate critical aspects of the subsequent substantive theory. Finally, the researcher reflects upon the contributions made to the existing body of knowledge on a theoretical as well as methodological level. Considerations for future research opportunities are presented.

1.12 SUMMARY

Chapter 1 introduced the concept of tacit knowledge in relation to innovative teachers in their use of emerging technologies. The research problem of translating the practice into theory in order to create a better understanding of the ongoing relationship between technology and

education was presented. The research questions directing the research were presented within the research puzzle and a detailed overview of the research methodology was given. The history of the Grounded Theory method was documented and the different approaches to this method were fully explored before finally settling on the Straussian Grounded Theory method. Key analytical strategies to consider when conducting the Grounded Theory were discussed. A brief explanation of the current discourse surrounding the relevance of a literature review when following a Grounded Theory Method was given and a motivation for the literature review as a contextual frame for the study was supplied. Furthermore sampling methods, ethical considerations, anticipated benefits and significance of this research were presented.

In Chapter 2 the literature relevant to the issues pertaining to the implementation of ICT in education is reviewed. This is done in an effort to present the contextual framework that bounds the study. A historical glance which investigates the technology solutions in education is presented along with a chronological view of teaching and learning theory.



CHAPTER 2. TO ESTABLISH THEORETICAL SENSITIVITY

“ Knowledge is emergent and contestable, part of the on-going project of humankind to establish and codify what is known.”
Somekh (2007, p. 30)

2.1 INTRODUCTION

Chapter 1 introduced the research problem to be investigated and presented the philosophy that supports the research approach. An outline of the research design and the historical backdrop and evolution of the Grounded Theory Method (GTM) was given. A motivation for the choice of the Straussian GTM to investigate the phenomenon of pedagogical efficacy when innovative teachers engage with emerging technologies was given. Knowledge gaps between theory and practice were identified and a research puzzle, which shed light on the topic under investigation, was formulated.

This chapter serves to sensitize the researcher and the reader towards the research problem and related literature. To achieve this objective, the researcher plans to examine the background of teaching and learning theory as well as the use of emerging technologies in schools in relation to new innovative pedagogical practices designed to engage both teachers and their learners in the process.

2.2 THE FRAMEWORK OF THE STUDY

The review also aims to identify the major contributors in this field and to document their perspectives so that these can be revisited during the conceptualization of the emerging categories which will be derived from data collected and analysed in this study. Findings from international studies are used to establish the current research context and existing models that have been used to structure this field of research are considered as sensitising instruments.

Zandvliet and Buker (2003) considers aspects of the learning environments and ICT as a field which requires continued research in order to determine tangible results. They further consider studies, describing psychosocial learning, as able to identify factors that may influence or determine learning with technology. Zandvliet and Buker (2003) also emphasise the interdisciplinary nature of conducting research in education because of the complexity of learning environments. To this end the framework designed by Gardiner (1989) is an appropriate choice to describe a general outline for contemplating the pressures which might drive change in these learning environments. Gardiner's model consists of three overlapping spheres which he describes as the *ecosphere*, the *sociosphere* and the *technosphere*. In this model he postulates that people generally deal with three dimensions in their existence namely: the natural world or the *ecosphere*, other people in their social world or *sociosphere* and the man-made artificial world or the *technosphere*. Human beings, located at the centre of these three spheres, are subjected to all three influences. The overlapping of these dimensions creates tension and these intersections give direction to future trends, hinting at how to manage the complexity of the post- industrial society.

As was the case in previous studies in technological settings (Zandvliet & Buker, 2003), the researcher uses a conceptual model derived from Gardiner's *Three Interfaces of Adam* model and relates the original conception of the joint influence of the *sociosphere*, *ecosphere* and *technosphere* to consider the areas of potential influence where teachers (in their quest to exploit emerging technologies through innovative pedagogical practices) rely on their awareness and knowledge of critical philosophy, professional and organisational learning including aspects of teaching and learning theory, and emerging technologies as presented in Figure 2-1 below:

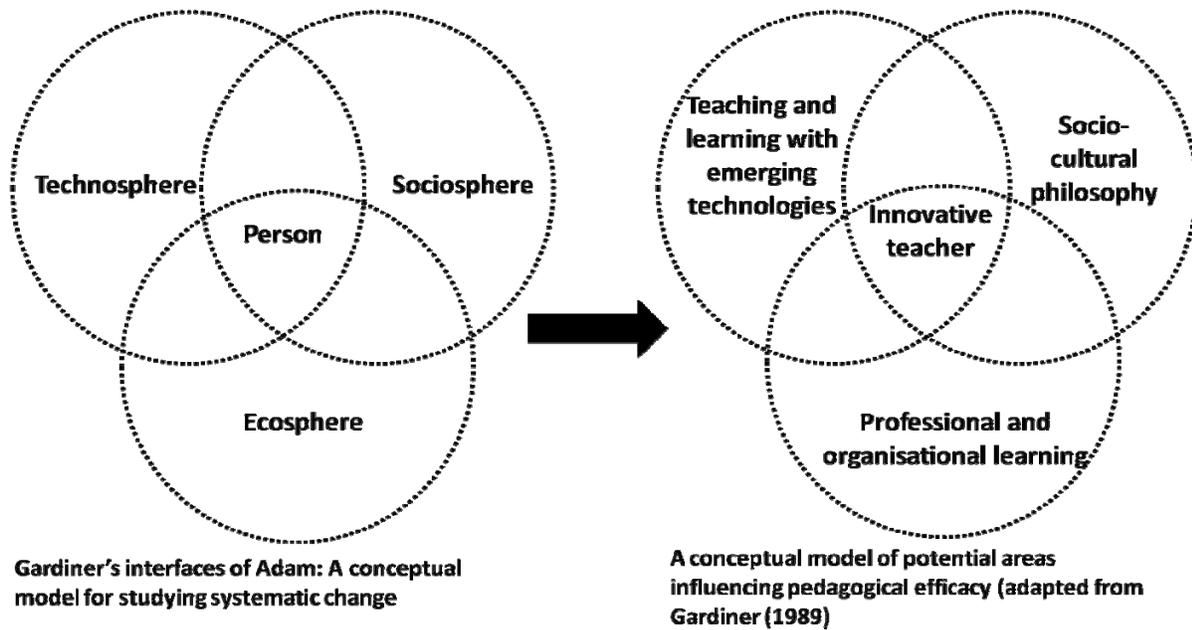


Figure 2-1: Framing the literature review of this study

Teachers are reflective beings by nature and use their own systems of beliefs to pursue solutions to existing problems as determined by their contexts (Bernstein & Solomon, 1999). In the past critical theory has been used to examine the ethical situation of educational technology in society and how critical theory can be used to exacerbate unequal social relations which result in the exclusion of groups of people in the process (Driscoll & Rowley, 1997). Critical theory is also a way of thinking about and transforming the relationship between classroom teaching and the production of knowledge (MacLaren, 2000).

In this study, the *technosphere* contains the affordances potentially offered by emerging technologies, the *ecosphere* demarcates the learning surroundings and the tendency to exploit technology in the learning environment affecting organisational systems and the *sociosphere* encloses the area of critical philosophy, informing the discourse that guides decisions and actions of members within a community. As these three intersecting spheres come together in a shared space and influence each other, the dynamic interchange leads to new knowledge creation and informs our understanding of innovative teaching and learning.

Historically, learning was situated in the industrial society but it is currently moving towards a more post-industrialized society dominated by knowledge workers. The technosphere is starting to encroach on the other dimensions with direct consequences for the remaining two spheres (Kerr, Fisher, Yaxley, & Fraser, 2006). Separating these three components or spheres (emerging ICT, teaching and learning theories and critical philosophy) is an analytical act and one that is difficult to untangle in practice. In actuality, these components exist in a *state of dynamic equilibrium*. The philosopher Thomas Kuhn (1996) proposed a different context namely *a state of essential tension*. To unravel this dynamic interplay would require a nuanced understanding of specific contexts and not a perusal of each sphere in isolation as they are so interdependent on one another (Mishra & Koehler, 2006). Despite the intricate dependencies within these context spheres, it is imperative to gain a better understanding and negotiate a shared meaning for each one.

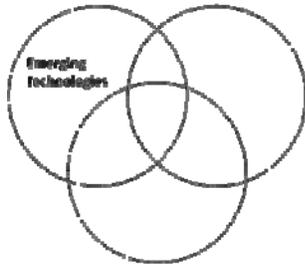
In presenting the literature, this study draws on the proposed conceptual model (Figure 2-1 above) to establish a shared understanding that recognises the need to establish the interrelationships between practice, practical knowledge and the theory of teaching and learning with emerging technologies. In order to understand the fit between these concepts the following should be considered:

- The position of *emerging technologies* in teaching and learning (*cf.* Section 2.3).
- The coverage of current *teaching and learning theory* through which the rich descriptions for innovative, technology based pedagogical practices are to be viewed (*cf.* Section 2.4).
- The aspects of *critical philosophy* need to be elaborated upon as they foster an appreciation for the personal theories, beliefs and practical knowledge teachers draw on in their innovative uses of ICT in their teaching and learning (*cf.* Section 2.5).

Each of these concepts mentioned above interact with one another and thereby create new dimensions and properties. The resultant new spaces draw on elements from the original spheres, as mentioned in Figure 2-1 above, and can be viewed as one part of the individual spheres or on its own. The next section will present the man-made technosphere focusing on emerging

technologies. The problem of language and the establishment of a shared understanding of terminology as well as the existing trends of using ICT in innovative ways to affect teaching and learning are then discussed.

2.3 THE TECHNOSPHERE: EMERGING TECHNOLOGIES



Chapter 1 provided a brief historical glance on the role of technology in education. This discipline may currently be one of the most fluid in the academic world and therefore the role, concepts and definition of this discipline are constantly changing (Kozma & Anderson, 2002). The continual renewal of new applications and devices further complicates the research of ICT integration in education. A plethora of new releases are fiercely marketed every year and customers often anticipate the newer and better version of some earlier model. All of these technologies are grouped under the umbrella terms *new technologies* or *emerging technologies* (Cox, 2009). The first step when conducting research is to define a common understanding of terminology especially in an area as diverse as Information and Communication Technologies (ICT) in education. The use of terms can differ from one context to another and this is largely due to historical and political legacies embedded within systems. Information Technology (IT) describes items of equipment (hardware) and computer programmes (software) that allow us to access, retrieve, store, organise, manipulate and present information by electronic means (DOE, 2004). Information and Communication Technologies (ICT) recognise the convergence of information and communication technologies, where appliances for computation and communication contain similar components and are increasingly capable of providing both facilities to people using them. Information and communications technologies (ICT) reflect the common understanding that a computer's potential is significantly enhanced by connecting to a local network and even more so by connecting to the Internet. In South Africa the term ICT is used in both the e-Education White Paper (DOE, 2004) and the SITES⁴ (Howie, Muller, & Patterson, 2005) report on South Africa. The White Paper defines ICT as follows:

⁴ SITES = Second Information Technology in Education Study

“[ICT is] the convergence of information technology and communication technology. ICT is the combination of networks, hardware and software as well as the means of communication, collaboration and engagement that enable the processing, management and exchange of data, information and knowledge” (DOE, 2004, p.16).

The term ICT is generally used in this study and refers to both the hardware and the capabilities that it provides, except in the case of direct citations or quotes.

Hawes (2008, online) reminds us that emerging technologies are in a state of change and once adopted by learners, they change our understanding of what learning is all about. Hinostrroza *et al.*, (2008) suggests the grouping together of these emerging technologies, based on intention, into one of the following three groups:

- *Expanding* new learning opportunities which result in anywhere anytime learning,
- *Creating* new learning scenarios in traditional contexts and
- *improving* the teaching and learning process (Hinostrroza, et al., 2008, p 90).

Harper (2010) speculates that one of the acceleration factors driving emerging technologies is the need for uniqueness that sets them apart from all other technologies or ideas. The benefit of diverse technologies available to teachers is that the curriculum can be delivered in a variety of ways.

2.3.1 Modes of curriculum delivery

Modes of curriculum delivery and interactions can range from face-to-face interactions, online or e-learning, m-learning, blended modes or a combination of all of these. Other than face-to-face instruction, each of the above modes of delivery is briefly explained in the following section.

2.3.1.1 E-learning

E-learning is an inclusive term that can comprise all forms of electronic learning. It incorporates individual as well as collaborative, online and offline and synchronous or a-synchronous

interactions. To fully utilise the advantages of e-learning in a subject, the entire structure of the subject needs to be designed and directed carefully. So many tools and technologies are available and therefore the authenticity of a subject can get lost amongst a myriad of gadgets and “nice-to-haves” (Romiszowski, 2004, p. 5-11). A balanced approach, which ensures that the technology is a tool and medium but not the message, should be emphasized (De Villiers, 2005).

In e-learning the conscious decisions of learning theory, principle and strategy is even more important than in face-to-face interactions as the distance between learner and teacher emphasises any shortcomings, weaknesses or limitations. E-learning brings a richness and flexibility to teaching and learning that could not be achieved with traditional strategies only (Callaghan, 2008).

Mobile learning is differentiated from e-learning in its ability to liberate the user from a fixed infrastructure and limited accessibility as characterised by the more traditional modes of curriculum delivery (GSMA, 2010).

2.3.1.2 Mobile learning

Young people in our modern society have access to a wide range of digital devices and little is understood or known about the transfer of skills acquired in informal learning environments to the more formal settings (Cox, 2009). Despite the increase in ownership of mobile enabled devices amongst the youth, many are finding that the skills they are developing informally to manage their own learning is unvalued within the formal school environment (Pearson & Naylor, 2006). Teachers are increasingly challenging this embedded mindset and are capitalizing on the affordances offered by this technology. Educators are forging new ways to extend the inter-relationships between learners, the curriculum and the more personalized learning environments and thereby they are encouraging a move towards more self-regulated learning (Webb, 2009).

Mobile learning means different things to different communities. The Kaleidoscope Mobile Learning Group situated within the Technology Enhanced Learning European Advanced Research Consortium (TELEARC) views mobile learning as:

- learning with portable technologies, where the focus is on the technology (which could be in a fixed location, such as a classroom),
- learning across contexts, where the focus is on the learner's interaction with portable or fixed technology and
- learning in a mobile society, with a focus on how society and its institutions can accommodate and support the learning of an increasingly mobile population.

A generally accepted definition of mobile learning is:

“Any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies” (O'Malley, et al., 2003).

Pachler, Bachmair and Cook (2010) are of the opinion that mobile learning can only be understood against the backdrop of societal and cultural transformations, even when the individual enlists it for his or her own personal learning. Therefore mobile learning cannot just be limited to content delivery only, but is valuable in navigating the components within differing learning environments.

Taking into account the societal and cultural contexts, mobile learning in Africa is seen as a *lifeline* when compared to other more developed societies where mobile technology's value is perceived in terms of its ability to facilitate convenient, personal and mobile connectivity. In Africa, and specifically South Africa, these values are not only experienced in terms of the mobility provided by and through the technology, but it also encompasses the concept of *ability*. The concept of *ability* is seen as the capacity of users to access and contribute to the World Wide Web, to be included in virtual collaboration, to gain access to specialist information and to develop skills needed to function in a technological society. These very skills are becoming paramount in today's world (Botha, Batchelor, Van Der Berg, & Islas Sedano, 2008).

When considering the *learning* aspect of *mobile learning* (mLearning) one needs to distinguish between *general information* being made accessible to users and *content that is educational* and

has been developed to teach the end user a skill or to provide new knowledge. Consequently, learning activities should enable the achievement of stated objectives and learning outcomes as mapped in a content area school curriculum. Although the delivery method will influence the learning format, learning and educational resources should focus on content and not content delivery. The Development Fund has devised a framework for mLearning (Figure 2-2 below) to help categorise the many options in this expansive and complex landscape.

Technology	IVR		MESSAGING		MOBILE WEB		APPLICATIONS	
	VOICE		SMS	USSD	GPRS	BLUETOOTH		WiFi
	LOW END				FEATURE		SMART	
Mode	SYNCHRONOUS				ASYNCHRONOUS			
	FORMAL				INFORMAL			
Learning Area	Foundation Primary Secondary Tertiary		Vocational Certified Self Improvement		Teacher Training Ongoing Education and Support		Languages Practice/Improve Learning New	
							Life Skills Development Education	
							Literacy Numeracy Tech Financial	
							Health Education Patient Education Practitioner Education Support	
Leamer	STUDENT		TEACHER		EMPLOYEE		SELF MOTIVATED	
Method	COMPLEMENTARY In addition or support to other learning activities				INDEPENDENT As a standalone way of accessing educational tools, resources or courses			
Players	ACADEMIC COMMUNITY		CONTENT PROVIDERS		GOVERNMENT ORGANISATIONS		MOBILE NETWORK OPERATORS	
							NON GOVERNMENT ORGANISATIONS	
							TECHNOLOGY VENDORS	

Figure 2-2: mLearning framework (GSMA, 2010)

Because of the complexities facing the developing mobile learning landscape, there is no one-size-fits-all solution. Each context is dependent on a different set of variables and therefore the results between service usage and uptake of offered applications differ greatly. It is however critical, when planning and executing solutions, to take all the levels of the framework into account as this increases the sustainability of the desired solution. This framework also serves to

categorise and find similarities between projects and therefore it can determine a product niche or identify gaps in the market.

When considering mobile technology, the notion that learning can take place at any time and in any place, leads to a much broader conceptualization of the use of computers in education (Voogt & Knezek, 2008a). Six years ago, Wagner (2005, p. 44) encouraged educators to prepare themselves for the use of mobile technology in learning stating that: “Whether we like it or not, whether we are ready or not, mobile learning represents the next step in a long tradition of technology-mediated learning.” As a society we have embraced mobile technology in our personal lives and only now are we ready to take the step towards formalising mobile learning into South African schools (Souter, 2011).

Methods of delivering a curriculum can combine elements from both the mobile and e-learning environments resulting in a mix of learning strategies and methods.

2.3.1.3 Blended teaching and learning

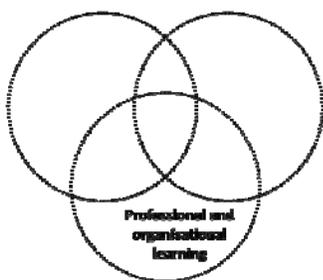
Blended teaching is not restricted to simply supplementing classroom teaching with ICT tools but also to extend the boundaries of face-to-face instruction scenarios with on-line synchronous and asynchronous instances and instructional resources. This approach increases the flexibility of teaching and learning in a variety of scenarios and with multiple delivery methods. Thorne (2003 p, 17) states that “blended learning should be the ultimate perfect solution to tailoring learning to fit not only the learning need, but also the style of the learner”. The success of blended learning is mainly dependent on matching the delivery methods with the planned learning events and thereby maximising learning opportunities (Valdez, 2001). Collins & Van Der Wende (2002, p. 7) found that ICT has firmly been established as part of a blend, “gradually stretching the traditional ways of teaching and learning” and Allen & Seaman (2003) relate that the majority of academic leaders in institutions of higher learning are already under the impression that the learning outcomes for online education are on par, or even exceed, those of face-to-face instruction. Garrison and Vaughan (2008) report that learners are embracing the flexibility and relevance of blended learning educational experiences and environments.

Currently the International Journal of Mobile and Blended Learning (IJMBL) provides a forum for researchers in this field where they can share their knowledge and experience of combining e-learning and mLearning with other educational resources. The potential of blended learning is vast and can accommodate not only individual learning styles but also allows for experiential learning which can be highly individualised, depending on personal needs.

2.3.2 Summary of technosphere: Emerging technologies

This section looked at the characteristics of emerging technologies and the current modes of curriculum delivery in educational institutions ranging from e-learning, mobile learning and blended learning scenarios. The ecosphere section will cover teaching and learning theory and how they are influenced to keep pace with technological developments.

2.4 THE ECOSPHERE: PROFESSIONAL AND ORGANISATIONAL LEARNING



The aim of this section is to cover *teaching and learning theory* to provide an update to current contexts against which one can consider the use of emerging technology to change and amend pedagogical practices. School organisational structures cannot remain unaffected when innovative teachers as staff members employ emerging technologies in their teaching and learning practice. In-service training of teachers through formal and informal continuous professional development creates opportunities for the diffusion of practices and a level of skills transfer.

Pedagogy refers to instructional matters, strategies and methodologies associated with teaching and learning. Fraser, Loubser and Van Rooy (1990) consider teaching to be an intentional and reasoned act which takes place across differing contexts. They further state that at the core of teaching is the desire to enhance the success of learning. In turn, Anderson and Krathwohl (2001) view learning as a universal, life-long activity during which individuals change their behaviour to adapt to their environment. The learning activity is greatly improved if the learner is focused on benefiting from the teaching process. Biggs (2002) put forward the notion that teaching and learning should not be limited to the classroom environment, but should integrate

all aspects of teaching to support higher level learning. More recently Lai (2008) states that the teaching and learning environment, that is comprised of people (teachers and learners), technology, materials, classroom layout (or the virtual classroom) and the environment, is central to the pedagogy.

The following section explores how teaching and learning theory has developed over time to accommodate different educational approaches to learning. Teaching and learning theories are grouped into broad categories: behaviourism, cognitivism, constructivism and social constructivism. Each of these approaches to learning is briefly described as well as how they influence the choice of technology solution in relation to learning.

2.4.1 A chronological view of teaching and learning theories

Behaviourists, such as Skinner and Tennant, assumed that behaviour was shaped and moulded according to measured and objective standards. Immediate feedback, which reinforced positive responses by giving a reward or dissuaded negative stimulus by meeting out punishment, was employed to reinforce a correct response (Dabbagh, 2006). Facts, concepts and theories had to be learnt and learners had to be able to demonstrate acquired procedural skills. Knowledge and skills were transferred as learned behaviours, relying on extrinsic motivation in the mastering of the required skill set. Earlier computer-assisted-instruction (CIA) capitalised on this learning pattern and was used by teachers to reinforce learning, keep track of performances and provide feedback to those involved in the process (Dede, 2008). Factual knowledge was emphasised in these programs by repetitive drill-and-practice exercises. Used today, this form of computer-assisted-instruction, will most likely be found lacking as a technique in the current curriculum.

Cognitive theorists, amongst them Piaget, Hutchins and Wenger, advocate an approach which focuses on *internal cognitive growth* with the pedagogical focus being the *transmission of information* (Conole, et al., 2004). Today the power of ICT is harnessed to create learning connected opportunities which are rich in resources, where knowledge is shared and cognition distributed.

The Constructivist theory is based on the assumption that the learner will self-instruct according to his level of awareness and mastery. This theory is further based on the supposition that learners discover skills through experimentation and practice. Earlier learning theories mainly focused on the progress of individual learning and the acquisition of cognitive skills whilst neglecting the social dimension (Chan & van Aalst, 2008).

During constructivist learning activities teachers are encouraged to act as *guides* and learners as *sense makers*. The role of the teacher must be altered from *authoritative* to *collaborative*. Different components of constructivism can be emphasised and a parallel can be drawn between the radical and social aspects of this theory. Von Glaserfeld (1996), supported by Dabbagh (2006), stipulates the underpinnings of both aspects as follows:

- knowledge as a whole, not only the learner's subjective knowledge, is deliberated;
- methodological approaches are required to be more reflexive;
- the focus of the learner concern is broadened to include cognition, beliefs and conceptions of knowledge;
- the focus of teacher concerns includes diagnostic skills, beliefs and personal theories;
- others have realities independent of our own and these realities cannot be accepted as being fixed and
- an awareness of the social construction of knowledge.

Alessi and Trollip (2001) direct designers of constructivist learning events to create educational environments that enable the construction of knowledge. They suggest ways of accomplishing this goal and emphasize the *actions* and *thinking* of learners in the process of *active learning*. They advocate the use of discovery or guided approaches to learning which in turn are anchored in the real world, thereby drawing on authentic learning environments.

The social constructivist theory relies heavily on the collaborative nature of learning, encouraging co-operation amongst learners often resulting in many group work activities.

Variables impacting on the effectiveness of the group include size, dynamics, gender, cultures, language skills and levels of competence in the set task. During a collaborative learning event each individual member of the group has the opportunity to add value to the final product (Panitz, 1997). The collaborative approach has a lot to offer due to its rich history of theory, research and use within the classroom. Collaboration maximizes learning, which in turn ensures healthy cognitive and social development, amongst other many other important instructional outcomes (Johnson & Johnson, 2000).

In short, *behaviourists* believe that learning can only be measured in altered behaviour whereas *cognitivists* believe that learning occurs when learners add new concepts and ideas to their cognitive structure. In contrast, constructivists hold forth that learners individually construct knowledge for themselves. All three learning theories have significant implications when designing learning events and activities (Reddi & Mishra, 2003).

In Table 2-1 below, Christensen (2001, p. 4) gives a comparative summary between major learning perspectives by looking at motivational and instructional strategies and labelling the role of learner as performer, processor, explorer or collaborator. She neglects to state how she perceives the role of the *teacher* but does refer to the role of *instruction*. This comparison does not take into account the changing role of the teacher as *instruction* is a *performed action* whilst a *teacher* is in essence a *facilitator*.

Table 2-1: Major Learning Theory Perspectives (Christensen, 2001, p. 4)

	BEHAVIOURISM	CONSTRUCTIVISM	
		COGNITIVE	SOCIAL
MAIN METAPHOR	The Black Box - focuses on inputs and outputs (behaviours); and not worried about what is happening inside	The Rhizome – focuses on root-like (unlimited) growth and development through interaction with environment and/or others	
NATURE OF KNOWLEDGE	Knowledge is “out there” and needs to be acquired and used	Knowledge is individually “constructed” through interaction with environment and others	Knowledge is “co-constructed” through interaction with others
ROLE OF LEARNER	Performer—acquires and demonstrates use of knowledge	Explorer—interacts with environment and others to make individual discoveries	Collaborator—creates meaning through social negotiation, interaction and cooperation

		CONSTRUCTIVISM	
ROLE OF INSTRUCTION	To transmit knowledge by managing and supervising the learning environment	To provide experiences and resources so students gain personal understanding	To provide meaningful social contexts for co-constructing knowledge
MAIN INSTRUCTIONAL STRATEGIES	<ul style="list-style-type: none"> • Present knowledge • Define actions • Correct mistakes 	<ul style="list-style-type: none"> • Create puzzlement • Provide opportunities to experiment and articulate ideas 	<ul style="list-style-type: none"> • Create social learning environment • Provide opportunities to interact and articulate thinking
MAIN MOTIVATIONAL STRATEGIES	Provide positive (or negative) reinforcement	Stimulate interest or curiosity in an anomaly	Create authentic, inherently challenging situations

These are not *unified theories* but rather *a collection of theories* that are distinct from one another, but associated by a common set of fundamental assumptions (Dede, 2008). Today all learning theories propose that learning involves mental processes but they differ on how best to encourage these processes and in how to evaluate them effectively. Both behaviourism and constructivism offer definite ideas of how instruction or rather scaffolding of learning should occur and agree that existing knowledge should be used as a foundation from which to advance constructs. New knowledge is evaluated in a concrete way to assess whether learning has taken place. All learning implies that *information* has been transformed into *knowledge*. This transformation takes place according to an absolutely individual process which is based on the learner's foreknowledge, experience and cognitive potential (Lauridsen, 2009).

2.4.2 Principles of learning

In a recent study Callaghan (2008) researched teaching principles which contribute to the success of learning. She selected four well documented sources and compiled a list of the ten most common teaching principles. These sources cover the fields of Higher Education, Primary and Secondary Education and online instruction with regards to distance education. Table 2-2 below presents the ten teaching principles researched and then re-applied to different educational

settings (including online teaching and learning, computer-assisted teaching and learning, teaching and learning in various subject fields).

Table 2-2: Teaching Principles Summary and Descriptions (Callaghan, 2008 p. 93)

PRINCIPLE	DESCRIPTION
Activity	The learner should be actively involved in the learning process.
Motivation	This includes extrinsic as well as intrinsic motivation, intellectual excitement and the demand for quality.
Socialisation	Learner-learner contact and the social context.
Diversity	Recognising and incorporating learner differences in the learning process.
Contact	This entails learner/facilitator/management contact and learner support.
Control	The monitoring of the learning process as well as assessment and feedback.
Planning	Well organised learning processes and material.
Perception	Linking learning material to previous experiences and to real life applications.
Totality	Presenting a holistic picture of integrated learning content. Help students to <i>organise their knowledge</i> .
Science	Subject matter built on existing knowledge of the topic and presented based on sound teaching and learning practices.

Untangling the principles of teaching that contribute to the success of learning becomes more complex when one harnesses the emerging technologies in teaching and learning. A significant contribution to this area of interest is the study conducted by Kerns, Elhoua, Sterling, Grant, McGowan, Rubash, Neelly and Wolfe (2005). They found that all the principles mentioned in Table 2-2 above, can be amplified with the use of appropriate technology that aligns the teaching and learning activities and relevant assessment tasks which gauges the learner's processes of meaning construction.

Contemporary beliefs regarding learning have moved away from knowledge transmission models which advocate the mere imparting of information to generative knowledge models where knowledge is negotiated between parties and transformed learning occurs (Chan & van Aalst, 2008). In the process of meaning-making, technology is roped in to support the communication and co-construction of new knowledge resulting in new communities of practice (Lave & Wenger, 1991).

Meaningful social contexts for co-constructing knowledge within social learning environments provide opportunities to interact and articulate thinking. Technology offers the means to access and interact within these social environments. Knowledge is co-constructed in collaboration with other people during a process of social negotiation, interaction and cooperation which creates a shared understanding. The main motivational strategies employed are the stimulation of interest and curiosity and the creation of authentic, inherently challenging situations which give rise to transformative learning.

Technology, due to its inherent characteristics, has the ability to represent content, engage with learners, model skills and assess a learner's progress, this all resulting in more effective and quality learning. A particular technology can provide affordances that concurrently influence the content, the pedagogy and/or the assessment of a curriculum (Dede, 2008; Voogt & Knezek, 2008a). These theories of learning inform the goals and models associated with instruction, which in turn influence perspectives on the use of technology in teaching and learning (Dabbagh, 2006; Dede, 2008). To better understand how far we have progressed in integrating technology into our learning and where we are headed, we need to reflect on where it all started.

2.4.3 ICT in Education. Where did it all start?

When the computer was first used in the classroom, it was viewed as a type of assistant taking over some of the teacher's tasks. With the convergence of various technological systems such as satellites, video and audio and advances in computer hardware and software, a powerful new medium was created with capabilities to transform teaching and learning. Electronic learning materials could be accessed and delivered through the internet, CD-ROMS or the television giving rise to the term e-learning (Voogt & Knezek, 2008a). *Elearning* was initially more suited to the field of *distance learning*, as materials could be easily distributed through the post or the internet but had limited uses in classrooms.

In the early 1990's the learner computer ratio was still very low in the school environment and access to computers was limited to dedicated computer rooms. Consequently it was very difficult for teachers to integrate electronic media and instruction into the curriculum. Increased

ICT penetration rates in schools, as a direct result of more affordable hardware and software, as well as better training opportunities for teachers affected change on a larger scale (Souter, 2011).

Today the software and hardware used *in* class directly reflects the tools used daily in the world *outside* the school environment. The technologies, as illustrated in Figure 2-3 below, depict a wide spectrum of ICT devices and their functions which can be used for capturing, interpreting, storing and transmitting information.

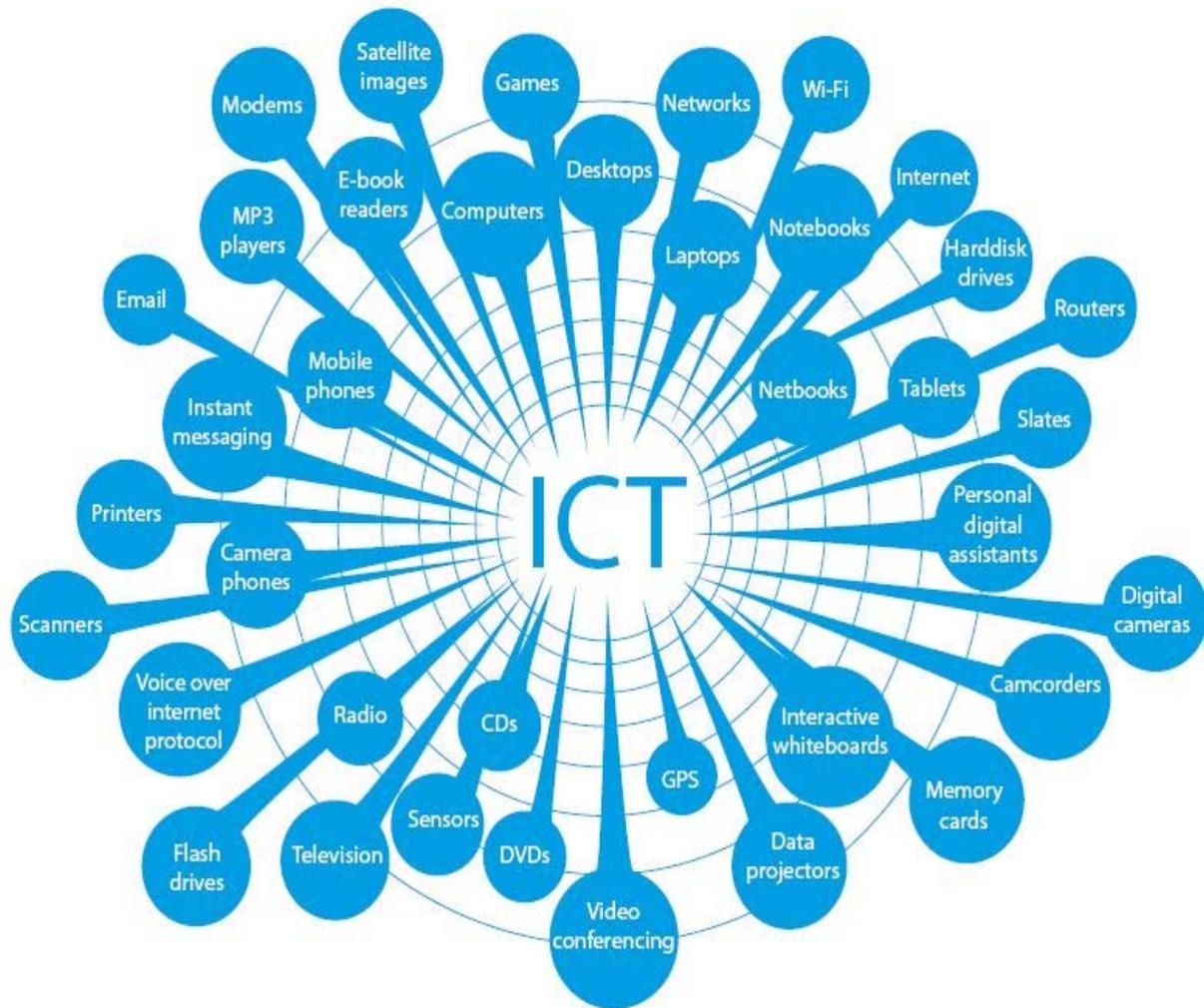


Figure 2-3: ICT spectrum (Anderson, 2010, p 13)

Teachers found the improved instructional design of materials, which better accommodated different learning styles, resulted in greater learning benefits for the end users as individualised

instruction was possible. The rich interactive multimedia materials, which utilised more than one media simultaneously, stimulated interest in learning and held the attention of the learners for a longer period of time. Assessment and immediate personalised feedback resulted in self-paced and self-directed learning (Anderson, 2008) which allowed the user control over the *when*, *what* and *how* elements. Learners could thus dictate their learning journey, resulting in a greater uptake of the learning aids (Reddi & Mishra, 2003).

Over the last few decades, information technology has become more mobile, personal and connected (Traxler, 2009). Daily inventions of new technologies provide a major challenge to implementing educational strategies and have the potential to change our concept of education as it is no longer limited to one physical environment (Anderson, 2008; Kukulska-Hulme, Sharples, Milrad, Arnedillo-Sánchez, & Vavoula, 2009; Voogt & Knezek, 2008b). It is therefore imperative to explore the affordances offered by these new technologies in order to understand the potential and implications for teaching and learning and how these affordances impact upon the continuing professional development of teachers. As a result of this ever-changing technology, new literacies which include and elucidate upon perceptions and understandings linked to new modes of presentation and representations are changing the emphasis and the balance in terms of the production, content and meaning of educational resources. This shifting landscape is often not understood by teachers and researchers (Cox, 2009).

Recently, Beetham and Sharpe, in the introduction to their jointly edited *Rethinking Pedagogy for a Digital Age*, proposed that bridges need to be built between technology and the transformation of education through “a reconsideration of the pedagogical practices that underpin education” (Beetham & Sharpe, 2007, p. 1). Even in 2007, such bridges were still envisioned as a future occurrence and not as a *fait accompli*.

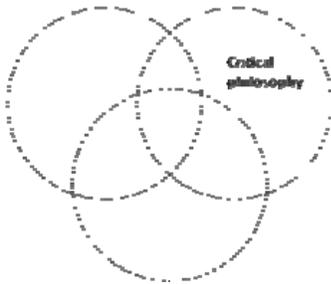
2.4.4 Summary of ecosphere: Professional and organisational learning

This section provided a chronological view of how the teaching and learning theories developed and covered the main tenets for each. This process resulted in the formulation of a table of comparison between the major theories of *behaviourisms* and *constructivism*. Ten principles of learning that contribute to the success of learning aligning activities and assessments were

presented. The integration of ICT in the classroom was covered and the development of new literacies, due to the pressure that emerging technologies exert on teaching and learning theory, was highlighted.

The next section will look at the remaining sociosphere and the role of critical philosophy in addressing the tacit knowledge of innovative teachers in their communities and society as a whole.

2.5 SOCIOSPHERE: CRITICAL PHILOSOPHY



The role of critical philosophy in this study is to understand the complex character of technology within a social setting such as a school environment. Friessen (2008) finds that critical theory remains largely unrecognised and underutilised in areas of practical research on the use of ICTs in educational institutions. Critical theory questions the established power relations within social settings, recognises the true interests of advantaged groups and privileged individuals but actively promotes the empowering of the restricted members of a society (McLaren, 1998). Critical theory is not meant to only highlight the negative but it can also be used to reveal positive and hopeful aspects of life and therefore it is imperative to take the innovative teachers' position in their communities into account when considering any aspect of technology use in education. Critical philosophy thus considers the cultural-historical context of innovative teachers for it takes into account issues of empowerment captured within pedagogy. It is in this cultural-historical context that critical pedagogy raises the consciousness and questions the value of *educational theory* over the value of *educational practice*.

2.5.1 Cultural-historical context

The expansion of the expert knowledge base is central to the concept of empowerment with Henry Giroux, a leading figure in the field of critical pedagogy who currently holds the Global Television Network Chair in English and Communications, remaining steadfast in the belief that *knowledge must be shared through education and other technologies of culture*. He maintains that shifting historical contexts challenge dominant teaching practices and that there is a more pronounced global pessimism today. He further challenges teachers to become engaged intellectuals who actively linking pedagogy to social change (Giroux, 2003). The cultural-historical context is echoed in studies by Paulo Freire who holds forth that symbolic meanings have particular power and relevance today and the illumination of these has to be an act of

“historical un-forgetting” (MacLaren, 2000, p.16). Freire’s viewpoint reinforces our own belief that our knowledge about education is particularly bound to context (Carr & Kemmis, 1986). The learning curriculum needs to reflect societal changes and then only can it be successful in assisting in the transformation of the workplace and facilitating the rise of new occupational areas and the decay of others.

The manifestations of educational technology in the social learning domaine can reveal dependencies on culture, history and embedded power relationships (Nichols & Allen-Brown, 1996). The hidden effects of teaching and learning can be uncovered by objectively searching for clues to unlock the mystery surrounding the infatuation with new technology and its use in educational settings and the development of teachers’ tacit knowledge that encapsulate their inherent personal belief systems (Brown, 2009).

The concept of *tacit knowledge* can be liberating as knowledge workers become empowered but it can also easily become a thinly disguised veil for the abuse of power. Bordum (1999) calls for *tacit knowledge* to be *made explicit* as the notion of non-communicable knowledge can pose a threat to rationality. If tacit knowledge remains encoded and inaccessible, it can lead to the abuse of power where knowledge is purposefully withheld in order to manipulate others. However, once open and accessible to all, knowledge can result in the growth of other individuals within an organisation.

Anderson (2008) points out the implications for education, when attempting to harness technology in the knowledge era, requires a deeper understanding of the tools and their contexts. These contexts stretch well beyond the limits of the educational milieu to include the social contexts as well. Therefore the need to understand the underlying influences within the overall system is an essential tenet to the concept of the information society.

2.5.2 The information society

It is a widely recognised fact that our society is changing from *an industrial* to *an information* society (Voogt & Pelgrum, 2005). This shift necessitates the development of skills to sift, manage, process and disseminate large amounts of information with the use of ICT. In an effort

to classify the key skills needed to encourage the capacity of “learning to learn” Voogt and Pelgrum (2005) indicate the desire of education to journey this transition. They show the pedagogical approaches in the industrial and information societies by using the words *less* and *more* to indicate this shift. Table 2-3 below provides an overview of the differences in educational approaches as manifested in the industrial and the information society.

Table 2-3: Overview of pedagogy in the industrial versus the information society (Voogt and Pelgrum, 2005, p. 158)

ASPECT	LESS (Pedagogy in an industrial society)	MORE (Pedagogy in the information society)
Active	Activities prescribed by teacher Whole class instruction Little variation in activities Pace determined by the program	Activities determined by learner Small groups Many different activities Pace determined by individual
Collaborative	Individual Homogeneous groups Everyone for self	Team work Heterogeneous groups Support each other
Creative	Reproductive learning Apply known solutions to problems	Productive learning Find new and innovative solutions to problems
Integrative	No link between theory and practise Separate subjects Discipline based Individual teachers	Integrative theory and practice Relation between subjects Thematic Teams of teachers
Evaluative	Teacher directed Summative	Student directed Diagnostic/ Formative

ICT can be implemented to facilitate the demands and competencies as identified in Table 2-3 above. It is therefore essential to incorporate these said elements into learning environments if one wishes to foster the development of the listed competencies. The Horizon report (*The Horizon Report, 2006*) states that skills essential to critical thinking, research and evaluation of content and to cultivate creative demonstration of mastery or knowledge, need to be developed. These particular skills are reportedly underdeveloped in many students. In the pedagogical environment *group work* is on the increase and this specific teaching method asks that pupils be able to find, navigate and assess relevant information from the array of resources available both on- and offline. As these *crucial skills* are acquired and honed, the entry barrier into the e-World

slowly diminishes and this, in turn, creates more opportunities for learners. The process of knowledge acquisition, sharing and reflecting is continuous and life-long for every human being (Garai & Shadrach, 2006, p.13).

Pinter (2008) discerns three closely interrelated approaches to the information society as presented in Table 2-4 below. These approaches differ in three aspects namely: timeframes, advocates and the content.

Table 2-4: Three approaches to the information society

DEFINITION	ONSET	ADVOCATES	CONTENT
Theoretical (descriptive, exact)	After World War II, up to and including the sixties and seventies	Theoreticians, social scientists, researchers	Technology Employment structure Economy Spatio-temporal structure Cultural values and norms
Political (promotional Program-like)	From the nineties of the 20 th century forward	Politicians, technocrats, entrepreneurs and expert advisors to business and governments	Political program "Revolution from above" Modernization as the main objective Those lagging behind shall drop out
Everyday prosaic (amorphous, utopian)	Not before 2010 or 2020 forward	Mainstream media, participants of utopian controversies, sci-fi movies	Ubiquitous and total information and communication technologies

When investigating the phenomenon of innovative teachers it is therefore necessary to not only include the visible aspects of technology integration but also to expose the underlying social relations and the political agendas, especially towards development.

For the purpose of this study the concept of *information society* needs to integrate all three approaches; theoretical, political and the everyday prosaic. Technology plays a central role in the information society along with the concepts of a *networked society* and a *network economy*. The use of technologies also results in new types of communities; of continuous adaptation to the ever-changing environment; of new kinds of inequality; and globalisation. The political agenda promotes the narrative for development as is demonstrated in the following extract from a recent presentation articulating the South African Vision for ICT in 2015:

“South-Africa is an inclusive information society where ICT-based innovation flourishes. Entrepreneurs from historically disadvantaged population groups, rural communities and the knowledge-intensive industry benefit and contribute to the well-being and quality of life of our citizens. South-Africa has a strong national ICT brand that captures the vibrancy of an industry and research community striving for excellence, characterised by innovative approaches to local and global challenges, and recognised for its contribution to the economic growth and well-being of our people and the region” (Maredi & Neethling, 2010, p. 12).

To accommodate the above vision the following strategic objectives were set:

- Strengthen research activities at Higher Education Institutions and Research and Development institutions to create recognised world-class research competencies in the country.
- Create strong and robust innovation chain which results in increased ICT patenting, improvements in digital divide indicators and a vibrant hi-tech ICT Small Medium and Micro Enterprise (SMME) industry and
- advance human resource capacity to achieve a marked increase in the ICT skills base thereby enabling focused research and innovation.

It is towards these strategic objectives that it becomes imperative to not only look at what is happening in the classroom with the technology, but to also consider the wider social contexts of the teacher that influences the progress and the type of research required in this field.

“The key phenomena might be the visible diffusion of information and communication technologies, the continuing fundamental socio-economic transformations, the political programs for development, or, finally, the results of scientific research being carried out in this field” Pinter (2008, p. 222).

2.5.3 Summary of sociosphere: critical philosophy

This section looked at the role which critical philosophy plays in exposing the undercurrents of power that drive development agendas. In this regard cultural-historical contexts challenge dominant teaching practices and emphasise the importance of articulating tacit knowledge to avoid the potential unequal positions of power in the education space. The move from an *industrial* to an *information* society has resulted in the networked and connected members of that society sharing in the advancement of and the burden for skills development placed on the education system.

This chapter made use of a conceptual framework for literature review to examine the background of teaching and learning theory and the use of emerging technologies in schools in relation to new innovative pedagogical practices designed to engage both teachers and their learners in the process.

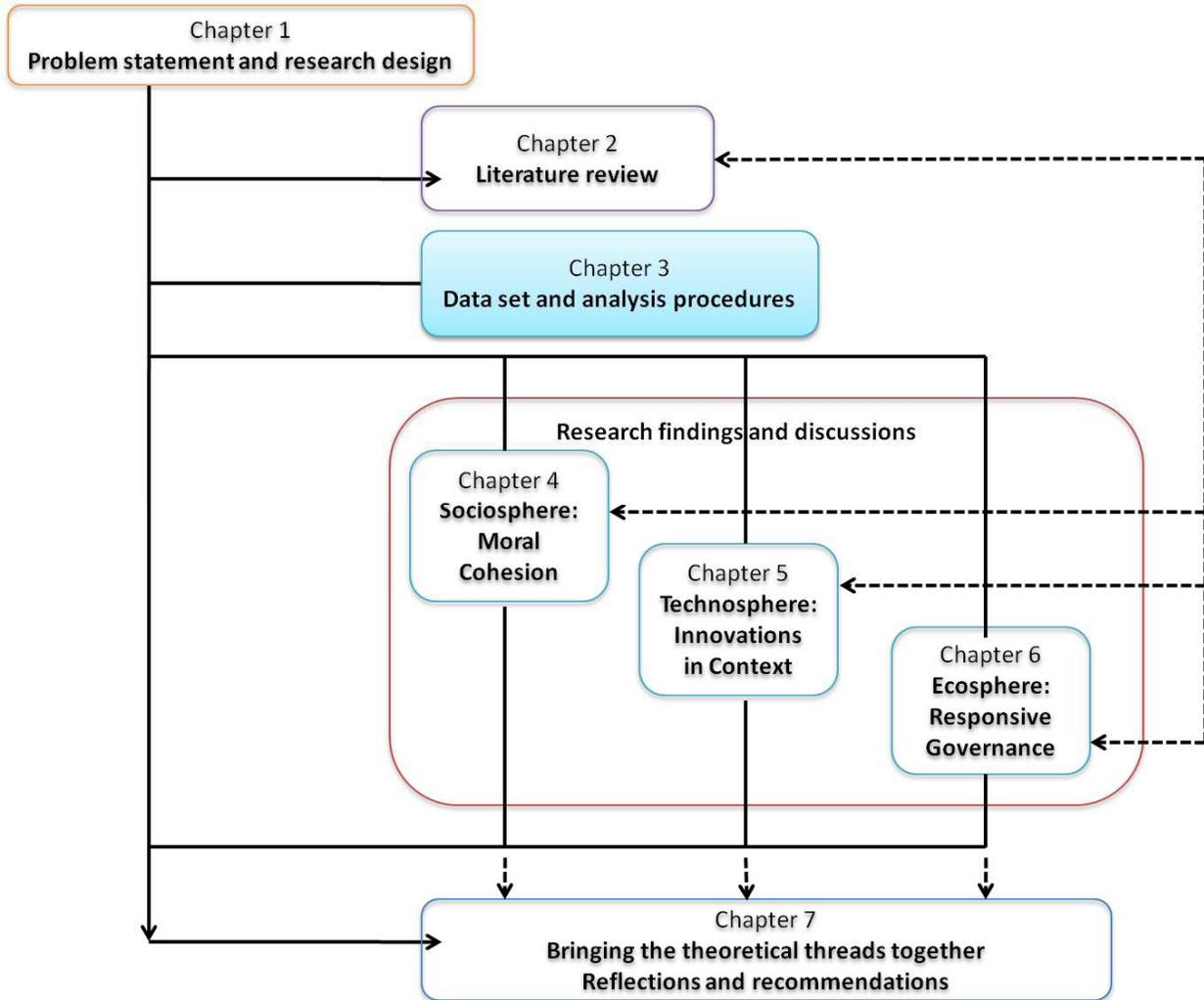
The three areas considered for review were derived from Gartner's *Interfaces of Adam*. They were the techno-, eco- and sociosphere (Zandvliet & Buker, 2003). The *technosphere* takes into account the affordances potentially offered by emerging technologies. The *ecosphere* demarcates the learning milieu and the ways in which technology is appropriated within the learning context. The *sociosphere* encircles the area of critical philosophy, informing the discourse that guides decisions and actions within the school education system. A brief overview of the literature review is provided in Table 2-5 below.

Table 2-5: Overview of literature review

Gartner's Interfaces of Adam	Area of research	Focus of literature review
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Technosphere	Emerging technologies	<u>Characteristics of emerging technologies:</u> Expanding new learning opportunities (learn anywhere anytime); Creating new learning scenarios in traditional contexts (tools for learners focused on improving learning in schools) and Improving teaching and learning process (tools for teacher focused on improving teachers' classroom teaching (Hinostroza, et al., 2008, p 90). <u>Modes of curriculum delivery</u> E-learning Mobile learning Blended learning
Ecosphere	Organisational learning	Presented a chronological view of teaching and learning theory Principles of learning ICT integration in education
Sociosphere	Critical philosophy	Cultural-historical context Information society Vision for ICT in South Africa

Chapter 3 presents the data set and the background information to the Microsoft Innovative Teacher Forum from which the research participants were sourced. The researcher explains the application of the *Straussian Grounded Theory Method* with its limitations and describes the qualitative instruments that were used to gather data. Finally, data analysis strategies are shared and consideration is given to the emerging themes for this study.



CHAPTER 3. DATA SET AND ANALYSIS PROCEDURES

“This is a time of transitions both for technology and pedagogy. Our role as researchers is to accompany these exciting processes, shed light on the factors for success and failure and recognize evolving trends, and help devise new and improved pedagogically sound practices using ICT.”

Mioduser, Nachmias, Tubin and Forkosh-Baruch (2002a)

3.1 INTRODUCTION

In the previous chapter a literature review, within a conceptual framework that covered areas of emerging technologies and that which they have to offer the innovative teacher in their pursuit of pedagogical efficacy, was undertaken. Other areas considered, pertinent to tacit knowledge creation, was teaching and learning theories as well as aspects of critical philosophy. The contextual framework was formulated whilst taking into account the demands of the information society.

This chapter presents the decisions pertaining to data collection and analysis made by the researcher and the subsequent direction and various stages of the research study. Even though the research design was mapped out prior to engaging in the research, as explained in Chapter 1, it did not remain rigid but responded to the various demands encountered in the field. The research design evolved and developed over time in response to the demands of the research context. Strauss and Corbin (1990) ascribe the reflexivity in research design to the notions of *theoretical sensitivity* and *theoretical sampling* as anticipated in a Grounded Theory study. Pragmatic decisions and actions follow a natural path as greater understanding is reached in both the methodology and the research problem. The subsequent collection of data was guided by the emergence of codes and related categories.

3.2 WHY GROUNDED THEORY?

The researcher's initial interest in Grounded Theory was sparked during a research support session regarding qualitative research. The topic discussed was that of different research designs and in an attempt to involve everyone, attending candidates were divided into groups and each was assigned a particular design. The researcher's group was assigned Grounded Theory and our task was to study examples and prepare a presentation as feedback to the cohort. Up to that point the researcher had had a very vague understanding of Grounded Theory but was immediately attracted to the research method's ability to generate theory. It became an intellectual challenge to wade through the rich Grounded Theory history featuring Glaser, Strauss and later Corbin and Charmaz who were all involved in crafting variations of the method which allowed it to evolve in order to incorporate wider areas of interest.

The complexity of the method soon became apparent and this added an extra dimension to the research in that it was not only about *studying a phenomenon* but also about *mastering the design as a methodology*. Personal learning was challenged on two fronts. On the one hand the researcher was theorising about the research problem in an effort to answer the research question and build a substantive theory and on the other hand it was a case of trial and error. The researcher remained engaged in the Grounded Theory methodology in a continuous effort to advance.

It became evident that this methodology had been widely applied in other areas such as health science and the information sciences but its use had been under-reported in the educational domain. The researcher started to actively seek publications which detailed the process and level of abstractions, specifically in relation to educational settings. There appeared to be space for the application of the Grounded Theory method in education settings. The opportunity to address this gap presented itself and the researcher elected to contribute to the understanding of not only the *research problem* but also the *methodology*.

3.2.1 Learning by doing Grounded Theory

Because of still existing methodological ambiguities between the different forms of Grounded Theory, researchers experience a period of confusion and anxiety before entering the field for the first time (Buckley & Waring, 2005; Luckerhoff & Guillemette, 2011). Heath and Cowley (2004) suggest that the novice researcher should set aside anxieties about whether they are *doing it right* and adhere to the central principles of Grounded Theory such as constant comparison and theoretical sampling to discover which approach best suits their cognitive style. The purpose of Grounded Theory, they argue, is not to discover theories but rather *a* theory that aids understanding in the area being investigated.

The process begins with the raising of generative questions that help guide the research. These questions do not remain static and frequently change as the research progresses and analysis and interpretation of data unfold (Ng & Hase, 2008). Data analysis begins early in the process with the researcher deciding upon and clarifying data classification categories. Subsequent data collection is aimed at learning as much as possible about the emerging categories and to uncover any disconfirming evidence in the process. Additional concepts revealed through further analysis lead to revisions in the categories or the relationships amongst them. Moving back and forth between *data collection* and *data analysis* may highlight areas for further exploration and possible new directions in data gathering. This is sometimes called the *constant comparative method* (Leedy & Ormrod, 2005, p. 141).

Eventually abstraction will result in a conceptually dense theory as each new observation leads to new linkages which, in turn, lead to revisions in the theory and more data collection. The resultant emerging theory is not in any way abstract but is rooted in the data. Conceptualisation can continue indefinitely (Huehls, 2005) and the researcher is at liberty to stop when s/he wishes. Arguments for discontinuing the study need to be articulated clearly in order to increase the thoroughness of the research. A *systematic procedure* for inducing theory is followed and this results in a *substantive theory* which has been derived from a *substantive or empirical area of social enquiry* (Ng & Hase, 2008, p. 155). Formal theory, on the other hand, grapples with

theory which are developed to deal with areas of inquiry that operate at high levels of generality, such as systems theory (Burden & Roodt, 2007).

Initially, as the researcher begins to gather data, core theoretical concept(s) are identified. These concepts are used to create tentative linkages to the data. This is usually a lengthy process where the researcher immerses him/herself in the data to establish categories that will mature and develop into *core categories*. The process of verification commences with the resultant confirmation and summary of the results.

3.2.2 Limitations of Grounded Theory

Grounded Theory is not without limitations and Flick (2006, p. 306) highlights the following difficulties in utilising Grounded Theory as research method:

- Blurred lines between art and method.
- Potential endlessness of options for coding and comparisons.
- Unclear criteria for theoretical saturation.
- Uncertainty as to which codes should be further elaborated upon, which codes seem less instructive and which codes could be omitted with respect to the research question.

The concerns listed above are valid and can only be addressed by thoroughly documenting the data collection and analysis process and by making decisions which guide actions clearly through the course of the study. Chapter 4 is devoted to *providing the reasons* for the direction taken and to *clarify procedures* as considered during the critical phases of this study.

3.2.3 Which one to choose?

In general, a Grounded Theory study focuses on a process related to a particular topic, with the ultimate goal of developing a theory about that process. The approach has its roots in sociology but in recent years it has been applied to diverse topics ranging from nursing, anthropology, education and social work (Leedy & Ormrod, 2005).

The first approach, which is clearly inappropriate to this study and which can therefore be dismissed, is the *constructivist approach* as articulated by Charmaz (1990, 1994, 2006). Here the emphasis is on the individual's experience and the researcher becomes co-opted into telling its story. Charmaz advocates a writing style that is more literary than scientific in intent and functions as a developing narrative which is rich in detailed descriptions. This process of *narration* is viewed as much more meaningful than the breaking down, restructuring and conceptualising of data as is the case in this research. The remaining methods which can be considered are Glaser's *classic approach* and, in contrast, the more *controlled method* of Strauss and Corbin.

There is an enticing simplicity to the central theme of Glaser's approach which is the constant comparative method: "categories emerge upon comparison and properties emerge upon more comparison. And that's all there is to it" (Glaser, 1992, p. 43). However, for the novice researcher in Grounded Theory, this lack of procedural guidance can be very daunting. A possible advantage of the Strauss and Corbin approach, lies in its more structured and practically oriented approach which assists the researcher in making sense of large volumes of qualitative data. However, whilst their procedural advice is more specific than previously articulated versions of Glaser and Strauss, the researcher following their general approach still has flexibility in choice of method and data interpretation.

Buckley and Waring (2005) deem both Glaser's and Strauss and Corbin's approaches to be intricate and believe they can only be mastered with mentoring from experienced researchers. Stern believes that this way of thinking cannot be learnt from a book: "It may be possible to learn brain surgery from a book, but it is far from usual. And brain surgery is easier!" (Stern, 1994, p. 219)

Moreover, it could be argued that if a researcher is to make an informed choice about the correct methodology which suits his/her field of research and view on the nature of reality, then an understanding of the complexities surrounding the Strauss/Glaser debate is essential. Goulding (2002) argues that any attempt to pick and mix from the two approaches identified by Glaser,

and Strauss and Corbin would be inappropriate as there are differences in terminology and procedures.

In Table 3-1 below, Onions (2006) provides a tool to help guide researchers when selecting between the Glaserian and Straussian approaches in their own studies. This table presents the Glaserian and Straussian perspectives as well as the perspective followed in this research.

Table 3-1: Key differences in Grounded Theory Method approaches (Onions, 2006, p. 3)

'GLASERIAN'	'STRAUSSIAN'	THIS STUDY
Beginning with general wonderment (an empty mind).	Having a general choice of where to begin.	The researcher decided the point of departure for this study would be the innovative teachers' tacit knowledge as this particular field of research was found interesting and the phenomena engaging, prior to the study.
Emerging theory with neutral questions	Forcing the theory with structured questions.	The sub questions emerged naturally from the data within the conceptual framework as determined prior to the study however, the main research question is articulated before engaging with any data.
Development of a conceptual theory.	Conceptual description (description of situations).	Emerging theory rests on the coding and clustering of related concepts in the attempt to develop themes reflecting the patterns found in data.
Theoretical sensitivity (the ability to perceive variables and relationships) comes from immersion in the data.	Theoretical sensitivity comes from methods and tools.	Theoretical sensitivity comes from being a participant as well as researcher and data were analysed using structured methods and tools.
The theory is grounded in the data.	The theory is interpreted by an observer.	Practice is interpreted by the researcher but also by the participants during the theoretical sampling.
The credibility of the theory, or verification, is derived from the grounding in the data.	The credibility of the theory can be ascribed to the rigorousness of the method.	Credibility of the theory comes from the rigorousness of the method, the data trail and the triangulation of the sources.
A basic social process should be identified.	The basic social processes need not be identified.	The basic social processes within the study are not identified for the main focus is on investigating the phenomenon.
The researcher is passive, exhibiting disciplined constraint.	The researcher is active.	The role of the researcher evolves with time and change from participant to participant-researcher.
Data reveals the theory.	Data were structured to reveal the theory.	Data were fractured, and reconceptualised into a new structure according to themes.

'GLASERIAN'	'STRAUSSIAN'	THIS STUDY
Coding is less rigorous, a constant comparison of incident to incident, with neutral questions and categories and properties evolving. Care is taken not to 'over-conceptualise' and identify key points.	Coding is more rigorous and defined by technique. The nature of making comparisons varies along with the coding technique. Labels are carefully crafted at the time. Codes are derived from micro-analysis which consists of analysing data word by word.	A multitude of codes are generated through an open coding process, first coding sentence by sentence before looking at the data in bigger sections to get the overall impression.
Two coding phases or types, simple (fracture the data then conceptually group it) and substantive (open or selective, to produce categories and properties).	Three types of coding, open (identifying, naming, categorising and describing the phenomenon), axial (the process of relating codes to each other) and selective (choosing a core category and relating other categories to that).	Open coding, axial coding and selective coding were used to establish relatedness between categories.
Regarded by some as the only 'true' Grounded Theory Method.	Regarded by some as a form of qualitative data analysis.	The researcher regarded the method as a tool to interact with the data directing the gathering and analysis process along structured guidelines.

Taking above mentioned the key differences into account, the researcher decided that this study would embrace the Straussian GTM (*cf.* 1.6.5.2) for the following reasons:

- The research area and research problem are predefined and not open to input from the participants.
- The researcher was an active participant in the early stages of the study.
- The chosen method allows that a large amount of data can be restructured and reconceptualised in an organised way.
- Following set guidelines establishes rigour in the analysis and creates a data trail increasing the validity of the findings and

- the choice of this method facilitates an opportunity to evolve the GTM in an educational setting and to make recommendations for future projects.

3.2.4 Application of grounded theory in this study

The Grounded Theory results in the formation of close relationships between data collection, analysis and the development of the eventual substantive theory. Concepts arising from the rich data set, in turn provide ideas which pursue and sensitise the researcher. Charmaz (2006, p. 16) also emphasises these close relationships and suggests that the practice of using the Grounded Theory across various disciplines displays certain common characteristics. These considerations are listed and compared to actions taken during this study in Table 3-2 below.

Table 3-2: Set of common criteria in doing GT as suggested by Charmaz (2006) matched to actions taken in this study

Criteria suggested from Charmaz (2006)	Actions during this study
Simultaneous involvement in data collection and analysis.	Data collection developed in an iterative pattern in parallel to data analysis.
Constructing analytic codes and categories from data and not from preconceived logically deduced hypothesis.	No predetermined hypothesis was formulated to investigate other than the main research question. Codes were generated through data analysis and compared to each other from early on, this leading to the emergence of additional research questions.
Using the constant comparative method.	Data were constantly compared with emerging categories and existing literature
Advancing theory development during each step of data collection and analysis.	Emerging categories formed the basis for further theoretical sampling.
Memo writing to elaborate categories, specify their properties, define relationships between categories and identify gaps.	Memo writing continued throughout the data collection and analysis until the memo-on-memo phase, where conceptualising increasingly focused in on the core concept.
Sampling aimed towards theory construction, not for population representativeness.	The sample was directed in an attempt to answer the research question and therefore it was theoretically motivated.
Conducting the literature review after developing an independent analysis.	A preliminary literature review was conducted to sensitise the researcher to the phenomenon as encouraged by Leedy and Ormrod (2005, p. 141) who suggest the use literature to provide a rationale and a context for a study.

The criteria which guide Grounded Theory research assists in the determining of the data collection methods and instruments to be considered in this research. The next section will further elaborate upon aspects such as data collection, analysis and reduction and will also present some background on the Microsoft Innovative Teachers Forum Awards.

3.3 SOME BACKGROUND INFORMATION TO THIS RESEARCH

The Microsoft Innovative Teachers Forum competition is an annual event that provides an opportunity for teachers to extend their practice of teaching and learning with technologies and to showcase their work and gain recognition for their efforts. Exemplary entries are selected from across the county and entrants gather at a central venue to be judged. To be chosen as one of the finalist is a great accolade and acknowledges teachers that use their creative spirit to forge new teaching and learning practices with technologies. Peer recognition serves as a validation of intuitive emerging practices and adds credibility to teachers harnessing the potential of technology in the teaching and learning milieu. This process finally influences policy development.

This competition first made the researcher aware of the unheard voices of teachers who, in their everyday context, struggle and go to great lengths to make learning real for those in their care through engaging in innovative practices with the use of emerging technologies. As individuals they strive to change the face of education in South Africa and thereby they improve their own fate and develop 21st century skills in their colleagues and learners in the process.

The researcher has been associated in various capacities with the Microsoft Innovative Teachers Forum for the past four years (*cf.* Section 1.6.6.2) and has an integral understanding of the phenomenon under investigation. She, having been involved as a participant, facilitator, observer and judge at competition events, has a unique insight and understanding of the competition. Said researcher is well known to (Microsoft South Africa) and the organisers (SchoolNet SA) of the event and she is accepted by the members of the innovative teacher's forum cohort having met with some of the participants during facilitation workshops prior to the annual competitions.

This event is held once a year and involves twenty finalists that are brought together for a two day event in Johannesburg. During the actual competition, the researcher had the opportunity to sit in on their presentations, interact with the participants and judges which helped in the gaining of greater insight and clarity as regards the final conceptualization phase of the study. The final act of data collection and verification was scheduled in the form of follow-up interviews targeting specific participants to shed more light on the main themes and their interrelatedness.

3.4 DATA GATHERING CONSIDERATIONS

The Grounded Theory Method entails an iterative process that revisits the data throughout the study to the *point of saturation* or a *point of diminishing returns* where no new insights are gained from the data set (Robson, 2002). Data gathering is guided by the research design as presented in Chapter 1 (*cf.* Figure 1-1). Data were typically field-based, flexible and likely to change over time. Interviews normally play an integral part but documents, images, observation or anything else of potential relevance to the study can be used. The only restriction is that the data collected must include the perspectives of the people being studied (Charmaz, 2006; Strauss & Corbin, 1998). In this study an attempt was made to access data in a variety of formats to create an opportunity for triangulation and verification. A full layout of the data collection methods and the instruments used during data capturing is presented in Table 3-4 on page 84.

3.4.1 Preparing data for analysis

Because of the sheer magnitude of data generated, especially through a Grounded Theory approach, computer-aided qualitative data-analysis software (CAQDAS) has become very popular amongst South African and international researchers (Babbie & Mouton, 2001). The development of the software program ATLAS.ti was heavily influenced by the Grounded Theory perspective and therefore very useful in the analysis and building of models with interrelated concepts (Coffey, Holbrook, & Atkinson, 1999). ATLAS.ti allows for data, from a variety of sources, to be categorised, grouped and interlinked and specific lines of enquiry to be examined. Sources can also be compared to discover existing patterns through the building of networks (Friese, 2010).

The choice of ATLAS.ti 6 as the data software analysis program for this study was a perfect match. This program was selected to document and examine the data because of its ability to assist in the analysing of diverse documents including plain text, images, audio or video and also pdf documents (Muhr, 2004). ATLAS.ti is described as a *knowledge workbench* enabling researchers to fracture and piece together data from reworking to assembly. ATLAS.ti also has the ability to search and query, capture, visualize and share findings (Friese, 2010). The program was particularly useful in managing the plethora of unstructured data that was produced in various formats by many different sources. The data could also be analysed on a textual and conceptual level.

The accumulative steps in the data analysis process generate an audit trail which is essential in increasing research rigour and ensures some level of credibility. The ability to navigate the multitude of primary documents and to recall instances of events was a definite advantage in determining connections between codes and themes as they emerged. In the management of the conceptual level of analysis, the advantages of using network views in ATLAS.ti to relate concepts to each other was helpful (Coffey, et al., 1999; Friese, 2010).

3.4.2 Sampling

“The quality of research not only stands or falls by the appropriateness of the methodology and the instrumentation but also by the suitability of the sampling strategy adopted” (Cohen, et al., 2000, p. 92). Factors such as time, accessibility and expense often influence the size of the sample and therefore information from a subset of the population needs to be gathered in such a way that the knowledge gained is representative of the total population being studied. This study uses two types of non-probability sampling namely *purposive* and *theoretical* sampling and the researcher acknowledges that the participant cohort does not represent the wider population but is compatible with the Grounded Theory Method (*cf.* Section 1.6.6.1).

3.4.3 Purposive sampling

During purposive sampling, the researcher handpicks the participants for inclusion in the study on the basis of their suitability to provide relevant information to illuminate the phenomenon

under investigation. In this way the researcher builds up a sample that is satisfactory to the needs of the study. Whilst this type of sampling may suit the needs of the researcher it cannot be seen as representative of the wider population and it is thus deliberately selective and biased (Welman & Kruger, 2001).

The initial purposive sample of participants to this study included those teachers who attended the multiple Microsoft Innovative Teacher workshops held across the country. These teachers attended the workshops in an effort to learn more about the framework and the judging criteria for the competition or simply to enhance their own teaching and learning practice. Included in the sample were also the top 20 finalists of the competition.

3.4.4 Theoretical sampling

Theoretical sampling is the process of collecting data for comparative analysis through looking at *data instances* and *categories* that emerge from the data. There is no need to wait until all the data has been collected before the analysis proceeds. Theoretical sampling is specifically suited to generate theory and explicate theoretical propositions (Haig, 1995). A new sampling is judged on its theoretical relevance and its ability to further develop emerging categories. Therefore *data collection and analysis* and *further sampling* take place in tandem (Kinach, 1995). The critical question in theoretical sampling is: To what group does one turn next to further the development of emerging categories?

During the theoretical sampling phase of this study, participants were selected according to their ability to shed more light on the categories that emerged during data analysis and open coding. To further the conceptualisation of themes the participants, during this phase of the study, were tasked to establish the relationship between the codes derived from the data or to elaborate on their understanding of the emerging sub themes. Participants were first presented with categories and then a discussion followed in which they were asked to motivate their choices.

3.5 DATA CAPTURING

Data collection during the competition is a demanding task as events are usually fast paced and interactions can vary between informal interactions, semi-structured occasions, organised exposure and opportunistic events. The actual competition is the only time that participating teachers travel from across South Africa to meet one another face to face and thus an ideal opportunity for the researcher to be introduced to and identify with suitable candidates. These teachers may then also be contacted at a later stage, if deemed necessary, during the purposive and theoretical sampling phase of this study. During the competition the researcher is not the only person collecting data. Multiple role players interact with the participants during the event, collecting a variety of data which is not all relevant to this research agenda. Therefore all data collected is categorised as *primary*, *secondary* and *experiential* instances and further explained in Table 3-3 below:

Table 3-3: Data categories

Data engagement	Primary	Secondary	Experiential
Instances	<i>Primary observations</i> are those in which you would note what happened or what was said at the time.	<i>Secondary observations</i> are statements by observers pertaining to what happened or what was said and it includes the observers' interpretations (usually collected as video footage or judging notes).	<i>Experiential data</i> were based on your own perceptions and feelings as you conduct your research. Researchers are generally advised to keep a journal and to document their own growth throughout the process as values and perceptions change over time (Saunders, et al., 2000, p.233).
Data sources	Primary sources are contemporary accounts of an event, written by someone who experienced or witnessed the event in question. These original documents (i.e., they are not about another document or account) are often diaries, letters, memoirs, journals, speeches, manuscripts, interviews and other such unpublished works. They may also include	Secondary sources can be described as at least one step removed from the event or phenomenon under review. Secondary source materials, interpret, assign value to, conjecture upon, and draw conclusions about the events reported in primary sources. These are usually in the form of published works such as journal articles or books, but may include radio or television	

Data engagement	Primary	Secondary	Experiential
	published pieces such as newspaper or magazine articles (as long as they are written soon after the fact and not as historical accounts), photographs, audio or video recordings, research reports in the natural or social sciences, or original literary or theatrical works.	documentaries or conference proceedings.	

Primary research data were obtained from SchoolNet and contains entries to the competition from 2007 to 2010. SchoolNet SA was established as a national organisation as a result of the efforts by volunteer educators and innovative thinkers in school networking during the 1990s. SchoolNet SA was formally founded in 1997 with the support of the Department of Education's Centre for Educational Technology and Distance Education and several corporate sponsors. The first projects included training teachers in the Telkom 1000 project, The Open Society Institute for South Africa and the World Bank's Links for Development in the late 1990s. SchoolNet SA operated under the auspices of the International Development Research Centre until 2001 when it became a Section 21 non-profit organisation. SchoolNet has more recently played a role in influencing decisions and content pertaining to The E-education white paper and the teacher development framework (DOE, 2004).

3.6 RESEARCH DOCUMENTS

Because Grounded Theory methodology was employed during this study, the nature of the research instruments changed as more insight was sought in clarifying the research questions. Various documents were considered for inclusion in the study ranging from multimedia artefacts, posters, images, text, Virtual Classroom Tours and structured and semi-structured interviews as well as personal reflections.

A summary of all the research documents is presented in Table 3-4 below. This table includes data collection methods, the research question addressed, number of objects or participants, nature of the data collection instruments, category of the data and the analysis technique applied.

Table 3-4: Data gathering and instruments used during the research process

Data collection method	Research question	Number of objects or participants	Data instruments	Category of data	Data Analysis Technique
Virtual Classroom Tours (<i>cf.</i> Section 3.6.1)	RQ1, RQ2, RQ3	2007: 15 2008: 16 2009: 20 2010: 20	Virtual Classroom Tours embedded with word documents, spreadsheets, images and, multimedia.	Primary source	Hermeneutic circle of analysis. Coding according to guidelines set by Strauss and Corbin (1990). Set of principles for interpretive research of Klein and Myers (1999). (<i>cf.</i> Table 1-1 in Section 1.6.7) and (<i>cf.</i> Section 3.7)
Posters and Leaflets (<i>cf.</i> Section 3.6.2)	RQ2	2008: 6 2009: 9 2010: 14	Photographs of original posters and hardcopy of the leaflets which were scanned for analysis.	Primary source	
Multimedia Artefacts (<i>cf.</i> Section 3.6.3)	RQ2	34	Instructional content videos created for mobile phone use.	Experiential and secondary data	
Formal structured interviews (<i>cf.</i> Section 3.6.4.1)	RQ2, RQ3	WWITFA 2008: 22 ITFA SA: 17	Videotaped interviews with transcriptions.	Primary data	
Unstructured interviews (<i>cf.</i> Section 3.6.4.2)	RQ1, RQ2, RQ3	8	Digital recording with transcriptions.	Primary data	
Impromptu Informal conversational pieces (<i>cf.</i> Section 3.6.5)	RQ1,RQ2, RQ3	64	Field notes, digital voice recordings with transcriptions of researcher's reflections, researcher journal.	Primary and Experiential data	
Workshops with open discussions (<i>cf.</i> Section 3.6.6)	RQ1, RQ2, RQ3	Gauteng: 17 Eastern Cape: 22	Digital voice recordings, concept maps, training material.	Primary observations, Experiential data	

In the following section, each of the data instruments used is discussed in turn. A snapshot is also provided of the way in which the document was analysed.

3.6.1 Virtual classroom tour (VCT)

As was indicated in Table 3-4 above, the data collection commenced with Virtual Classroom Tours. Knowledge sharing amongst teachers, specifically knowledge pertaining to the experience of technology integration during a learning event, is difficult to capture in conventional show and tell sessions. The Virtual Classroom Tour (VCT) is a universal template which was developed by the Microsoft Innovative Teachers Program. The VCT is based on a PowerPoint Presentation as illustrated in Figure 3-1 below. A total of 71 VCTs were submitted in the entries from 2007 to 2010 and were included in the sample for analysis during the first phase of this research. Each tour contextualises a project and offers insights as to the expert teacher's modus operandi to engage their learners through creative, constructivist, technology rich projects.

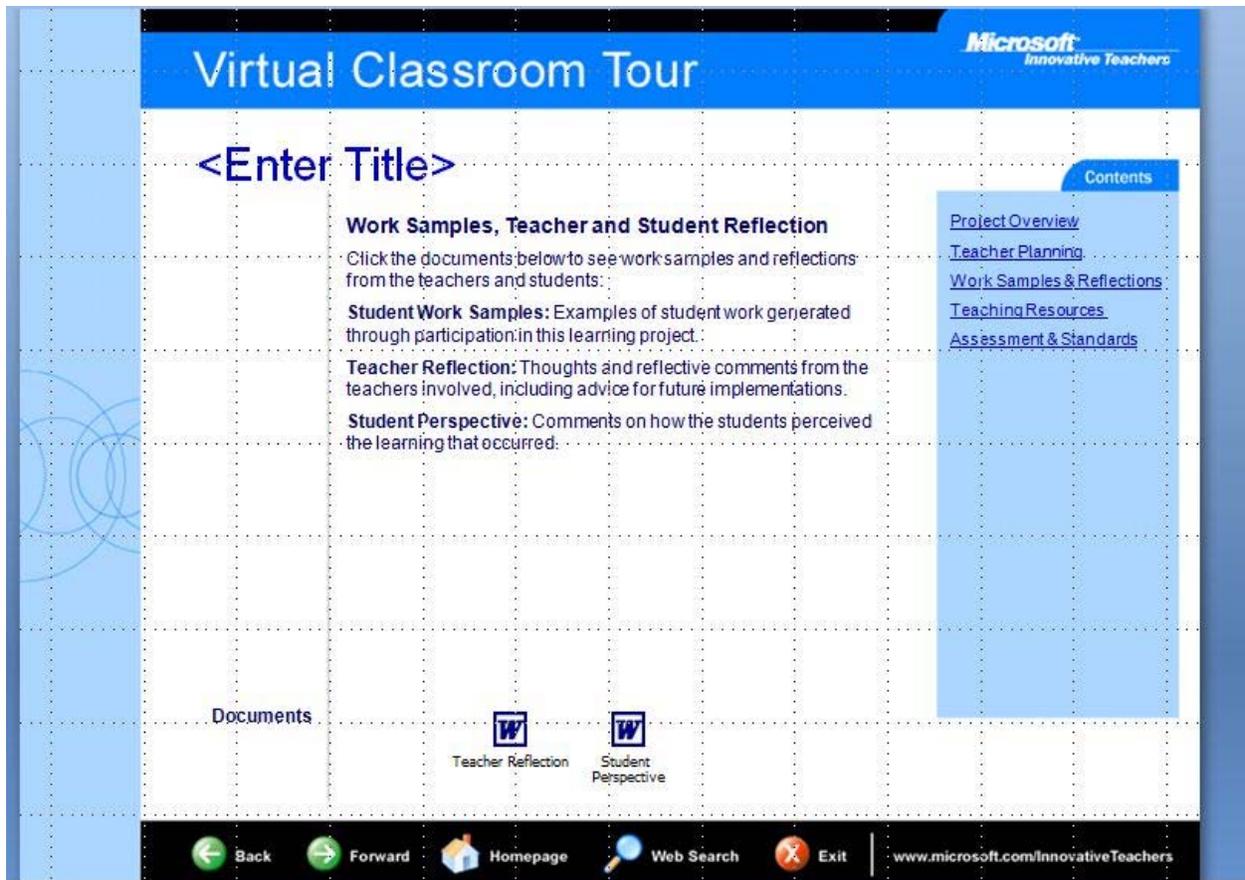


Figure 3-1: An example page of a Virtual Classroom Tour

Innovative teachers compile a VCT describing their project in general terms and then also embed more detailed documents such as text, video clips, images or artefacts created by learners. Each slide can contain multiple objects which all impart information regarding the successful employment of ICT in specific teaching and learning projects as set out in Table 3-5: Contents of slides of a Virtual Classroom Tour. The VCT contains all the documents needed to re-create and adapt the activity for use in your own classroom but also provides insights into the reasons a unit was developed in a certain way, or the motivation for using an ICT tool in a specific manner. The VCT also includes teachers' and learners' reflective comments.

Table 3-5: Contents of slides of a Virtual Classroom Tour

SLIDER NUMBER AND TOPIC	SHORT DESCRIPTION OF CONTENTS
Slide 1 – Project Overview.	General background information on the project which was undertaken. The details of the school, learning area, grade of the learners and duration of the project are provided. This slide also contains an embedded document that lists any resources used in the VCT for which the author has acknowledged copyright.
Slide 2 – Teacher Planning and Management.	Embedded documents, with details on how the project was conceptualised, planned and managed, are given. Images, including classroom layouts and specialized equipment, are shown. Teacher and learner reflections, in which they comment on aspects that went well and areas which proved challenging, were captured. They also share their thought on what they would do differently if they have to do the project again.
Slide 3 – Teaching Resources.	Includes links to any pupil handouts and other resources created during this project. Typical examples include learner project overview documents, list of learning resources as well as ICT considered and utilized during the project.
Slide 4 – Assessment and Standards.	Pertains to assessment materials developed for or during the project and information about how the project's learning objectives map to learning area and curriculum standards.
Slide 5 – Teacher and School Information.	Contains contextual school information along with a detailed teacher profile.

In addition to submitting a VCT for the competition, participants also prepared a 1.5 by 1.2 metre poster and leaflets documenting and promoting their work. The analysis of images and their subsequent interpretation can help uncover unique properties and clarify inherent ambiguities encapsulated in other documents (Marshall & Rossman, 2006; Schwartz, 1989).

3.6.2 Posters and leaflets

As indicated in Table 3-4 on page 92, the next data collection process considered posters and leaflets. As part of the judging process, each participant must design a poster which portrays their project. During the actual competition week the participants can then either refer to their poster, VCT or other multimedia material or they may even give a demonstration in which they use other digital devices such as mobile phones or tablet computers in their informal discussion with interested parties. Some participants also elect to create leaflets which explain their project and which may then be distributed as a tool to stimulate interest, further explain critical aspects or promote their projects. A mix of traditional paper-based format, the poster and leaflets and the technological multimedia is achieved seamlessly. A total of 29 posters and leaflets were included during the first phase of this research for analysis. Some posters were printed on good quality paper and professionally prepared with clear graphics. Other posters were of lesser quality but still managed to capture the essence of the entry.



Figure 3-2: South African finalists in the Worldwide Innovative Teachers Awards Forum in Hong Kong 2008. From left to right: Jacqueline Batchelor, Peter de Lisle, Saretjie Musgrave and Thamsanqa Makhatini

In Figure 3-2 above, the South African contingent to the Worldwide Innovative Teachers Awards (Hong Kong, 2008) display their posters and pamphlets and as they prepare to engage with other participants via live demonstrations and interactive displays.

An example of coding a pamphlet and poster is displayed below. Posters were photographed and imported as primary documents into the ATLAS.ti document manager and subsequently coded. These posters were a rich source of additional material that offered a more distilled perspective of each the entry. Additional information was displayed in the form of images that were not necessarily part of the VCT and the updated version of ATLAS.ti 6 proved its worth by enabling the researcher to code photographs as well. Figure 3-3 below display a poster entry submitted to the 2008 South African Competition with the visible codes.



Thesis submitted by Jacqueline Batchelor in partial fulfilment of the requirements for the degree of Philosophiae Doctor (Computer Integrated Education) in the Department of Curriculum Studies, Faculty of Education, University of Pretoria, 2011.

Figure 3-3: Poster entry from 2008 displaying codes

Pamphlets were also available as source documents, however, some were embedded within the VCT and therefore exported as a primary document to ATLAS.ti for coding. Other pamphlets were only made available in paper format. The relevant hardcopy pamphlets were photographed and in some cases scanned before they were coded. The ability to engage with multiple sets of data pertaining to a single competition entry allowed for the cross verification of emerging codes and categories and subsequently increased the trustworthiness of the process. Figure 3-4 below illustrates a pamphlet in pdf format that was coded using ATLAS.ti 6.

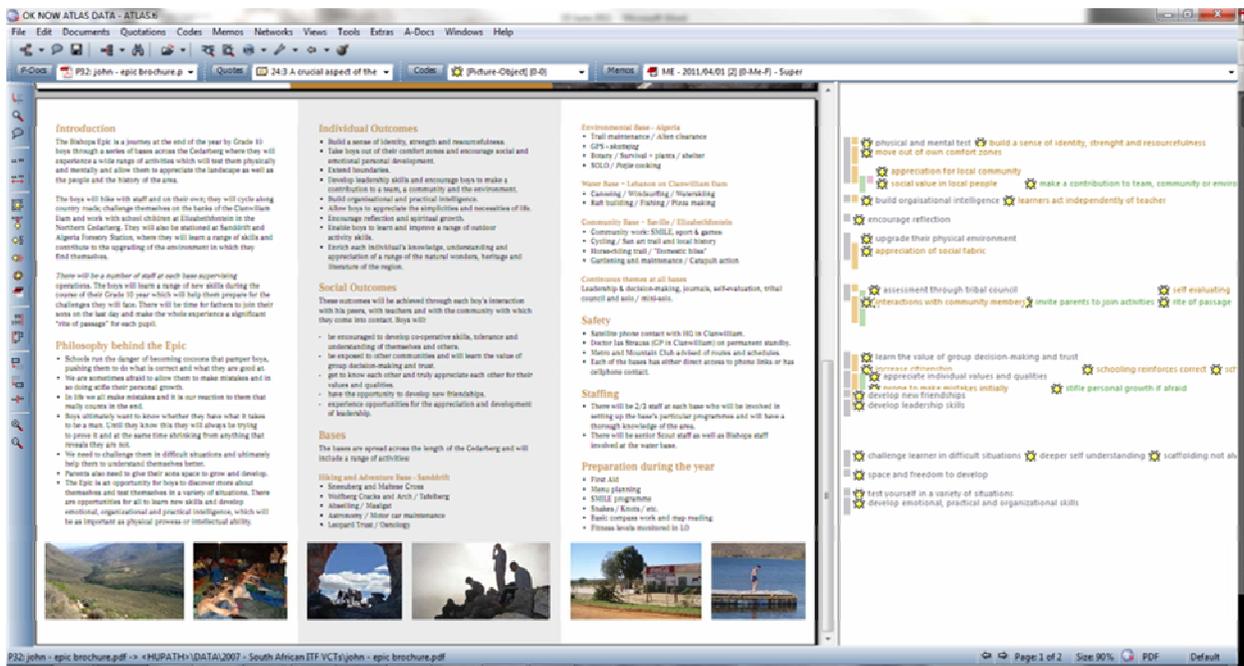


Figure 3-4: Pamphlet used as supporting material to an ITFA entry with relevant codes

The difference between coding a photograph and a Pdf document is that the selected areas in the photographs were very visible, whereas in the pdf document the boundaries for the various codes were not as visible. This makes it difficult to grasp the original intent behind the created code when retrieving data.

3.6.3 Multimedia artefacts

As indicated in Table 3-4 on page 92, the data collection proceeded with the addition of the multimedia learning artefacts created by teachers and learners. These artefacts formed part of the evidence contained within the VCT entries to demonstrate the scope and benefits of the project. These multimedia artefacts were a bit more challenging to analyse, however, they were too good a source to dismiss. Of importance in these artefacts is not necessarily the narration, but the learner's thought processes as they pertain to certain elements. The depth of content coverage and the way multimedia artefacts were presented (as a mix of music, voice and text) made it difficult to code and it would have been a futile exercise to transcribe the narrative as all these subtle nuances would have been lost in the process. In this case, the researcher relied on her years of experience as a teacher well versed in mobile learning research to interpret these learner created artefacts. The researcher viewed each artefact multiple times and interpretations were recorded digitally and transcribed before being coded to form part of the dataset. The learners' comments, included in the VCT, and the assessment rubrics created for this particular task were also of valuable assistance. Figure 3-5 below displays a selection of the multimedia entries that were considered for data capturing.

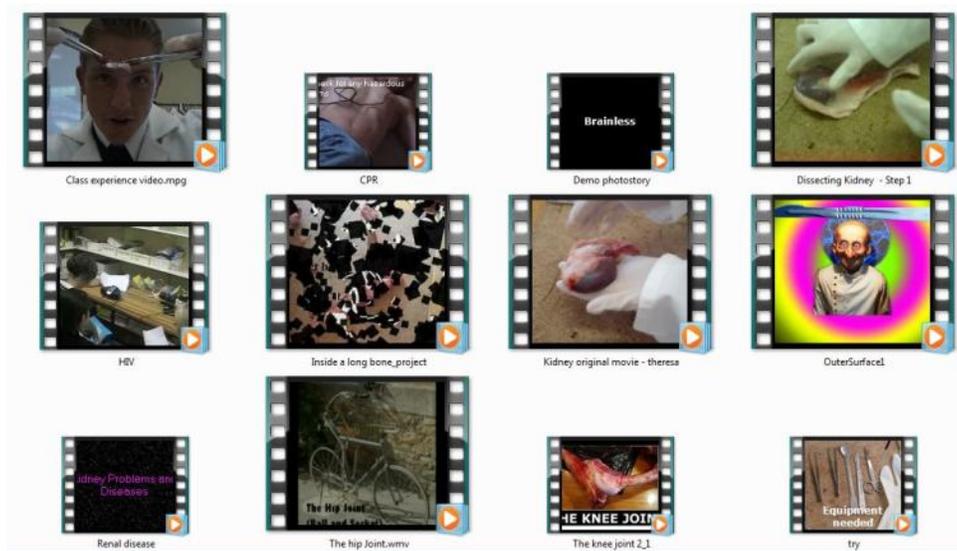


Figure 3-5: Multimedia curriculum aligned artefacts for mobile use

3.6.4 Interviews

As indicated in Table 3-4 on page 92, the data collection progressed to include videotaped formal structured interviews, digitally recorded unstructured interviews and impromptu informal conversational pieces. Qualitative interviews are events that can be used to explore participants' experiences and interpretations and require the researcher to engage with participants in reflective conversations. Interviews are used to uncover the *meanings of structures* that participants use to *organise their experiences* and make sense of their worlds (Hatch, 2002, p. 91). These structures are often hidden from direct observation and taken for granted by participants. Qualitative interviews offer opportunities to uncover these structures and make them accessible for analysis and interpretation.

The advantage of interviews is that they provide a means to probe "what is in and on someone else's mind" (Patton quoted in Hatch, 2002, p. 92). The power to share rests with the participants involved and they may be reluctant to divulge what is on their minds for whatever reason. Researchers should therefore be sensitive to this reluctance and make provision for enough time to build a rapport and engage with participants. Lincoln and Guba (1985, p 268) identify five outcomes of interviewing which can be abstracted as follows:

- *Here and now constructions.* Participants' explanation of events, activities, feelings, motivations and concerns.
- *Reconstructions.* Explanations of past events and experiences.
- *Projections.* Explanations of anticipated experiences.
- *Triangulation.* Verification or extension of information from other sources.
- *Member checking.* Verification of information developed by the researcher.

During this study a very real effort was made to accommodate all of the above mentioned outcomes. Some of the interviews were formally structured events conducted by a third party and some were personally conducted and semi-structured. The latter were conducted at a later stage at the convenience of teachers. The educators were scattered across the country and this

necessitated the use of Skype to facilitate video calls, record interviews and share documents for discussion during the call. All the interviews were transcribed using Windows 7 Speech Recognition software. This procedure was initially time consuming as the software had to be voice trained before it could be used but once fully mastered, it reduced the transcription time significantly. The original materials were kept for record and internal auditing purposes.

Interview protocols during the study differed depending on the context. Interviews that were conducted during competitive events were informal, opportunistic and rich in capturing the essence of the innovative concepts. The researcher kept a reflective diary throughout consisting of jotted down text and diagrams. The researcher also habitually sought out a secluded spot in between events where she could reflect upon previous sessions, whether interaction or observation, and record thoughts with a voice recorder. These ponderings and reflections became invaluable during the conceptualisation period of this study.

3.6.5 Video recorded formal structured interviews

A series of interviews recorded during the World Wide Innovative Teachers Forum Awards (WWITFA) in Hong Kong became available in the open domain soon after the competition ended and they provided an unexpected rich set of metadata. Participating teachers sign an agreement, prior to the competition, which enables Microsoft to use materials generated during the competition. From 176 entries, 9 semi-finalists in each 3 categories were chosen to participate in the last round where they were each judged according to *content*, *community* and *collaboration*. The questions were devised by the competition organisers and the same questions were put to all 27 semi-finalists. The interviewer did not engage in discussions and did not probe any answers provided. These unedited versions of the interviews were posted on the internet and later edited versions followed. In this study the *unedited* versions were used. Due to language difficulties and inadequate interpreters, five of the interviews had to be discarded.

The five questions posed to the semi-finalists are presented in Table 3-6: interview questions posed to the semi-finalist in the World Wide Innovative Teachers Forum Awards (WWITFA) Hong Kong, 2008 Table 3-6 below. The questions have been divided into different target topic areas.

Table 3-6: interview questions posed to the semi-finalist in the World Wide Innovative Teachers Forum Awards (WWITFA) Hong Kong, 2008

TARGET TOPIC	QUESTION POSED
Organisational Context	What were the main challenges you faced in your job before you introduced this project?
Technological challenges	How did the technology support or help you to be more effective and what were the problems you had that were solved?
Professional impact	Name at least three advantages that this project brought to your job and to your students? (focus on the results)
Pedagogical legacy	Explain briefly why you consider this project as a major improvement in the learning process and explain the way you see the role of this project in future.
Personal change	How do you see the effects of the changes you made on your students and on you as a teacher?

Transcriptions of these interviews have been used to inform the emerging categories and have also aided in the generalisation of some of the findings beyond the South African scope. It is worth noting at this stage that the researcher was also selected as a semi-finalist and that the recorded interview was used as a *bracketing interview*. Finlay (2008) sees the purpose of a bracketing interview as an instrument which allows for the clarification of pre-existing notions pertaining to the knowledge field under investigation. However, for the purposes of this study, the existence of a bracketing interview is not considered restrictive as the researcher's inherent beliefs and orientations are not considered a restriction when using the Grounded Theory method. Everything relevant to the research, including the orientation of the researcher is regarded as valid data and these beliefs complement the interpretive nature of the study.

During the South African competition, a similar format to the WWITFA Hong Kong competition was followed, although the videotaped interviews were less structured and not made available in the open domain. However, Microsoft South Africa granted the researcher permission to use the data for the purpose of this investigation (*cf.* Appendix B). The finalists were interviewed by a third party but different questions were posed to them. The interviewer, an education and technology integration specialist, posed questions *which were more probing in nature*. These questions allowed the participants the opportunity to reflect on the highs and lows of the project, the lessons learnt through the process and what they would do differently in future. Each

interview was approximately 15 minutes long and the focus was firmly on the *use of technology during teaching and learning activities*. The interviews did not explore areas outside the classroom such as historical contexts. Nevertheless, some valuable light was shed on the practicalities of developing new pedagogies and the strategies teachers employ in their practice.

3.6.6 Unstructured interviews

Once the data obtained from participants had been analysed and coded, additional interviews were scheduled to clarify concepts uncovered during the initial data analysis phase. Subsequent candidate sampling for additional data capturing semi-structured interviews was purposeful. Flick (2006, p. 169) promotes the use of a recording device and advises the interviewer to carefully explain to the interviewees what to expect during the process but not to stick too rigidly to pre-conceived ideas as opportunities might be missed for interviewees to unfold their own views. It is therefore important to plan for the asking of probing questions and not to remain too general in the quest for clarity on concepts and to keep in mind that the interview can be extended to a second meeting if required.

A determining factor guiding the design of the interview protocol was the mode of communication. The best possible scenario would have been to conduct face-to-face interviews but because teachers were scattered across South Africa, the option fell to conduct video calls via SkypeTM. The advantage of using SkypeTM to conduct interviews is that it enables the sharing of files during discussion and participants' initial instinctive responses are captured. There was no lag between sharing the file and the participant's reading thereof and thus the discussion could unfold in a natural way with the shared documents acting as a catalyst for further conversation.

There are, however, limiting factors to take into account when using SkypeTM to facilitate an interview. The quality of network services differ across the country and the strength of the signal can vary resulting in poor call quality to the detriment of the interview. The following strategies were devised to cope with the limitation of using SkypeTM for interviews:

- Interviews were scheduled for after office hours, in the early evening and at the convenience of the participants when internet connectivity is at its best as fewer users are online during this time of the day. This allowed for a better connection.
- After contact had been established via a video call connection and initial pleasantries had been exchanged, the video feed was terminated and the interview continued as a voice call. This significantly improved the quality of the call. Before the interview concluded, the video feed was re-activated and the participant thanked for his/her contribution.

The objective of the interview was to determine the interrelatedness of the categories as they emerged from the data and to gain alternative perspectives and additional insight from which to construct affinity diagrams.

3.6.7 Impromptu informal conversational pieces

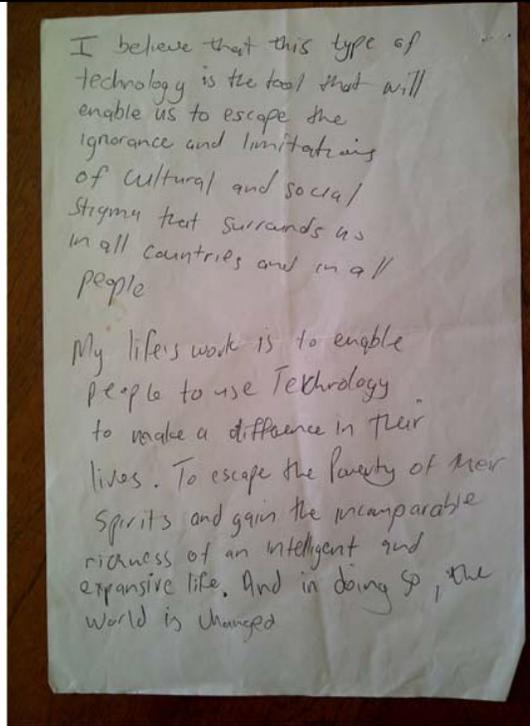
The informal conversation pieces are relaxed in nature and the conversations develop naturally. In this study a series of encounters during the course of the two day competition was used as a source of information. These encounters are generally short in duration and follow a pointed and direct line of questioning to clarify and follow up certain points raised in a presentation or comments made during an open session. It was necessary to make notes next to a participant's name as questions would crop up during his/her presentation. The researcher would then approach the relevant participant afterwards, during tea or lunch, and engage him/her in a discussion. The advantage of using this technique, is the almost immediate clarification of a raised issue. However, it is much more challenging to record the conversation as the audio quality can be poor due to background noises and other voices. Not being able to record the conversations meant that the researcher had to rely on field notes to capture the essence of the conversation after the fact. Not being able to recall everything that was said was a source of frustration and thus the conversations were kept short in order to allow the researcher to recall the interaction as best as possible from memory and notes.

3.6.8 Innovative teacher workshops

As indicated in Table 3-4 on page 92, the data collection allowed for the gathering of information through innovative workshops. In March 2008, the researcher attended an Innovative Teacher workshop held in Johannesburg. Subsequent to winning the content category in the ITFA 2008, the researcher was invited to facilitate two workshops, one in Pretoria, Gauteng and the other in Port Elizabeth, Eastern Cape. These workshops were two days long and allowed for multiple opportunities to interact with the teachers in a formal and informal capacity. During these workshops teachers from the surrounding areas come together to work on their innovative projects, reconceptualise their teaching practices, reflect upon their own development and to share with one other. Seventeen teachers participated in the Gauteng workshop and twenty two attended the Eastern Cape workshop. Documentation gathered during the workshops ranged from hardcopies of teachers' reflective writing, digital images of individual or group work during brainstorming sessions as well as the reflective diary kept by the researcher during this time (*cf.* Table 3-7).

Table 3-7: Samples of data sources generated through the workshops

A reflective note from a teacher who attended the Pretoria workshop.



Group brainstorming session with resultant mindmap.



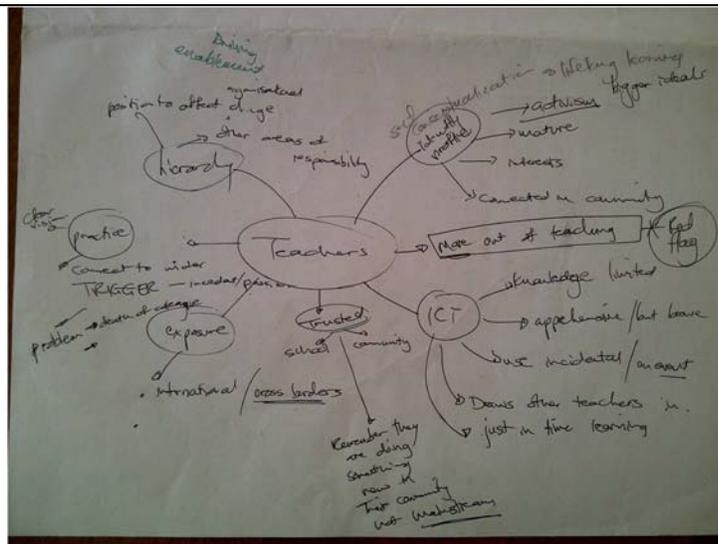
Presentation by Nicci Hayes (finalist teacher in 2009) during the Eastern Cape workshop.



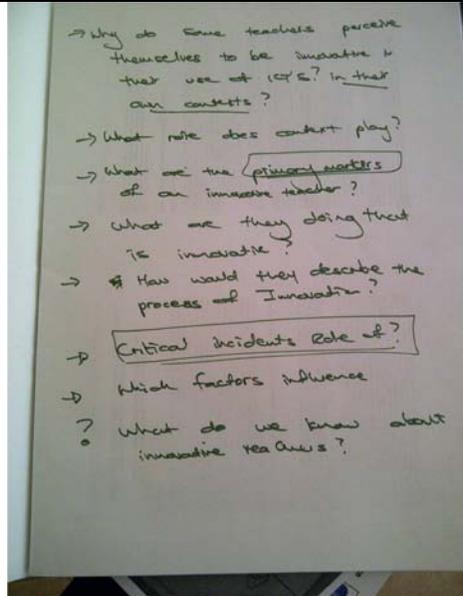
Teatime – a great opportunity to get to know each other and share ideas.



Researcher's reflective mindmap subsequent to a workshop.



A sample of interview questions that emerged during engagement with teachers in their workshops.



A sample of the data sources is provided in Table 3-7 above. Even though the collected data sources varied greatly during workshops they were rich and descriptive, allowing for the in-depth exploration of concepts. It was also an opportunity to triangulate data through the use of multiple sources. At the time when this workshop took place the researcher was midway through coding the Virtual Classroom Tours which had been collected earlier in the study and the initial open codes, as they emerged from the analysis, could be discussed in an informal manner. These discussions instilled confidence in the researcher as to the validity of her interpretations during open coding. Areas requiring more discussion were identified as *gaps* in the data collection and therefore more attention was paid to these issues in subsequent theoretical sampling. Particular areas that had been omitted thus far were the issue of *innovation context* and the *influence of the community* in the innovative teachers' work.

3.7 DATA ANALYSIS

During a Grounded Theory study, *data analysis* and *data reduction* takes place iteratively. A detailed illustration of the process is found in Figure 3-6 below.

Data were interpreted through the use of hermeneutics in an effort to generate greater understanding. An old saying which originated from the interpretation of ancient texts states that “The whole should be understood from the part, and the part should be understood out of the whole” (Dobrosavljev, 2002, p. 607). This saying is still valid today. The hermeneutic circle (*cf.* Figure 1-7, Section 1.6.7) aids the analysis process in that it progresses from considering the whole document and its context, to parts of it, and back again to the whole document being analysed. The components of the hermeneutic circle move from *understanding* to *explanation* and finally *appropriation* to generate new insights and understanding. The researcher continues to provide logical explanations for decisions and interpretations.

Initially all data collected sourced from many different localities, is analysed through coding techniques. Findings from this initial analysis identify knowledge gaps in the existing data which gives rise to more data collection. This process continues up to a point of saturation where no new codes are generated from collected data. It is at this point that data analysis ceases. A typical progression through data analysis is illustrated in Figure 3-6 below.

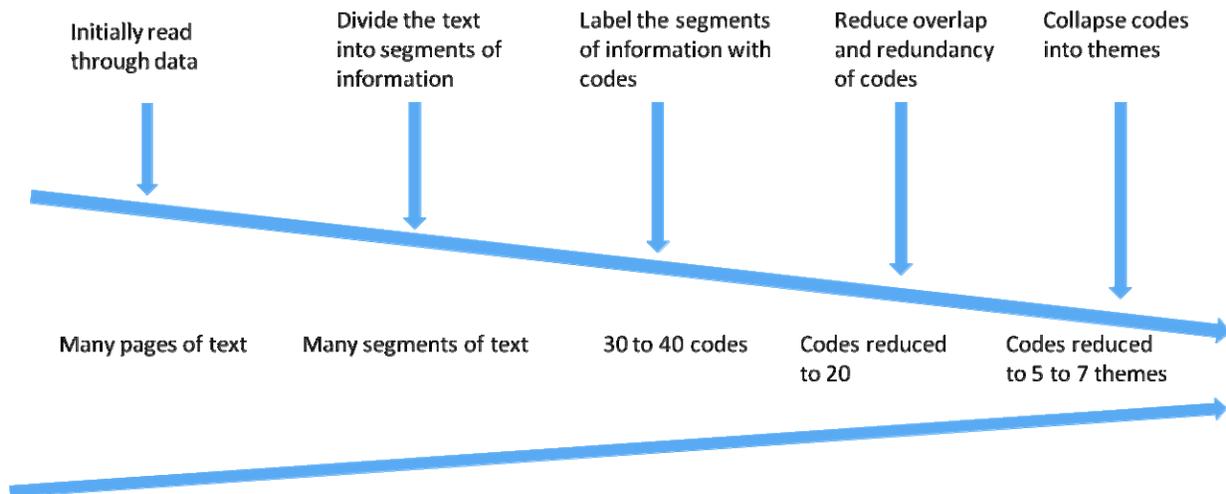


Figure 3-6: A visual model of the coding process in qualitative research (Creswell, 2005, p. 238)

During the process of data analysis, decisions are made as regards the suitability of material for inclusion in the study, based on the relevance to the research question. Therefore data that does not provide evidence for the emerging themes is disregarded. The inductive process further narrows the codes down to a few themes, eliminating redundancy and the overlapping of codes. To manage the large quantity of data generated by a Grounded Theory study, a methodical approach is recommended for the systematic analysis to proceed fluently. The suggested strategies follow in the next section.

3.7.1 Key analytical strategies to follow when doing Grounded Theory research

Coding is a process for *categorizing qualitative data* and *describing the implications and details of these categories*. It can further be described as a process of fracturing data through considering the ideas captured in them, expressing the interpretation in textual form and giving shape to ideas and concepts.

In Figure 3-7 below, the process is illustrated with multiple sources of data which have been considered in various formats and then broken down into ideas. These resulting ideas are then compared, reconceptualised and restructured to give rise to new insights into a phenomenon.

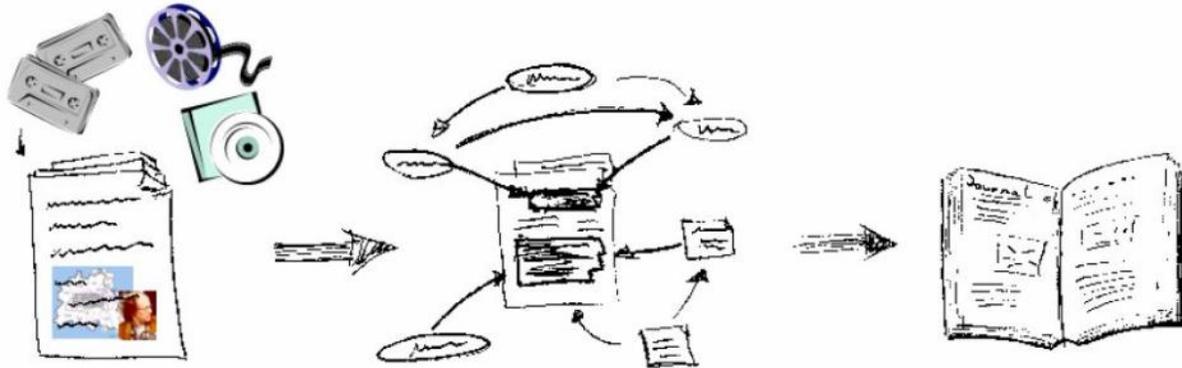


Figure 3-7: ATLAS.ti Text-Structure Text Process

Different coding options are available to the researcher such as open coding, priory coding, in vivo coding or coding by list. *Open coding* is the selection of text and assigning of value to it from a name or a term so that the meaning is clear (Saunders, et al., 2000). *Priory codes* come from terms used in existing literature, however, the experience and depth of knowledge of the researcher can impact the usefulness of this form of coding therefore a prior exposure to the research field under investigation is advisable. *In-vivo coding* is based on the actual words used by the participants. A pre-existing *list of codes* can also be generated prior to the study and then, when working through a selection of data, only codes from the list are assigned and no new codes are generated.

During this study the researcher made use of primarily *open* and *in- vivo coding* techniques. In the role of participant, the researcher had to interpret the meaning behind the words or images as a hermeneutic exercise. ATLAS.ti provides a toolbar to facilitate the coding, as seen in Figure 3-8 below, allowing a list of codes to be generated and organised alphabetically in the code manager.

<i>The coding options in the primary document toolbar:</i>	
 OPEN CODING	Create a new code, ask user for name of code
 CODE IN VIVO	Creates a code from the selected text
 CODE BY LIST	Selects existing codes from code list
 QUICK CODING	Codes with the currently selected code

Figure 3-8: Coding options in ATLAS.ti

Initially open coding is applied to consider every miniscule detail while developing some tentative categories which are then examined for specific attributes or properties and placed into subcategories. During axial coding the focus moves more towards establishing interconnections between categories and subcategories in a process of relating codes (categories and properties) to each other, via a combination of inductive and deductive thinking.

Using a *constant comparative method*, categories are continually refined further as new data were collected and analysed. Later on more *selective coding* is used when moving towards systematic coding with respect to core concepts. This selective coding is done in an effort to form a storyline of the phenomenon being studied. The process, illustrated in Figure 3-9 below, is taken from Warburton (2005) adapted earlier from Harwood (2002).

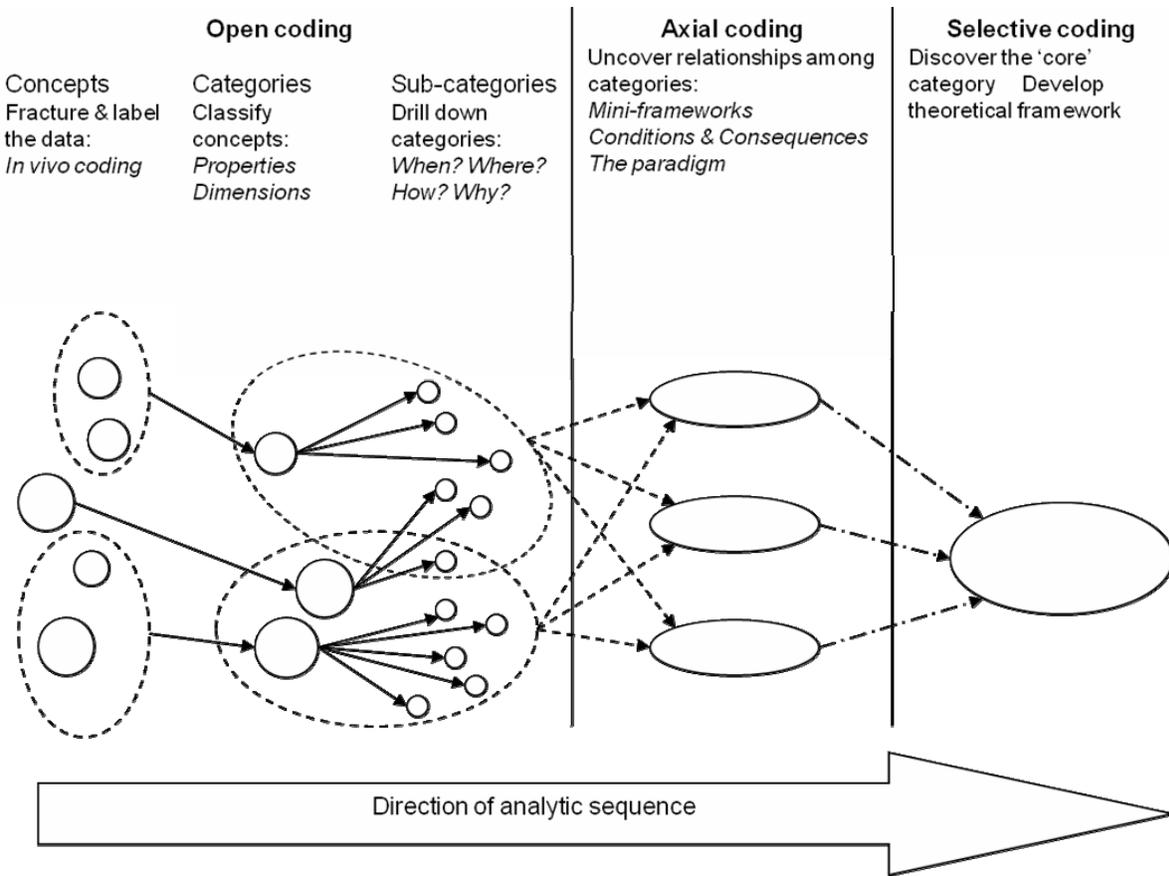


Figure 3-9: The Grounded Theory analytical process from Warburton 2005 (adapted from Harwood 2002, P. 76).

The series of steps presented provides a systematic way of reducing vast quantities of data into a concise conceptual framework that describes a particular phenomenon. To aid the researcher new to Grounded Theory, Coyne (2009, p. 17) in Table 3-8 below designed a guide in the form of a *series of stages*. This guide was adapted for the purposes of this research.

Table 3-8: Stages in the analytical process as adapted from Coyne (2009, p. 17)

PROCESS	STAGES		PURPOSE
Data analysis (Open coding)	Line by line substantive coding	→	Breaking down data
	Record incident and codes	→	Keeping record of analysis
	Write comments and memos	→	Deliberate and capture cognitive patterns
	Capture quotations	→	Enrich reflection and provide context
	Write theoretical notes in memos	→	Capturing ideas about data fragment
	Compile list of codes	→	Abstraction from data
Concept formation (Axial coding)	Group codes into categories	→	Integrating the codes
	Constant comparison of notes	→	Discovering and building categories
	Movement of codes	→	Building and developing categories
	Compare and contrast with previous codes	→	Integrating the data
Concept development (Selective coding)	Memos on categories	→	Capturing ideas and documenting recurring themes
	Identify theoretical codes	→	Developing links and relationships between categories
	Mapping of categories	→	Visual representation of categories and relationships

In addition to the guidelines proposed by Coyne above, this study also followed more practical suggestions initially put forward by Tesch (1990) with added suggestions much later by (Creswell, 2005) in handling data. They are:

- Get a sense of the whole. Read all the available data carefully and write down some ideas as they come to mind.
- Pick one document at a time, preferably the shortest and most interesting. Go through it and try to make meaning of its contents by writing down one or two words.

- When this action has been completed for several documents, make a list of all the topics. Cluster similar ones together and form them into columns that can be arranged as major topics, unique topics and leftovers.
- Take the list and go back to the data. Abbreviate the topics as codes and write the codes next to the appropriate segments of the text to see whether new categories and codes emerge.
- Find the most descriptive wording for the topics and turn them into categories. Reduce the total list of categories by grouping together topics that relate to one another. Lines can be drawn between categories to show interrelationships.
- Assemble the data material belonging to each category in one place and perform a preliminary analysis. Re-code existing data if necessary.

The problem when working with a large number of codes, in this specific research study in excess of five hundred, is that the codes tend to *start repeating the same concept* but because coding is done along a continuum, you tend to lose direction of what kind of code was assigned previously to which concepts. An example of generated open codes describing a set of similar circumstances could be the following: unfavourable teacher learner ratio, classes too large, crammed classrooms. Figure 3-10 below illustrates the coding of a primary document.

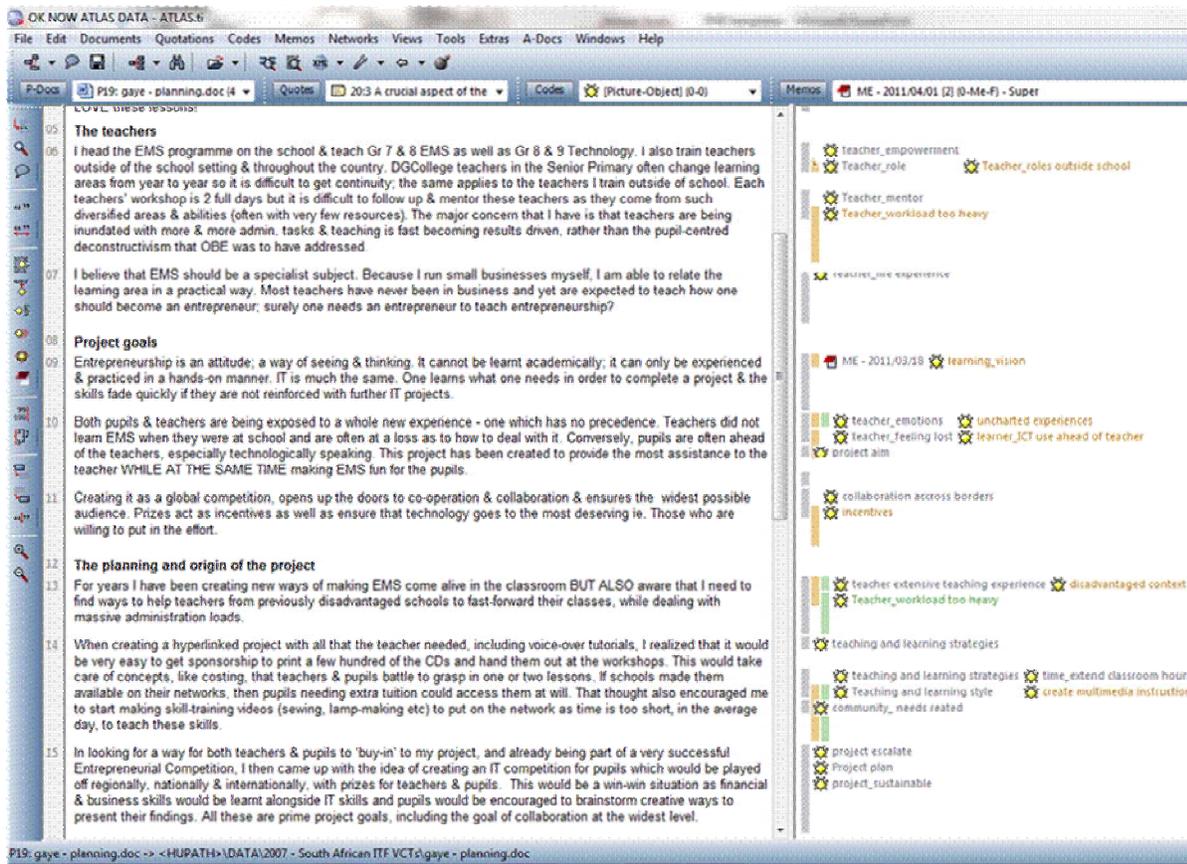


Figure 3-10: Generating codes from a primary document

Another problem experienced in coding, was working with an ever-growing list of codes that is arranged alphabetically. When assigning a *code by list*, it becomes much harder to recall from memory whether something similar has been assigned a code in the past. Therefore the same concepts end up being assigned to closely related codes but this problem is addressed when codes are arranged into categories. As researcher confidence in coding grew and expertise levels increased, the process became more fluent and the ensuing generated codes became more accurate and refined.

Coding is an abstract act and researchers are encouraged to examine the intricacies of the Grounded Theory method before embarking on a study. Glaser (2003, p. 62) advocates that novice researchers must have an ability “to conceptualize, to organize, to tolerate confusion with some incident depression, to make abstract connections, to remain open, to be a bit visual, to think multivariately and most of all to trust to preconscious processing and to emergence.” The

researcher found this to be a fair warning for it prepared her for the level of turmoil that was experienced for prolonged periods during the study. The framework in Figure 3-11 below provides an insight as to the degree in which levels of theory and concepts are developed and can be used as a device to clarify what good Grounded Theory might look like (Urquhart, Lehmann, & Myers, 2010, p. 366).

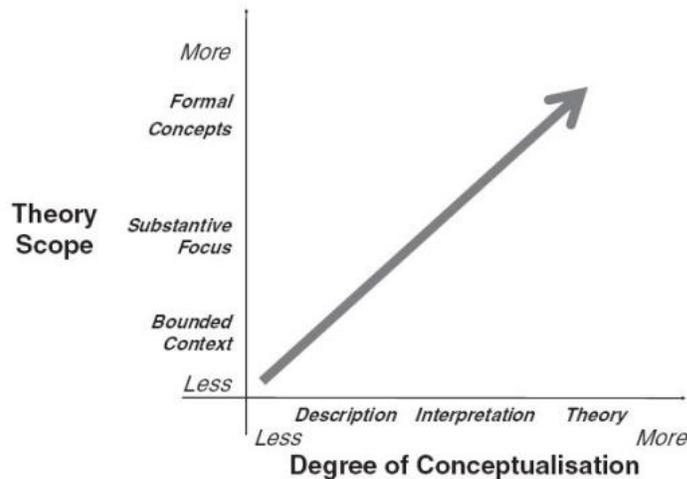


Figure 3-11: A framework for analysing Grounded Theory studies (Urquhart et al, 2010, p 366)

Even though the two axes illustrated in Figure 3-11 above are related to each other, the aim of Grounded Theory studies is to move as far up the Y-axis as possible. *Descriptions* are the most basic of conceptual constructs which are mostly derived from open coding. If the developing theory stays within the bounded context, thus merely representing anecdotal evidence and limited exploratory fieldwork, then the resultant theory will be judged to be inferior. Ideally researchers should aim to move from the *bottom left quadrant*, along the diagonal arrow as much as possible, to the *top right hand quadrant*. It is therefore important to move on to the level of *interpretation* to specifically explain areas under investigation and thus generate a substantive theory with significant empirical support.

A process is followed where data were simultaneously ordered, analysed and reduced into units which are, in turn, grouped into categories. Once this has been achieved, the researcher can dig

deeper into these newly identified categories to form concepts and map these interrelated constructs through revising, contrasting and testing until data were saturated. The condensed list of categories can be found in Appendix D of this document. Memos are written, in conjunction with conceptual level coding, to give insight into an incident, action, event or process and to thereby capture cognitive patterns that start to emerge from the data.

Integrated diagrams are used to pull all the details together and to help make sense of the data with respect to the emerging theory. These diagrams can vary from simple pen-sketches or cartoons to concept maps which summarise thoughts and ideas. Ideally one should work in a group as the sharing and integrating of ideas can increase insight into emerging theories (Leedy & Ormrod, 2005; Trochim, 2001). During this study, concept maps to determine the interrelatedness between categories, were shared with the participants who formed a part of the theoretical research sample (*cf.* Section 3.4.2.2).

3.7.2 Use of memos

Memos, in which the researcher records his/her observations as the analysis proceeds, are written during the coding process. *Memoing* can be described as the process of recording your thoughts and ideas as they evolve throughout a study. Again, early on in the process these memos tend to be open, whereas later they tend to increasingly focus in on the core concept. These memos form part of the dataset. The goal of writing memos while coding is that ideas generated from the data are not lost to the researcher but captured and formalised in some way. Memos help one to develop ideas about naming concepts and relating them to each other and so associations are created between concepts by means of interrelation diagrams. Writing memos develops a pattern of building perceptions based on a perception as the conceptual level rises and the generated concepts are sharpened systematically (Glaser & Holton, 2004). Also, during this process additional questions may emerge which lead to the re-examination of the data, or the researcher may seek new data to illuminate aspects of the emerging theory (Carvallho, Scott, & Jeffrey, 2003, p.11).

Memos are deemed important as they:

- Provide, through the process discussed above, leads to theoretical sampling.
- Capture and keep track of the emerging theory.
- Are totally free and emergent in both the process (memoing) and the product (memo).
- Accumulate and mature as they reach the saturation point and then need to be sorted out and written up (Glaser, 1998, p. 177).

Sorting memos into groups resulted in new ideas and generated the memos-on-memos phase of the study edging it ever closer to the final substantive theory.

3.7.3 Constantly capturing thoughts in informal memos

The researcher developed the habit of always carrying a notebook to capture thoughts as different aspects of data were contemplated throughout the day. Depicted in Figure 3-12 below

are some of the scribbled notes that were eventually captured in ATLAS.ti and coded.

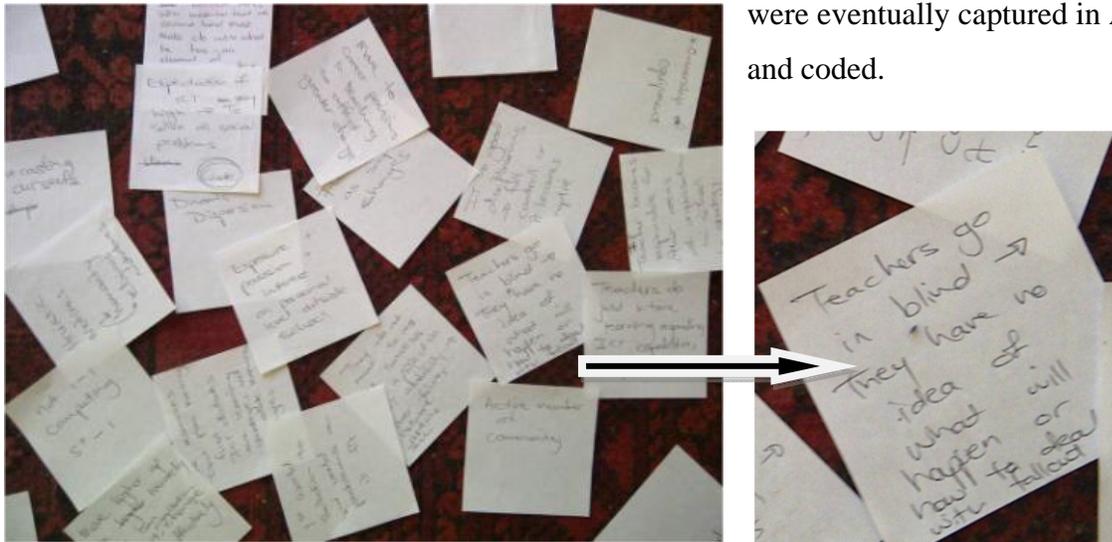


Figure 3-12: Sample of researcher's paper based memos

These sometimes random and hastily jotted down thoughts, ideas and reflections became invaluable during the concept formation. Some memos were short and to the point such as:

*Teachers seem to have a special rapport with their learners and use this as a form of **leverage** to get them involved.*

Others memos were a bit longer and more speculative as noted below:

*There seems to be a common strategy where teachers link the task or the deliverable to a community benefit, however, these perceived benefits must be clearly articulated and negotiated in advance. Being accountable to not only themselves and their teacher but to the more immediate community consisting of members outside of the school environment such as their family and community members seem to drive accountability and participation where they reach higher levels of academic competency. The concept of **relevance** to the community needs to be further explored.*

The contents of Table 3-4: *Data gathering and instruments used during the research process* and Table 3-8: *Stages in the analytical process as adapted from Coyne (2009, p. 17)* were combined to provide an overview of the research process below in Figure 3-13: *Map of the Grounded Theory process of this research*. This figure illustrates how data collection, analysis and concept development fit together and result in the emergent theory.

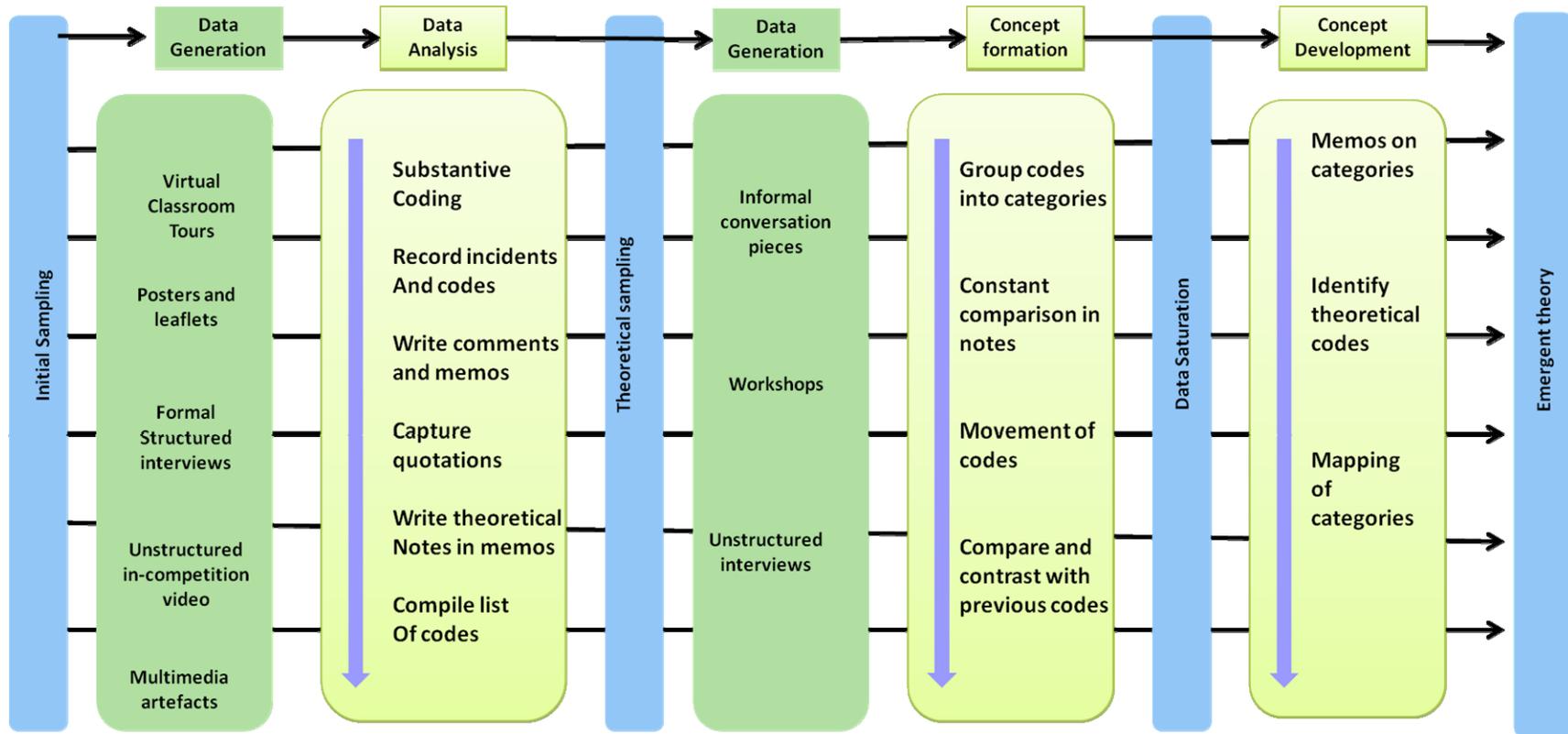


Figure 3-13: Map of the Grounded Theory process of this research

As indicated above in Figure 3-13: *Map of the Grounded Theory process of this research* the initial sample included the work of the finalists in the Microsoft Innovative Teachers Forum competition. Data gathered during the first data generation phase consisted of virtual classroom tours, posters and leaflets, formal structured interviews, unstructured in-competition interviews and multimedia artefacts. Data were analysed through substantive coding with the recording of incidents and codes whilst continuously writing comments and memos. Descriptive quotes were identified for use during the discussion of the findings and a list of all generated codes was compiled. During the theoretical sampling, opportunities were used to expand the list of codes and to seek greater clarity on concepts through reflecting on informal conversation pieces, interacting with participants in workshops and engaging selected innovative teachers for unstructured interviews until theoretical saturation was achieved. The list of codes was systematically whittled down as redundant codes were dismissed and similar codes were grouped together into themes. Literature was revisited in a constant comparison manner and incidents of exception were explored. Finally, through a process of concept formation, the categories were mapped and the theory emerged.

3.8 EMERGING CATEGORIES PRESENTED

This study generated 572 codes originating from 291 primary documents. The process of restructuring and conceptualising the emergent theory is reflected in Table 3-9 below. Inter-related codes were grouped together into 48 categories through a process of constant comparison. Subsequent axial coding and further theoretical sampling, supplemented with selective coding, clustered these categories into 8 themes. Core categories to finally emerge were:

- Moral cohesion
- Innovation negotiations in context
- Responsive governance

Each of the core categories are briefly described and expanded in subsequent chapters.

Table 3-9: Codes structured and organised to reflect the emergent core categories

OPEN CODING (open codes grouped together to form categories)	AXIAL CODING (categories clustered in sub themes)	SELECTIVE CODING (Emerging themes derived from sub themes)	CORE CATEGORY
Awareness of African context Historical and political context	African renaissance	Professional Burden	Moral cohesion
Social value of experts in community Community involvement and benefit	Stewardship		
General availability to learners through technology Use of personal resources	Ethical considerations		
Teacher's past experiences Teacher's attitudes and values as influences Rebellion against mobile ban policy	Teacher disposition	Teacher as Bricoleur	
Teacher's serendipitous / incidental exposure to ICT Teacher's skill set Teacher's formal training	Teacher training		
ICT availability and distribution Hardware and software issues ICT multiple integration	ICT availability and distribution		
Mobile delivery channels Design for mobile Technology bartering	Mobile Technology	Technology implications	Innovation negotiations in context
Technology choice ICT use time constraints Differing skill levels and competencies of learners regarding ICT use	Technology appropriation		
Creative conception Innovation process and sequence	Innovation process		
Learner initiative Task orientation	Learner disposition	Innovation strategy	
Managing learning events Learner workload Project fatigue	Managing expectations		
Pedagogical reasoning Content considerations	Curriculum issues		
Assessment renegotiated Track formative and summative evaluation	Assessment quandary	Reflexive pedagogy	
Incremental steps Multiple roles	Unprecedented initiative		
Pedagogical leadership Self promotion	Self empowerment		
Personal change Engage with other professional bodies	Self-development path		
Formal and informal staff development Wider reach – facilitate teacher growth outside of own environment (formal workshops)	Capacity building		
Taken out of the classroom Task differentiation Increased workload	Hierarchal movement	Organisational change	
Tangible rewards Professional recognition	Incentives growth		

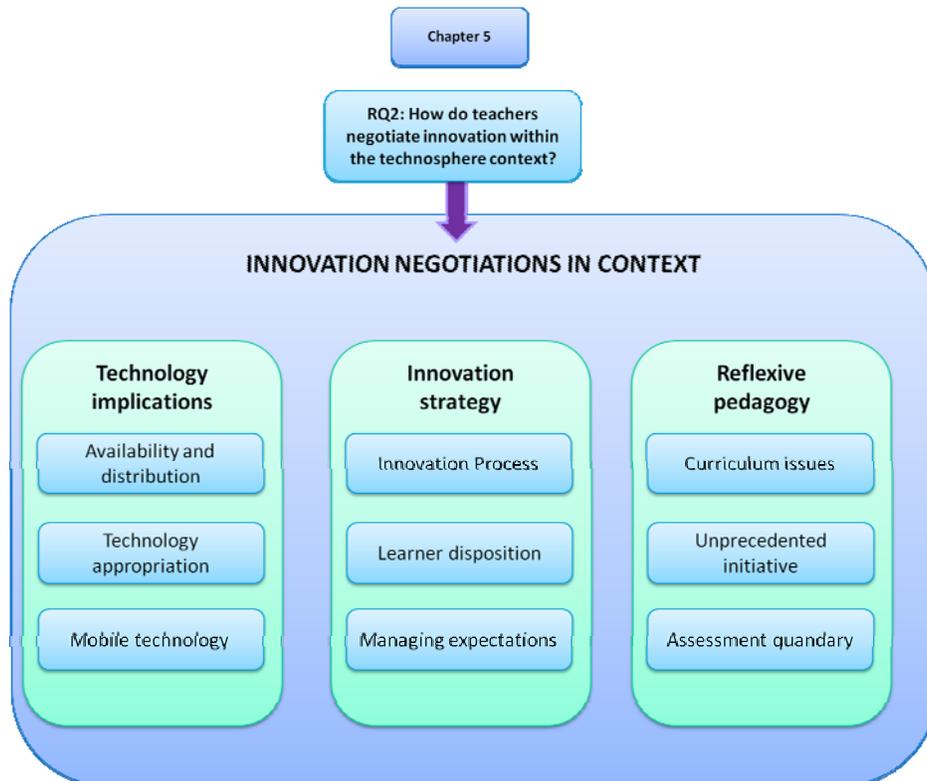
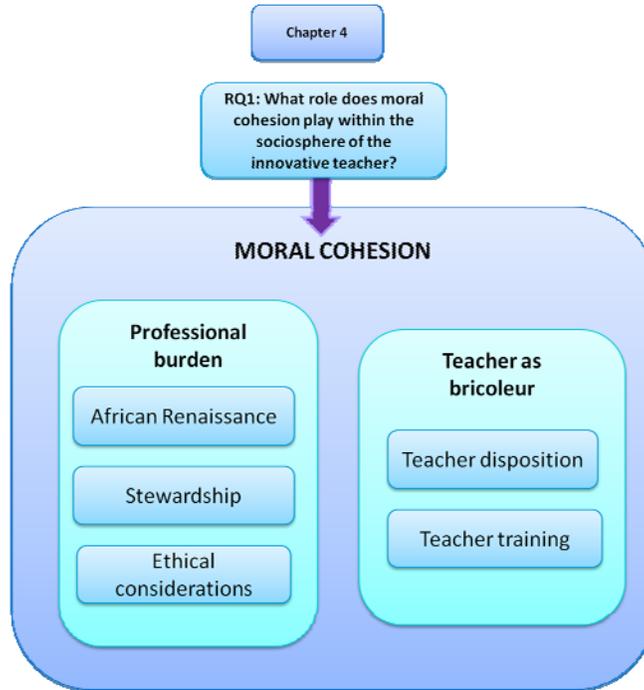
Engage with different forums Seek out conferences and platforms	Lobby for change		
Skills drain, teachers leave		Leave teaching	

The result of the investigation into how innovative teachers' tacit knowledge manifest when they engage with emerging technologies to achieve pedagogical efficacy in a developing context is presented in the next chapters through means of an explanation, visual models and quotations. The resultant theory is entirely based on the data collected and consulted literature.

3.9 SUMMARY

Looking back on this chapter, the researcher gave an account of the research process explicating aspects of data gathering and analysis as well as how to deal with large quantities of data through the use of computer-aided qualitative data-analysis software (CAQDAS). The coding process was detailed and the initial categories presented. The technique of fracturing, conceptualising and developing concepts and categories was presented.

In the next three chapters the emergent categories of moral cohesion, innovation negotiation in context and issues pertaining to governance are presented and discussed. Literature, as an additional data source to enrich and amend the emerging theory pertaining to innovative teachers' pedagogical efficacy when engaging with emerging technologies in their practice, is considered. The contents of Chapters 4, 5 and 6 is depicted in Figure 3-14: *Map of research findings to be discussed in subsequent chapters*.



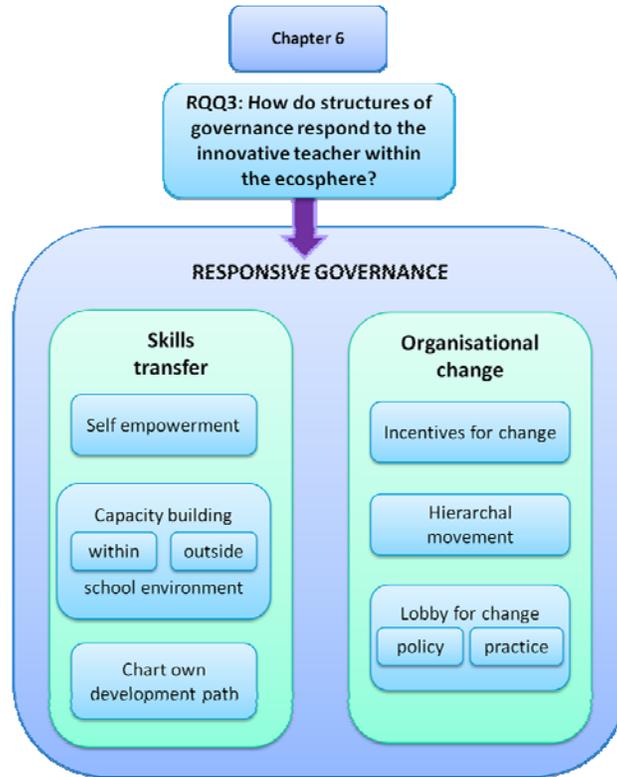
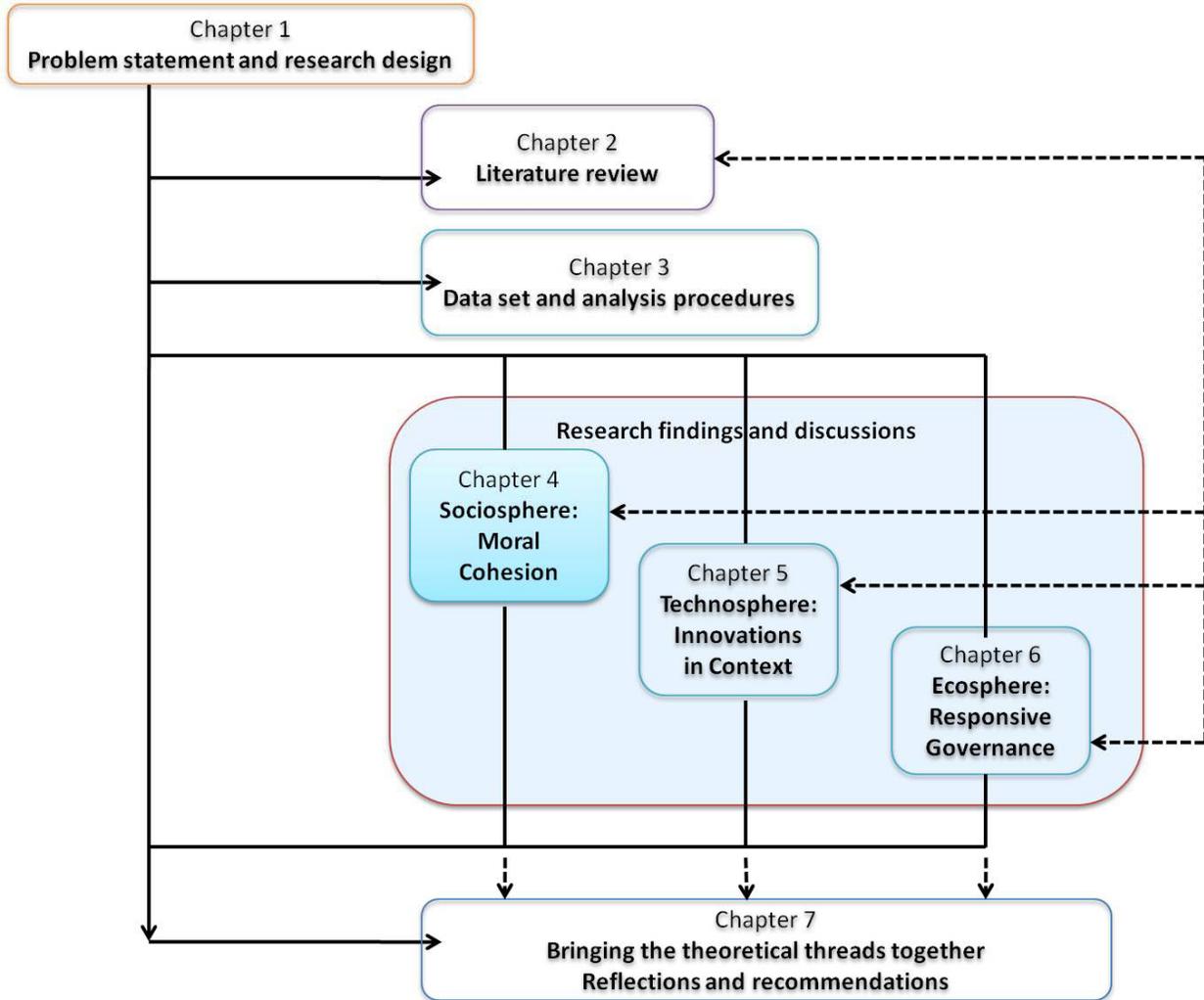


Figure 3-14: Map of research findings to be discussed in subsequent chapters

These chapters were written in tandem in an effort to first put the emerging theory on paper and then to interweave the existing literature to form the substantive theory. Kelly (2004, p. 422) provides some guidance in stating "... the process of interpretation continues and even accelerates as one writes up the research report. Writing, collecting data, reading theoretical work, analysing data, and so on often happen more or less simultaneously. This is especially so in grounded theory, but it is also a general feature of interpretive research". The final chapter covers the research reflection and contributions of this study and gives direction to future research.



CHAPTER 4. SOCIOSPHERE

Education is a social process. Education is growth.

Education is, not a preparation for life;

Education is life itself. — John Dewey

4.1 INTRODUCTION

In the previous chapter the data set and analysis procedures were presented and the reasons for selecting the Straussian Grounded Theory Method were explained. Data gathering considerations, such as the sampling methods employed, were discussed and detail concerning the preparation of data analysis was covered. The various research documents and the key analytical strategies for coding data were also outlined.

In Chapter 1 the research objective for this section was presented as part of the research puzzle (*cf.* Table 1-1) which is briefly revisited in Table 4-1 below.

Table 4-1: Research puzzle for moral cohesion

Research Question	Objective	Subsidiary research question
How does tacit knowledge manifest when innovative teachers engage with emerging technologies to achieve pedagogical efficacy?	To investigate personal convictions, social structure and relationships within the wider community that can hold sway over the innovative teacher.	What role does moral cohesion play within the sociosphere of the innovative teacher?

In this chapter the objective is to focus on the first research subsidiary question: What role does moral cohesion play within the sociosphere of the innovative teacher? To answer this question the researcher collected data (*cf.* Table 3-4) and analysed it in order to investigate *personal convictions, social structure* and *relationships* within the wider community that can influence the innovative teachers' pedagogical reasoning. Evidence from the data will be presented in the form of *quotations* and *reflections* to support the interpretation of the researcher.

Where actual direct quotes are used, for the sake of confidentiality, the participants' names will not be revealed. In order to keep track of these participants however, they have been assigned a special *handle* which refers to the type of data instrument used as well as a number for example PL13 refers to the poster and leaflet of participant number 13. These codes are presented in Table 4-2 below. Where the information is available in the public domain, the participant's identity is not concealed. The following list will be used for the purposes of this research:

Table 4-2: Codes assigned to different data collection instruments during analysis

Data collection instrument	Code
VCT	VCT
Posters and leaflets	PL
Multimedia artefacts	MA
Video Interviews WWITFA	WI
Unstructured interviews	UI
Innovative teacher workshops	IW
Informal conversation	IC

The collected data analysis was supplemented by instances from literature in a constant comparative method. According to Strauss and Corbin (1998, p. 45), when conducting a Grounded Theory study everything is to be considered data whether it be vague, interpreted or derived from literature. This notion is supported by Glaser as assisted by Holton (2004) and encourages the researcher to be proactive and receptive to literature and regard it as another voice, not only to create theoretical sensitivity but also to provide concrete examples of similar phenomenon that can then enlighten the properties and dimensions of categories once they emerge. This process allows the researcher to *rethink* and *re-examine* the data with a different perspective. Therefore in this study, literature is used as another source of data and integrated into the study as part of the constant comparative analysis once the categories have fully emerged.

4.2 SOCIOSPHERE: CRITICAL PHILOSOPHY



Critical philosophy is used within the sociosphere of the innovative teacher to not only reveal the negative power relationships and the issues of concern that exists within a community but also to illuminate the positive aspects and underlying belief systems around teaching and learning with emerging technologies. The cultural-historical context is considered as it situates the participant *within a space* where the technology tools selected for use in an education environment carry the inherent burden of responsibility. The innovative teachers' educational setting includes the relationships between *participant teachers*, their *immediate school environment* which manifests itself through a range of stakeholders including learners, teachers, school leaders and the *wider social setting* encompassing parent and broader community attitudes and values toward education and ICT.

Teachers reflect on curricular changes as influenced by the ideals of the information society (*cf.* Section 2.5.2) and aim to equip their learners with the skills required to make them contributing members of this society.

Before proceeding with a discussion of the data, the first of the emerging themes of the sociosphere is presented below in Table 4-3 along with their sub themes. These emerging themes and sub themes are a result of analysing the data through a process of open coding, concept formation through axial coding and finally concept development through selective coding as previously set out in *Table 3-8: Stages in the analytical process as adapted from Coyne (2009, p. 17) on page 114.*

Table 4-3: Moral cohesion as the emerging core category with expanded theme *professional burden* highlighted for discussion

AXIAL CODING (Categories clustered in sub themes)	SELECTIVE CODING (Emerging themes derived from sub themes)	CORE CATEGORY
African renaissance (cf. Section 4.3.1)	Professional Burden (cf. Section 4.3)	Moral Cohesion (cf. Section 4.5)
Stewardship (cf. Section 4.3.2)		
Ethical considerations (cf. Section 4.3.3)		
Teacher disposition (cf. Section 4.4.1)	Teacher as Bricoleur (cf. Section 4.4)	
Teacher training (cf. Section 4.4.2)		

In the next section each of the listed themes as highlighted in Table 4-3 above, with their related sub themes, will be discussed in more detail and evidence from the data will be presented to support the interpretation of the researcher. Literature will be visited in a constant comparative process to refine the constructs as they emerged.

4.3 PROFESSIONAL BURDEN

The general core duties of teachers are to plan, prepare and execute an instructional program aligned to the national curriculum statements for the subject areas they are responsible for. To this aim they are required to provide learning materials, instruct, assess, keep records updated, manage learner behaviour through a code of conduct, participate in extracurricular activities and interact and communicate with parents and caregivers. Other duties are of a pastoral nature as they not only look after their learners' academic needs but also their social wellbeing. Teachers are also required to invest in themselves and participate in staff development activities so that they can continually review their own methods of teaching and keep abreast of developments in their own subject area (DBE, 2011).

Other than the prescribed traditional teacher duties outlined above, a participating teacher offers a more general version of how he/she views professional duties, as is revealed by UI6:

I see teaching as team responsibility with the team members being myself, the learners and their parents. I am not only to teach the content; I have a responsibility to myself and my learners to keep things interesting that means to teach in a way they will find relevant and not to force my own agenda too much as there must be room for collaboration in an exchange of ideas. I try to keep abreast of developments within my subject but also to keep pace with technology and what it can do (UI,6).

Teachers do not lose sight of their own personal convictions. One of the underlying reasons participants give for their innovative spirit, is their answering a personal call to emancipate not only their learners but themselves and in the process restore and rekindle their passion for teaching as expressed below by UI8:

I want my learners to know what the true value of their education is and how they can make a difference to others through their own learning. It is not about the final score on the report card but about what you are going to do with all the knowledge and skills that you have acquired and how you are going to uplift those that have not had access to the same level of education. Even though teenagers in general are very self-absorbed, they can be made aware of how powerful they are as individuals and they can reach out (UI,8.)

The theme of *professional burden*, as emerging from the analysed data, consists of the sub themes African renaissance, stewardship and ethical consideration. Each of these as displayed in Figure 4-1: Expanded emerging theme: *Professional burden* below will be discussed in greater detail (cf. Sections 4.3.1 – 4.3.3).

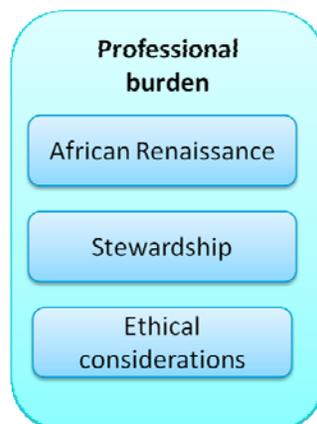


Figure 4-1: Expanded emerging theme: *Professional burden*

4.3.1 African renaissance

The concept of the African Renaissance was placed on the world agenda by the former State President of South Africa, Thabo Mbeki in the mid 1990's. It promotes the notion that the nations and people of Africa, being intimately familiar with their current challenges, can work together to combine African knowledge and values of solidarity towards renewal in economic, scientific, cultural and educational spheres. African ministers of education, from across the continent, met in 1999 and stated:

"We are more convinced than ever, that education is the sine quo non for empowering the people of Africa to participate in and benefit more effectively from the opportunities available in the global economy of the 21st century" (Fleshman, 2000, online).

In addition, the ministers stressed the developing of:

"non-formal strategies for reaching disadvantaged children, including street and working children and refugees; making curricula more relevant to local cultures; promoting use of the mother tongue in the early years of primary education and in adult education; integrating education into the family, community and workplace; and involving teachers and their unions in the development of the teaching profession" (Fleshman, 2000, online).

To achieve these ambitious priorities within the closed educational system, requires investing in the development of human capital in the form of administrators, teachers and learners. Increasing the self-esteem and their wellbeing through a consciousness to inspire free inquiry; to inspire free criticism; and to inspire a new confidence in the possibilities of human thought and creation (Mogale, 2011; Xulu, 2004).

The increased esteem in which the school is held is intrinsically linked to the availability of technology and in this specific case to the establishment of the school computer room. A section extracted from the VCT of Abdullah Sujee reflects sentiments of pride and expressions of hope:

Furthermore, the establishment of the school's computer rooms saw to the school offering computer classes and the ICDL course. When South Africa celebrated its 10 years of democracy and the 200 years of the un-banning of Islam, the school unveiled its own flag and began hoisting the national and school flag daily side by side commemorating the Freedom Charter of South Africa. The school stands as a beacon of hope for South Africa in its pursuit of educational excellence as the school has a history of

100% pass rates at grade 12 level for the past 18 years of its blessed existence (Abdullah Sujee, VCT 2007).

Figure 4-2 below contains an image of a discarded document that was picked up after one of the workshops conducted during the 2009 Microsoft Innovative Teachers Forum Awards.

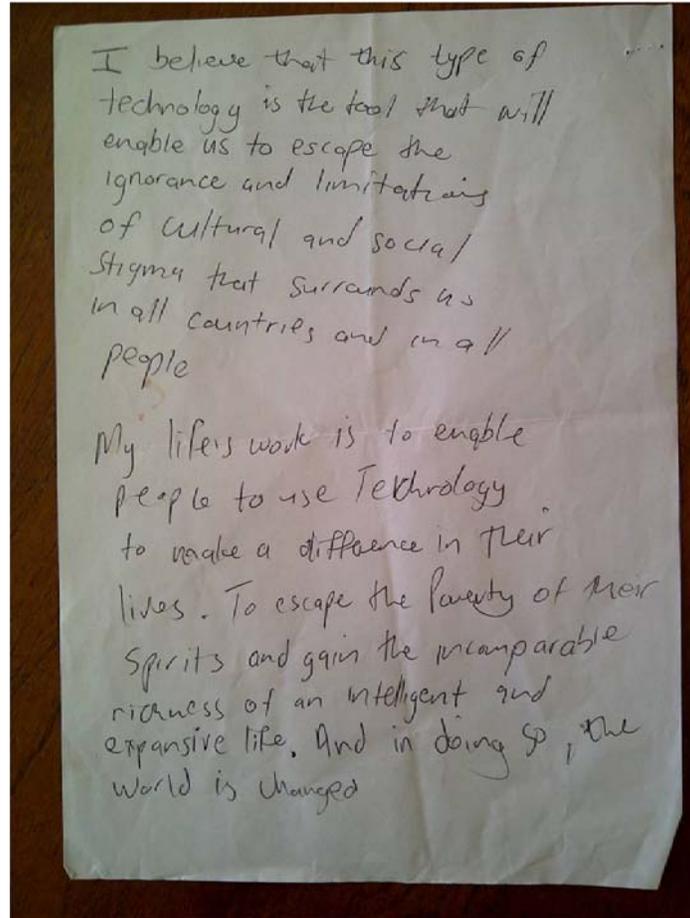


Figure 4-2: Handwritten reflection from a workshop participant in the 2009 Microsoft Innovative Teachers Forum Awards.

I believe that this type of technology is the tool that will enable us to escape the ignorance and limitations of cultural and social stigma that surrounds us in all countries and in all people. My life's work is to enable people to use technology to make a difference in their lives. To escape the poverty of their spirits and gain incomparable richness of an intelligent and expansive life, and in doing so, the world is changed (Finalist Teacher at the ITFA 2009).

These sentiments are echoed in policy documents generated by the African education ministers as they remained optimistic that Africa's educational systems can be significantly improved, given "the recent political progress and increased investment in education in parts of Africa and

the opportunities offered by new information and communications technologies" (Fleshman, 2000, online). The general mindset of optimism has garnered a patriotic display towards the country as displayed below in Figure 4-3: *Classroom on the outskirts of a rural village painted in the colours of the South African flag* after they received a computer centre.



Figure 4-3: Classroom on the outskirts of a rural village painted in the colours of the South African flag

Gruner (2008, p. 16) captures the positive sentiment that is encapsulated within the technology package: "South Africa is still maintaining an astonishing spirit of hope, optimism, perhaps even euphoria, as far as the idea of overcoming poverty and misery by means of technology is concerned." A more recent sentiment from a participant teacher in the Pretoria workshop explains this further by saying that:

We as a people know how to fix this country and for that matter Africa. We just need more dedicated teachers that are not afraid to work with technology. If they do not engage with technology they are letting themselves and their learners down. At the moment the expectations of ICT in a community are very high. It is expected to solve all social problems which we know it cannot (UI,3).

This comment suggests that the naïve perspective of viewing technology as the vehicle which will alleviate all social problems is still prevalent amongst teachers as members of society. The sense of optimism also prevails in schools (as in the example below) which claim that a

functioning computer centre is a *major breakthrough*. The statement below contains descriptions of the rural setting.

Rotterdam Secondary is in Rotterdam Village in the Limpopo Province of South Africa. It is a public school that came into existence in 1992 but only ten years later (i.e. in 2002) it was inducted, along with 102 other schools, into the government's Maths and Science Project called Dinaledi (Sotho translated to Stars). It is found in a predominantly subsistence agricultural setting of the Mopani District some 70 km from either of the following towns: Tzaneen, Giyani and Louis Trichardt. It is a school attended by over 820 Black African learners of mixed abilities, with Xitsonga as their mother tongue and English the medium of instruction. A major breakthrough in the history of the school was the donation of 20 networked computers with server in 2003 by the Telkom foundation. These computers also have internet connection via satellite (Victor Ngobenj, VCT 2007).

However, only a fraction of the schools in South Africa was included in the original Dinaledi program mentioned above, with thousands still lacking basic services. An ambitious program was launched in 2001 to equip each school in the Gauteng province, the most heavily populated province of South Africa, with a fully functional computer centre. The program known as *Gauteng online* was soon dubbed *Gauteng offline* (UI,3). Miscommunications between vendors resulted in computer hardware being installed without the supporting software being delivered and thus many computer centres were rendered useless. The concerns of teachers and schools are addressed on an ongoing basis.



Figure 4-4: Unused school computer centre

The particular school computer centre shown in Figure 4-4: *Unused school computer centre* above, has been unused for two years. The chairs still have their original plastic coverings and the screens and keyboards are covered with blue dustcovers. All the hardware was installed but no software has been made available, as per original agreement, to operate the computers. Other schools, which have functional computer centres, keep them locked as there are no trained teachers to facilitate the classes and staff fear that the computers might be stolen. More recently schools with operational computer centres have had their modems suspended and connectivity severed due to a lack of funds. A sense of disillusionment has set in amongst schools that were originally provided with computer centres. Yolande Peters shares her experience:

In developing countries such as South Africa, it often happens that international donors and local corporations make inappropriate donations to schools in impoverished areas. These donations, in many instances, take the form of computer hardware, and they are given, sometimes, without establishing whether the school has access to electricity, or (more often) without establishing whether the school has the necessary expertise and capacity to initiate computer literacy lessons at the school, and whether the school can even afford the extra monetary expense that the computers will generate as a result of their use. As a result, many computers, given with the best intentions, gather dust in a forgotten corner of a rural school. However, this is not the norm, and the context in the paragraph above serves to highlight the need for full back-up service by large corporate wishing to fulfill their social investment. Such was the case at Byletts Combined School where a donation of computers came together with the added expertise for capacity building (Volunteer Africa, Mr. Mike Denison) as well as the support of an environmental education support service (Wildlife and Environment Society of South Africa, Mr. Phillip Wilkinson). Together with the educator Ms. Peters, the project "The cost of Learning" for computer literacy was integrated to all learning areas and to all lifestyle ethics for the full benefit of South African learners (Yolande Peters, VCT 2008).

As explained in the quote above, there are schools that in spite of the challenges, have managed to deliver teachers that are innovative in their practice and determined to overcome the obstacles. These teachers do not only rely on the technology provided within the centres, but exploit other technologies as well in the community to achieve their objectives.

At the start of this section *African Renaissance* as a sub theme and as part of the emerging theme *professional burden* revealed the widespread conviction amongst teachers and policy makers that the integration of technology into the education system will solve other social problems and catapult the African people into the information society. The disconnect between policy and practice and the largely unsuccessful efforts to implement large scale solutions is well documented, however, the innovative teacher as individual within the education system stays

true to the ideals of the *African Renaissance* and finds unique ways to harness resources from within the community to achieve their objective of emancipating learners through the use of emerging technologies.

In the next section the sub theme of *stewardship*, as part of the emerging theme of *professional burden*, is presented.

4.3.2 Stewardship

The general understanding of the idea *stewardship* is *to be held responsible for something or to tend to the needs of someone or a cause that has been entrusted to one's care*. Within the confines of this thesis, the concept of stewardship means that innovative teachers feel responsible for and tend to the needs of the learners in their care to develop them to their full potential so that they can contribute to their own communities. The concept of stewardship can be expanded to include expert members of the community in an effort to include their indigenous knowledge systems, so increasing community involvement in teaching and learning. One project which displays similarities with the innovative teachers is the School at the Centre of Community (S@CC) Project. Moolman (2011, online) articulates their goal to “ignite active citizenship around the school (to engage parents and other members of the community so that the burden of responsibility for raising and educating our children is shared by more people than a small group of teaching staff.”

Innovative teachers extend their traditional teaching duties to address problematic issues within their community and henceforth reach out to its members in a joint effort to build a cohesive society as demonstrated below:

The topic deals with the environment in which our pupils live. The area of Umzinto and the surrounding areas have been seriously damaged by the floods and no repairs have been done yet. Since our topic for this term was on a healthy environment I decided to get the pupils to research these problems and involve their community so that amicable solutions can be found. At the same time pupils needed to learn the skills and become aware of their rights to a safe environment so that as future residents they take care of their areas of residence (Annie Behari, VCT2009).

Community experts are approached and strategies to harness their capability and know-how are devised in an effort to incorporate their knowledge into learning projects. This gives recognition

to the elders and community leaders and so indigenous knowledge is treated as a valuably rich resource. Indigenous Knowledge Systems (IKS) can be defined as knowledge that is unique to a given culture or society. Decisions are based on local knowledge which in turn is “dynamic and continually influenced by internal creativity and experimentation as well as contact with external systems” (Flavier, 1995, p. 479). The value of IKS is also expressed by the following quote of Yolande Peters below:

Our rural communities are rich in Science and they do not know that, it is the responsibility of the young generation to keep science in our cultures alive. They have to reach out to our communities make them proud of their culture and keep it for them for the next generations. Old people are our great resources, let us use them, they enjoy it with the help of technology (Yolande Peters, VCT 2009).

Innovative teachers and their learners are also confronting their internal creativity. Because of their exposure to a variety of technologies, and the world outside their community, they continually amend their personal knowledge systems but still rely on their community for input and support as the quote below indicates:

Learners realized that social problems are not just for researchers or community leaders, but there they found themselves conducting studies and that was a great experience. They saw mathematics in action and hence realized that, some of the issues can be resolved and consensus being reached if there could be intensive research activities in all societies using statistics. They were delighted to see their results and also overwhelmed to have them published for the broader school community. My learners were very happy and I wish the projects were published in the whole country (Thamsanqa Makhlatini -Let's fix it, VCT 2007).

At the same time community involvement allows learners to develop a healthy respect for their neighbourhood and a sense of inclusiveness. This process leads to a strengthening of the social fabric of a particular society as is illustrated in Simphiwe Njoko's words:

My feeling about the whole project is, it was great and unexplainable because it was good work and good experience to do this project. It was challenging to learner and the main thing is they benefited from it. Their business plans were then invited by the local counsellor in the ward to have more training on entrepreneurship skills (Simphiwe Njoko, VCT 2007).

The resurrection of indigenous knowledge systems is high on the social agenda as teachers encourage learners to take ownership of their culture and value their place within the community. The objective of teachers to engage their learners in projects that target their communities' indigenous knowledge resonates with the University of the Free State research focus area 3.5:

Indigenous Knowledge Systems for People's Transformation Development. The scope of enquiry includes research into local communities (peoples), organisations and institutions which are made up of social and political structures of society, identities, legal practices and jurisprudence, traditional governance and decision processes, conflict resolution, taboos, community controls, communal services, the role of community cohesion pillars (e.g. chiefs, sangomas) and gender roles (UFS, 2011). A project which places value on the indigenous knowledge systems is illustrated below:

Time is ripe to consider the reinstatement of the most important cultural values in indigenous knowledge system such as indigenous trees and herbs. Seeing that the school is having wonderful indigenous tree and herbal gardens, the learners are constantly taken in the garden to learn.. . consult the adult members of the community to research the significance of the plants. Community involvement in this project was the most interesting as the community is highly involved in the project. They voluntary look after the two gardens, purchase herbs and indigenous trees for diabetes, high blood pressure, headaches, body sores, appetite, perfume, as well as for insecticides. Learners are found to be more interested in finding out from their parents and grand- parents about the usefulness of the indigenous trees and herbs (Mmipe Mokghele, VCT 2008).

This focus on community issues was initiated by Jaramillo (2010, p. 51) when he states that “teachers are encouraged to facilitate, to create, and to see themselves as participants within the community.” Because innovative teachers are members of a community, they share the burden of localised problems in the area. These teachers use their position in society to mobilise action, as indicated by Mfeka Hlengiwe below:

Knowing that the school is a micro society, we have seen that what affects learners from their society is carried over to the school. So in order to deal with problems affecting learners in schools, we had to go out and look at the root cause of the problem in the community (Mfeka Hlengiwe ,VCT 2009).

The responsibility to mobilise learners does not only extend to the community members but to governmental structures as well. The *Zero tolerance for bribery campaign* poster by Chris Gatsi, presented in Figure 4-5 below, demonstrates this issue. The project is an anti-bribery campaign which was later brought to the attention of the Department of Home Affairs. The learners had to produce a media campaign, publish articles on a website and produce a DVD to raise community awareness on the effects of bribery and ways to stop it. With this project the teacher aimed to make learners aware of positive citizenry.



Figure 4-5: Zero tolerance for bribery - poster by Chris Gatsi, 2010

It is also important that learners think about their broader role within the community. Learners that cannot rely on their care-givers for support in their projects will actively seek it from other members of the community.

By involving leaders and experts from the community my learners get a sense of where they fit into a community and what their responsibilities are towards safekeeping its values or what needs to be set right (Murphy Mugabi, VCT 2007).

Jaramillo (2010, p. 48) also support Murphy Mugabi's statement by saying that "it is imperative for teacher educators to gain knowledge of and insight into a wide array of educational philosophies and to ground their teaching practice historically and socially in the communities they serve". This is further alluded to by Annie Behari in her statement below:

My project "Recreational games for rural South Africa" is innovative as I do not only intend to achieve learning outcomes, assessment standards or 21st century skills. I believe that our youth need to learn to create a violence free society, they need to live in a society where family structures which are harmonious thereby leading to emotionally, physically, mentally and socially well balanced members of their community who are able to make decisions to create better environment for the future generations via sport. Via recreational games I intend to bring family members to play together thereby encouraging

togetherness, teamwork, team spirit, communication between child and parent and caring for the elderly as they are the fountains of morals and values (Annie Behari, VCT 2008).

Participant teachers' expressed feelings connected to the people of greater Africa as they all share similar burdens. However they saw it fit to make a start within their own communities with the hope that their ideas and interventions would stretch across to other schools and communities. In the case below, the teacher advocated the promotion of local business through engaging youth from both the rural and urban areas in an exchange of lifestyle reflections. A short description of his objective is contained below:

The concept "Bright lights or Dust Bowl" carries symbolic inferences. Young men and women (learners included) from the rural areas are the ones who are particularly attracted to the city. They think everything in the city is beautiful and lovely. Most of them view the city as "beautiful Bright Lights" and the rural area as dull and boring, in fact, nothing but a "Dust Bowl. One of the possible solutions to this problem is to promote businesses in rural areas. In order to make this project successful we had to expose learners to the nearest cities. We had to time our trip in such a way that we arrived in the city in the early morning, and left in the late afternoon. This was deliberately done to expose the students to one of the pressures of city life, which is traffic congestion. They made contact with other youth in town and subsequently communicated and were encouraged to share their life experiences in an exchange of poems, essays and ideas reflecting on the pressures they have to cope with in their own environments (Victor Ngobeni, VCT 2007).

At the start of this section the sub theme *stewardship*, as part of the theme *professional burden*, was described as *to be held responsible for something or to tend to the needs of someone or a cause that has been entrusted to one's care*. Subsequent to the review of data and literature, the concept of indigenous knowledge systems surfaces as a strong influence on stewardship. Indigenous knowledge guides the innovative teacher and the learners to make sense of their own place within the community and also the particular value they are capable of adding through their more modern approach. They examine their use of new technology to harvest knowledge from members of their community and contribute their ideas and solutions to uplift their own society.

The next section will look at the ethical dilemmas innovative teachers face within their practice of teaching and learning with emerging technologies.

4.3.3 Ethical considerations

In the statements below Gruner indicates the importance of ethics for innovative teachers:

“Innovation in Technology has triggered Innovation in Ethics, because the “old” ethics was not sufficient to cope with the moral problems of a “new” world created by the advent of new technology” (Gruner, 2009, p. 18).

Ethics, in relation to this research, include determining codes of conduct, rules, policies and procedures in the formal learning environment and, in an increasing fashion, to the informal learning environment.

Pressures brought on by the information society are directed from three differing perspectives (*cf.* Table 2-4: *Three approaches to the information society* on page 72). Teachers are influenced from within the theoretical, political and the everyday prosaic perspectives. When considering all three perspectives, the political narrative is currently the strongest as reflected in policy documents articulating the South African vision for ICT in 2015. The development narrative continues with the emphasis on entrepreneurial and research skills to build capacity and address local and global challenges (Maredi & Neethling, 2010). In contrast to the governmental organisational structure and its agenda, innovative teachers are ensnared within the everyday prosaic, unstructured and utopian perspective. In this space there is an onslaught of technologies bringing with it a range of ethical concerns. At the same time teachers struggle to come to terms with the ethical choices they are forced to make in the execution of additional obligations.

The full impact of using emerging technology for the purposes of teaching and learning can never be fully predicted. There are *unintended consequences* as each emerging technology reshapes previous parameters.

One field of applied ethics that resonate with this study is the *ethics of responsibility* as articulated by Ströker in Gruner (2009, p. 19). Ethics of responsibility is divided into four categories:

- *Future Ethics.* Modern technology has far-reaching consequences not only for today but future generations.
- *Social Ethics.* It is acknowledged that the most difficult and moral problems of our time are the result of complex structures of collective behaviour rather than the result of individual activities.
- *Ethics of Nature.* Modern technology does not only affect humans but also natural resources on which human living and survival depends.
- *Ethics of Democracy.* Political, power and scientific expertise are ambivalent as regards whom to serve.

When engaged in the art of teaching and learning with technology, teachers are required to be responsible in carrying out their duties and in turn they cultivate this notion of *acceptable behaviour* in their learners. The act of being responsible in the use of emerging technologies inherently include the ethics of the future, social, nature and democracy in an attempt to mitigate the unintended consequences that could transpire in the unfolding of the innovative project. In every situation where *responsibility* is demanded, it must also be clarified *who* is liable, for *what*, and to *whom*. Thus the issue of power re-arises in the question: What means of sanctions are available against those who have not honoured their responsibilities?

Thus considerations are given to the personal and learner owned devices selected for voluntary use in the classroom. Teachers grapple with issues such as availability of such devices, whether they can reflect on their practice in open forums and have an open opinion on events taking place within and outside of the classroom. In the case of learners they lament the lack of guidance from authorities as most responses seem to be knee-jerk reaction in response to a controversial issue that involves the inappropriate use of mobile phones by learners. Authorities offer little proactive guidance and therefore no real support. The following compilation of issues was taken from a variety of sources including VCT's, workshop discussions and interviews. Teachers seek answers to the following recurring questions:

Should I be available to my learners 24/7? What is a reasonable response time to their queries? Should formative learner work be made available to a larger audience? How do I instil in my learners aspects of digital safety for they tend to share too much? What do I do if they share too much with me as their

teacher that is of a personal nature? We make the rules up as we go along but when are they going to be standardised? Learners are generally more available through technology especially on their phones but where is the limit? Who carries the cost for the use of learner owned devices? Not all learners have equal access to technology and even if they did they have limited amount of airtime – how do I not waste their money? How do I design tasks allowing for collaborative group work when the capabilities of their devices determine the level of their participation? Is it proper for parents and learners to contact me on my own personal technology? How do I separate my personal from my work online profile? When learners create digital artefacts, should their names be included in the work to be displayed for all to see? Learners sometimes include photographs of themselves in their created resources – can they be shared online?

The lack of guidelines, which should help teachers through the difficulties of dealing with new technologies and the ethics they raise, is corroborated to some extent in a documented case study about managing unrealistic expectations as regards the availability of lecturers at an institution of higher learning. This case is equally relevant to teachers in secondary schools. Hodgkinson-Williams and Ngambi (2009, p. 17) state that: “. . . lecturers and tutors are not as available as students would like. DFAQ certainly extends the availability of lecturers, tutors and other students during non-teaching times . . . clearly there is a danger that – unless clear guidelines are set about reasonable response times – lecturers and tutors will not be able to meet the unrealistic 24/7 expectation that they feel some students have.”

Another concern that needs to be dealt with is how to manage the parents' expectation, especially with regard to the use of their child's mobile phone for teaching and learning purposes. A participant in the Innovative Workshop held in Pretoria states the following:

Parents often misunderstand the implications of using new technologies. They react with fear and there is little trust. Where in the past they have trusted us with the education of their children, they now frown on the use of mobile technologies especially their children's' own mobile phones to further their education. They don't trust it and view it as a threat. Because of the negative association we have a lot of push back to conform to what parents conceive as the normal way of teaching. It therefore becomes a problem not to only get the learners on board, that is the easy part. It requires a lot more work to get parents behind you. That is why you need to do everything in a transparent manner (IW,Pretoria).

Parental concerns are real and Wishart (2010, p. 17) writes about the ethical implications of mobile learning in secondary schools commenting that "(w)e have ever more fantastic learning opportunities to look forward to as handheld devices gain acceptance, reliable and affordable connectivity and even the ability to project images on nearby walls or screens. Yet we are in danger of losing such opportunities through collective fear of cyber-bullying and irresponsible

use by pupils of a technology whose potential their teachers haven't been given time to fully explore." To prevent the potential loss of using new devices in teaching and learning, innovative teachers are going to great lengths to manage the fears of parents and the school community and put mechanisms in place to educate their learners in the responsible use of their own and other connected devices. The following is a brief description of the project titled *Cyber Crisis. Can I make a difference?* extracted from Lyneth Crighton's, VCT, 2008 that focused on digital safety:

The Challenge

Research a danger of the Internet to children and develop a PSA that will create a public awareness about that problem.

Learners have to create a Public Service Announcement (PSA) on an Internet danger to children that they have identified.

Subject area

In Computer Applications Technology the learners are required to learn a presentation package; Microsoft Photo Story 3 gives the learners an alternative to the usual presentation packages of Microsoft PowerPoint or FrontPage and are easily converted to play on any mobile phone.

General comments

The learners were excited to do something different, and use a program which they could use for recreational purposes too. They liked the ability to share their creations via cell phone technology and were proud of what they had learnt and what they had achieved. Learners could warn friends about relevant dangers in a fun and innovative way.

Project Brief

Too many children surf the Internet without being aware of the dangers? There has been a lot in the media, lately, about the dangers in "Cyber Space". Happy Slapping; Cyber-Bullies; Child Pornography are all Cyber crimes that are on the rise with increasing Internet bandwidth and access to the Internet on a variety of device that learners own. Educating children, parents and teachers of the dangers, while not reducing the education value of the information that can be found on the Internet creates an interesting debate. How do you communicate the seriousness of the situation and make all the stakeholders aware of the dangers?

Key Thought: *In many areas of the Internet, children can be exposed to numerous dangers! How do you get through to them?*

Tone & Style: *Emotional*

The *Cyber Crisis* project featured above, offers some insight into the response of a proactive and innovative teacher who was able to manage fears regarding digital safety in the school community. The very devices which are feared most namely mobile phones were used to bring the message across.

The universal standard which currently guides members' ethical conduct hails from the Association for Educational Communications and Technologies (ACET, 2007). Points relevant to innovative teachers in the execution of their duties and their practice of using emerging technologies have been selected and are presented in Table 4-4 below.

Table 4-4: Code of professional ethics (ACET, 2007, online)

Sections of responsibility	In fulfilling obligations teachers:
Commitment to the individual	1. Shall encourage independent action in an individual's pursuit of learning and shall provide access to varying points of view. 2. Shall protect the individual's right to access materials which contain varying points of view. 3. Shall guarantee each individual the opportunity to participate in any appropriate program. 4. Shall promote current and sound professional practices in the use of technology in education. 5. Shall, in the design and selection of any educational program or media, seek to avoid content that reinforces or promotes gender, ethnic, racial, or religious stereotypes. 6. Shall seek to encourage the development of programs and media that emphasize

Sections of responsibility	In fulfilling obligations teachers:
Commitment to society	<p>the diversity of our society as a multicultural community.</p> <ol style="list-style-type: none"> 1. Shall honestly represent the institution or organization with which that person is affiliated, and shall take adequate precautions to distinguish between personal and institutional or organizational views. 2. Shall represent accurately and truthfully the facts concerning educational matters in direct and indirect public expressions. 3. Shall engage in fair and equitable practices with those rendering service to the profession. 4. Shall promote positive and minimize negative environmental impacts of educational technologies.
Commitment to the profession	<ol style="list-style-type: none"> 1. Shall accord just and equitable treatment to all members of the profession in terms of professional rights and responsibilities, including being actively committed to providing opportunities for culturally and intellectually diverse points of view in publications and conferences. 2. Shall not use coercive means or promise special treatment in order to influence professional decisions of colleagues. 3. Shall inform users of the stipulations and interpretations of the copyright law and other laws affecting the profession and encourage compliance. 4. Shall observe all laws relating to or affecting the profession; shall report, without hesitation, illegal or unethical conduct of fellow members of the profession to the AECT Professional Ethics Committee; shall participate in professional inquiry when requested by the Association.

Before using technology in the classroom attention should be given to issues relating to social and ethical issues:

“Identifying and addressing safety and ethical issues as an integral part of a teacher's role in preparing digitally literate citizens to use technology within the networked global community in a safe and socially appropriate manner, must be viewed as a keystone supporting wise and thoughtful practice in the networked classrooms of the 21st century. Promoting responsible practices will occur only through the explicit preparation of teachers who are aware of what they are doing, as opposed to those who are not” (Hicks, Sears, Gao, Goodmans, & Manning, 2004, p. 480).

One of the stumbling blocks to the explicit preparation of teachers is the problem of *currency* as technology is very dynamic with new solutions and devices continually being released into the market. Guidelines which were appropriate for established practices soon become irrelevant and outdated. The prolific use of social media brings about new habits and therefore new inherent

dangers emerge. Generic guidelines are therefore necessary and they should remain flexible enough to grow with technological capabilities and new practices in the learning interactions. Table 4-5 below contains some strategies that were adopted by innovative teachers in their use of emerging technologies.

Table 4-5: Coping strategies to address ethics as adopted by innovative teachers in their use of emerging technologies

Strategies	Description
Communication	Negotiate with learners and governance structures within the school to reach a common understanding of ethical issues that impact collaboration, information sharing and ownership of created artefacts.
Managing expectations	Involve effective communications with managing staff so that there is an effective chain of command ensuring that they stay informed. Guidelines are circulated to parents and caregivers. Boundaries such as teacher availability, adequate response time and level of support are discussed prior to deploying new technologies in the teaching and learning space. Values vs Rules. Govern the social and personal engagement of learners and teachers with new technologies according to a shared value set. These values are widely promoted and shared.
Policies	Draw up guidelines in consultation with learners and management to ensure that they are inclusive. Clearly articulate roles, responsibilities and related sanctions.
Inclusiveness	Design learning events and group activities that allow for the sharing of available technologies to accommodate technological diversity and to avoid exclusion on the basis of owned personal technology or lack thereof. Allow for technology bartering amongst group members (<i>cf</i> Section 5.3.2).
Licensing of learner and teacher created resources	Teachers and learners are encouraged to licence their work through creative commons to determine the level of copyright before sharing it online. This provides a sense of autonomy.

At the start of this section the sub theme *ethical considerations*, as part of the larger theme *professional burden*, was presented with reference to literature and concrete examples from innovative teachers' reflections and described activities. The data analysis revealed an uncertainty amongst teachers regarding appropriate ethical conduct when allowing new technology into their teaching and learning space which was previously reserved for more traditional and widely accepted forms of educational technology like the interactive whiteboard. Due to a lack of structure and guidelines from governing authorities teachers navigate ethics in their practice by articulating their own set of practical rules to guide themselves and their

learners. They try to keep these guidelines generic and fluid in order to accommodate new technology developments and move from a *rules based system* of governing to a *value based system* (Batchelor & Botha, 2009b). In this way teachers inadvertently include Gruner's Ethics of responsibility (*cf.* Page 131) which emphasises social and future ethics in their course of action.

The next section will focus on the remaining theme to be covered in this chapter. *Teacher as bricoleur* is composed of elements that emerged from the data and were grouped together to form the sub themes of *teacher disposition* (*cf.* Section 4.4.1) and *teacher training* (*cf.* Section 4.4.2) as highlighted in Table 4-6 below.

Table 4-6: Moral cohesion as the emerging core category and related expanded theme *teacher as bricoleur* highlighted for discussion

AXIAL CODING (Categories clustered in sub themes)	SELECTIVE CODING (Emerging themes derived from sub themes)	CORE CATEGORY
African renaissance (<i>cf.</i> Section 4.3.1)	Professional Burden (<i>cf.</i> Section 4.3)	Moral Cohesion (<i>cf.</i> Section 4.5.)
Stewardship (<i>cf.</i> Section 4.3.2)		
Ethical considerations (<i>cf.</i> Section 4.3.3)		
Teacher disposition (<i>cf.</i> Section 4.4.1)	Teacher as Bricoleur (<i>cf.</i> Section 4.4)	
Teacher training (<i>cf.</i> Section 4.4.2)		

4.4 TEACHER AS BRICOLEUR

Teachers are knowledgeable in the art of using *whatever means* and *whatever is at hand* to reach pre-determined learning outcomes in challenging contexts. As a result they have been described as *bricoleurs* in relation to their craft (Attwell & Hughes, 2010; Pearson & Somekh, 2006; Wiseman, Groves, & Appignanesi, 2000). This behaviour is not new or unique to the teaching

profession but in relation to this study it encapsulates the original ideas of the anthropologist Claude Lévi-Strauss. He described the actions of a *bricoleur* as he begins his work:

“His first practical step is retrospective. He has to turn back to an already existent set made up of tools and materials, to consider or reconsider what it contains and, finally above all, to engage in a sort of dialogue with it and, before choosing between them, to index the possible answers which the whole set can offer to his problem. He interrogates all the heterogeneous objects of which his treasury is composed to discover what of each of them could ‘signify’ (Lévi-Strauss, 1966, p. 18).”

When innovative teachers engage in the task of designing projects wherein emerging technologies are to be incorporated, they take into account the repertoire of skills which they have accumulated in the course of their teaching careers. Even though the technology they will be using is new to them and they have not fully anticipated the results of using it in the classroom, they are confident in their ability to solve problems and the challenges they present. This is a skill they do not only require from their learners but also apply to themselves and in collaboration with learners they deliberate the best solution for a given task.

Capra in Kincheloe (2007, p. 12) states: “The social and physical worlds are so complex that they can only be understood like human beings themselves: not machine-like, but unpredictable, dependent upon context, and influenced by minute fluctuations.” Thus bricoleurs focus their attention on addressing the complexity of the lived world and understand the reality that the knowledge they produce should not be viewed as a trans-historical body of truth. In this framework, knowledge produced by bricoleurs is provisional and subject to change. Teachers continually augment their understanding as their access to more diverse technologies increases. Bricoleurs know that tensions will develop in social knowledge as the understandings and insights of individuals change and evolve (Blacker, 1995).

The process of using technology for creation, remixing and sharing is bound together by a set of possible relationships and teachers, in collaboration with their learners, find new ways to benefit themselves and their communities.

Attwell and Hughes (2010, p. 24) believe that the success of the bricoleur, whose ideas and solutions straddle the virtual as well as the physical world, “will depend on their judgments as

well as an element of trust to drive the innovative process forward.” There is little regard for perceived correct procedures but teachers and learners are pragmatic and more focused on the completion of the task. Judgments are made on the premise of pre-existing knowledge as to their learners’ capabilities, their skill levels and the affordances of the emerging technologies they are considering for use. Trust on the other hand is built up over a period of time and it is forged through teachers’ relationships with those involved in the learning event.

The next section will focus on the sub themes of *teacher disposition* and *teacher training* as it emerged through the data analysis. Each of these as displayed in Figure 4-6 below will be discussed in greater detail (*cf.* Sections 4.4.1 – 4.4.2).

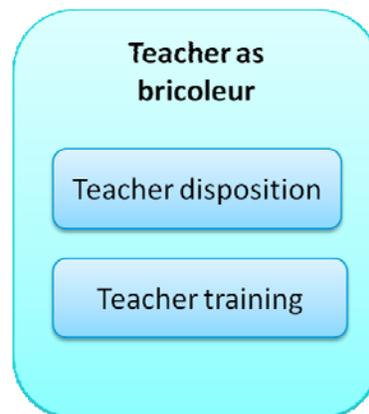


Figure 4-6: Expanded emerging theme: Teacher as Bricoleur

4.4.1 Teacher disposition

The definition of *disposition*, within the realm of social foundations in education, should be shaped by John Dewey’s idea which enhances both the intellectual and social growth of teachers and thus helps them to acquire characteristics that support their teaching activities (Dottin, 2010). Teacher disposition has a strong influence on student learning and development. Stronge (2002) puts forward six dispositions displayed by effective teachers that have bearing on learner achievement namely caring, fairness and respect, positive attitude towards teaching and friendly and personal interactions with learners. Van Manen (1991) offers the following as critical characteristics inherently found in teachers: love for children (caring), sense of responsibility, self-critical openness, moral intuitiveness, interpretive intelligence, passion for knowledge and learning, moral fibre, humour and hope in the face of crisis.

All the comments below were extracted from Gaye Pieterse's VCT. She presented a workshop at her school on how to use ICT to develop teacher and learner entrepreneurial skills. The workshop was conducted over a weekend. Teachers travelled from across Kwazulu Natal to attend the workshop. These are some of the comments at the end of the workshop:

Without a genuine and personal investment in what and how we teach, the job just becomes a mindless set of actions. Teach with the technology that personally inspires you (Gaye Pieterse, VCT 2008).

"Such a phat, fab, & fantastic workshop that has opened our eyes & enriched us with more skills on how to make EMS fun. For me, it was my energizer, so I'm refreshed & ready to go out there & make a difference'." - Olga Stima (Nansindlela Combined School - Richard's Bay)

"The workshop was so interesting. It empowered us. So now I am going to cascade the information to my learners as well as community. We need more of this!" - Zanele Sithole (Khethindlelenhle – Pietermaritzburg)

"A very wonderful and educative workshop. Provided me with confidence and skills to face classroom challenges. Unlocked my potential & will equip me a lot. Workshop also looked at leadership skills & motivates me to do more for my learners." - M.B. Shandu (Inguzegcwensa Primary - Pietermaritzburg).

"An excellent workshop. Made me confident again. Thought I'd lost myself forever. Now I can help my kids achieve the dreams/goals cause I believe in myself. Thanks." - Reshma Rajcoomar (Palmview Secondary - Durban)

"I feel very inspired to go back to school & assist the boys in becoming 'global entrepreneurs'. I have really enjoyed this workshop and thank Gaye for her inspiration & passion which is very courageous." - Janine Adams (Glenwood High - Durban)

Teacher outlook, prior life experiences and beliefs influence their participation in ICT related initiatives as evident in the following quotation taken from Annie Behari's VCT:

I love challenges and dare to go against norms of the 1960's teaching methods which still exist at my school . . . I believe that my learners are Y2K kids and they need to be taught in their "language" which is inclusive of technology. Y2K pupils need to be challenged so that we uplift the calibre of the employee in the place of work (Annie Behari, VCT 2009).

According to Nespor (1987, p. 19) as cited in Li and Hughes-Wilhelm (2008) "Beliefs are far more influential than knowledge in determining how individuals organize and define tasks and problems and are stronger predictors of behaviour." Richardson, Anders, Tidwell and Lloyd (1991), later supported by Webb and Cox (2004), found that a change in beliefs preceded a change in practices. The implication therefore is that studying teachers' practices will give us a

glimpse into their belief systems. The following innovative teacher holds a life philosophy of constant change that heavily influences classroom practice:

You need to develop a habit of change. A habit of evolution. Maybe Lamarcks theory of evolution “the acquired traits” is perhaps better to use than Darwin’s “the fit will survive”. By that I mean the earlier and more simplistic way of looking at evolution whereby as a teacher I possess the ability to develop and acquire new traits ,specifically in my use of new ways of looking at how I plan and execute my lessons. Therefore, the more I move in a new direction, the better I become in it and the more comfortable I am to keep the momentum going. The same applies to my learners. If we do the same things day in and day out there is never any expectation for change to happen (UI, 7).

Positive reinforcement from learners in the class and the constant demand for keeping abreast of new developments serve as a powerful motivator to innovative teacher Warren Sparrow. He states:

Although I am the computer teacher, I also teach in other classes, regardless of subject or grade. Every day is different and keeps me motivated. As technology changes, I am able to change what we do in class. There is always something new that the learners have not seen and it keeps us all on our toes! (Warren Sparrow, VCT 2010).

The implementation of innovations in the teaching practice is a comprehensive process, requires continued enthusiasm. Teachers look for support from their learners whose affirmation they highly value (Novotný, 2003). The overall worth of teachers is reinforced by positive comments from their learners. This particular learner, participating in the project *My community my Pride*, explains how his regard for himself and his teacher changed in a positive way. He says that his respect for himself and his teacher has grown in the course of the project:

It was an interesting and encouraging project, as I’ve learnt many things. This project also helped me to know and identify the class and type in which my community falls. Working with people made me a well known person within my community. It also helped me practice and gain many skills that will help me in the workplace. It was like I’m doing a certain course in which I will be something after it. This took me from being lowest to highest. “God is the first factor that can take you from zero to hero “But” Mrs Mfeka is the second factor (Mfeka Hlengiwe, VCT 2009).

Activism also plays a role in teacher disposition as it dictates levels of interaction and mobilisation of learners within a community as shown below:

I carried out this project about indigenous plants as a way of creating awareness about their scarcity among the learners as well as the members of the community across the country. I am also a member of Greenpeace international in Lesotho. With this project, I have realized that to research about the indigenous plants, like any other topic, educators need to be proficient in the use of a technologies such as cell-phone, digital cameras and computers in order to help learners together with the community to collect, manipulate and analyse information (Moliehi Molefe, VCT 2009).

Spillane (1999) developed a multifaceted model that illustrates the elements which influence a teacher when he/she attempts to initiate change within their practice. He proposed a six P's model to untangle the complexities at play in the personal zone of enactment as depicted in Figure 4-7 below.

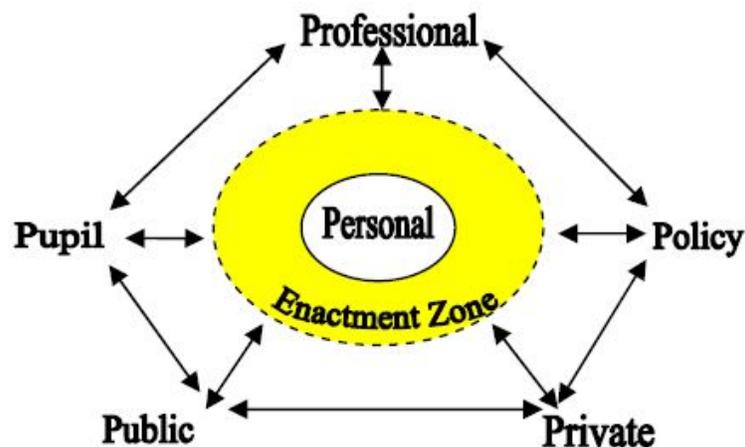


Figure 4-7: Reform of classroom teaching (Spillane, 1999)

The personal enactment zone is an area of potential development and also the space in which the teacher makes sense of innovations while taking into account the external factors within the outer circle namely professional, policy, private sector, public and pupil. The engagement with the external elements is essentially a social process and each encounter can provide either encouragement or detract teachers from learning about and changing their practice. Each of these factors is elaborated on in Table 4-7 below:

Table 4-7: External elements influencing the proximal zone of enactment (Spillane, 1999)

External elements	Description
Professional	Refers to the associations on both the formal level in teaching bodies as well as the informal contact amongst educators in their daily engagement.

External elements	Description
Policy	Encapsulate all the policy initiatives driven by education authorities and school governing bodies.
Private sector	Includes curriculum and resource developers and the business industry.
Public	Includes the interests of parents and community concerns.
Pupil	More specifically teachers' perceptions about their pupils have an important influence on teacher practice in education reforms.
Personal resources	The teachers have for learning about their practice and the opportunities they are bound to notice and exploit to further their practice.

Central to the Spillane model is *the zone of enactment* that is depicted with a dotted line in Figure 4-7 above, demonstrating its dynamic nature as it expands along a continuum from individualistic to social. Teacher initiative and change does not only depend on their own capabilities but also on their interactions with external incentives and opportunities. These outside elements of policy, professional and public are filtered through the teachers' own personal beliefs, knowledge and dispositions before enacted in their reformed practice.

Hansen (2001) cautions that the acquisition of disposition is not an add-on feature of a teacher but rather inherent in the process of education. He states: “. . .the moral quality of knowledge lies not in its ‘possession’ . . . but in how it can foster a widening consciousness and mindfulness” (Hansen, 2001, p. 59). The widening realization stems from the additional life experiences teachers have that impact on their practice as reflected in the thoughts of innovative teachers below:

- *My passions beyond (and within) teaching include environmental concerns based on a deep love of nature and animals; and gender politics. Other interests of mine are complementary healing techniques particularly massage, and Reiki; and Ballroom and Latin American dancing (Nicci Hayes, VCT 2009).*
- *My interests outside of the school provided me with confidence and skills to face classroom challenges (IW, Port Elizabeth).*
- *Because I run small businesses myself, I am able to relate the learning area in a practical way. Most teachers have never been in business and yet are expected to teach how one should become an entrepreneur; surely one needs an entrepreneur to teach entrepreneurship (Merna Meyer, VCT 2007).*

In Table 4-7: *External elements influencing the proximal zone of enactment (Spillane, 1999)* (cf. page 156) Spillane mentions that teachers' perceptions about their learners have an important influence on their practice. Innovative teachers Sunia Dokter, Shireen Persens, Ngaka Ralekoala and Lehentse Seekoei relate how the way they in which they viewed their learners evolved during the course of the project *Children who cares*:

As teachers we had the opportunity to meet learners at their level – listening to their vulnerabilities and their stories – which will always have an impact on the way we see the learners in our class – this project has changed the way we teach, listen and understand our learners (Sunia Dokter, Shireen Persens, Ngaka Ralekoala & Lehentse Seekoei VCT 2010).

In the *Children who cares* project, learners from participating schools received training in ethics and research methodology. They then conducted their own research in their local community to determine the needs of vulnerable children. Through this project, learners have been given the opportunity to collaborate with other schools, the University of the Free State as well as experts in the field of social action research from the De Montford University in the United Kingdom via the Internet. Part of the poster as illustrated in Figure 4-8 below, articulates the roles of learners, teachers and vulnerable children in the community.

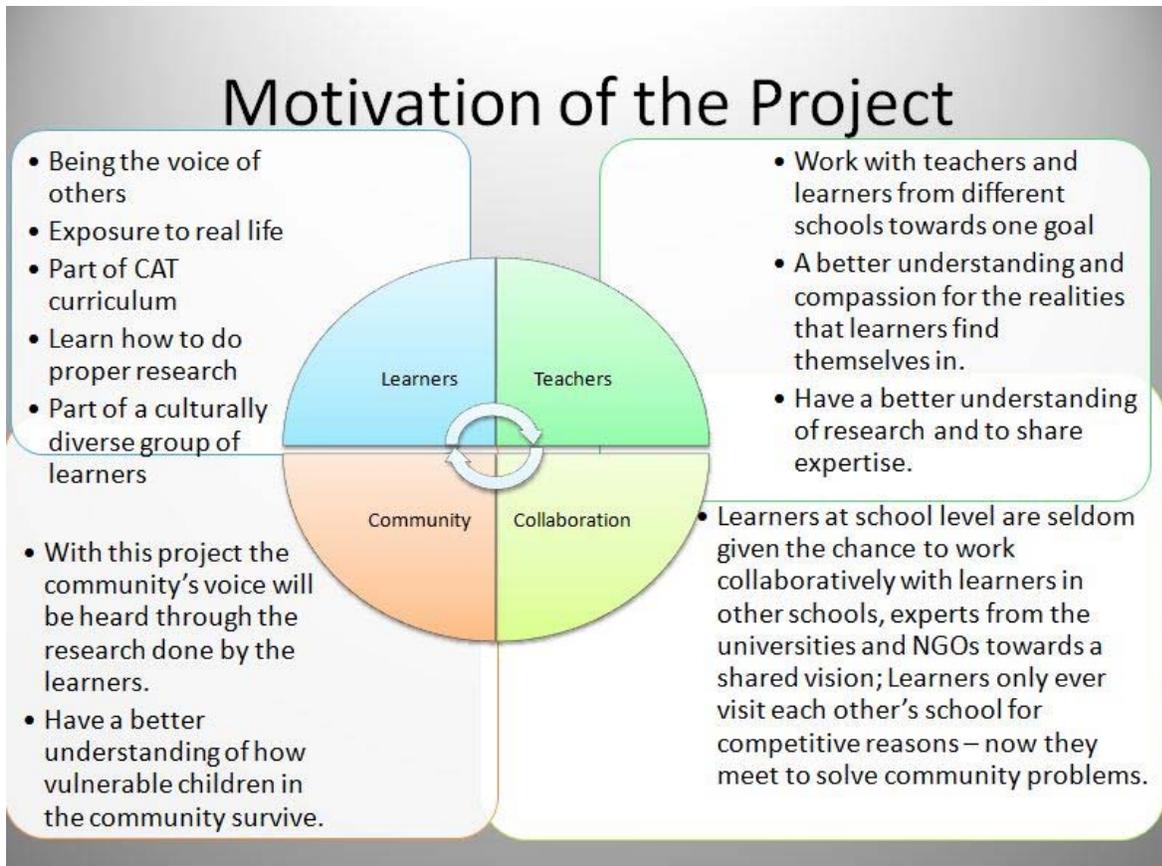


Figure 4-8: Poster section of the *Children who cares* project.

Teacher disposition is a complex construct which Spillane's proximal zone of enactment endeavours to clarify. Unbeknownst to the innovative teachers themselves, they managed to include all external elements in their practice that could possibly influence their personal zone of enactment (*cf.* Figure 4-7).

The section covering the sub theme *teacher disposition* as part of the emerging theme *teacher as bricoleur* revealed the tendency of innovative teachers to hold strong personal convictions around personal fulfilment and the need to continually refresh themselves and thereby increase their personal zone of enactment as articulated by Spillane (*cf.* Table 4-7). To this end the boundaries between personal interests and convictions become indistinct as innovative projects' topics reflect the teacher's stance on social issues.

The next section as part of the emerging theme *teacher as bricoleur* will look at the role that *teacher training* plays in the development of innovative teachers as they grow and develop their practice.

4.4.2 Teacher training

By nature training courses and materials are prepared long in advance to training events and in a fast changing environment, where technology is involved, the struggle to stay current becomes problematic (Siemens, 2006). Teachers that have been in service for a number of years have not had any formal training in computer literacy skills, or for that matter integrating technology into their curriculum. To make up for their lack of skills they avail themselves on a smorgasbord of training opportunities that come their way, however they find it difficult to judge the currency of content or the relevance of training courses as skill levels amongst teachers differ and current training programs do not adequately cater for personalised levels of learning.

Innovative teachers report that they have built their particular skill set over a number of years though a combination of formal ICT training events as well as serendipitous exposure to a number of different training opportunities. Not all of these opportunities were related to ICT but rather inspiring incidences that sparked their creativeness. This is reflected in the following statements below:

Most applications within the IT domain were self taught through trial and error. Teaching with television and animation DVD's is the closest that I could get to an interactive multi-media approach, as the art room does not have the facilities to accommodate interactive computer programmes, nor an "open" link to the Computer Centre (Merna Meyer, VCT 2007).

I am a science teacher with two years experience teaching science and passionate about environment and making my teaching relevant and applicable. I had no formal training on IT training and learned how to use software on a need to know basis (Moliehi Molefe, VCT 2009).

Prior exposure to ICT in personal and professional life and learning histories influence strategies adopted for utilising technology for teaching and learning, which is indicated by unstructured interview number 5 below (cf. Table 4-2):

You need to expose yourself and learn from other disciplines eg films, gardening; hobbies for you must remain interesting to yourself to remain inspirational to your learners. You also feed on the creativity that are stimulated by something outside of your work environment and you find it then manifest itself in another ways when it crops up in your teaching. (UI, 5)

Innovative teachers have exposure to and passions and interests outside of school and use these to build their teaching repertoire and simultaneously increase their technological knowledge. An

example, illustrating this concept, is a teacher who builds a project in which her learners use technology to provide specifically tailored solutions and services to the individuals in the community that have special needs. Her teaching history reveals that she previously taught at a school for learners with special needs (IC, Saretjie Musgrave).

In the formal domain teachers exploit every training opportunity but they choose their events carefully to complete the perceived gaps in their skill set as depicted in the feedback below:

- *This workshop unlocked my potential and will equip me a lot. It motivates me to do more for my learners and increased my confidence. I thought I'd lost myself forever (IC,26).*
- *You only learn how to do these things by being forced to do them I thought it was too hard but now I'm proud of what I've achieved! I didn't think I could do it (IW, Pretoria).*
- *Learners are often ahead of the teachers, especially technologically speaking it was my energizer, so I'm refreshed & ready to go out there & make a difference'. I am no longer scared to use technology in the classroom because now I know that it is OK not to know everything (IW, Port Elizabeth).*
- *My own experience revolves around teaching Art related subjects. I have studied art (BA. ed. Art Hons), received in-house training as a Computer Graphic Artist (SABC), in-house training in Computer Literacy and exposure to animation programmes such as SoftImage Toy Stories (Merna Meyer, VCT 2007).*

If one regards the statements above, it seems as if the main areas of concern is the need for further training and the resultant emancipation of the teachers through increasing their self esteem and minimising the fear of technologies and thereby addressing notions of inadequacy. Teachers that find themselves in this position need access to training opportunities and role models that can guide them in their practice. Vanita Coetzee reflects on her training below:

I received training to be a facilitator for the RADS peer support group and was also trained by the Education Department to be a lay councilor for the children in need at our school. I had to learn how to bead and do other art and craft projects. I received training in ICT as part of the eLapa project, for which Ikanyegeng was a pilot school and was very fortunate to attend the BETT exhibition in London in 1995. (Vanita Coetzee, VCT 2007).

Vanita Coetzee's training history alludes to the different roles she fulfils within the school environment. Her additional duties, which include the counselling of vulnerable learners after school hours fall well outside her subject area of Business Economics. She builds on the initial

opportunistic exposure to the BETT exhibition in London in 1995 by opting for formal ICT training that stimulated her professional growth.

Roles can also be reversed in the training with learners assuming the role of the experts conducting a workshop for visiting teachers. They planned the event, determined the contextualised content and tailored training to individual needs. Below is some of the feedback that attending teachers provided at the end of the day.



“I found the training very informative and rewarding. I felt like having a lecturer next to me, not a learner. It was really wonderful!” -Boitumelo Metoa



“The training also adds to the accepting of positive cooperation between the different races of South Africa with regard to teacher and student” – Thato Monyakane



“With this type of support I think I can go a distance. For me it must not be the last, but only the beginning.” – Daniel Mokhethi

Sarietjie Musgrave, VCT 2007

Teachers state that they are growing more comfortable with the fact that they do not always have to know everything concerning the technology their learners use. Innovative teacher Kathleen O’Conner, a finalist in the World Innovative Teachers Forum Award 2008 explains in a formal interview her attitude towards providing technical guidance to learners:

I am certainly no expert, in fact I am probably one of the worst person in the entire project to help them, so they have to work and if they can’t sort it out, they have to find somebody to help them because I may not be able to in fact I know I won’t be able but I am quite happy of them to find somebody else.(WI, Kathleen O’Connor)

This section revealed that successful teacher training is a combination of access to formal training events with trainers from across the spectrum (including private practice, other teachers and even learners as mentors) and the incidental informal exposure to new knowledge. The

serendipitous exposure to training played a significant role and innovative teachers generally maximised these opportunities.

The next section discloses how the emerging themes *professional burden* and *teacher as bricoleur*, along with their related sub themes, combine to form the core category *moral cohesion*. Relationships between the sub themes are presented in an interrelationship map to determine the main drivers directing the *moral cohesion* of innovative teachers in their practice.

4.5 MORAL COHESION

Moral cohesion is a multidimensional concept that is derived from the term *social cohesion* that supports the concept of an integrated society that shares the same ideals and values. The notion of moral cohesion was borne out of the suggestion that being part of a community pre-supposes that one subscribes to its ideals and belief system which is governed by common values and motivations that guide people in their actions. The idea of moral cohesion is further articulated as “collective well-being, that offers a means to achieve an individual end and not a collective measure to advance solidarity and moral cohesion around the imperatives of creating a just and equitable society (McClaren, 2010, p. xv).” The social foundations of education are also taken into account and contribute to meaningful teacher preparation *if* it helps teachers and other school personnel to:

- Understand and apply disciplinary knowledge from the humanities and social sciences to interpreting the meanings of education and schooling in diverse cultural contexts.
- Understand and apply normative and critical perspectives on education and schooling.
- Understand how moral principles related to democratic institutions can inform and direct schooling practice, leadership and governance.
- Understand the full significance of diversity in a democratic society and how that bears down on instruction, school leadership and governance.
- Understand how philosophical and moral commitments affect the process of evaluation at all levels of schooling practice and leadership (Council of Learned Societies in Education 1996, 18-22).

The first core category to emerge from the analysed data was labelled *moral cohesion*. The themes it contains are presented below in Figure 4-9. In this core category teachers expressed a strong sense of kinship with the people of Africa and aligned their ideals with those of the African renaissance movement. Innovative teachers take into consideration their position in society and contemplate their way forward when engaging in teaching and learning activities that involve the use of new technologies. They strive, through their projects, to uplift and enlighten their fellow teachers and the learners in their care by expanding their horizons. Towards this aim they rely on members of their community and activate their own personal network of contacts that stretches beyond the education sector. They gradually build their skills set through the pursuit of formal and informal training opportunities and struggle with difficulties such as personal resources and level of availability and support to their learners after school hours.

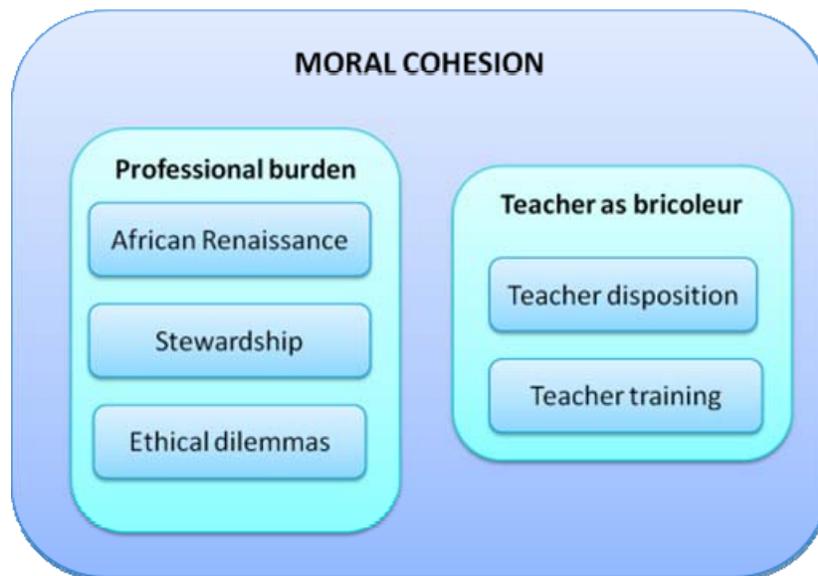


Figure 4-9: Building theory: *Moral cohesion* as emerging core category with expanded themes

Once the categories emerged an affinity diagram was developed through the use of axial coding.

Through theoretical sampling, interviews with pre-selected finalist in the Microsoft Innovative Teachers Forum competition were conducted to uncover relationships amongst categories. The interrelationships amongst the categories were determined through interviewing pre-selected and the categories were subsequently classified as drivers, links or outputs. Arrows between the categories identify the nature of the relationship and indicate the direction of influence. The resultant diagram, depicting moral cohesion as a core category, is presented in Figure 4-10 below

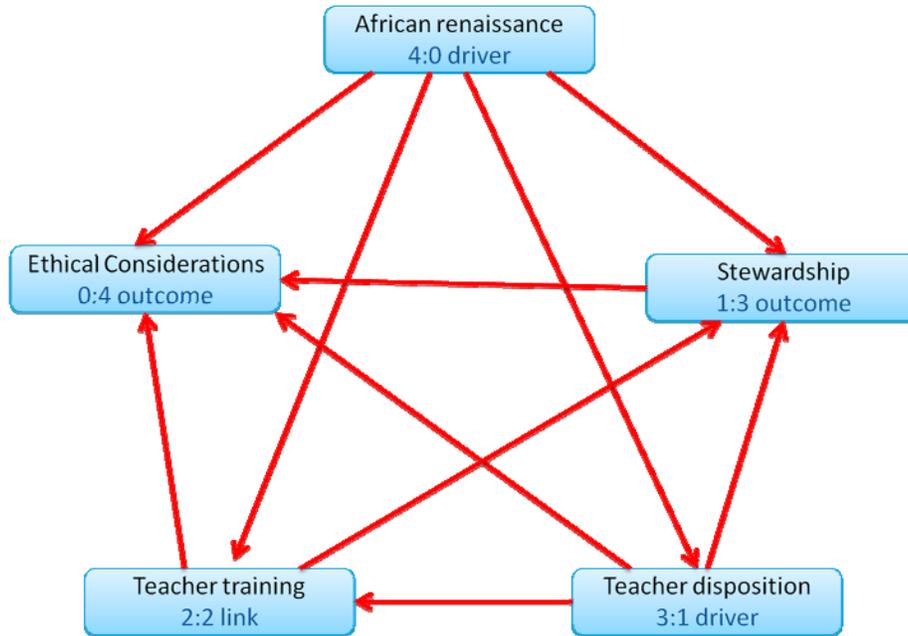


Figure 4-10: Interrelationship diagram of Moral cohesion

An affinity diagram presents cause-and-effect relationships between different concepts. Directional arrows indicate the nature of relationship pointing from the cause to the effect. The influence of concepts on each other was determined through interviews. The causal interrelationships were visually presented with arrows pointing towards or away from each concept. The ratio of arrows flowing in or out of sub themes determines the strength in relation to other categories and is therefore identified as a *driver*, *link* or an *outcome*. Table 4-8 below provides clarification as to the different types of relationships and identifies the categories *African Renaissance* and *teacher disposition* as the strongest drivers. *Teacher training* forms the link between the strong drivers and the outcomes manifest as *Stewardship* and *ethical considerations*.

Table 4-8: Type of relationships between sub themes of Moral Cohesion

Type of relationship	Ratio of arrows	Categories
driver	many out : few in	African Renaissance Teacher disposition
link	even in : out	Teacher training
outcome	few out : many in	Stewardship Ethical considerations

Over time, the ideas of social pragmatists such as Dewey, have garnered greater attention and have been adapted into various teacher education efforts to make the classroom more experiential, less teacher centred and more sensitive to the realities and experiences of students. In short, greater focus has been given to the creation of cooperative communities where students come together to problem solve, experiment and develop both moral and academic reasoning as Molefe indicates:

As a teacher and environmental activist I am passionate about the use of technology in teaching; especially teaching of subjects related to environment and i believe that learning is a three legged pot (the learners, the community and Technology) and that efficient learning requires the involvement of the three in order for learners to achieve (Moliehi Molefe, VCT 2009).

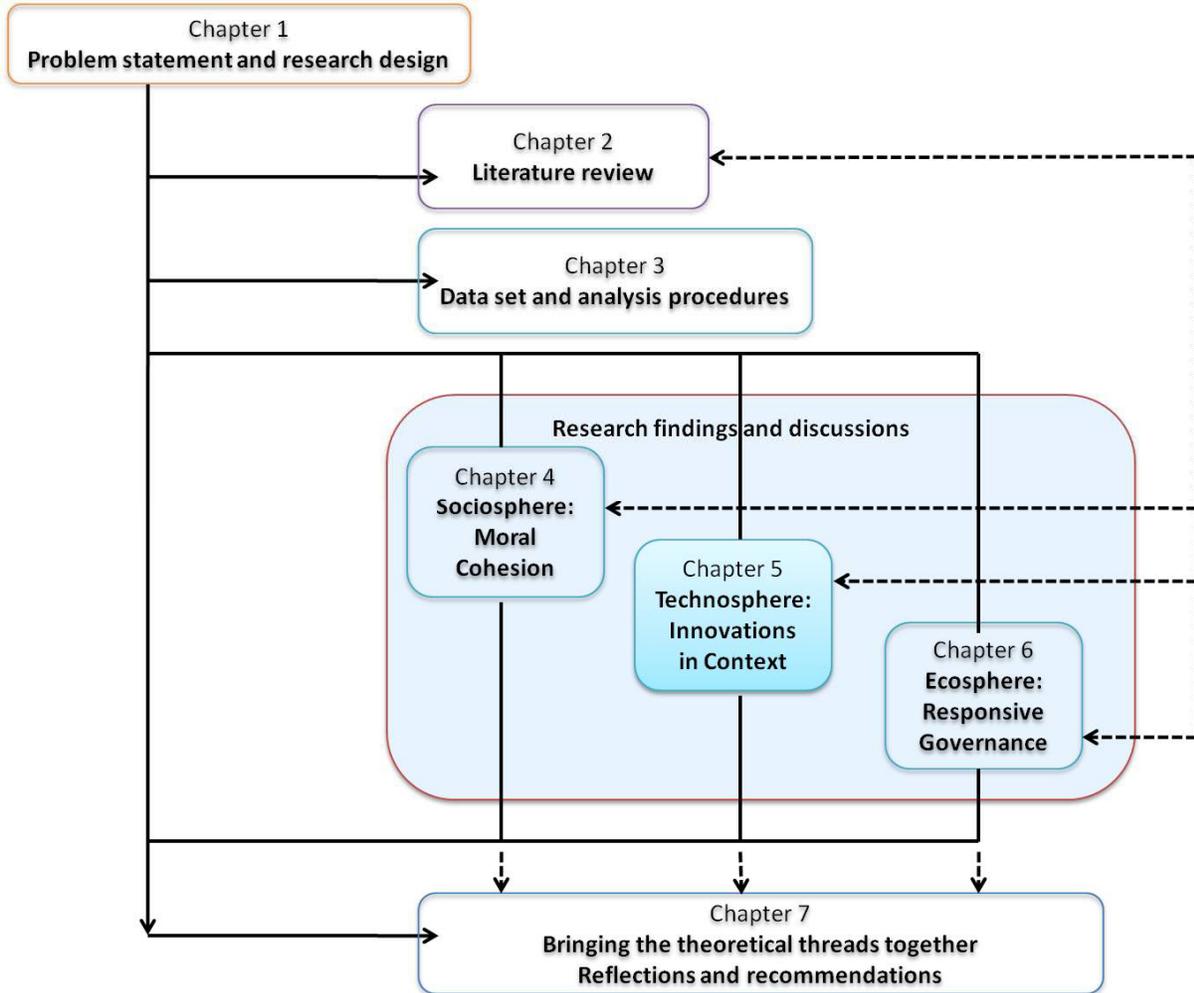
In conclusion, the following statement captures the sentiments of moral cohesion:

“It cannot be only self-interest that motivates teacher educators, but a moral and ethical imperative to provide service to a citizenry in addition to the knowledge and technical skills that make education possible” (Jaramillo, 2010, p. 45).

4.6 SUMMARY

This chapter covered the components of *moral cohesion* which became evident through analysing data delivered through various data instruments as illustrated *Table 3-4: Data gathering and instruments used during the research process* on page 92. The themes of *professional burden* and *teachers as bricoleurs* were presented and expanded upon in the form of quotes and references from literature. The interrelationship between the sub themes was investigated and the *African renaissance* was prioritised as a key driver with *teacher disposition* as a partial driver. *Teacher training* was seen as the enabling mechanism resulting in sense of *stewardship* and the resultant *ethical considerations* that needs to be taken into account when engaging with emerging technologies within the pedagogical space.

The discussion of the results will continue in the next section where aspects of the technosphere will be presented.



CHAPTER 5. TECHNOSPHERE

“If we try to present educational approaches that we currently use into this new mesh of interpersonal, interwoven information spaces, we are doomed to fail. Interaction in this new world is different – it is mediated as if by magic by multitudinous systems, many of which we have little or no comprehension of, and it is these differences in interaction that occurred at each of the historical shifts in approaches to education and learning.” Beale (2007, p. 65)

5.1 INTRODUCTION

The previous chapter considered the innovative teacher within the framework of the sociosphere and investigated personal convictions, social structures and relationships within the wider community that influence teaching and learning practice within the cultural historical context as articulated in Section 2.5.2. The emerging category *moral cohesion* was presented with the theme: *Professional Burden* and contributes to the sub themes of *African Renaissance*, *stewardship* and *ethical considerations*. The remaining theme *teacher as bricoleur* was further discussed as *teacher disposition* and *teacher training* (cf. Table 3.-9: *Codes structured and organised to reflect the emergent core categories*, p. 112)

In this chapter the objective is to focus on the second research subsidiary question: How do teachers negotiate innovation within the technosphere context? The research puzzle presented in Chapter 1 (cf. Table 1-1 on page 15) is briefly revisited in Table 5-1 below:

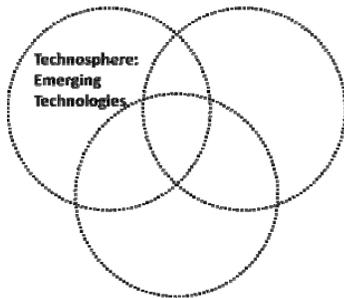
Table 5-1: Research puzzle for Innovation negotiations in context

Research Question	Objective	Subsidiary research question
How does tacit knowledge manifest when innovative teachers engage with emerging technologies to achieve pedagogical efficacy?	To describe areas of teacher innovation and engagement when using emerging technologies in their practice.	How do teachers negotiate innovation within the technosphere context?

The objective of this chapter is to describe the areas of teacher *innovation* and *engagement* when said teachers use emerging technologies in their practice within the context of the technosphere.

Gathered data (*cf.* Table 3-4 in Section 3.5) was analysed (*cf.* Section 3.7) and is presented in a combination of *participant quotes*, included to maintain the integrity of interpretations, and *researcher conceptualisations* against other research perspectives contained within literature. Consistent with the approach employed in Chapter 4, collected data analysis will be supplemented with instances from literature to contribute to the understanding of the phenomenon under investigation. Literature is therefore regarded as another source of data from which insights might be drawn. Chapter 5 presents the core category *innovation negotiation in context* developed through the research process described in Section 1.6 (*cf.* Figure 1-1). Findings were developed based on themes and sub themes which were identified during data analysis and coding of all the data collection instruments according to the Straussian Grounded Theory Method. As a result, themes emerged and each will be discussed in more detail in this chapter which only focuses on the technological issues.

5.2 TECHNOSPHERE: EMERGING TECHNOLOGIES



This section takes into account the facets of innovation and emerging technologies as set out in Section 2.3 whilst also taking into consideration the characteristics of emerging technologies and the current modes of curriculum delivery in educational institutions ranging from e-learning, mobile learning and blended learning scenarios. In an effort to match the pace of technological progress, our understanding of innovation and innovation models have changed with time. At this moment in time, education is caught in the space between *preserving the status quo* and *the need for innovation*. Emerging technologies can provide the means to cross the gap from *the stagnant* to *the proactive* (Carneiro, 2007).

When considering the phenomenon of emerging technologies, the researcher heeds Veletsianos's call (2010) not to restrict the conceptualisation of emerging technologies to technological tools only but to also embrace ideas, theories and approaches to learning with the use of these technological tools. Veletsianos regards emerging technologies as tools, concepts, innovations and advancements which are there to serve varied education-related purposes. In the analysis of the data, the researcher thus considered the pedagogical strategies which innovative teachers

employ and how they continue to harness the increased capabilities of new technological tools available to them and their learners within their teaching and learning spaces. Earlier Hinostroza (2008) stated that emerging technologies are capable of *expanding* new learning opportunities, *altering* the traditional teaching and learning context and *improving* the actual process of teaching and learning.

Before a discussion of the data is presented, the first of the emerging categories of the technosphere is presented in Table 5-2 below along with their sub-categories. The core category, with associated themes, is revealed as a result of analysing the data through a process of open coding, concept formation through axial coding and finally concept development through selective coding as previously set out in Table 3-8: *Stages in the analytical process as adapted from Coyne (2009, p. 17) on page 114.*

Table 5-2: Innovation negotiations in context as the emerging core category with the expanded theme of technology implications

AXIAL CODING (Categories clustered in sub themes)	SELECTIVE CODING (Emerging themes derived from sub themes)	CORE CATEGORY
ICT availability and distribution (cf. Section 5.3.1)	Technology implications (cf. Section 5.3)	Innovation negotiations in context
Technology appropriation (cf. Section 5.3.2)		
Mobile Technology (cf. Section 5.3.3)		
Innovation process	Innovation strategy	
Learner disposition		
Managing expectations		
Curriculum issues	Reflexive pedagogy	
Assessment quandary		
Unprecedented initiative		

In the following sections, the second emerging core category *Innovation Negotiation in Context*, will be discussed along with its themes *Technology implications*, *Innovation strategy* and

Reflexive pedagogy. Each one of these themes will be presented and discussed along with their associated sub themes. The first highlighted theme in Table 5-2 above, *Technology Implications* with its sub themes *ICT availability and distribution* (cf. Section 5.3.1), *Technology appropriation* (cf. Section 5.3.2) and *Mobile technology* (cf. Section 5.3.3) will be discussed first.

5.3 TECHNOLOGY IMPLICATIONS

In this section of the research study literature pertaining to the affordances of new and emerging technologies and the current perspectives regarding the use of technology in education will be discussed. The themes, which emerged from the analysis of the data, will then be presented. Within the context of this research, the *technosphere* contains the affordances which emerging technologies could offer to teaching and learning as articulated in Section 2.2. *Affordances* can be described as the properties of a system, as perceived by the user, which allow certain actions to be performed and which encourage specific types of behaviour (Webb & Cox, 2004). “It is the relationship between the pedagogy within a subject, the subject domain and its culture, and the technology within the learning setting that is crucial to engendering quality learning” (John & Sutherland, 2005, p. 405). Besides the perceived affordances of technology within the learning space, factors which emerged from this research include the availability, distribution, choice of technology and the differing levels of competencies within the classroom. The context in which the technology tools are employed impacts directly upon the quality and sustainability of learning experience. “In reality, learning is always distributed in some form between the technology, the learner and the context and there is nothing inherently in technology that automatically guarantees learning. The expectation is there that the digital tools will extend children’s abilities as their affordances are used to transform learning outcomes” (John & Sutherland, 2005, p. 406).

Dede (2008) is convinced of two critical entities when ICT is harnessed to deliver and assess curriculum, *the first* being that ICT tools are instrumental in making the job of teaching and learning easier as it allows for a variety of pedagogies to be utilised, and the *second* is that a higher quality of education is attained *with* the use of ICT tools than without. Brummehuis and Kuiper (2008) are of the opinion that there are currently two different forces driving ICT

integration in education. The one notion suggests that ICT should be considered a catalyst for educational change, a veritable “technology push,” while the opposing view holds that ICT has to follow educational needs, thus “educational pull”. Table 5-3 below, taken from Voogt and Knezek (2008a p. 15), summarises the implications of the *push* and *pull* manifestations of different technologies and their use in education.

Table 5-3 Perspectives for Technology Use in Education (Voogt and Knezek, 2008a p.15)

	Information Society	Enhancing the Teaching and Learning Process
Technology push		
Focus	Creation of learning environments to encourage flexible learning	Enhancing existing (behaviourist/cognitivist) teaching and learning practices
Examples of IT applications	Content management systems, online learning environments, virtual high schools, mobile technologies	Commercially available IT-enhanced curriculum materials (e-books, websites added to textbooks)
Educational Pull		
Focus	The use of technology to master 21 st Century skills	Enhancing in-depth learning, constructivist learning environments
Examples of IT applications	General application software; GPS systems; Internet and e-mail	Specific IT applications for education (simulation games) knowledge-sharing environments, augmented reality

Information and Communication Technologies (ICT) have not always been part and parcel of education but were introduced on a large scale during the 1980's (Plomp, Anderson, & Kontogiannopoulou-Polydorides, 1996). Since then ICT has morphed into a massive industry sprouting new fields of research and creating jobs tailored specifically to the needs of education and its reliance on technology. The dependence of teachers and learners on these tools in their daily teaching and learning activities have formed the basis for global studies such as the *International Association for the Evaluation of Educational Achievement (IEA)* in a project called the *Second International Technology in Education Study (SITES)*, Module 2, (Kozma, 2003).

The main purpose of the SITES study was to uncover innovative pedagogical practices using technology and the factors affecting and influencing them (Nachmias, Mioduser, Cohen, Tubin, & Forkosh-Baruch, 2004). The results of this international study, which involved 28 countries,

were documented in a special issue of the *Journal of Computer Assisted Learning* of 2002. South Africa was the only African country to participate whilst Chile was the only other developing country included in the study.

Schools were selected based on their innovative pedagogical practices using technology (IPPUT) and had to submit evidence of a significant change in teacher and student roles whilst displaying concrete evidence of learning outcomes and some elements of potential scalability (Anderson, 2002). Findings indicate that learners often possess better ICT skills than their parents and teachers and that this affects teaching roles and learning modes. The study was particularly interested in *islands of innovation* and the scalability of teaching practices and factors transforming the school environment (Mioduser, Nachmias, Tubin, & Forkosh-Baruch, 2002b).

SITES2006 was a follow up international comparative study of pedagogy and ICT use in schools in which mathematical and science subject areas were mainly targeted. This study examined the extent to which pedagogical practices, which are considered to be conducive to the development of *21st Century Skills*, were present in comparison to traditional teaching methods. The capacity to engage in life-long learning (understood as self-directed and collaborative inquiry) and as connectedness (communication and collaboration with experts and peers around the world) were identified as *21st Century Skills*. SITES 2006 also examined how teachers and students used ICT and whether ICT use contributed differentially to learning activities geared towards the development of 21st Century skills.

It was noted that amongst the 22 participating nations, South Africa was the only country where computers were not generally available for teaching and learning purposes. A noteworthy finding of the study was that no significant correlation could be made between *using ICT in traditional instructional activities* and students' perceived learning outcomes (Blignaut & Howie, 2009). The implication is that when traditional instructional activities remain unchanged, even with the availability of ICT, and pedagogy is not adapted to suit the powerful array of ICT capabilities, few of the 21st Century Skills will be developed.

The theme *technology implications* (cf. Figure 5-1) emerged from the analysed data and it encapsulates the sub themes *availability and distribution*, *technology appropriation* and *mobile*

technology. Each of these will be discussed in greater detail in the following sections (cf. Sections 5.3.1– 5.3.3).

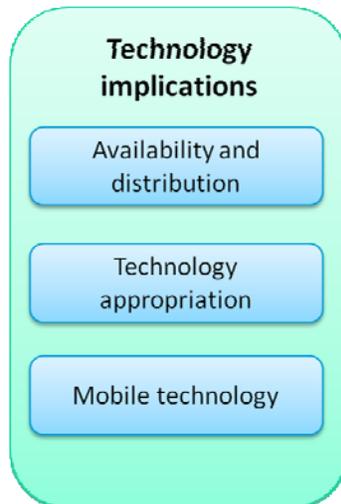


Figure 5-1: Expanded emerging theme: Technology implications

The first sub theme *availability and distribution* takes into consideration computer hardware and software issues as well as the difficulty of integrating multiple technologies within the same educational space.

5.3.1 Availability and distribution

Innovative teachers have to take into account the infrastructure and resources as specific to their context when planning and executing innovative projects. In South Africa great disparity exists regarding the computer, learner and teacher ratios and how these technological resources are distributed throughout the school. In some schools, which can be described as *technology rich*, each learner has access to a personally owned laptop that they take to every classroom. However, these schools are in the minority and are mainly privately owned independent schools. There are some public schools which are equipped with a computer centre where learners have access to desktop computers during scheduled hours of the school roster resulting in a few visits a week. As a result of these intermittent opportunities to work in the computer centre, teachers have to plan ahead and design learning events. Innovative teachers combine *technology dependent* with *technology independent* tasks to action a project as explained by Vanita Coetzee who conducted club activities after school hours:

Unfortunately the school does not even have enough classrooms for normal teaching activities and therefore it could not allocate a specific venue to us. We made use of the staffroom, the hall, the science laboratories, the library, the computer room, and any other available class we could find (Vanita Coetzee, VCT 2007).

Innovative teacher John Lancer supports the notion of building flexibility into projects and so allowing for a switch to technology independent tasks when the need arises. He comments below:

Learners can switch learning tasks to be ICT independent in the case of ICT failure. They do not want to rest the success of a project on ICT availability. Non-computer activities can run parallel and then support the computer activities. They have a different area of knowledge to chase down and pool their knowledge in the end. You don't wait in Africa or you can be waiting forever (John Lancer, VCT 2007).

The limited access learners have to computer centres is a recurring theme but innovative teachers negotiate with other teachers for more access time and tend to work after school hours. Warren Sparrow and Neen Hollick comment on how extra access is structured to their school computer centre in the eventuality learners do not finish their allocated tasks during the lessons:

The computer centre is open every Tuesday and Thursday at second break for the learners to complete work or to work on their projects (Warren Sparrow, VCT 2010).

There is no technology laboratory and the learners mostly work outside, occasionally in an empty classroom and in the Computer Centre when the timetable allows. The Computer Centre is available to the learners for two afternoons per week for 45 minutes (Neen Hollick, VCT 2007).

It is noted that access is granted to all learners during break times, which are 20 to 30 minutes long, but that the computer centre is then heavily over subscribed in that time. In some schools every pupil has access to his/her own computer during class visits to the school computer centre, but in other cases learners are required to work together in groups. Murphy Mugabi explains that he needed to negotiate with parents to ensure that learners at his school were allowed to stay after school to work on their projects. He also arranged access to the media centre, where the school computers are located, during the weekends. He reiterates that each group had access to a computer.

The learners used the media centre to conduct their project. They accessed the media centre during lunch time, after school for at least an hour and on some weekends especially on Saturdays. Learners worked in groups, and each group was researching on a specific task in a project. Computers were enough for each and every group to research at the same time in the media centre. I had to arrange with the

learners' parents so that they can stay for an hour after school normal time so we can work on the project (Murphy Mubgabi, VCT 2008).

The notion of extending access to computer centres by increasing the time they stay open is also demonstrated in Paul Wilton's project. He explains his reasons below:

The project was very successful. Learners were falling over each other, enjoying the learning process inside the classroom. Many intervals, afternoons and occasionally evening I had to stay in class because learners were so committed to completing their tasks. The level of excitement and commitment was unquestionable, at a level not seen in any other subject at the school (Paul Wilton, VCT 2007).

Teachers are required to be skilled in setting group tasks that allow all members of a group equal opportunity to grow their computer skills as well as contribute to the task at hand. The result is that even though the learners' cognitive conception of connected learning is developing, their actual keyboard, mouse control and navigational skills lag behind. Merna Meyer highlights the perception that some subject areas are regarded as *more important* and therefore have been allocated more ICT resources than other subjects, which are regarded as *less crucial* to learner development. The Dinaledi school project was initiated by the National Department of Education to improve mathematics and science in schools located in underprivileged areas by allocating more resources to these schools to be used particularly in these two subjects. Even though other schools do not form part of the Dinaledi project, the notion of other subjects being of less value to the development of learners and their ability to contribute to society is reinforced by school governing bodies when they divert more resources to specific subjects. A case in point is illustrated below:

I have access to some technology but my learning area is not regarded as crucial so, in comparison to other learning areas, I have restricted access to technology - I do not have a Smartboard or data projector in my class and I also share time in my classroom with another teacher. There are some teachers who have all the technology in their classrooms, depending on their needs/importance in the curriculum. I am restricted to booking time in the computer room when it is available, which is not always optimal to the way in which I teach. All my notes are digital and hyperlinked so having a data projector in the class would make life easier (Merna Meyer, VCT 2007).

Where there is no access to technology at all, teachers are prone to donate their personally owned devices to be used by learners in their classes to achieve the objectives for set learning tasks. In the absence of data projectors and classroom computers, learners use the teacher's laptop to

present their projects to the rest of the class. Table 5-4 below contain some descriptions and images of classroom environments with differing access to ICT.

Table 5-4: Various classroom environments with differing levels of access to computers

<p>Teacher: Simpiwe Njoko</p> <p>Learners are using my personal laptop during a class presentation. Even though the screen is small and the rest of the learners are not able to view the presentation clearly, it is very important for them to be able to conceptualise the end product.</p>	
<p>Teacher: Paul Wilton</p> <p>Learners work in groups when visiting the computer centre and have to share tasks and technology equipment during their visit.</p> 	

Teacher: Vicor Ngobeni

In this lesson each learner has access to a computer for the duration of the lesson which can last between 45 and 60 minutes. The class visits the centre for a total of three lesson periods a week. However, they are allowed to work in the computer centre some afternoons after schools as well.



<p>Teacher: John Lanser</p> <p>The layout of the classroom is very 'old fashioned', but there is a reason for this. The boys need a power source and my classroom does not have modern wiring. It is dangerous to have extension leads all round the classroom; therefore the wiring is restricted to the sides of the classroom. The boys also need to be in a position to see the data projector screen without having to turn around or strain their necks. The tables have been placed in groups of two's or three's so that learners can assist one another.</p>	
<p>Teacher: Olalikan Adeeko</p> <p>Learners learn how to fix computers so that they can help maintain the equipment as it is too much for one teacher to do and it also helps them in their future.</p>	
<p>Teacher: Ali Kagone</p> <p>Learners, in a traditionally organised classroom, face the front where a presentation is projected on a material screen hung in front of the chalkboard. The teacher's own laptop is being used during this lesson.</p>	

Yolande Peters reports on the limited opportunities learners have available to work in the computer centres as well as the fact that teachers are held responsible for not only teaching the

subject, but that they also carry the additional burden of maintaining the computers in the centre. Her coping strategy was to divide learners into groups and source volunteer teachers through private sponsorships for the first year of her project. Yolande Peters details her approach:

Each grade was divided into three groups, as the classes were too large to accommodate all learners from each class at the same time. Computer classes were run from Tuesday to Thursday 10h00 until 13h00 on a rotating system. The learners only had access to the lab during school hours, although learners could use the computer lab during break times if there were staff present during these periods. Computer lessons were conducted by two volunteer teachers who were also responsible for maintaining the computers during their times with the school. As the lead teacher in the project, all liaisons with the school time table and curriculum was conducted through me. The lab is also opened from 15H00 to 16H00 in the afternoons for learners boarding at the school (Yolande Peters, VCT 2007).

Learners also express the desire for increased access to computers and Gaye Pieterse notes that her learners would like their own laptops to thus increase *time on task*.

They would have liked to have had more time in the computer room and difficulties arose when they had to finish work at home; some learners do not have IT facilities. All decided that the ideal scenario would be for each one to have a laptop in the classroom. (From the teacher's perspective, it would also be helpful, stopping them spending time e-mailing each other rather than working on the task!) (Gaye Pieterse, VCT 2007)

More affluent schools have programs that financially assist learners from disadvantaged backgrounds to purchase laptops, thus allowing for equal access to learning opportunities. Cheryl Douglas explains that her school made a concerted effort to accommodate marginalised learners during the transformation process when the school embarked on a one child per laptop program in 2008.

Bishops has a laptop project that starts in grade 9 and continues until the end of grade 11. It is compulsory for all learners in grade 9 to purchase laptops. The school is presently involved in transformation and we have a number of learners from disadvantaged backgrounds who are financially assisted (Cheryl Douglas, VCT 2010).

Lack of resources does not only impact on hardware, such as access to desktop computers and in some cases laptops, but also on the availability of software in schools. Supply vendors are licensed to install only software packages as per agreement with governmental structures that reflect their negotiations with software companies. Innovative teachers report on their need for additional software programs and often do not have the assigned administrator rights to download free software packages to the computers in the school as special permission needs to

be obtained from the administrator. If teachers want to use software packages outside of the approved list of software programs as provided by government, they need to submit a lengthy application. To compensate for the restrictions inherent to pre-loaded software, innovative teachers design learning tasks that can accommodate the limitations of software trial versions. They have to carefully consider the task time limit to ensure that it falls within the trial period of the given trial versions. Murphy Mugabi used only software trial versions for his project.

Because all the software we used in this project were trial versions and had so many limitations. Time was a big factor as well as the trial version that did not have all the functionalities compared to the one that you pay for. In spite of the restrictions the learners were able to achieve their task objectives (Murphy Mugabi, VCT 2007).

This section covered the general availability and distribution of technology within schools and reported on the differing educational contexts innovative teachers work in. Innovative teachers put additional measures in place to mitigate the apparent lack of resources and they illustrate a willingness to make their own resources available to their learners and even to conduct maintenance to computer hardware.

The next section will look at the sub theme *technology appropriation* that became evident through data analysis (*cf.* Table3-9, P. 112). Related literature is consulted and used as an additional data source to expand and amend current understanding of the choices teachers and learners make when selecting technologies for use in their learning events.

5.3.2 Technology appropriation

This section gives consideration to the categories that emerged from the data analysis related to the choices teachers and learners make when selecting ICT for use in teaching and learning.

Technological appropriation, characterised by experimentation, occurs when the user tests out new practices and implements new solutions that challenge the initial embedded design of the technology and therefore it is considered to be uniquely innovative (Bar, Pisani, & Weber, 2007). The appropriation of technology into a learning environment also recognises the integration of multiple devices with the understanding that each device mediates activities in various ways (Waycott, 2004). With the affordances of different technologies, different forms of learning are supported in various ways, and learners adopt diverse learning styles and approaches to

maximise benefits from their technologies. Lai (2008) asserts that educators are aware of these affordances and propose that blended approaches to learning be employed, since different topics, styles and learners benefit differently from alternative approaches.

Innovative teachers introduce the use of multiple devices in their teaching and learning in spite of the fact that they do not always know how to operate these devices. These devices are owned by learners or colleagues and integration of multiple devices allows for various content delivery channels. Simpiwe Njoko relates how his learners figured out how to integrate these devices in the carrying out of their tasks:

Various devices were linked together to achieve the requirements through bluetooth, Cell phones, Laptops, Desktop and Printers as well as PDA's . Some of the devices were obtained from other teachers and the learners could achieve this project successfully. Learners are able to produce documents that are fascinating. Learners managed to apply their own skills and knowledge to integrate these devices to get connected to the outside world. When the PCs are broken, they fix them. Some learners criticized the fact that not every learner has an access to the Computer (Simpiwe Njoko, VCT 2007).

Teachers make technology choices based on personal rules that are based on intuition and experience. ICT tools make it possible to customise education to fit individual needs which leads to greater personalisation of learning (Somekh, 2007). Factors that need to be taken into account when teachers select technologies as revealed in the data analysis include:

- Level of learner competency and/or teacher competency.
- Connectivity.
- Number, variety and compatibility of technology tools.
- Personal vs institution owned devices.
- Timeframe and different time zones need to be taken into account when collaborating internationally.
- Speed, clarity and cost of services.
- Cultural orientations.
- Availability of contextual and curriculum aligned content.

- Existing policies and guidelines.

Innovative teachers report on their own lack of knowledge regarding new technologies and prompt learners to select the devices of their choice and software applications to accomplish a particular task. Through this process, learners share their own knowledge and skills to benefit all within the learning space as they negotiate the value of using one application rather than another. The project *Spread the Sunshine* is an excellent example of application selection where learners drive the choice of technology. In this project the innovative teacher Saretjie Musgrave allowed learners to discover new technology which enabled them to address the needs of handicapped individuals.

The ICT tools chosen for this project were all carefully selected. Firstly the learners had to identify a handicapped individual within the community that could benefit from ICT in some way. Once they had familiarised themselves with the needs of the individual, they had to expand their knowledge and design and implement a solution.

** The community are made aware of the needs of handicapped.*

** The handicapped was empowered/helped/ made "visible."*

Learners are guided towards discovering relevant new ICT to solve their specific problem e.g. For one handicapped person that could not talk, the learners created a tool using Clicker that can now be used to help the handicapped "talk" by clicking on the "what I want for supper" icons.

It is important to note that each group had to end the project with a well motivated list of ICT related tools specifically designed for their disability of choice (Saretjie Musgrave).

Innovative teacher Murphy Mugabi supports the tendency of letting learners select their own technology solutions. The more proficient learners became empowered and acted as experts who could mentor their peers. His comments follow below:

What matters is that groups of learners did what they had to do to make their selection of software work for them. A wonderful side benefit was that I developed "learner experts" who could then help out other learners use particular programs as they needed it throughout the year (Murphy Mugabi, VCT 2008).

Other than grappling with strategies to allow learners more choice and access to ICT within the school environment, innovative teachers report feeling beleaguered by the number of Web.2.0 tools available. Desmond Neal Cross seeks answers to the following questions:

With the plethora of Web 2.0 tools around I have been overwhelmed with the following dilemma: Which tools do I use to develop a successful “paper trail” of the process and the final “sanitised” product? Are these tools free and are they going to be around for a long, long time? Are they useful in assisting students to develop an understanding of science? (Desmond Neal Cross, VCT 2010)

Arguments for best technology options often change before they can be proved right or wrong. Hinostroza, Labbé, López and Iost (2008) surmise that there is not enough evidence to produce responsible recommendations regarding the ICT choices enacted by schools. They ascribe their reasoning to the rapid changes in availability of choices because of either new pedagogical approaches or due to new opportunities arising from new technologies that are introduced in schools or that are being adopted by learners.

In relation to the choice of technologies, Peter de Lisle in his project *Why do we hate?* challenge learners to make use of ICT-based thinking tools. He explains below:

Although thinking schemes can be developed without ICT, the ICT-based thinking tools allow for:

- **Flexibility** which allows one to “play with” ideas, an important part of thinking.
- **Formative involvement** by the teacher – ideas can be challenged and developed there and then.

The online thinking tools also provide:

A Collaborative environment which promotes sharing of ideas and so develops thinking (Peter de Lisle, VCT 2008).

One of the forces driving change in education is that teachers and learners can readily access a multitude of differing devices. Limited guidance from subject specialists or their governing bodies regarding policies and practices therefore result in a plethora of disjointed and undocumented practices. Hinostroza et al. (2008), recognises the complexity of ICT choices. Factors such as a particular context, pedagogy and activities during the lesson influence the selection of the technologies. Dede (2008) argues that these choices are driven not only by the affordances of the technology, but also the pedagogy and state:

“ the exact demarcations between content, pedagogy, and assessment are difficult to establish . . . content, pedagogy, and assessment are not discrete containers; and a particular technology may provide affordances that simultaneously influence more than one aspects of curriculum (2008 p. 44)”.

Beale (2007) asserts that history has shown that new technologies do not tend to best support existing practices, but instead they open up new opportunities for alternative learning that better suits the medium. It is also understood that ICT as such does not support learning but requires the full integration of ICT into the learning environment (Voogt & Knezek, 2008a).

Law and Plomp (2003) categorise the role of ICT in education as *learning about*, *learning with* and *learning through* ICT. The latter involves a full integration of ICT to bring about learning experiences that would otherwise not be possible. The implication is that there is a distinct difference between practices where learning is merely supported by ICT to enhance existing instructional practices and learning that relies solely on the various applications used to enact teaching and learning.

This section looked at technology appropriation and the factors that teachers consider when they select technologies for classroom use. Teachers expressed their confusion when confronted with the magnitude of available software solutions and the rapidity of new developments.

The next section looks at mobile technology and how it increases the availability and distribution of technologies in the classroom. Concrete examples, from past entries in the innovative competition, are presented along with the teachers' reflections.

5.3.3 Mobile technology

This section contemplates the unique position and rich promise of mobile technology in education. Mobile technology, used as a mediating tool can facilitate learners towards constructing meaning and it can also assist them in interpreting the world. Looi and Hung (2004, p 92) state that *experiencing* Information and Communication Technology (ICT) is different from just *knowing* about it. The current limited access provided by mobile technology can serve as the introduction to a technology enhanced community. As Africa, and the rest of the developing world, are possibly growing along a different ICT path than the developed world, mobile technology may remain the only avenue to becoming a participant member of the knowledge society. A ubiquitous technology is a step beyond mobile technologies, with a vision where technologies become embedded around us in the everyday world, on our person and in the devices we carry. This term refers to the ever-presence of computer technology in the

environment giving rise to the concept of ubiquitous learning. Beale (2007, p. 64) states: “These systems communicate with each other and with us, connecting us ever closer to a digital web in which information, the environment, other participants and ourselves are closely interwoven.”

There is a sudden and strong move towards greater digital equity in ICT for education (Voogt & Knezek, 2008b) with the new affordances offered by low-cost mobile technologies making it possible that one-to-one access can be achieved in education. During a formal structured interview, Andrew Douch explains his reasons for using these devices in the learning scenario:

We are not introducing new tools we are not trying to implementing new things. We are using technology the students already have and already enjoy. We are just giving a valid educational context for those tools to be used. And that makes them very successful. (WI, Andrew Douch)

In an unstructured interview, a participant teacher describes the use of mobile technologies in the classroom as *a form of self-indulgence* and explains how her own learning process is stimulated:

Innovation using technology is a form of self-indulgence. It satisfies my own curiosity. I can keep my learners engaged through using the technology they own and in the process grow my own knowledge of the ever increasingly powerful capabilities of these devices. Every few weeks a learner will get a newer model or a more updated one as their parents renew their contracts with the service providers. These new models create new opportunities to expand our strategies as to how far I can explore my teaching strategies (UI,3).

When considering the use of mobile devices for learning in a developing context within a school environment, more consideration is placed on the learning component than on the mobile aspect of mobile learning. A clear distinction is made between information that is available in general and content that is specifically designed to curriculum specifications and that adheres to set standards allowing learners to develop new knowledge. There is less of an emphasis on informal learning in a school environment as data transfer remains expensive. To this end the GSMA suggests that learning and educational resources should focus on *content development* and not *content delivery* recognising that the delivery method will influence the learning format.

Garai and Shadrach (2006) view access to knowledge as an important link which enables human development from an early stage. Knowledge is referred to as one of the key ingredients for effective human functioning. Mobile technology has the ability to level the playing fields by creating access to gain and share information which culminates in the creation of new knowledge

without discrimination. Kumaras Pillay's innovative project *Mlearner.co.za* is aimed at making curricular content available at a very low cost. He explains the motivation for his design below:

*Under performing learners not only in my classes, but in our entire nation must be given the opportunity to pass Maths/Science in a manner that is cheap; simple; relevant and yet exciting. The poorest of our learners should not be discriminated against because they lack finances, educators or resources. My research indicates that a significant number of individuals in rural communities do have access to cell phones; although computers and the associated internet access is virtually non existent. As a result I explored mobile learning as a powerful tool that could be used to reach ALL our learners who nationally, are primarily from disadvantaged backgrounds. The technology is organized in an incredibly easy-to-use and easy-to-follow manner. It is non-intimidating and extremely user friendly. Access is instantaneous, free (excepting the 2c/page that the ISP charges), available **anywhere** and **anytime** and can be accessed by **anybody** (no password to get into the system). It was easy to manage; once learners were on the system, they were able to work individually (or in groups) at their own pace in order to consolidate the work taught in class. It extended beyond Burnwood classrooms, beyond Durban, beyond KZN and into the whole nation.*

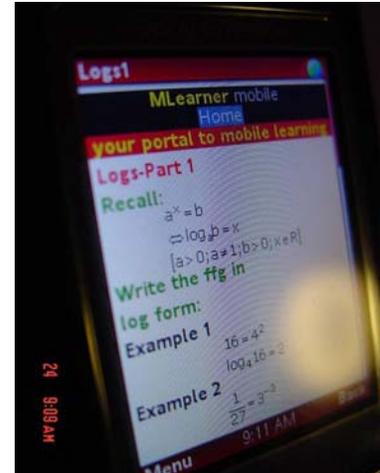


Figure 5-2: The Mlearner.co.za displayed on a mobile phone

*When presenting my **Mlearner** project to high ranking officials from the Department of Education (KZN), they embraced my innovation and heralded it as a breakthrough in education, stating that this was the first of its kind – my research started about 2 years ago. It required technological mastery and the use of cutting edge technology. For the product to be successful it had to be cheap, easily accessible and FUN. It also had to be available ANYWHERE and ANYTIME. It also had to be FREE. (Kumaras Pillay, VCT 2007)*

As viewed in the project Mlearner, as described above, low cost and affordable mobile phones in Africa are developing a new conduit for learning and are gradually influencing the way in which teachers view instruction. There has been a slow shift in focus from the advantages offered by mobile technology in mobile learning to the development of mobile learning content and the adjustment of instructional content. It therefore becomes imperative to focus on the

context of learning, the content that is being created as well as the process of learning with these mobile devices. Content suitable for desktop computers does not transfer well to the mobile phones and therefore Tsai, Young and Liang (2005) called for research to focus on the articulating content design criteria specific for mobile devices.

A proliferation of new technologies has given rise to different ways in which learners and teachers can communicate with each other and this has resulted in spontaneous collaboration between all members within the learning space. Knowledge becomes less of a *bargaining tool* and more of a *community property* (Botha, 2006). New knowledge is created in a social-constructivist learning environment, validated by peer review and then released to a wider audience. The resulting feedback is processed and this starts an iterative cycle of review and contribution. An array of personally owned devices, each configured to its owner's preference, allows for a wide variety of activities to be mediated in any particular learning event. In accordance Beale (2007) notes students instinctively maximize the benefits to be gained from technology to enhance their own learning styles.

When acting as participants in the mobile design process, learners are confident of their abilities and consider themselves experts who can identify their aptitudes from personal experience (Mazzone, Read, & Beale, 2008). Today's socially networked and connected students are not just passive consumers, they actively contribute to their own learning in the creation of reusable resources. They have the opportunity, the skill and the tools to create curriculum content that is relevant to their peers, and, in the process, to liberate their own learning (Batchelor & Botha, 2009b). Mazzone, Read and Beale (2008) acknowledge that "designing with children is often an inspirational activity" which brings learners into the design team to provide instructional designers with a better understanding of the essence required in an digital artefact.

Dissections for All was an innovative project the researcher conducted over a period of four months in 2008. The participating learners were well versed in mobile technology and its instructional uses and socially aware of the disparities within their diverse society.

Dissections for All was a concept that was conceived and executed by the learners themselves after the completion of a dissection module in which they captured a large range of images and video to augment their own personal learning. When confronted with the prospect of letting it all go to waste (they had no means of sharing their learning at that stage) they decided to translate their own learning experience of

anatomy dissections into learning objects with the use of available ICT tools and applications. These learning objects were to contain and reflect the content knowledge they deemed necessary to reach the curricular outcomes as stipulated in the Assessment Standards of the Grade 11 Life Sciences syllabus. They owned this project from the start and got completely carried away by the potential and scope. They learnt about anatomy, humanity and humility and the limitations of their own skills and in the process managed to articulate design criteria for mobile phones. Their will to create something worthwhile challenged their ICT skills as they constantly moved the goalpost as they came up with new ideas to enhance their digital learning artefacts. They remain very conscious of the impact their humble efforts can have to improve the quality and availability of learning resources to learners in disadvantaged schools where lack of resources like textbooks are paramount (Jacqueline Batchelor, VCT 2008).

Learners had robust discussions in which they hashed out the acceptance levels of created artefacts and, through a negotiation process, agreed upon design criteria suitable for mobile phones. The multiple created artefacts were put through a peer review system, allowing a reflective formative approach. They spontaneously formed groups with differing levels of competence in order to accommodate the less ICT literate students. Learners identified ICT experts amongst themselves and consulted with them during lesson time and after school. Even though they were very competent mobile phone users, they were not as confident in their traditional ICT skills. Context-related limitations, such as unscheduled power cuts which impeded their progress, had to be overcome. Goalposts moved as they became more rigid in their levels of acceptance. In order to comply with agreed standards learners needed more time, as they felt the pressure to do justice to their audience of underprivileged students who were relying on the accuracy of the created content.

These learning artefacts gave an immediate insight as to the level of skill required in creating usable resources specifically for mobile phones. The created resources are contextualised and culturally sensitive demonstrating the repurposing of content. Of additional significance are the components of instructional design that were taken into account by the learners when they constructed their learning artefacts.

A greater transfer of skills was expected from one medium to the next and from more traditional ICT skills to mobile phone skills. In most cases it turned out to be the other way round as learners' conceptual knowledge of mobile phone skills guided them in their negotiation and acquisition of the relevant traditional ICT skills. Students reported being far more comfortable and secure while working on mobile phones than when working on the personal computer.

A learner working on the *Dissections for All* project remarked on the long-term prospects of the project: “It is a project also suited to preparing for the future, as eventually books will be replaced by technological devices; it gave us a chance to become more computer literate and allowed us to expand our knowledge of the subject itself.” In creating new knowledge to help contribute to the learning of others using the technology tools of their choice, their own learning acquired new meaning. This demonstrates that preparing for an unknown future with unknown technologies is a skill essential to lifelong learning.

This section looked at how innovative teachers introduce mobile technologies into their teaching and learning environment and why learners are so enthusiastic about using these personally owned devices. Consideration is given to the utilisation of mobile devices for content delivery. Learners articulated the need for content that is specifically designed for mobile phone use. Learners regard the use of mobile devices for teaching and learning as an aid which helps them to prepare for their own future – a future in which technology is constantly changing.

The sub theme *technology implications* as part of the theme *innovation negotiation in context* covered the unequal distribution of ICT in schools across South Africa and also within schools where certain subjects were routinely favoured over others. Innovative teachers relied on their resourcefulness to harness the full potential of the technology at their disposal, whether personally owned or in the hands of the learners. The technological choices they made in selecting solutions to set tasks were in some reported cases left to learners.

The next section sets out the emerging sub theme *innovation strategy* bound within the theme *innovation negotiation in context* and focuses on aspects of the innovation process (*cf.* Section 5.4.1) and how innovative teachers manage learner disposition (*cf.* section 5.4.2) and learning events (*cf.* Section 5.4.3) within the educational space as highlighted in Table 5-5 below. *Innovation strategy* will cover aspects revealed during the analysis of data that concentrated on aspects innovative teachers take into account when designing and managing innovative project based learning events. The innovative strategies they devise make room for learner initiative and the creative conception of solutions to articulated problems.

Table 5-5: Innovation negotiations in context as emerging core category with the theme innovation strategy highlighted for discussion.

AXIAL CODING (categories clustered in sub themes)	SELECTIVE CODING (Emerging themes derived from sub themes)	CORE CATEGORY
ICT availability and distribution	Technology implications	Innovation negotiations in context
Technology appropriation		
Mobile Technology		
Innovation process (cf. Section 5.4.1)	Innovation strategy (cf. Section 5.4)	
Learner disposition (cf. Section 5.4.2)		
Managing expectations (cf. Section 5.4.3)		
Curriculum issues	Reflexive pedagogy	
Assessment quandary		
Unprecedented initiative		

5.4 INNOVATION STRATEGY

ICT-supported innovative pedagogical solutions implicitly bring about a shift in educational practices, cultivating the emergence of new forms of instruction and assessment (Pelgrum, Brummelhuis, Collins, Plomp, & Janssen, 1997). In a study pertaining to innovation in Israeli schools, innovation is found to be much more than a technical development, but rather a “qualitative educational shift towards a new paradigm as a result of an ongoing process” (Mioduser, Nachmias, Lahav, & Oren, 2000). Educational innovation spans the areas of learning, teaching, curriculum and time and space configurations. These innovations take place mainly through informal communication channels and are relatively slow in their diffusion (Forkosh-Baruch, Nachmias, Mioduser, & Tubin, 2005). Findings further indicate that learners immersed in media-rich technology-enhanced environments are more susceptible to innovative teaching and learning practices (Conole, de Laat, Dillon, & Darby, 2008).

Rogers (1995, p. 11) defines innovation as “an idea, practice, or object that is perceived as new by an individual or system”, however, the term *innovation* is bandied about loosely in every sector of industry and therefore is often referred to as a type of commodity. It is used to describe

virtually any form of change and notwithstanding the growing literature on the subject, clarity about the form of innovation suitable for given contexts is not easily established. Most often *innovation* is used in the same breath as other terms such as transformation, change, competitiveness and even improving the bottom line in business cases. Clarification is required in relation to technology use in education in order to identify genuinely new and exciting pedagogical practices. At its broadest level, innovation can be conceptual – a new idea that is acted on. Central to this conception of innovation is the emphasis on novelty, difference and change (Davis, 2010; Straub, 2009).

A recent report titled (2008) found that there is no shared understanding of what innovation encapsulates, what it entails and what it brings to teaching and learning. The next section, as set out in Figure 5-3 below, provides greater clarity on innovative teachers' conceptions of innovation and presents the sub themes of *innovation process*, *learner disposition* and *managing expectations* as it emerged from the theme *innovation strategy*. Each of these will be discussed in greater detail (*cf.* Sections 5.4.1 – 5.4.3).



Figure 5-3: Innovation strategy as sub theme with expanded categories

The first sub theme *innovation process* takes into account teachers' conceptions of innovation, elements of learner disposition, task orientation and project fatigue that need to be carefully managed during the process of teaching and learning with emerging technologies.

5.4.1 Innovation process

This section will mainly focus on the innovative process as derived from literature and explore the innovative teachers' perceptions around aspects of innovation whilst making use of their own projects and words to demonstrate their practices.

Gann and Dodgson (2007) identify five generations in the innovation process. The first two generations are recognised by their linear process approach whereas the latter generations are more integrated and open in their methods. Innovation models moved from the research-push of the early 1950s to invention engineering and manufacturing to marketing of the new products. This changed to a demand-pull in the 1960s where innovations were directed by a perceived demand which influenced the direction and rate of technology development. The coupling model in the 1970s focused more on the feedback from the research phases and the market effects with the challenge of managing significant investments in cross-organisational communication and integration.

The early 1980s saw the birth of the collaborative approach with partners in the external and internal structures of organisations recognising technology as assisting in the innovation process. The potential of alliances with other firms and competitions drove innovation forward. Challenges to this generation moved beyond the research and development and marketing spheres and centred more on strategic planning and aspects around sources of knowledge. The 1990s saw a higher level of strategic and technological integration with suppliers and customers forming a value chain with lead-users and first tier suppliers. The period from 2000 onwards saw the innovation process riddled with risk and uncertainty in an unpredictable and turbulent marketplace with increased emphasis on best practices and maximum responsiveness to cope in these contexts.

Over the last few years the speed of change has become more evident and businesses are now positioning innovation as a core business process. It is no longer only solutions and products and the processes by which they are delivered that are of interest, but it is also increasingly about harnessing the distributed creativity of a network of related actors inside and outside an organisation to bring together the most effective strategies for delivering value (Gann & Dodgson, 2007, p. 9).

Educational innovation has not kept pace with the business innovation, however, educational organisations systems are taking note of the work done by the innovative teachers and are actively encouraging them. They are becoming better at recognising the value of the teachers leading the curve and are making attempts to harvest and learn from them through workshops.

During the course of this research, participants were asked to describe their notions and reasons for innovation in teaching and learning. Merna Meyer explains that her approach to innovation is combining two different cultural objects through the use of ICT. She expresses her hopes that her efforts to stimulate creativity whilst introducing new technologies will improve their employability in future:

What is innovation? By combining two diverse cultures (Greece and South Africa) the project goals were to enable the learners to make a conceptual leap from one cultural environment to another and move between two different eras and then to blend these different influences to create something completely new. It was hoped that by using multi-media these difficult conceptual gaps could be bridged and enable new innovations to emerge. My decision to integrate multi-media techniques into the classroom to encourage the development of creativity, innovation and dealing with difficult (and sometimes alien) concepts whilst simultaneously introducing learners to new technology will improve the likelihood of them accessing formal jobs in the future. Our province need the skills in the workforce these learners would have acquired and would improve their success in finding a job (Merna Meyer, VCT 2007).

Peter de Lisle's take on innovation in his project: *Why do we hate?* is to combine the use of two differing software programs to complement each other in the learning task and he provides the following reasons below:

The combination of Sketchup and Google Earth is unique. It is relevant because it:

- *Emphasises the **importance of place** in building understanding.*
- *Provides a **powerful and flexible design environment** which allows for an excellent balance between creativity and structure*
- *Learners, themselves having been challenged to move beyond comfort zones, are empowered to change others' attitudes because the project is online and open to all, other schools and learners will be drawn in and will share their views; through the sharing process, attitudes are confronted and changed (Peter De Lisle, VCT 2008).*

Teachers attending the innovative workshop in Pretoria in 2009 were asked to reflect upon a specific memorable learning moment whilst still at school. In recalling these instances they were made aware of the "moments of magic" they experienced and could still remember years hence.

The discussion moved to their more recent teaching activities and they were tasked to extend their personal memorable moments into their own teaching space with the introduction of ICT.

The following is a snapshot of their comments regarding the concept of innovation as captured by the researcher on the day of the workshop:

What does innovation mean for you as a recognised innovative teacher?

- *Innovation is not a rational affair. It is a mystery of where and how we go next.*
- *As teachers we go in blind. We have no idea of what will happen or how to deal with the fallout other than our experience and intuition to fall back on.*
- *Innovation is neither problem nor solution oriented but it is about the process.*
- *Innovation is not necessary new things, more of a new approach.*
- *There must be a purpose to the innovation and not just innovation for the sake of innovation.*
- *Challenge your own assumptions and keep it simple and doable. Take two ordinary objects and build unconventional objects.*
- *Innovation can flow in and out of your teaching because you do not need to be innovative all of the time as routine tasks build the foundations for innovation.*
- *Product is a surprise and negotiated. Learning through discovery is not only for the learners but also for the teacher.*
- *Innovation can represent multiple intelligences, according to the strengths of each person.*
- *Transform teaching but keep in mind that the learning stays pedagogically sound.*
- *It is mandatory to have fun in a creative environment. Fun is paramount in the process of learning with less emphasis on the end product.*
- *Novel idea is to use the learners to explore and find solutions.*

The above collection of comments from innovative teachers indicates the dynamic and spontaneous flow and unpredictable nature of innovative teaching and learning practices. Innovative teaching can thus be defined as dynamic, inclusive, open-ended, confronting conventions, process focussed, not always rational, pedagogically sound, engaging and fun. It is also important to build in some unstructured time during the project allowing learners the opportunity to explore new areas of interest within the project. Because of the unprecedented

nature of these projects and the as yet undetermined capabilities of the emerging technology employed, additional time is needed to fully explore possible solutions. An innovative teacher during an interview explains:

Unstructured time during learning tasks gives learners the freedom to explore off-task and during this “play” activity they bring solutions / opportunities for unique growth of the project or task. It might not have been known to them otherwise as the teacher is usually oblivious as well (U1,8).

One of the elements that were mentioned consistently throughout the day was that the fun element was required to be the present in all the activities within an innovation. Jekubeni Ndoda in the project *the next gold rush* explains his approach to keeping learners engaged during the project on entrepreneurial opportunities in tourism in the East London area:

The project is truly innovative because in the beginning the learners were having fun and thinking that the whole exercise was just for enjoying their interactions and it took them by surprise midway that actually what they were doing was learning and they continued doing that excitedly. The people with whom the learners were interacting also, expressed a view that they wished that the way learning is taking place nowadays could have been there in their time while they were still learners. (Jekubeni Ndoda, VCT 2009)

Teacher Rae Gagiano, sets out her innovative pedagogical strategies in Figure 5-4 below when directing her learners to develop a virtual art museum featuring local artists. Her project addresses the need for contextual content lacking in the currently available instructional resources.

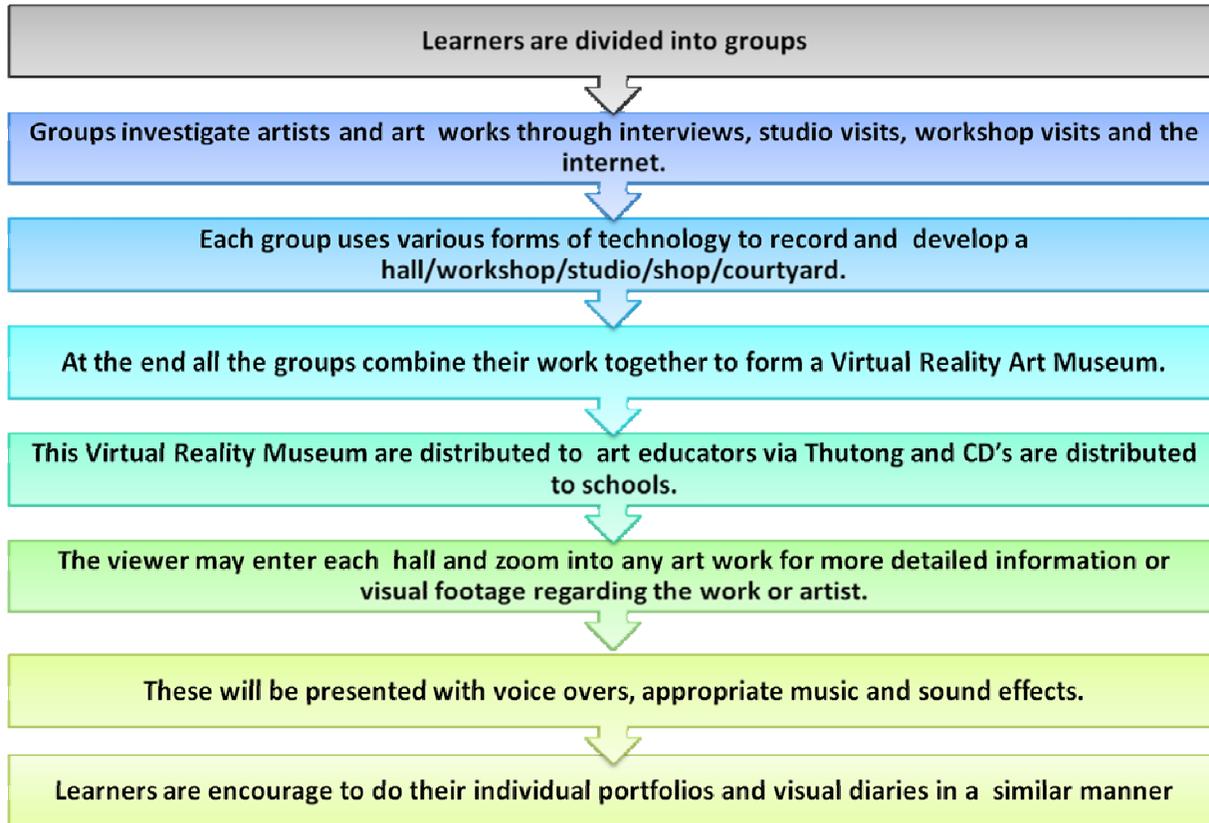


Figure 5-4: Learning process in the virtual art gallery: Anywhere art (Rae Gagiano)

Evident from the steps as set out above in Figure 5-4, learners enjoyed the freedom to select an artist of their choice, the instruments to investigate their work and the opportunity to select technology of their choice as well as the final deliverable. Their combined efforts resulted in the virtual art gallery guaranteeing access to anywhere art.

The innovative process has been linked to senior, well experienced, confident teachers willing to initiate, conceptualize and promulgate new approaches (OPM, 2008). Building blocks for innovation are presented as various steps reflecting an iterative cycle of events as illustrated in Figure 5-5 below. The process starts with *generation of ideas* before sharing and *refining* the concept then moves to *testing* and *evaluating* and finally *championing* their solutions or practice.

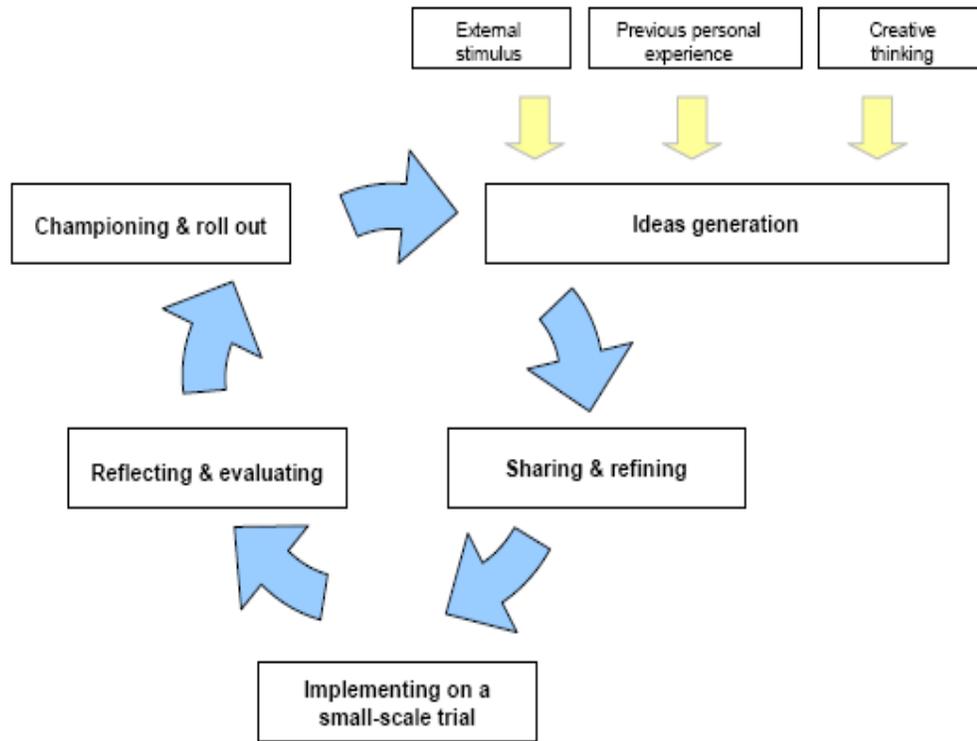


Figure 5-5 Innovation Process (OPM, 2008)

The innovation process is dotted with instances of evolutionary practices and through iteration cycles it is refined and embedded. Because a collaborative community of practice exists in many schools, the champion has an increased responsibility in communication and actioning their ideas. It is important to note at this stage that where these skills did not form part of their repertoire of pedagogy, they essentially developed their own practice.

Innovative teachers as participants in this research displayed a similar sequence of innovation; however, they are more linear in their innovation process moving from *conception* to *completion* without implementing on small scale. Trial versions do not often feature highly as they move to new ideas and do not spend too much time finding alternative solutions. Innovative teachers refine and reflect on a continuous basis in consultation with learners that share the learning environment. The sharing and refining of ideas and concepts are not separate steps in their innovation process and they are more dependent on their learners to initiate new ideas. Learners

are active participants in the innovation process and their dispositions continue to influence decisions teachers make in managing learning events during the innovation process.

In reflecting on the innovation process of innovative teachers there is a correlation with Argyris and Schön's double-loop learning organisational leaning model. In this model the more traditional teacher is situated in the exploitation phase, where conditions remain generally the same. Teacher disposition is such that they do not challenge the status quo therefore teaching efforts are directed to maintain or to make current practices more efficient.

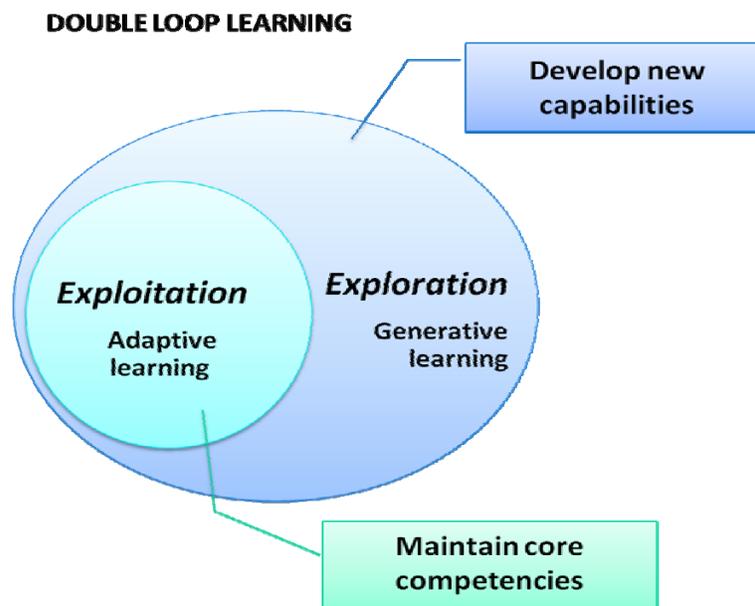


Figure 5-6: Process relevant to exploitation and exploration learning adapted form Argyris and Schön's (1978)

In contrast to the methods that *traditional teachers* apply in their practice, *innovative teachers* find themselves in a cycle of exploratory learning. They constantly question their teaching strategies and, through the introduction of emerging technologies into their practice, they necessitate the modification of their school's policies and practices. *Exploratory learning* is more reflective and creative than *exploitation learning* and it can also display unexpected consequences. Rapidly changing technological devices, along with their increased capabilities, introduce an element of uncertainty into the learning space. This in turn results in new competencies which generates a new cycle of exploratory learning.

At the beginning of this section the current generation of innovation process was explained. The best practices to cope with the uncertainty of solutions were emphasised and the risk mitigated within fast changing contexts. Innovative teachers' notion of innovation was conceptualised and described as dynamic, inclusive, open-ended, confronting conventions, process focussed, not always rational, pedagogically sound, engaging and fun. Evidence was presented as to how teaching and learning practices are changing to exploit emerging technologies and how teachers rely on learners to initiate and implement new ideas. The value and newly acquired knowledge of innovative teachers are beginning to be recognised and efforts are being made to direct their efforts towards organisational change.

The next section will cover the sub theme of *learner disposition* and how it ties in together with the main theme of innovation strategy (*cf.* Table 5-5, p. 191).

5.4.2 Learner disposition

This section covers aspects of learner disposition and highlights *learner initiative* and *task orientation* within their innovative projects. In section 4.4.1, teacher disposition was explained as the temperament that enhances both their intellectual and social growth and helps them to acquire characteristics that support their teaching activities. Learner disposition is more dependent on a particular learning environment.

Innovative teaching practices using emerging technologies bring about dramatic changes to learning environments. Learners respond in different ways to change within their learning environment. Innovative teachers need to be able to read the signs and mediate activities to decrease the additional pressure on learners as a result of changes to their learning routine. Fullan (1991) lists four possible reactions of learners to changes in classroom practice:

- *Indifference.* Learners anticipated more change than actually realised and therefore they became apathetic.
- *Confusion.* Learners are not exactly sure of what is expected of them.
- *Escape.* Learners are less interested in the change or the process and are more concerned with breaking away from the mundane everyday activities.

- *Heightened interest and satisfaction.* Learners approve new measures and cooperate with teachers and other learners to ensure continued change.

Strategies innovative teachers employ to mitigate learner indifference and confusion is to involve them early on in the planning of learning events. Inclusion at an early stage of the innovation process allows learners to demonstrate initiative and contribute their understanding of the learning objectives. Through shared collaboration learners take greater ownership of their growth and development.

Learners not only need to *acquire knowledge* through a process of socialization but through a parallel process *grow learning attitudes and values* associated with new knowledge. Anderson (2008) notes that embedding learning in a social context ensures subsequent practice. An example of such an embedded learning event, which relies on the social interactions within a particular challenging environment for its success, is a project coordinated by the innovative teacher John Lancer. As their teacher he reflects on what motivated his decisions and report learners' personal development. In the *Epic Outdoor Adventure* learners used a location based software program to prepare themselves for this activity.

We are sometimes afraid to allow them to make mistakes and in so doing stifle their personal growth. In life we all make mistakes and it is our reaction to them that really counts in the end. We need to challenge them in difficult situations and ultimately help them to understand themselves better. Take boys out of their comfort zones and encourage social and emotional personal development. They test themselves in a variety of situations, learn new skills and develop emotional, organizational and practical intelligence whilst building a sense of identity, strength and resourcefulness. The boys will learn the value of group decision-making and trust and have the opportunity to develop new friendships experience opportunities for the appreciation and development of leadership. Make a contribution to a team, a community and the environment. Encourage reflection. These outcomes will be achieved through each boy's interaction with his peers, with teachers and with the community with which they come into contact (John Lancer, VCT 2007).

Learners not only show initiative in exploring the boundaries of teacher control but also assume responsibility for their own learning as they establish their own rhythm in the learning process. Vanita Coetzee discovered in her project *SAVUKA! Waking up: Doing things for yourself*, that learners acquired ICT skills that she was not even aware of herself. She conveys her astonishment at their initiative:

To me it was really exciting to see the learners play around with different backgrounds, effects on photos and transitions. But the ultimate thrill came when an official of the Department of Education wanted to download this presentation from a memory stick and found that the presentation was password protected!! I was totally astounded. I never taught them how to do it; they discovered it totally on their own! (Vanita Coetzee, VCT 2007)

Within innovative teaching and learning spaces and projects, learners were inclined to self-organise their responsibilities and were happy to learn from one another. In the project: *Teaching and learning from a distance*, schools from rural and urban areas are connected and teachers/learners from all the schools can communicate by means of video, audio and desktop sharing. During learning sessions a lead teacher coordinates the efforts of learners and teachers in presenting the lesson with input and questions from all the connected schools. Learners observe how their peers tackle problems and model their own behaviour accordingly. A learner participating in the multiple schools project, run by innovative teacher Frans Kalp, shares his thoughts below:

I think that this program is a great learning experience, it is helpful and beneficial, especially because there is an interaction between learners of other schools and that helps us a lot in learning what other students find difficult in a lesson, and learn us how they tackle tasks, and therefore gain different ideas and knowledge from them, hence learning educational new things because it helps us to understand much better (Frans Kalp, VCT 2009).

Learners were also comfortable in openly sharing their areas of strength and weaknesses with their peers and freely engaged in skills bartering in the formation of their working groups. They assigned themselves roles and determined their own areas of potential growth in selecting peer mentors they felt comfortable with. Murphy Mugabi shares more from his project: *Electricity: More power to you:*

Learners formed groups of four to five learners to work on specific tasks in the project. If you thought that your skills might be a little weak in one area, like your computer skills, or if you haven't had a class in one subject that you think would be useful, you could try to select someone who can help balance these areas, and who might need a little help in your strengths. A number of learners strongly endorsed the value of learning from other learners. Learning was enhanced through interacting with others, sharing their knowledge, experience and ideas. This reflected a distinct and abiding tradition in adult education - that of valuing group learning and the contributions of each learner to the collective process (Murphy Mugabi, VCT 2008).

There is a noted diversification of the learner population in relation to their ICT ownership and their ICT skill levels. Not all learners are exposed to the same training and they all own different digital devices with differing capabilities. In setting tasks, teachers have to be cognisant of differing skill levels and competencies of learners regarding ICT use, particularly where learners have limited access to computers in school and do not own any of their own devices. Neen Hollock explains how learners, working in groups, organised themselves depending on ICT ownership and preferences:

Those learners, who have access to computers at home, have continued the process at home and then brought their knowledge back to the other learners in their group that were given tasks that were not dependent on computer use. Many learners found that they had special talents in certain areas and they then took on those tasks leaving other learners to work on sections that they enjoyed. Even if they chose to work on their preferred areas they still learnt a lot from each other (Neen Hollick, VCT 2007).

To deal with the differing skill levels of learners entering the school, Gaye Pieterse gives details of her strategy to mentor these struggling learners in her comments below:

It became more a project of mentoring, which was far more satisfying - it became very clear which pupils were struggling and needed extra help. This was especially evident with new pupils to the school who had no prior learning of IT. Learners that were ahead in their own tasks were assigned to assist these learners. Some of them discovered that they actually enjoyed the mentoring of others. Their own group members also guided them and in the end their skill levels almost matched those of their peers (Gaye Pieterse, VCT 2007).

Learner behaviour is another element to be considered when employing new technologies in a classroom environment. Any change brought to the teaching and learning space has the potential to disrupt the normal flow of learning due to heightened levels of excitement (Fullan, 1991). Warren Sparrow accounts for the decrease in disciplinary issues he observed during his project:

The learners are always keen to work with technology which makes very little discipline issues, as this is what they want to do and be part of. I have found that the attitudes in learners have changed immensely for the better and the learners want to be part of the learning that is happening in the class (Warren Sparrow, Pan African Finalist, 2010).

Redressing social injustice is a recurring theme that resonates with both learners and their teachers. Innovative teacher Vanita Coetzee relates the deep commitment learners have towards the vulnerable members of their communities and how they revel in their newly found power to address these needs in some way.

To see learners getting involved in the lives of others in a positive way was fantastic. It really touched my heart when learners used all the money that was raised by hosting a charity show in conjunction with Thabo Hlongwane and Kay-Gee, to buy warm winter tracksuits for learners residing in the orphanage in Koffiefontein (our neighboring town). It was extremely exciting to see the learners ICT skills growing. They felt very challenged at first, but the need to better their project motivated them to use computers. The inclusion of ICT motivated more learners to become involved in the project (Vanita Coetzee, VCT 2009).

Learners' consciousness of social injustice is also reflected in the *Dissections for All* project. Learners report that the strongest motivating factor during their project was the prospect of redressing social injustice by making a personal contribution to the liberation of their underprivileged peers as *"our artefacts had to leave a long and lasting educative message."* One learner's reflection on their learning process follows: *"Personally, I believe this is the most valuable project we have been required to do, as it is not only a mark, it is a life-changing learning tool which could eventually help many children in our community."*

The sense of community is also reinforced through projects such as *My community my Pride*. Learners identified a contemporary problem in their community and explored it using various technological tools. These tools were also used to promote thinking skills and to craft a suitable response. They were challenged to devise strategies which would address the problem they identified and then present their action plan through formal presentations to local leaders, municipality officials and the community at large. It is hoped that the municipality might implement some of the suggestions through their Department Planning Programme. One learner comments:

What a great experience doing this project. At first I was very frustrated but as the time go by it got more exciting and more fun. Being with the Local Government the head man and council for the first time having an opportunity to communicate with them get valid answers and shake hands with them and take photos. I have gained skills like how to be independent when it comes to communicating ideas. I learned that ideas should be shared and co-operates to one another (Mfeka Hlengiwe, VCT 2009).

Learning comes to life when learners create something that was meaningful to them. Saretjie Musgrave comments in the importance learners place on the personal meaning below:

This was a highly successful project, because learners were given the opportunity to apply their knowledge to the real world. They became critical thinkers who came up with solutions to a very real problem in their community and the wider school community of South Africa. In just one Saturday, 41 teachers from schools as far as 350 km away were given the chance to cross the digital divide. The

biggest change was in the attitude of the students themselves. They ended the project, knowing that they can play a positive role in the wider community by sharing skills, knowledge and giving of their time (Sarietjie Musgrave, VCT 2007).

A pertinent criterion to becoming a participating member in society is to first acquire the skills needed to function in this world. The use of more personal and familiar devices such as mobile phones allows users to become more confident and self-reliant as they develop their ICT skills. Using personally owned mobile devices has the ability to “enable non-threatening, personalized learning experiences and enable peer-to-peer learning and support” (Attewell, 2005, p. 2). Self-confidence and self-esteem increase with the recognition of previously uncelebrated skills. Mediation to successful learning is not restricted to mobile devices or personally owned devices but any vehicle can be used to encourage involvement as demonstrated in the project *Paying/Playing It Forward* by Rae Gagiano. Once sufficient motivation and purpose is established for the specific task, ICT is introduced and is then used as a vehicle to achieve the objective.

*The learners completed fun workshops before they were challenged to put their newly found skills to use by uplifting their community. Gift of life – with the support of Social workers and a psychologist, club members created storybooks for babies that were “dumped” by their mothers at Rosepark Hospital – learners spend time caring for the babies and then made storybooks were these babies became the heroes in the story. The learners hope that these storybooks will travel with the babies to their new families. The project also addressed the learning of essential skills in an integrated way using technology as a fun tool to achieve new ways of creating stories and by sharing it with the not so privileged, it enhance values and appreciation of their own life experiences. This project has **opened new horizons** for learners regarding the value of ICT, story telling, and the true value of giving and sharing with other people (Rae Gagiano, VCT, 2009).*

Teachers adapt their pedagogy to accommodate and anticipate future demands on their learners and to equip them with transferable skills and so maximize their opportunities (Swart & Pye, 2003). Other than transferable skills, innovative teachers aspire to develop societal values that can improve citizenry. Innovative teacher Karin Horne in her project: *Who is responsible for the future?* expresses the kind of attitudes and values she tries to encourage in her learners though the exposure they gained in the project: *Who is responsible for the future?*

To instil in the learners a caring attitude, responsibility towards, and an understanding of what each of them can do to contribute to reversing some of the community problems..... The one thing I am very

aware of is that this project is not only for the learners I teach, but also include important issues that go beyond the classroom. (Karin Horne, VCT 2007)

Innovative teacher Saretjie Musgrave describes her 2007 project as a community outreach program that focussed on first determining the ICT skill levels and training needs of teachers from previously disadvantaged schools in the surrounding areas before challenging her learners to provide support material and training for these school teachers in any of the following possible ways:

- *Create training manuals for teachers and provide an opportunity for learners to help train teachers with very little computer knowledge.*
- *Design computer generated worksheets for Grade 1 – 3 teachers from previously disadvantaged school.*
- *Make a training DVD for teachers using a video camera and Microsoft MovieMaker.*
- *Conduct a one day workshop for teachers in their neighbouring community.*

Saretjie Musgrave recounts how her learners changed their own conception of their perceived limitations:

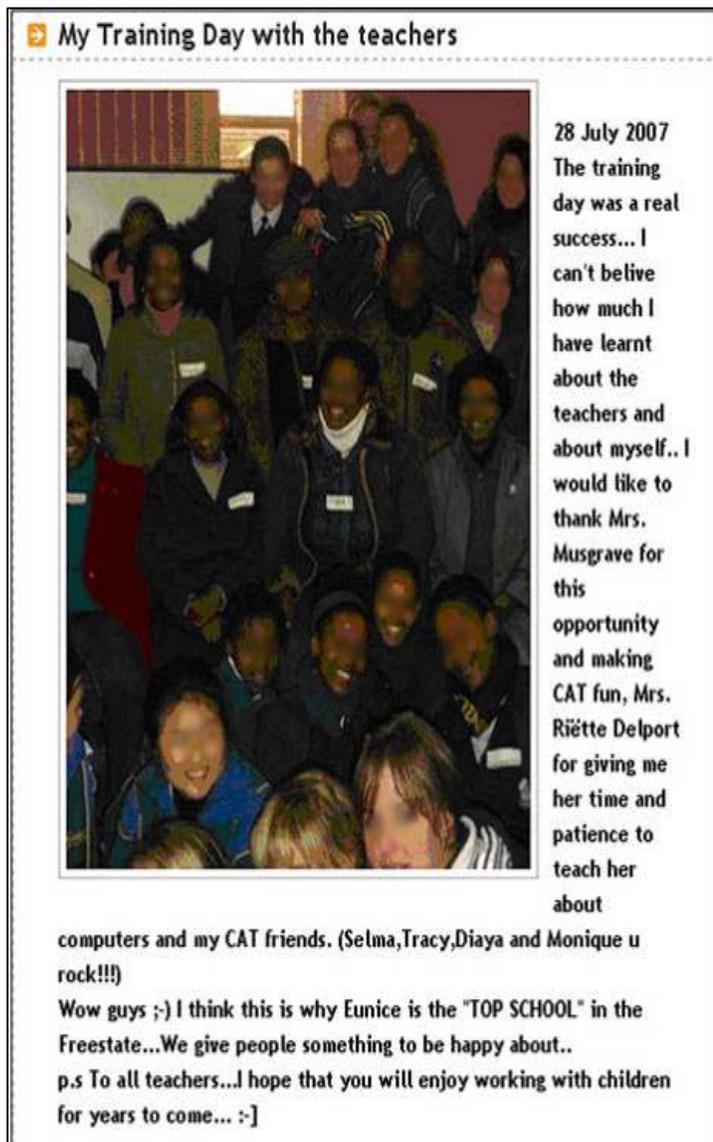


Figure 5-7: Screenshot of blogpage

Girls were also given the opportunity to cross the barriers in their own minds, where many of them thought they had nothing to give to those in need; this changed for the better!

The empowering nature of the learner experience is related in the following **quotes** that were taken from the learner's online journal (Blogger™) which they kept for the duration of the project:

- *What a great experience! This was an amazingly enriching experience, getting to know how teachers feel about the use of computers in their everyday life. I am in great debt to the teacher I trained.*
- *He was the reason that my project was a success. Mrs. Musgrave mentioned the day before the training that we will not know how much we mean to these people until we have actually trained them. I can now say that I have a full understanding of what it means to truly enrich someone's life.*
- *It really tried my patience to teach someone for 7 HOURS ON A SATURDAY! Mrs Musgrave, seriously, I'm still tiiiired. I never want to be a teacher, it was incredibly hard to be patient and understanding, I learnt a lot of self-restraining that day. I hope Thabo [the teacher I tutored appreciated the effort....*
- *On Saturday morning, we had to train. I was extremely nervous because I did not know what to expect, but once the teachers arrived I felt much better knowing that I could really help an adult concerning computers. I have to say that I also learned alot, especially how to be patient...HA HA HA. I will never regret attending although it was a long and condensed day, because I felt part of something that is crucial in our every day life.*

During this research two distinctly different approaches to task articulation manifested. The traditional approach is more *teacher driven* where the teacher determines the objectives, method and final deliverable. On the other side of the spectrum *learners steer the process* from conception to the final deliverable with the teacher acting as mentor and mediator. Learners choose their topic area, their own tools, grow the required skill set and negotiate tasks with each other according to their strengths. Learning becomes self-directed and tailored to suit the skill level of the particular learner as they chart their own development path. Innovative teacher Nicci Hayes describes below how her teaching practice changed:

I rely increasingly on workshopping as a methodology as this allows learners to explore themes and concerns that are relevant to them and their environments (Nicci Hayes, VCT 2009).

Innovative teacher Murphy Mugabi describes a blend between the traditional and the innovative approach where he relinquished some level of control allowing learners the opportunity to negotiate time frames, however, he remained in control of assigning the tasks.

Time frames and proposed dates of completion of the project were discussed and learners had a chance to give their input. Tasks were assigned to different groups and proposed dates of meeting were laid out to ponder on what the respective groups have gathered (Murphy Mugabi, VCT 2008).

Desmond Neal Cross in his project, *Real Science*, observed that learners who focused on the final deliverable, tended to achieve less learning than those learners who emphasised the process of acquiring new knowledge. Not being too wrapped up in the final outcome freed their learning and thus allowed for the additional exploration of problems.

Some learners were successful because they were not too fussed about the outcome and more about the process. This allowed them to be creative and not to focus too much and perfection (Desmond Neal Cross, VCT 2010).

At the start of this section learner disposition was noted as heavily influenced by social contexts and learning attitudes. Values associated with new knowledge develop in a response to finding solutions to a situated problem. Learners became progressively empowered as projects unfolded and they acquired ICT skills beyond the scope of their specific tasks as they took the initiative to explore and implement their own preferred outcomes. They expressed the inclination to work on areas that interest them and they engaged in peer coaching and mentoring learners with weaker skills resulting in a high level of skills transfer within group work. Learners also enjoyed the relative flexibility within the innovative teaching and learning environment and were gratified that their efforts were appreciated and validated by the community. Learners were far more socially conscious as their projects drew to a close.

The next section considers the sub theme *managing expectations* as part of the theme *innovation strategy* and relates how teachers manage learning events and constantly monitor *learner workload* in an effort to prevent *project fatigue*.

5.4.3 Managing expectations

The general core duties of teachers, as mentioned in Section 4.3 on page 132, to plan, prepare and execute instructional programs and to provide learning materials, instruct, assess, keep records updated and manage learner behaviour through a code of conduct. In carrying out these core duties, innovative teachers have to also pay particular attention to learner interests and behaviour. When using emerging technologies in innovative projects, not all of the variables are known prior to implementation. The teaching and learning events tend to be more open ended in process and the final deliverables are regularly re-negotiated as new problems surface during the execution of a project. New solutions need to be explored and this can result in amended outcomes. Teachers therefore need to be vigilant and proactive in their class management and avoid learner project fatigue due to increased learner workload that tends to creep in as the scope of the project grows. Motivated learners get caught up in the ideals of a project and invest more energy and resources in ensuring the success of their project and in doing so they can sometimes lose sight of the original learning objectives. Innovative teachers have to be conscious of learners taking their projects to extremes and they need to intervene in time to avoid project fatigue. The researcher encountered this phenomenon in her own project *Dissections for All*. The following extract is taken from her reflective diary:

The cycles of iterations had to be halted, as students exhausted themselves redoing their work, constantly trying to improve it. The most extreme case was one student spending 7 additional hours to redo an animation after his group discovered a spelling mistake in the cartoon that formed part of the introduction to the multimedia artefact. The original FLASH source files were lost and he had to redo everything from scratch. His group wanted their artefacts to be perfect and did not want to short-change any learner relying on their resource for instruction. They even went as far as to create additional worksheets based on their artefacts to serve that could be used as resources or assessment instruments. These additional initiatives fell outside the scope of the project but as a group they felt that it completed the learning packaged. The group still maintain that the additional effort was worth it. (Reflective comment from Jacqueline Batchelor – the researcher)

Learners also expressed difficulty in estimating the amount of time it would take to get a task done, especially when they were using newly acquired ICT skills. It invariably takes them much longer than they initially anticipate resulting in the neglect of other tasks and even failure to

complete assignments on time during formative and summative assessments. Gaye Pieterse recalls her struggle to keep learners to deadlines:

A crucial aspect of the project is to have learners hand in tasks on given dates so that marks can be collated for each term and so that a check is kept on those unable to progress. I had great trouble in keeping all learners at the same pace & cut-off dates for hand-ins were extremely important, both for me & the learners (Gaye Pieterse, VCT 2007).

In cases where learners had to share computers because of restrained availability and distribution mentioned in Section 5.3.1, skills were acquired at a much slower pace. Another element teachers need to be cognisant of is task avoidance or procrastination due to lack of ICT skills. Group members play a critical role in mobilising these learners as Neen Hollick reports below:

Initially the learners appeared to be far too relaxed in their attitude towards the research portion and many of them wasted time, although, initially, some said they were afraid to tackle the task (Neen Hollick, VCT 2007).

When managing learner expectations during innovative teaching events and projects, teachers have to pay close attention to learner workload and ensure that tasks are distributed fairly amongst group members. They need to step in to prevent project fatigue that can result in learners losing interest and enthusiasm for future projects.

This section looked at the theme *innovation strategy* and covered aspects of the *innovation process, learner disposition* and *managing learner expectations*.

Table 5-6: Innovation negotiations in context as emerging core category with reflexive pedagogy expanded and highlighted for discussion

AXIAL CODING (categories clustered in sub themes)	SELECTIVE CODING (Emerging themes derived from sub themes)	CORE CATEGORY
ICT availability and distribution	Technology implications	Innovation negotiations in context
Mobile Technology		
Technology appropriation		
Innovation process	Innovation strategy	
Learner disposition		
Managing expectations		
Curriculum issues (cf. Section 5.5.1)	Reflexive pedagogy (cf. Section 5.5)	

Assessment quandary <i>(cf. Section 5.5.2)</i>		
Unprecedented initiative <i>(cf. Section 5.5.3)</i>		

The next section considers the remaining theme *reflexive pedagogy* as it manifested within the core category of *innovation negotiations in context*. The sub themes emerging from data analysis are covered in turn and include the areas of *curriculum issues*; *assessment quandary* and *unprecedented initiative* (cf. Table 5-6).

5.5 REFLEXIVE PEDAGOGY

This main section considers the skills required for learners in the 21st Century and the pedagogies needed to grow and support their skill development. Effective pedagogy necessitates that the teacher engages in the pursuit of techniques to stimulate and influence learners' acquisition of new knowledge. The rapid advance in technology and the multitude of devices with differing capabilities require continuous pedagogical renewal to ensure the currency of learning strategies. The reason for innovation, as sited by teachers in a recent study conducted by the Innovation Unit (OPM, 2008), is a recognition of the changing landscape their learners inhabit. Innovative teachers make a concerted effort to keep pace with the demands of change. The idea is no longer to simply enhance teaching and learning through the use of ICT in education, but in order to be considered truly innovative, one is required to move from *merely enhancing* to *rethinking* and *reforming* curriculum delivery.

Beetham and Sharpe (2007, p. 3-7) examine the nature of pedagogy. The research proposes that a shift in focus teaching content to *passive recipients*, to one of *active learner participation*. They argue that pedagogy embraces the active learning process; the preparation, scaffolding and facilitation of that process and reflective practice. In the context of the digital age these aspects of pedagogy that were previously taken for granted become much more visible, thus necessitating a much greater emphasis on the design of the learning process. At the same time that the approach to learning becomes more systematic, the creative, contingent and unpredictable nature of classroom interactions needs to be accommodated whilst the relationship between teacher and learner remains paramount.

Innovative teachers not only rely on their knowledge, beliefs and values but must also be able to identify the affordances provided by ICT resources in their teaching and learning. Pedagogical reasoning influences decisions regarding lesson plans, schemes of work and teachers' behaviour during instructions. Knowing the affordances of ICT allow teachers to deploy resources in the context of whole class, individual or small-group combinations. These affordances should match the activity to the needs of the students allowing for increased uptake (Webb, 2008). Pedagogy is therefore not in stasis as the demands on the teacher, learners and technology is in constant flux. Within the innovation context, there is a constant pedagogical renewal resulting in pedagogical reflexivity.

Anderson (2008) suggests that new developments in technology have the potential to change the skill requirements for learners as well as the ability to change existing practices such as radical new ways to do homework. Table 5-7 below tracks the major implications of the global knowledge economy for the skills and learning strategies of young people, particularly those entering the work force.

Table 5-7: Implications of the demands of the global knowledge economy for youth in terms of required skills and learning strategies (Anderson, 2008).

Demands from society	Required skills	Learning strategies
Knowledge as commodity	Knowledge construction	Inquiry, project learning, constructivism
Rapid change, renewal	Adaptability	Learning to relearn, on-demand learning
Information explosion	Finding, organising, retrieving information, ICT usage	Multi-database browsing exercises
Poorly organised information	Information management utilization	Database design and implementation
Incompletely evaluated information	Critical thinking	Evaluation problem solving
Collectivization of knowledge	Teamwork	Collaborative thinking

The rapidly changing knowledge society has far reaching implications for education in general. As information becomes more readily available, prospective employers who increasingly seek candidates with the ability to learn and relearn and who are able to participate in collaborative thinking.

Appropriating ICT's in everyday life requires the development of 21st century literacy skills as outlined in Table 5-8 below:

Table 5-8 Educational outcomes required for the 21st Century (derived from: Anderson, 2008)

21ST CENTURY EDUCATIONAL OUTCOMES IN THE FOLLOWING SKILL AREAS	
SKILL AREA	DESCRIPTION OF OUTCOME
Communication	Constructing logical arguments, reasoning from diverse evidence and sensitivity to audiences through the use of ICT tools.
Creativity in knowledge creation	Creative new knowledge solutions help solve problems with organisations of all kinds.
Collaboration	Knowledge-intensive organisations require teamwork as well as coordination. Networks and network-based tools become prerequisites to cooperative work.
Critical thinking	The ability to critically evaluate and judge information and knowledge claims.
ICT literacy	New literacies in the digital age lie at the foundation of preparing learners for the next century as software and tools continues to stimulate the growth of human intellect.
Life Skills	These consist of the skills of the last century (e.g. ethics, leadership, accountability, and self-direction) as well as those which have become more relevant (e.g. personal productivity and personal responsibility).

These 21st century educational outcomes cannot be viewed in isolation but must build on the values of the last century that emphasised good ethics, accountability and self-direction. The current educational agenda and emphasis on ICT literacy skills can result in the neglect of life skills which are so paramount to the development of the holistic learner. Innovative teachers are cognisant of their professional burden and grapple with the pressures of changing their pedagogies to accommodate the 21st century educational outcomes whilst trapped in the curriculum and context.

The next section will present the last theme to emerge from the core category *innovation negotiations in context*. The remaining theme *reflexive pedagogy* consists of the sub themes *curriculum issues* and *assessment quandary experienced* because of the *unprecedented initiative*

of the innovative teaching and learning practice. Each of these, as displayed in Figure 5-8 below, will be discussed in greater detail (*cf.* Sections 5.5.1 – 5.5.3).

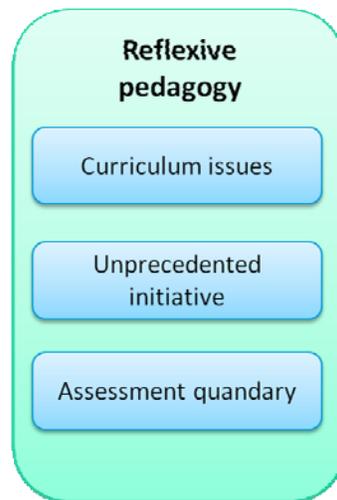


Figure 5-8: Expanded emerging theme: Reflexive pedagogy

5.5.1 Curriculum issues

This section will look at teachers' pedagogical reasoning process as they make decisions regarding the curriculum and the planning of their teaching and learning activities. A *curriculum* can be defined as a policy statement that is written down as a set of intentions which are then actioned by individual teachers according to a planned program. Much is made of the *curriculum on paper* but the *curriculum in action* comprises the *hidden curriculum* that includes informal contact between teachers and learners as well as contact between the learners themselves. These social interactions often have a much bigger influence on what is actually learnt than the guidelines in the formal curriculum.

Seymour Papert is of the opinion that the idea of a curriculum in today's teaching should become obsolete as it implies that learning is limited to the content that is planned to be learnt by a class of learners on a particular day. He advocates the idea of placing the learner in an environment where he learns where he needs it. He goes on to say: ". . . it means we're going to put kids in a position where they're going to use the knowledge that they're getting" (Papert, 2001, online).

The emergence of new technologies adds a layer of complexity to pedagogical reasoning because it brings along with it a technological dimension (Mishra & Koehler, 2006; Webb & Cox, 2004).

Teachers are forced to make decisions regarding the *potential* of a specific technology with little guidance and limited knowledge of how it will end up as this process is mainly done through trial and error. This process thus leads to uncovering new pedagogical strategies when teachers deploy technologies within the classroom for teaching and learning purposes.

“The classroom is an uncertain place where it is difficult to anticipate how a particular activity will work out. During teaching, teachers resolve tensions among competing goals as they make moment-to-moment decisions about what to do in a particular situation” (Uhlenbeck, Verloop, & Beijard, 2002, p. 244).

During their Mathematics Internet support project, Ramanijafy Hortense Liliane from Antananarivo in Madagascar, evaluated their practice before and after the completion of their innovative project. They reflect on their own growth and the growth of their learners as a result of their intervention in Table 5-9 below:

Table 5-9: Before and after evaluation of their practice: Ramanijafy Hortense Liliane

Before	After
Teachers	Teachers
Dictations	Summarized lessons
Rewriting of corrections	Consistent practices
General follow-up of learners	Individualized follow-up
Everything has to be oral or written since the teacher remains the sole information source	Information more generally available and not solely controlled by the teacher
There is no time for dialogue	Enabled dialogue
Stick to working on their own	Group work
Learners	Learners
Poor involvement in their skills reinforcement	Supervision of their own learning
Obligated to endure a rhythm that is more or less adapted	There is a way to progress as per individual learner
Due to the number of learners in the class, concentration problems result	Increased self confidence
Fully reliant on the teacher	Learners are left on their own to foster a sense of autonomy
Little communication: they are not given an opportunity to speak	Open spirit – open communication
<u>Results:</u> General pass rate : 35% Bad results	<u>Results:</u> A better general pass rate : 80% Progress in other subjects

Documented areas of pedagogical change include classroom management and the adoption of group work as a strategy to include more interaction amongst learners enabling dialogue. Learners are given opportunities to act independently of their teacher. However, a note of caution to teachers, a complete lack of teacher control or learner guidance creates insecurities in learners as they become unsure of what is expected of them in a particular learning situation and it can thus result in poor quality education. Desmond Neal Cross in his project *Real Science* reports that his lack of initial guidance kept his learners from committing to the project as they needed more support to get started. He explains that:

I struggled initially to get buy-in from learners for the project because, although I was giving them some direction, I was not giving them much direct support or scaffolding (Desmond Neal Cross, VCT 2010).

Other factors that contribute to poor quality education are the lack of a clear and appropriate curriculum, contextual content and teachers' skills to implement the subject guides. Freshman (2000) reports that the quality of education is generally poor, and educational content is often irrelevant to the needs of the learners and of social, cultural and economic development. In an effort to make the curriculum more valued by teachers and learners, the National Department of Basic Education drafted the new CAPS ("*Curriculum Assessment Policy Statements (CAPS)*," 2011). The CAPS is a national policy document that contains subject and learning area statements, as well as learning programs and assessment guidelines. The CAPS is to be revised every few years and updated to reflect changes in society and knowledge areas in an attempt to stay current.

The general availability of the CAPS document to teachers, however, does not ensure good quality educations for learners. The document makes no recommendations as to content delivery channels or suitable content resources. It therefore comes as no surprise that innovative teachers and their learners target these areas to improve their fit into their teaching and learning environments. Suitable content delivery channels, through the use of ICT, is continuously revised to exploit the affordances of emerging technologies. This is done in an effort to in create contextual content and increase coverage and access to suitable subject matter.

In support of the above the innovative teacher, Rae Gagiano turned her attention to an area she identified in the subject she is responsible for teaching and through her project addressed the need for contextually culturally sensitive learning resources. The project *Virtual reality Museum: Anywhere Art* by Rae Gagiano deals with the need for art resources featuring local cultural art. This project is illustrated in Figure 5-9 below.

Learning Tasks and Activities

There is almost no content available in Visual Culture Studies that art educators can use. The idea is to create a virtual reality Art Museum with various exhibition halls inside, consisting of:

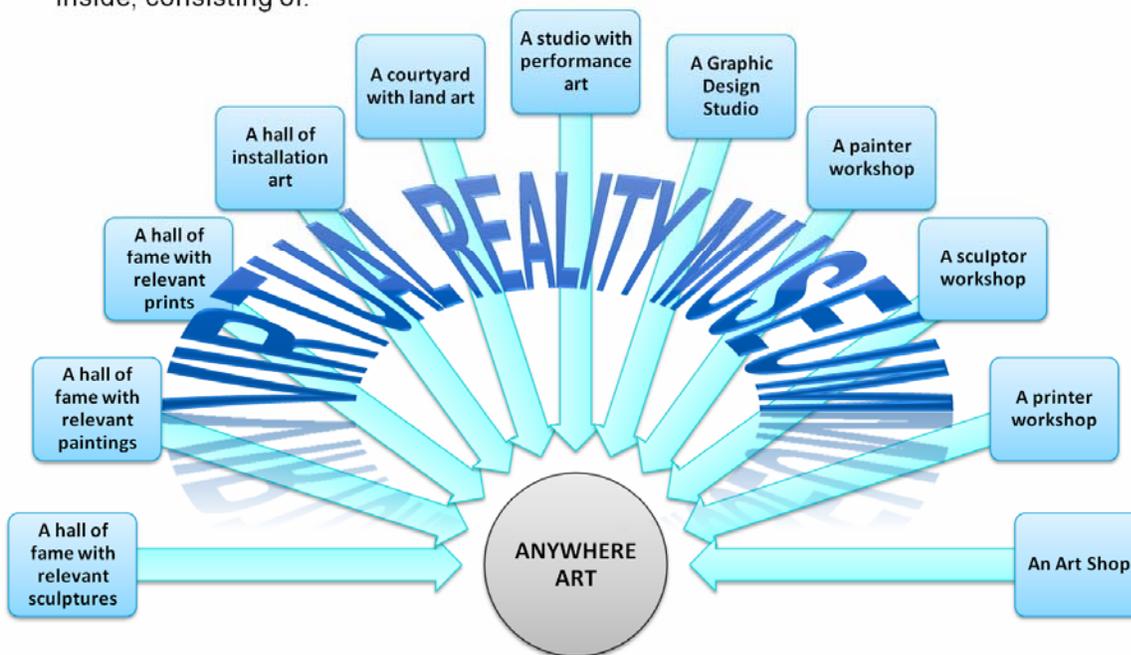


Figure 5-9: Poster section from *Anywhere Art* by Rae Gagiano

Where there is a perceived void, learners create their own artefacts for distribution to other like minded learners as previously mentioned in Section 5.3.3.

Linda Bradfield is a teacher at St John's Pre-Preparatory in South Africa. Linda received the Best Practice award in the *Innovation in Collaboration* category for her project entitled *Trash to Treasure* at the 2010 Pan-African Innovative Educators Forum. Linda's project challenged Grade 11 learners to collect as much waste as possible, recycle it and then donate the generated funds to charity or purchase essential school equipment. She comments on her increased awareness of curricular statements as a result of her changed practice below:

I have found that teaching project-based lessons is most rewarding. It has also made me acutely aware of all aspects of the curriculum as well as the assessments standards. The children have been very responsive and motivated. Each lesson and activity has been exciting and they have so enjoyed the variety of technologies that they have been able to use. I have also learnt that it is just as important to teach 21st Century skills to grade 1's as it is to teach them to older children. They can do it!! The Pan-African Event was an eye-opener. It was so rewarding to see all the good work that is being done in Africa and to be exposed to the many different cultures. This was a true lesson in collaboration (Linda Bradfield Pan African winner, 2010).

This section considered aspects of the curriculum that are impacted by innovative teaching and learning projects. Content considerations included areas of content delivery and questions relating to the availability of contextualised subject matter. Teachers' pedagogical reasoning in the planning and execution of their learning events highlights the need for reflexivity as the variables are not all known prior to engaging with emerging technologies.

5.5.2 Unprecedented initiative

This sub section describes the strategies teachers employ to deal with eventualities that manifest during an innovative teaching project. One technique teachers employ is to build on their accumulated tacit knowledge in small incremental steps. "Knowledge is not just something which we are conscious of, but consists of the *dispositions* we consciously use in understanding what now happens. Only that which has been organised into our disposition, so as to enable us to adapt the environment to our needs and to adapt our aims and desires to the situation in which we live, is really knowledge" (Dewey, 1944.p 344 cited by (Dottin, 2010, p. 401). In this instance Dewey clearly refers to the *tacit knowledge* that needs to be made explicit before it can be expressed effectively. Tacit knowledge is very personal in nature and the individual teacher finds it hard to formalise and communicate their new knowledge in relation to their amended pedagogies with their colleagues.

When teachers and learners embark on a new class project and use emerging technologies to achieve the project's objectives, subsequent teaching and learning practice manifests in novel outcomes. Anderson (2004, p. 4) finds that "in the practice of teaching, selecting the best practices or the most appropriate instructional strategies constitutes complex problem solving. In such situations teachers develop tacit knowledge to address the challenges". Innovative teacher Murphy Mugabi reflects on the general attitude of teachers wanting to know everything in

advance to a learning event. He recalls that, in spite of not having all the answers prior to the learning event, he felt completely comfortable and trusted his learners to solve any technical problems that might occur during their project. He states:

As teachers, we tend to want to "figure" or "learn" everything before we give it to learners. There was no way I could do that with this project, since learners had the choice to select any presentation software they wanted. Besides, I'd never worked out a documentary (Murphy Mugabi, VCT 2008).

Innovative teachers relate how they tried to anticipate technical problems, however, most of the solutions were discovered along the way and it is only in hindsight that problems could have been avoided. Innovative teacher Nicci Hayes found keeping up with changing technology to be the most challenging part of a project and that she could not anticipate additional problems. She did however value the opportunity to develop life skills in dealing with problems that do not always have obvious solutions. She explains what she would have done differently if she had the opportunity to redo the project:

I would make sure that the girls saved their original footage as a final version (as a backup) to avoid tears later after hours of editing. (I have also learned a thing or two in terms of the technology this time around!) Keeping up with the changing technological needs was the most difficult. The initial project, as it stood was good, and dealing with the unexpected additional presentations was a good life skill for the group! (Nicci Hayes, VCT 2009)

Looking back on his project, John Lancer would rethink the design of his learning activities to address the need for a smaller data set. It also transpires that the biggest problems he experienced were technical in nature and he made doubly sure that learners were taking additional steps to ensure their data security by making regular backups. He states:

The greatest obstacles are the numerous technical problems that are encountered. Pupils were instructed to save their projects into their home directories on the intranet as well as on the hard drives of their laptop. In future I'll reduce the size of the data set, which is very large and takes up a lot of hard disk space. I'll also reduce the number of steps from seven to five and eliminate some of the activities (John Lancer, VCT 2007).

Even though teachers and their learners engage in troubleshooting any technical problems, innovative teacher Gaye Pieterse is convinced of the lasting nature of this new knowledge. Newly acquired ICT skills, developed during the course of a project, need to be reinforced through follow-up projects. She explains below:

Entrepreneurship is an attitude; a way of seeing & thinking. It cannot be learnt academically; it can only be experienced & practiced in a hands-on manner. ICT is much the same. One learns what one needs in order to complete a project & the skills fade quickly if they are not reinforced with further projects making use of ICT's (Gaye Pieterse, VCT 2007).

One of the learners participating in the project: *Connecting the digital tribe* admits being confused whilst working with a specific software application. Even though their group completed the task successfully, he did not fully master or retain any of the skills he was exposed to. He comments below:

It was a fascinating project but I got a bit lost in some aspects especially when it came to "converting text to speech" even up to now I can't remember what I did. What I do know is that with a bit of time I will be able to figure it out again because I have done it once before (Murphy Mugabi, VCT 2007 - Learner comment).

Innovative teachers need to be cognisant of the fleeting nature of skills that are not initially reinforced. Even though the collectivization of knowledge is a skill that is required to function in the knowledge economy (*cf.* Table 5-7, p. 212), where other members of the group action their own knowledge and compensate for the inadequacies of other members, planned learning strategies should allow ample time for learners to increase their capabilities through skills transfer.

Innovative teachers have learnt, through experimentation, that when they include emerging technologies in their projects they should break projects into smaller learning events so as not to overwhelm their learners. Gaye Pieterse reflects on her future teaching strategy:

Learners love this type of project but also find it quite intimidating to begin with – it looks too big. I would separate the whole project into bite-size parts next time so that it becomes manageable psychologically .It is about the number of baby steps that accumulatively make for a giant leap and you only realise it when you take a look back (Gaye Pieterse, VCT 2007).

Apart from effectively managing learning projects by breaking them down and overseeing them on a smaller scale, it is imperative not to micro- manage learner initiative. Innovative projects have a tendency to get a life of their own and it is imperative to allow for spontaneous growth and not stick too rigidly to the design originally planned for the project.

You cannot micromanage the project. It gets a life of its own. If you control everything too tightly, learners lose interest and you effectively kill their enthusiasm. The teacher is in charge of the bigger

scope such as accountability and looking out for scope creep when it becomes too big for learners to cope with because many of them do not know their own limitations yet (UI,3).

“Educators must become more than information experts; they must also be collaborators in learning—leveraging the power of students, seeking new knowledge alongside students, and modelling positive habits of mind and new ways of thinking and learning” (ACOT2, 2008, p. 8).

The next section looks at *assessment quandary* teacher and learners find themselves in when they engage in unprecedented initiatives. Learners are continually assessed during *formative and summative evaluation* processes to gauge their progress in an effort to ascertain whether they have reached the desired outcomes as stipulated in the subject assessment standards.

5.5.3 Assessment quandary

This sub section considers the difficulties innovative teachers experience when faced with assessing learner progress or learner work. Teachers have no suitable assessment instruments available to evaluate unprecedented learning initiatives. Both formative and summative instruments are drafted in collaboration with learners. This particular problem was predicted by Seymore Papert (1980), in his seminal work titled *Mindstorm: Children, Computers, and Powerful Ideas*. He made the forecast that even with the introduction of new technologies into formal learning environments, that assessment methods will remain unchanged. In the past assessment was very focussed on whether learners could reproduce and represent knowledge accurately. It is no longer adequate to only measure personal knowledge gained, and there is agreement amongst educators that assessment strategies and instruments must reflect the new kind of skills required to contribute to the information society. These 21st century skills (cf. Table 5-8) cover three main areas namely learning and innovation skills; information, media and technology skills and life and career skills. Much value is placed on the ability to communicate effectively whilst working with other learners as a member of a team and demonstrate personal productivity and responsibility in life.

There are two distinctly different forms of assessment applied in education today. *Formative assessment* takes place *before* a piece of work is submitted for final assessment. It is an opportunity to receive constructive feedback from peers, parents, educators and even members of the community and allows the learner the opportunity to act on suggestions to improve his/her

work. *Summative assessment* on the other hand is when the teacher evaluates the *final product* submitted by the learner according to set criteria, usually in the form of a rubric. The final result is calculated and the cumulative work of the learner is used to determine their academic progress.

When assessment standards are applied in innovative projects they are found to be inadequate to judge the range of skills learners acquire during the project. Because of the unprecedented initiative demonstrated in these projects, teachers find themselves caught in an assessment quandary without adequate instruments to evaluate learner progress. The following quotes from innovative teachers capture some of their concerns:

- *The assessment strategies in project where there are new skills and tools used are largely uncharted territory. You make the rules up as you go along.*
- *Teacher is now a collaborator who provides guidance to the pupil as well as 'just in time' learning in use of technology. The teacher is able to assess pupils, have informal group discussions and help pupils stay on track.*
- *Initial assessment rubrics had been created and discussed with the learners so that they understood the scope of work. As the project grew with the learners applying new knowledge, they were involved in setting up the standards for further assessment.*
- *Pupils enjoyed watching each others' presentations and were quite accurate about assessing the best. It also gave each group an idea of what the other was doing and so extended their range of possibilities.*
- *Guidelines were set and as the knowledge of the groups expanded so these guidelines became more fluid.*
- *Learners worked ahead creating problems during assessment.*
- *Time was given for the learners to repair their work and represent to the class to ensure that the changes made were relevant. This led to the inclusion of additional rubrics to the ones originally used. Extra presentations meant that further rubrics were added to the project.*

Formative assessment is less structured and feedback is given to learners on a continuous basis from both peers and teachers. Learners and teachers recognise the inadequacies of the existing assessment instruments and together they craft appropriate assessments through a process of negotiation. Assessment guidelines are also described as being fluid and new rules are articulated as the project develops. One area of concern expressed in the drafting of assessment instruments during a project, is that learners that work ahead make it difficult to plan sufficiently

in advance as the corps of agreement cannot be reached. Enthused learners that have moved beyond the project timeframe might find themselves delivering work above and beyond the benchmark needed according to instruments that are designed after the fact.

Something else to consider when reviewing assessment strategies, is the correlation between engaged learners and improved academic performance. If an educator places less emphasis on *assessment* and invests more effort in *designing engaging learning events*, progress is ensured. Andrew Douch, in a formal interview during the Worldwide Innovative Teachers Forum awards Hong Kong, 2008 shares his observations:

I am seeing students with a passion for learning that in the previous 16 years I just haven't seen. There are always student who are keen and enjoy school but the level of enthusiasm for learning is something that I have not really expected to see and that has been really exciting. So whether they are performing better because they are more engaged or they are more engaged because they are learning better it is very hard to tell. In fact it is a bit of both they are probably learning better because they are performing better and they are performing better they are more engaged as well. It is very difficult but I think both of those things are true. They are learning better and they are enjoying it more (WI, Andrew Douch).

This section looked at aspects of pedagogical reflexivity and touched on aspects related to the curriculum where the rapid advance in technology and the multitude of devices with differing capabilities require continuous pedagogical renewal to ensure the currency of learning strategies. Examples were presented where teachers engage with their learners to address the lack of suitable content and developed their own for contextually culturally sensitive learning resources. Because of the unprecedented initiatives and the eventualities teachers have to deal with when engaged in innovative activities, research revealed their strategy of dealing with changes. They tackle change in their practice in small incremental steps whilst applying their new tacit knowledge. Teachers described existing assessment instruments as inadequate and cannot do justice to new knowledge that learners manifested and promote the emphasis on more formative assessment strategies.

The next section will look at how the themes *technology implications, innovation strategy and reflexive pedagogy* tie in together to form the core category of *innovation negotiations in context* that emerged from the analysed data and related literature when investigating the technosphere of innovative teachers (*cf.* Figure 5-10).

5.6 INNOVATION NEGOTIATIONS IN CONTEXT

This section consolidates the findings as drawn from the themes and sub themes of this chapter as depicted in Figure 5-10 below. It concludes with a comparison between *traditional teaching methods* and *innovative teaching and learning strategies* as recorded by the research into the practice of innovative teachers within the technosphere.

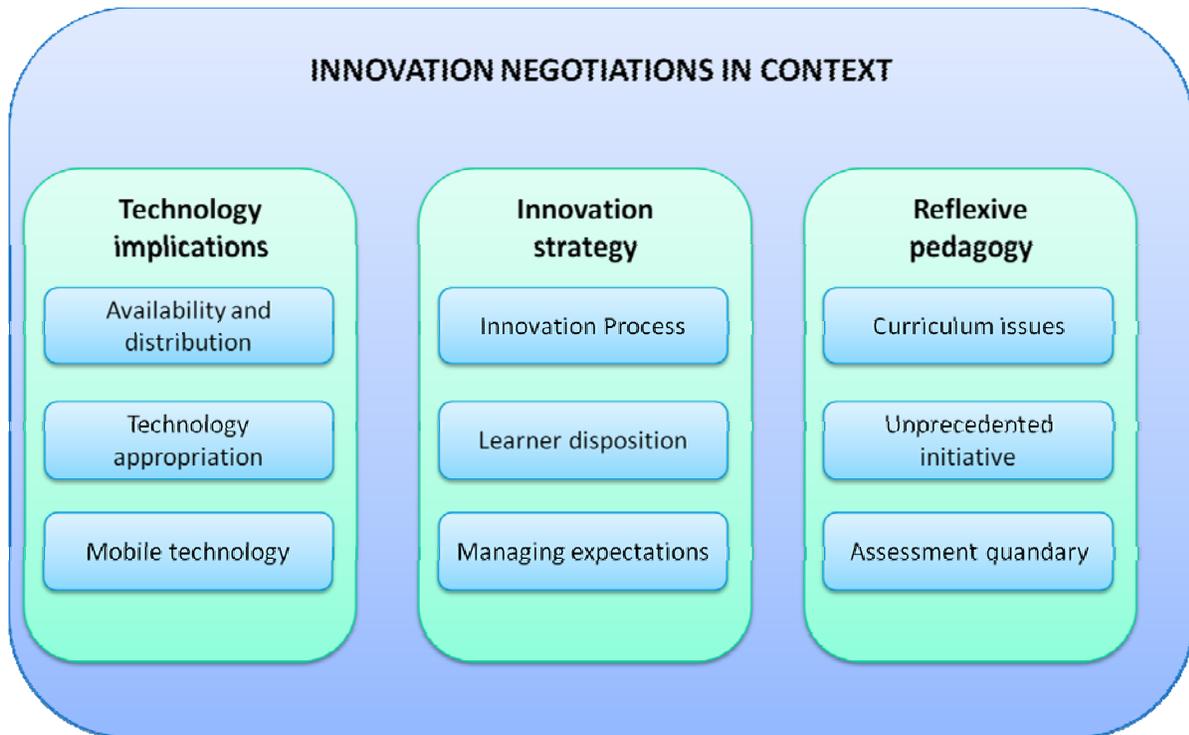


Figure 5-10: Building theory: *Innovation in Context* as emerging core category with expanded themes

When designing learning events, it is imperative to always place the needs of the learners first. Skills need to be mastered and the curriculum needs to be completed within a set period of time. This process requires extensive planning, as the learning event must be completed, independently of functioning technology. Innovative teachers in South Africa work in challenging circumstances and hence they design tasks that are both *technology dependent* and *technology independent*. These tasks complement each other and are interchangeable at a moment's notice. Innovative teachers describe *innovation* as a dynamic process where solutions and problems remain fluid and where learning dips in and out of traditional teaching and learning methods. Learners and teachers negotiate and revise tasks continually and on an ongoing basis. Assessment protocol is not always predetermined as the scope of innovative tasks change and

instruments are designed from scratch to measure unprecedented initiatives. Teachers have to guard against learner project fatigue by pacing the learning process as learners have a tendency to extend and overrun their involvement. Innovative teachers are proficient in designing tasks that are group orientated and thus they compensate for the limited availability and distribution of institutionally owned ICT's.

Teachers report that they know less about technology and applications than their students, but they do regard themselves as masters of the curriculum. Thus, teachers and learners complement each other, creating a dynamic teaching and learning environment. This process requires that both parties be honest and open about their limitations and communicate these in advance. Learners have great respect for teachers who admit their own lack of proficiency in the area of technology. Even though teachers might not always be equipped to help with the technology aspects, the learners will not think less of them, and they remain invaluable in confirming the work and accomplishments of learners (Batchelor & Botha, 2009a).

The term *next practice* emerged from the context of innovation while attempting to harvest the ideas generated through the processes of change and innovation in public enterprises including education (Hannon, 2009). Ongoing research is being conducted in the area of *best practice*. *Next practice* focuses on the issues of tomorrow and in that sense its study can never really be completed. However, the term *next practice* is meant to convey the notion of genuinely new approaches rooted in practical understanding. It is future orientated and is encapsulated by imagination but rooted in context. It is a mechanism which suggests a way forward towards purposeful interventions whilst optimising the scope for professional creativity and creating opportunities for practitioners to inform theory in action (Hannon, 2009).

Charles Leadbeater, a well known author and leading mind in innovation thinking, in an Improvement and Development Agency (IDeA) pamphlet conceptualises *next practice* as: “*emerging innovations that could open up new ways of working – and are much more likely to come from thoughtful, experienced, self-confident practitioners trying to find new and more effective solutions to intractable problems*” (Leadbeater, 2006, p. 8).

Watson (2001) proposes changing the way we view learning and calls for a movement away from a *retooling* agenda to a *reforming* outlook. In the educational sphere, *innovation* is often

linked to knowledge creation and accordingly can be defined as “learning to do things differently in order to do them better” (Hargreaves, 2003, p. 27). He suggests that subject specific curricula have remained static for lengthy periods and that they consequently date back to a time before the internet was available in the classroom or to the community. In avoid drastic curriculum overhauls, the little change in teaching and learning with technology is limited to using various applications to enhance existing curricula and in so doing attain the same outcomes as stipulated by a rigidly controlled syllabus. The concept of *retooling* therefore suggests a superficial change in the presentation of the curriculum without affecting the content and assessment methods in any way.

In contrast, *reforming* takes a fresh perspective and seizes the opportunities which technology offers to encourage a complete rethinking of the existing practice (Pearson & Naylor, 2006). This process does not advocate any form of technological determinism but encourages a move towards reconceptualising the role of the teacher, learner and curriculum by developing new strategies to ensure that new teaching and learning practices are sustained (Somekh, 2007). The myriad of modern day digital technologies available to teachers and learners and its multifaceted uses in education, increase the difficulty in understanding innovation within this context.

Innovative teachers' project innovation process is presented and discussed in Figure 5-11 below:

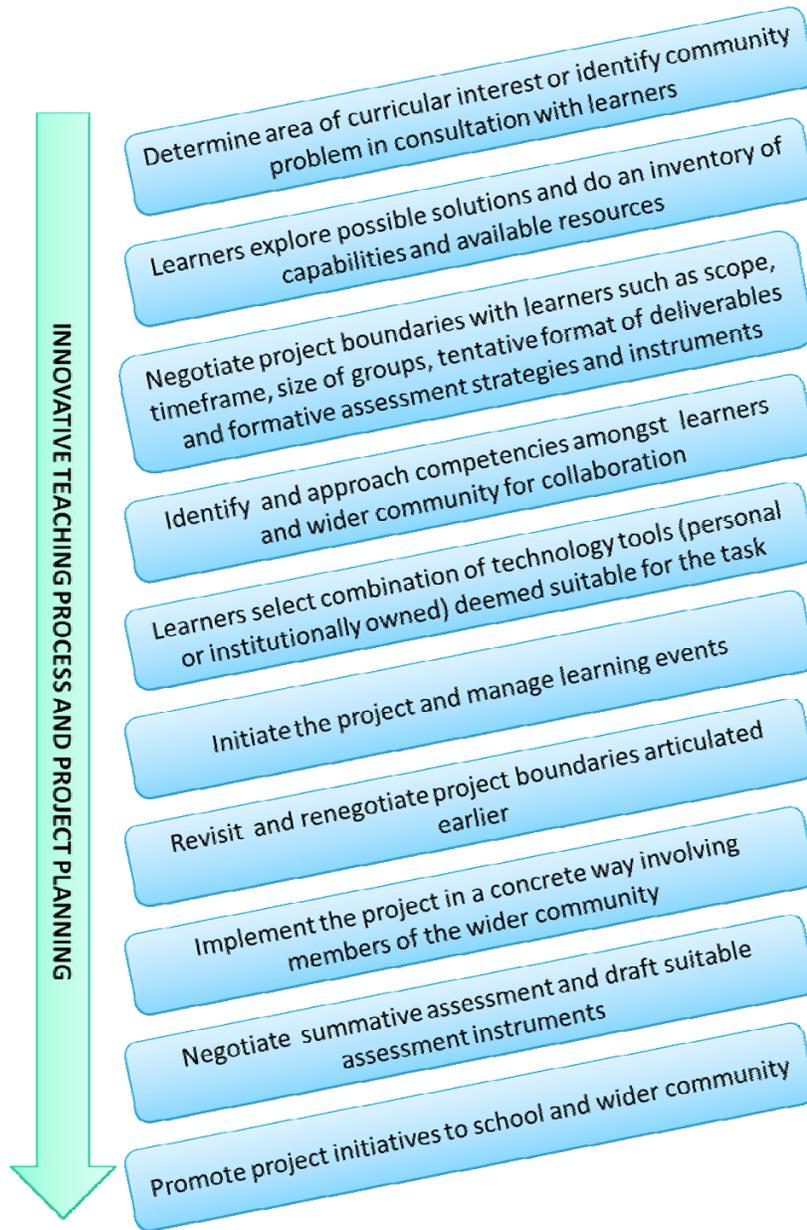


Figure 5-11: Innovative teaching process and project planning

In the design of learning events, innovative teachers measure the needs of the learners and accommodate for the restrictions experienced within their contexts such as the availability and distribution of technologies, the quality of resources, expertise available in their communities and inadequate assessment instruments. Skills need to be mastered and the curriculum needs to be completed in a set period of time. This requires extensive planning, as the learning event must be completed, independently of functioning technology. Innovative teachers in South Africa work in challenging circumstances and therefore they design tasks that are *technology*

dependent and *technology independent*. These two task categories complement each other and are interchangeable at a moment's notice.

Innovative teachers constantly reflect on their practice and engage in explorative learning as depicted in Figure 5-6: Process relevant to exploitation and exploration learning adapted from Argyris and Schön's (1978). Explorative learning results in next practice tendencies.

Finally, Table 5-10 below, presents a comparison between traditional and innovative teaching practices revealing *next practice* tendencies. This table also serves as a summary of the changed teaching and learning practices of innovative teachers as recorded in this research.

Table 5-10: Comparison between traditional and innovative teaching practices revealing *next practice* tendencies

Criteria	Traditional teaching and learning environment	Innovative teaching and learning environment
Task orientation	Predetermined by the teacher according to the curriculum. Learners are not granted an opportunity to provide their input.	Curriculum demarcates the subject area; however, there is freedom to explore contextual community problems. Current trend is for teachers to initiate areas of interest with learners conferring amongst themselves as to the possible solutions. However, in a few cases it is noted that learners carry the initiative in initiating projects.
Class organisation	Mainly individual activities. Limited group activities with no inter-dependency amongst group members.	Collaboration amongst learners dependent on group members with each contributing a unique angle or product as they co-construct new knowledge through distributed cognition. The power of collectivism in learning is recognised.
Planning and Process	Every event is mapped in advance and all eventualities covered.	The learning events allow the project to unfold naturally and eventualities are dealt with in a pragmatic manner.
Methods of instruction	One directional as the teacher determines lesson didactics.	Mainly explorative learning, free from formulaic methods relying on own initiative. Indigenous knowledge systems are employed through local community experts.
Assessment instruments and Strategies	Assessment instruments are used from pre-existing sources to those designed by the teacher and generally made available to learners prior to task.	Because of the unprecedented nature of innovation, existing assessment instruments are not adequate. New assessment instruments and strategies are developed and revised collaboratively with learners. Emphasis is placed on formative assessment

Criteria	Traditional teaching and learning environment	Innovative teaching and learning environment
	Series of summative assessments.	with few instances of or no summative assessment at all.
Technology choice and use	Accessibility to institution technology is tightly controlled by the teacher. Personally owned devices banned from school property with stringent penalties enforced for transgressions.	Mixture of institution and privately owned devices exploited for their capabilities and resources pooled. Technology bartering manifests in mediating task allocation. Compatibility issues managed. Freedom to select software of choice to suit task.
Teacher role	The only medium to content knowledge.	Teacher becomes the mentor and guide and sometimes a learner.
Learner role	Voiceless. Silent and passive and always subservient to the teacher.	Initiator of activities; collaborator; expert; community voice; represents vulnerable segments of society; an enabler and creative force.
Outcome/ product/ deliverables	Predetermined by the teacher strictly aligned to curriculum.	Open ended. Final deliverables are negotiated in collaboration between teacher and group members.
Product / solution implementation	Not necessarily related to real life contextual community problems. No expectation to implement solution.	Solutions to problems are implemented in the real world in collaboration with community members addressing the needs of a particular segment of society.
Timeframe	Tightly controlled.	A degree of flexibility is built into timeframes allowing for exploration of unexpected findings.
Learning emphasis	Individual subject. Knowledge that corresponds to external representations.	More emphasis is placed on the process than on the final product. The acquisition of skills valued by the community is a high priority.

When compared to the more traditional teaching methods, innovative teachers have pushed the pedagogical boundaries with their approach to teaching and learning. Learners enjoy a high degree of flexibility in their choice of topics, timeframes, modes of delivery and task orientation. In a formal interview, Tom Jackson shares his observations regarding the results of his changed practice:

The students are more involved personally with the learning of the subject matter that is taught to them. We are seeing a higher level of participation, we are seeing attendance rise, and we are seeing new technologies and devices being used. This is only a good thing. We are starting to work and

communicate with students about things that are important to them. Not just important to the teacher (WI, Tom Jackson).

The emphasis is less on assessment, with the focus on the final deliverable, and more on the increased capabilities and skill development acquired during the process. The innovative teacher's philosophy can best be summed up by a quote used earlier in Chapter 4 but equally relevant here. Moliehi Molefe from Lesotho stated earlier:

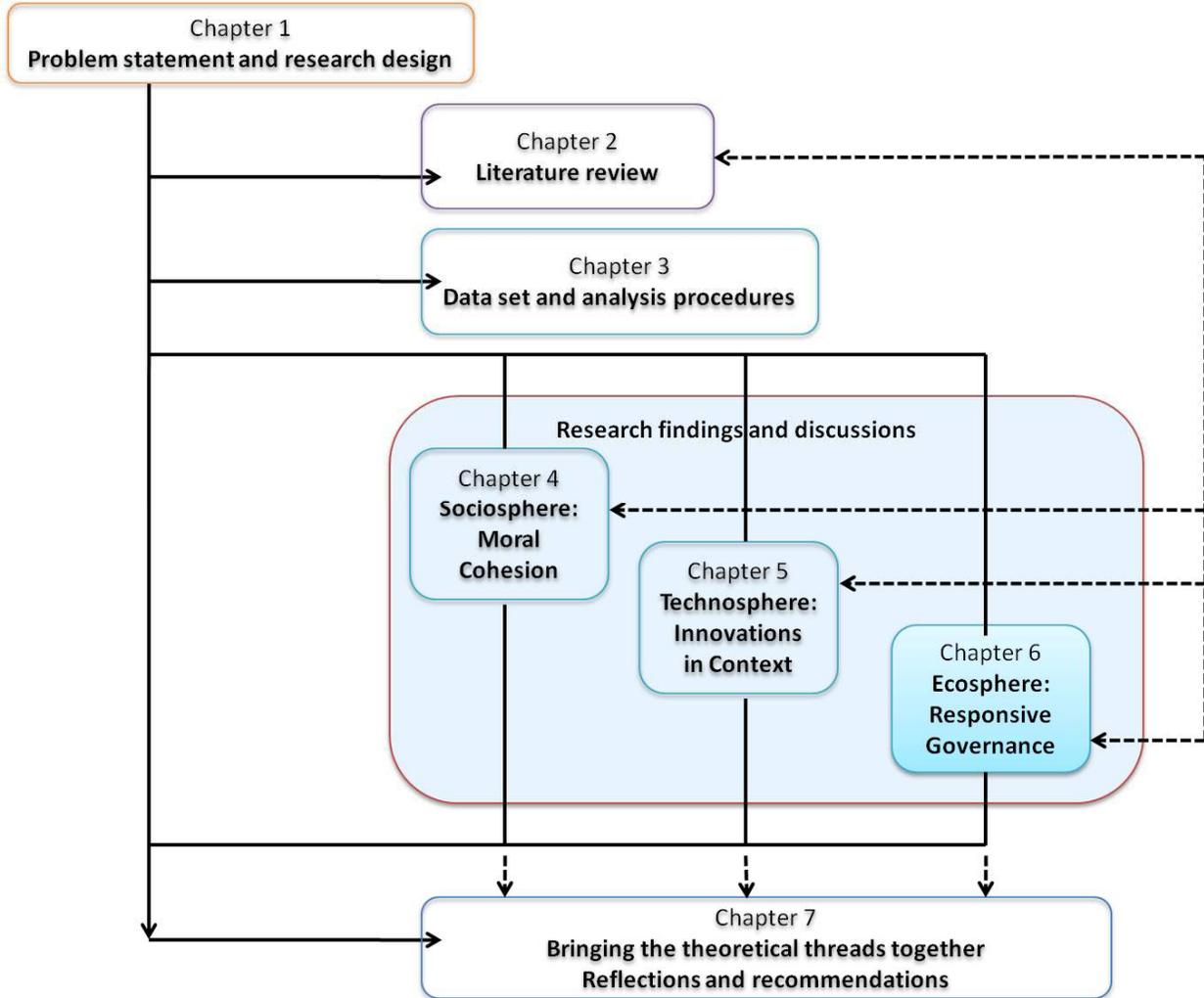
I believe that learning is a three legged pot (the learners, the community and Technology) and that efficient learning requires the involvement of the three in order for learners to achieve (Moliehi Molefe, VCT 2009).

The emphasis in innovative teaching with emerging technologies is therefore placed on the learners, their community and the technologies they employ to enable their development.

5.7 SUMMARY

In this chapter the researcher presented the findings emanating from the data collected within the realm of the innovative teachers' technosphere. The first concepts to emerge focused on the technology implications regarding the general availability and distribution of information and communication technologies in schools and how teachers and learners appropriate these technologies in their teaching and learning practices. The use of mobile technologies, as a personally owned device, was mentioned and practical examples provided of actual use and exploitation in formal and informal learning environments were provided. The subsequent theme *innovation strategy* covered the innovation process as articulated by innovative teachers and reflected on the significance of learner disposition in their quest for self determination. Problem areas that need to be constantly monitored and managed during learning events were highlighted. The significance of employing reflexive pedagogies, as a strategy to address curriculum issues relating to the often unprecedented initiatives of innovations, was explained. Lastly, the assessment quandaries experienced by innovative teachers were articulated and their solutions presented.

The next chapter will cover the last remaining core category *responsive governance* as it emerged from the ecosphere.



CHAPTER 6. ECOSPHERE

*It is a very strange wisdom.
 To get power you give away a lot of it.
 At that point you are poised to do a lot of good.
 The point of authority is to empower.
 It is wonderful when it work.*

Dell (2011)

6.1 INTRODUCTION

The previous chapter considered the current and potential affordances of emerging technologies within the frame of the technosphere. The core category *innovation negotiation in context* that emerged from data analysis was expanded upon and presented in the themes *technology implications, innovation strategy and reflexive pedagogy* (cf. Table 3-9, p.112)

In Chapter 1 the research objective for this section was presented as part of the research puzzle (cf. Table 1-1, p. 15). It is briefly revisited in Table 6-1 below.

Table 6-1: Research puzzle for the ecosphere

Research Question	Objective	Subsidiary research question
How does tacit knowledge manifest when innovative teachers engage with emerging technologies to achieve pedagogical efficacy?	To consider the response of governance harnessing the innovative teachers within the school environment.	How do governance structures respond to the innovative teacher within the ecosphere?

This chapter contemplates the last research subsidiary question: How do structures of governance respond to the innovative teacher within the ecosphere? To answer this question the researcher collected and analysed data (cf. Table 3-4). Literature, related to the emerging categories and themes, was considered and facilitated additional insight into the interpretation and

conceptualisation of emerging theory. The findings are presented in the form of *quotations* and *reflections* to support the interpretation of the researcher.

6.2 ECOSPHERE: PROFESSIONAL AND ORGANISATIONAL LEARNING



The last part of the initial conceptual framework to be considered in this research is the *ecosphere* which surrounds the teaching and learning theory as set out in Section 2.4. The *ecosphere* demarcates the learning environments and the way in which technology influences organisational structures and functions. Continued professional development through in-service training programs and the role of the innovative teacher as change agent within the organisational structures are contexts which are considered in this section.

Learning cycles within the education system are protracted and management structures have been slow to respond and exploit the transformational potential of digital technology. However, in the teaching and learning milieu transformation deals more with *human and organisational issues* than with the *use of technology*. Therefore a gap exists between the *turnaround time* for change within an organisation and the *adoption* of new practices. Innovative teachers, when engaging with emerging technology in their practice, fill this gap with a creative bloom of activities. The current imaginative use of technology in education within this group of innovative teachers is a *bottoms-up change process* in which teachers change their practice without guidance and leadership. If a *top-down change process* was in place, a clear strategy would exist and it would be widely communicated to all stakeholders within the community (Beetham & Sharpe, 2007). Because of the slow response time of education systems, teachers are lobbying for change within their own micro environments. They are concentrating their efforts on that which is within their immediate reach and those areas where they are sure to be successful.

Various data collecting instruments were used (cf. Table 3-4, p. 92) to collect data that was analysed in accordance with the Straussian Grounded Theory method. Instances from literature are used to supplement the research findings. In Table 6-2 below, the specific conceptualised themes (second column) which emerged from sub themes (first column) along with the specific

core category is provided. These themes were derived from the coding process where ATLAS.ti was used to determine the specific themes relating to ecosystem in this study.

Table 6-2: Responsive Governance as the emerging core category with expanded theme *skills transfer* highlighted for discussion

AXIAL CODING (Categories clustered in sub themes)	SELECTIVE CODING (Emerging themes derived from sub themes)	CORE CATEGORY
Self empowerment (cf. Section 6.3.1)	Skills transfer (cf. Section 6.3)	Responsive governance
Capacity building (cf. Section 6.3.2)		
Self development path (cf. Section 6.3.3)		
Hierarchical movement	Organisational change	
Incentives for change		
Lobby for change		
	Leave teaching	

This section will present the emerging theme *skills transfer* (cf. Section 6.3) which originated from the core category *responsive governance*. Sub themes *self empowerment*, *capacity building* and the *self development path* (cf. Sections 6.3.1 – 6.3.3) of innovative teachers are expanded upon and discussed in detail in the form of quotes from participants, competition entry documents, reflections from the researcher and representations from literature.

6.3 SKILLS TRANSFER

For the purpose of this section, a skill is seen as a learned capacity to deal with a specific set of domain related problems (Cordingley & Bell, 2007). In this research the transfer of skills pertains to *experts*, identified as innovative teachers, who share their practice with their peers and in so doing stimulate their development and growth. A teacher's new capabilities manifest themselves in *observable changed practice*. They conquer their fear of new technologies as they

start to engage with their learners in a more relaxed and accessible manner. Sharing expert knowledge can be structured in formal training sessions or it can be totally unstructured and serendipitous in nature.

If teachers wish to be more comfortable in developing 21st century skills in their learners, they themselves need to be exposed to models and examples relevant to their subject areas. Teachers need coaching and mentoring to improve not only their *digital skills* but the following skills areas as well:

- Generic skills related to teacher duties as articulated in Section 4.3.
- Time management, planning, organisational and decision making skills.
- Designing learning events to exploit emerging technologies to their full.
- Flexibility to deal with constant change and unexpected outcomes.
- Designing appropriate assessment instruments and
- Contextualising the curriculum through strategies which aim to harvest indigenous knowledge from community experts.

Innovative teachers transfer their newly acquired competencies to their colleagues in an effort to affect change within their own school and to elevate their profession as teachers outside the boundaries of their particular school become more capable of dealing with the added pressures of integrating technologies into their curriculum. Nussbaum (2000) views the transfer of expert knowledge as enabling people to access and develop human, economic, natural and social assets.

Innovative teachers split the practice of transferring their knowledge into two distinctly different actions. On the one hand they *introduce new knowledge* to their peers and on the other hand they *take measures to sustain and reinforce its use*. To increase their fellow teachers' confidence they also actively mentor their peers and collaborate with them on projects. Another strategy, suggested by Hargreaves (2003), which aims to ensure a higher rate of knowledge and skill transfer is to make use of ICT to access and share available contextualised examples of good

practice. A teacher can also use his/her own personal learning network or pre-existing networks to share practice between schools.

The next section will consider the value of the skills which innovative teachers have developed in their practice and how they disperse them amongst those that share their ecosystem. Each of these emerging sub themes as displayed in Figure 6-1 will be discussed in greater detail below (*cf.* Sections 6.3.1 – 6.3.3).



Figure 6-1: Expanded emerging theme: Skill transfer

6.3.1 Self empowerment

This section will describe and discuss *self empowerment* as one of the sub themes that stems from the main theme of *skills transfer*. Through the action of experimenting with emerging technologies in their teaching and learning environments, innovative teachers develop new skills that are highly sought after. This newly developed knowledge is held in mental models that are not generally accessible to the innovative teacher him/ herself or to others that share their environment (Brown, 2009). Unless the tacit nature of the new knowledge is explicitly shared, it remains a hindrance to organisational growth. As a result, innovative teacher exert control over organisational growth and simultaneously they grow their professional profile as they are held in higher esteem. Bordum (1999) warns that unless this new tacit knowledge is disseminated to

other teachers it can lead to an abuse of power and that it can even be used to manipulate others. However, once open and accessible to all, knowledge can result in the growth of other individuals within an organisation.

In making their knowledge explicit, innovative teachers provide pedagogical leadership in guiding their colleagues from the more traditional teaching methods to being more engaged and focused on community and learner needs. Pauline Skosana teaches in a rural community at a school which is still trapped in the conventional way of teaching. She explains below why she views herself as being innovative:

Why am I innovative? I am the first teacher in my school to integrate ICT in my lessons. Most of my colleagues are not computer literate and this is the best way of motivating them. Our area is disadvantaged and the only place for learners to be exposed to ICT is at school. The parents are excited because the school is their only hope for the future of their kids (Pauline Skosana, VCT 2008).

Through her efforts and leadership she has managed to keep herself motivated by experimenting with various emerging technologies in learning events which are greatly influenced by the school's rural context. In the process she has inspired her colleagues to change their practice and formalise their computer skills. Her personal and professional profile in the community has increased and parents are satisfied with the increased accessibility to technology and the additional opportunities which are being created for their children. *Innovation is heavily context dependent* and what might not have been deemed as innovative in a *technology rich environment*, is deemed innovative in the *rural technology poor environment*. Table 6-3 was extracted from Pauline Skosana's VCT and demonstrates her role as *change agent* within her school and community.

Table 6-3: Pauline Skosana reflects on the benefits that her innovative teaching has brought to her school and community noting changes in teacher and learner perceptions

TEACHER
Most of my colleagues have started learning computer skills so that they too can integrate ICT in their teaching.
Teaching is becoming a new exciting career amongst my colleague.
Even during my absence the lesson can be presented.
No learner misses my lessons.
Parents who can't afford to take their kids to schools in town are excited for ICT at no extra cost.
LEARNER

Learners are excited to use their cellphones, digital cameras and other own equipment for learning.
Even lazy learners are now doing their activities and tasks effectively.
No learner misses my period.
Learners are requesting their educators to use computer in their teaching.
The rate of absenteeism is minimised because learning is exciting.
Our learners are ICT competitive.

Innovative teachers report that there is a slight change in how they are perceived by their colleagues. As an insider in the organisation they are viewed as being approachable and find themselves being daily consulted for guidance and assistance in the use of technology during teaching. An innovative teacher comments on their altered status below:

I find myself now as the go-to-person that is able to help other teachers with their technology questions and the practical bits of how to use it in the classroom. As a result of using these technologies in the classroom I find that I now have more authority and have gained the respect of my peers as well as my principal (UI,1).

This section looked at the concept of *self empowerment* as innovative teachers find that their status within communities is elevated. They also provide pedagogical leadership to their colleagues and engage with organisations outside their schools to engender educational change.

The next section presents the concept of *capacity building* as it emerged from the data. Innovative teachers are involved, both in their own schools and in the wider community, in training efforts to uplift teachers and introduce them to pedagogies concerned with incorporating 21st century skills.

6.3.2 Capacity building

This section reflects on the tendency of innovative teachers to become involved in initiating training events of both an informal and formal nature. Because innovative teachers are located *within* a particular community and well versed in the contextual challenges teachers in their region face, they use techniques that resonate with the participants in their workshops. The notion of tailoring training material concurs with Dottin's (2010) earlier findings. His study found that experts structured their knowledge in a way as to reflect the contexts in which it is to

be used. These teachers also hold mental models that allow them to transfer their knowledge across contexts, making them highly valued in their profession.

Increased access to technology is sometimes used as a *reward*, however, it can also be employed as an *incentive for change* as reported by one of the school principals participating in the project: *Teaching and learning from a distance*. In this project participating schools team teach sharing lessons in real time through connected whiteboards, video, audio and shared desktops. Even though this particular school principal does not currently have the required skills to adequately manage the new technology that was allocated to his school through private donors, he expresses his determination to improve his competencies through training. The school principal states:

I feel privileged to be managing in a school with this equipment. I feel challenged to upgrade my management skills to equate to the development. The equipment has scored a first in the history of this school where black and white learners can directly share resources. The project has changed the attitude of learners towards Maths and Science to change for the better. The level of discipline has gone up. The teachers' preparation has improved as the internet helps them to research beyond the textbook. The profile of the school has improved. We are expecting more learners to enrol into the school (Frans Kalp, VCT 2009).

- *The broadcasting of lessons from the different venues will contribute a lot in helping our learners to uplift the quality of our schoolwork. It also helps all our teachers to learn from others and it is of great help to share information and learning aids through the server.*
- *The project has proved most successful in bridging the urban-rural digital divide and a positive attitude has been created, especially in rural schools . . . being able to share quality teaching among the geographically dispersed classrooms has had a marked improvement in the quality of lesson content and teaching methodology.*
- *To our amazement, the majority of the educators grasped the use of the technology very quickly, simply because they were not using a mouse, but their finger, which feels more natural (Frans Kalp, VCT 2009).*

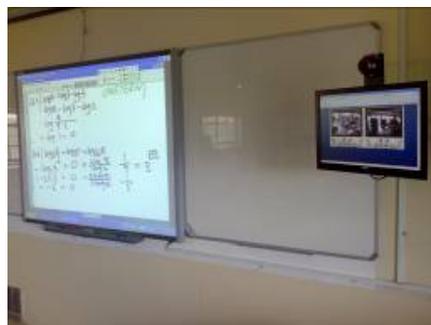


Figure 6-2: Classroom 27 km from Ligbron

The transfer of skills and capabilities are not only informally shared amongst staff members, but knowledge transfer from learners to teacher also occurs. Learners move from a subject area where they are engaged in learning with emerging technologies to a different subject area where teachers are not interested in changing their practice and cling to traditional methods of imparting knowledge. In such a case, learners slowly break down the barriers of these reluctant teachers as they share some of their ideas and practices in a non-threatening way. Learners tend to coach and inform their teachers of new developments in emerging technologies allowing for collaboration between learners and teachers in an informal way. In his project, *Local is lekker*, Thamsanqa Makhathini observed the growth in his learners and report their sharing of knowledge with other teachers. He writes:

I believe that the way they integrated ICT use and learning in general was one of the significant achievements that we can be proud of. My learners are now exploring the same strategies in other subjects which make me feel great that I opened another page in their learning environment (Thamsanqa Makhathini, VCT 2008).

During team teaching events, teachers transfer their skills through collaboration and thus get practical experience in methods to integrate ICT into their everyday practice. In the project *My community my pride*, Mfeka Hlengiwe shares the willingness of teachers from other schools to become involved in pooling their resources to the benefit of everyone. She relates her colleagues' growth through the project:

Several educators were involved and they claimed that they have learnt a lot from the project. Some of the educators have also suggested that this integration be extended even into their subjects. Teachers from other schools have shown interest and offered to help with other materials that will enhance our ability to use ICT in many other everyday activities. The members of the community that were involved also showed interest and were happy that indeed the school was part of the community and is affected as they are affected (Mfeka Hlengiwe, VCT 2009).

Disconfirming the concept of knowledge and skills transfer, some innovative teacher slow in recognising their own value to the organisation and could benefit from stronger leadership. Caren Roberson shares her insecurity as regards the intrinsic value of her own knowledge. Her insecurity should serve as a warning to schools that do not fully exploit the expertise of the innovative teachers in their midst. Caren Robinson explains:

"I am not sure that my knowledge of computers will be able to help you help others! But... I'm very willing to share – Caren Robertson.

Innovative teachers do not consciously create space for the involvement of other teachers in their projects. The hesitancy to get other teachers involved as co-learners early on in the conceptualisation phase of a project is evident from John Lanser's comments. He delays bringing other teachers on board until such time that he is confident in the design of his learning event and thereby denies his colleagues a learning opportunity.

The idea is to involve my colleagues in the creation of GIS projects, once I've ironed out most of the problems (John Lanser, VCT 2007).

Teachers progress faster through training or coaching that is tailored to their specific needs. Training can focus on reinforcing existing skills whilst building and increasing knowledge in small incremental steps so as not to overwhelm the participating teacher. The comment below made by an innovative teacher reflects:

Teachers come from such diversified subject areas & abilities and therefore within a school environment it is easier to tailor their training to their skill level. Mentoring is therefore much more personal and therefore more successful because you can cover practical examples of integrated ICT lessons related to their subject making it far more relevant to them (UI,2).

Innovative teachers engage in training opportunities outside their immediate school environment. Their motivation is increasing the proficiency of other teachers and in this way affect education at large. In their classroom they feel that their reach of affecting change is limited to the learners in their care, however, if they train other teachers they may indirectly affect and change the life of every learner in the care of the teacher they have just trained. Innovative teacher Sadique Boateng from Ghana shares his passion for training teachers from other schools:

As a leader and a regional ICT coordinator, I have worked with many other teachers from other schools in developing their own skills and to teach with ICT in their various subject areas. As a believer in sharing of ideas and resources, by empowering students and teachers to use a range of tools and learning methodologies has in many ways changed how teaching and learning occurs. More especially teachers and students are able to access online communities and use learning pathways and are able to go in many directions with their teaching and learning. Showing other teachers what their colleagues had achieved inspired and motivated many more teachers to experiment and use similar technologies in their

classrooms. Consequently, I still have a backlog of teachers I have to run workshops for (Sadique Boateng, VCT 2009).

During one training session a particular teacher questioned the way in which all previous training was conducted and he expressed a wish for more change in the teacher development programs. Subsequent to attending his training session one of his colleagues John Adjei, a physics teacher, had this to say:

Sometimes I'm sitting at the computer and I just open up my learning package project and say to myself, "I did that!" In our other courses, we are expected to listen to lectures, write what the lecturer says, and remember it for the exam. One time I was interested in a topic. I did some extra research in the library and even went to an Internet cafe. But when I included that information on the exam, it was marked wrong. We should be encouraged to learn on our own, to go beyond the lecture, but instead the educational system discourages initiative (John Adjei in Sadique Boateng, VCT 2009).

Innovative teachers also increasingly arrange training events for educators that are outside their own school environment. These teachers can be from the surrounding districts or from areas further afield. There are three distinctly different approaches to training which crystallised from this research. They are presented Table 6-4 below:

Table 6-4: Approaches to in-service training

Role of facilitator	Quotes from data as evidence to support claims
Learners develop training material and facilitate workshops during teacher training events.	<i>On Saturday morning, we had to train. I was extremely nervous because I did not know what to expect, but once the teachers arrived I felt much better knowing that I could really help an adult concerning computers. . . What a great experience! This was an amazingly enriching experience, getting to know how teachers feel about the use of computers in their everyday life. I am in great debt to the teacher I trained (Sarietjie Musgrave).</i>
Teachers, on their own volition, organise training events and act as facilitators. They actively source sponsorships to cover the cost of training events, resources, venue hire, transport and catering.	<i>Although what we do relies on sponsorships, there is a clamour for more of these and a kind of desperation in their lack of resources & training. It is for this reason that I wanted to share the work I have done (& continue to do) in training teachers (Gaye Pieterse).</i>
Innovative teachers are approached by training organisations to facilitate workshops that target teachers wanting to increase their ICT skills and the integration of technology into their subject areas.	<i>He's got a passion for computers, the trainings and workshops from Schoolnet keep him in touch with the latest trends in computer use in education (Murphy Mugabi).</i>

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Table 6-4 above reveals different approaches to conceptualising and delivering training to teachers in service. Contextual training materials are developed by volunteer teachers or learners facilitating in-service training sessions. Teachers are also approached to deliver in-service training on behalf of training organisations in which case the training materials already exist. The opportunity afforded innovative teachers to act as trainers and facilitators for organisations outside their schools, increases their awareness and exposure to further employment prospects.

Looking back on this section, the development of human capabilities to their fullest extent is of primary importance to innovative teachers. They seize every opportunity, whether formally structured events in their own school or structured workshops involving teachers from the neighbouring districts to provincial level. They develop training strategies in which they contextualise their examples thus ensuring a higher uptake of new practices. Innovative teachers also express a desire to shrink the current gap between teachers of formerly disadvantaged schools and their counterparts in better trained and resourced schools. One of their objectives is also to increase the stature of their own profession.

The next section reveals how teachers, because of their increased exposure and demonstrated skills, are increasingly valued in the organisations they serve and how they manage to chart their own development through selecting desired training opportunities.

6.3.3 Teachers chart their own development path

Innovative teachers enjoy the freedom to choose their own development path within their schools as they are highly valued by management and their school governing bodies. Because they are role models to colleagues, provide guidance and assistance on a regular basis to leadership in making decisions on ICT acquisition, they are afforded the opportunity to select training in their area of interest. Below is an extract from a Microsoft document profiling Saretjie Musgrave as one of the previous national innovative winners.

Soon, Saretjie was more than just the computer teacher and the school was integrating technology into the other courses on offer. She did her first Microsoft Partners in Learning ICT integration training course in 2003 through SchoolNet. This course is designed to help teachers organise, schedule and set exciting and stimulating lessons, while meeting the needs of the curriculum. "Microsoft, SchoolNet and Intel's training programmes have helped me widen my horizons, and their Peer Coaching training has taught me how to empower the teachers around me," she says. "The Partners in Learning training has helped in developing the teachers around me – and the initiative is just growing because of its impact of networking with other colleagues from all over the country." Saretjie encourages other teachers to reach out and grab the opportunities presented by these courses, to take it further and to get their fellow schools and teachers involved (MicrosoftSA, 2009, online).

This section looked at how the innovative teachers provide pedagogical leadership to their colleagues and engage with training organisations outside of the school environment. Their interest in developing human capabilities through formal and informal occasions to bring about personal growth, leads to an increased sense of self empowerment.

Moving on to the next section, also the last theme to emerge from the analysed and interpreted data, the core category *responsive governance* is presented with the expanded sub themes.

Table 6-5: Responsive governance as emerging core category with expanded theme organisational change highlighted for discussion

AXIAL CODING (categories clustered in sub themes)	SELECTIVE CODING (Emerging themes derived from sub themes)	CORE CATEGORY
Self empowerment	Skills transfer	Responsive governance
Self development path		
Capacity building		
Hierarchal movement (cf. Section 6.4.1)	Organisational change (cf. Section 6.4)	
Incentives for change (cf. Section 6.4.2)		
Lobby for change (cf. Section 6.4.3)		
	Leave teaching	

The next section will present the last theme to emerge from the core category *responsive governance*. The remaining theme *organisational change* consists of the sub themes *hierarchical movement*, *incentives for growth* and how innovative teachers *lobby for change* in their schools. Each of these as displayed in Table 6-5 above will be discussed in greater detail (*cf.* Sections 6.4.1 - 6.4.3).

6.4 ORGANISATIONAL CHANGE

Organisations such as schools cluster people together to accomplish a shared vision. Within a dynamic structure such as a school, people need to be managed effectively to reach their full potential and at the same time improve the performance of the organisation. The premise of organisational learning and change is rooted in Peter Senge's (1990) systems thinking model and comprises five core disciplines as presented in Figure 6-3 below.

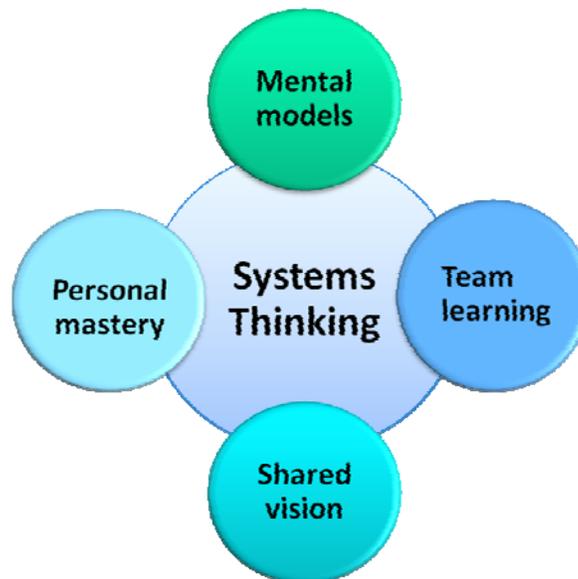


Figure 6-3: Senge's disciplines of systems thinking

Systems thinking lies at the heart of organisational learning, whilst personal mastery, mental models, team learning and shared vision all contribute to keep a system healthy. Systems theory considers the way in which the different parts of the system relate to each other. How these parts are organised and interact determines the properties of the system (Senge, 1990). Innovative

teachers function within an open system where they are able to respond to pressures from within their own school environment but where they can also be influenced by factors outside the school. Each element of the systems thinking model is described and then related to innovative teachers and their actions within a school as organisation in Table 6-6 below.

Table 6-6: The core disciplines of systems thinking applied to innovative teachers and their schools

Core discipline	Short description	How it applies to innovative teachers
Personal mastery	Personal mastery is the process of continually refreshing your own skills and pursuing areas of interest with an increasingly deeper understanding. Concurrently self esteem develops and the confidence and willingness to take risks and explore life experiences.	Innovative teachers constantly renew their skills and challenge their boundaries as they explore emerging technologies in their practice. The tacit knowledge which they develop is tested through trial and error.
Mental models	Each individual holds deep beliefs and attitudes that are ingrained in their world view. Individuals' actions are guided by these mental models and shape the decisions and responses to events.	Innovative teachers' mental models are dynamic and constantly change as they continue with exploration and generative learning. Their tacit knowledge needs to be articulated and disseminated so that it can be more accessible to other team members.
Shared visions	When everyone in an organisation is aware of and understands the current vision and future strategy and the responsibility of aligning their personal goals, it contributes to the overall success of the organisation.	By sharing their own goals with other teachers and governance it allows for growth changed by others' insight.
Team learning	Teams are safe environments in which to share experiences, question, reflect and address problem areas and vehicles through which to receive feedback. With team learning, the learning ability of the group becomes greater than the learning ability of any individual in the group. Being a contributing member of a learning team is fundamental to a professional learning organisation.	Innovative teachers initially function in their individual capacity where they action change within their immediate teaching and learning environment. However, they are very quick to engage with their colleagues and form teams to coach, mentor and collaborate with.
Systems thinking	<i>Systems thinking</i> ties all the other disciplines together and is described as the key component. The strength of an organisation is in how well these individual components are managed as	Strong leadership is required from governing structures to fully utilise the potential of innovative teachers as a valuable team member.

Core discipline	Short description	How it applies to innovative teachers
	the strength lies in the interrelationships rather than in the isolated parts.	

Organisational learning, which aims to bring about change, relies on tangible events and actions that are implemented step by step. These changes can be in the form of new infrastructure or technologies, new management methods and ideas around new pedagogies. Maintaining the change momentum, teachers develop an enduring capacity and appetite to refresh themselves and their practice and with continued support the school and governing structures are rewarded through commitment and innovation from their staff.



Figure 6-4: Expanded emerging theme: Organisational change

The next section describes the movement of innovative teachers within the organisational structures once they have been identified and recognised in the annual Innovative Teachers Forum Award competition (*cf.* Sections 6.4.1 – 6.4.3).

6.4.1 Hierarchal movement

This section will look at the tendency of innovative teachers to move up in the organisational school structure into positions of more authority. Professional learning communities, such as schools, are rigidly structured along hierarchical patterns. Subject areas are clustered together and are comprised of junior members of staff, who are usually responsible for overseeing the younger learners in lower grades, and senior teachers, who are allocated higher grades and are held accountable for maintaining exit levels though motivating their learners and maintaining the school's academic standard. Heads of subject areas oversee and coordinate the various members of staff within their team. Principals act in a more administrative capacity and can elect to teach a subject of their choice if they wish to do so. Deputy Principals assist in matters such as learner behaviour and are expected to teach a few lessons. One teacher that falls outside the normal hierarchical structure is the computer science teacher. Apart from teaching the specialist subject area of computer science, this teacher is often tasked with the additional duty of maintaining the technology framework within the school without any technical staff to assist. Andrew Moore, a former teacher facilitating innovative teacher workshops, shares his prior teaching history:

I had a growth spurt by doing my masters. It is kind of a fuzzy attitude - I did my masters and did little tasks and then thought "this is really useful" – it changed my teaching. I went from a very good history teacher to a very poor ICT teacher. It was very strange; I was struggling to master the basics in the subject. It was not satisfying. I knew there was something better and I moved on. I don't always get that anymore - that spark (Andrew Moore, WS 2008).

Teachers who are knowledgeable about technology and specifically how to integrate it into their subject areas, are highly valued staff members. These teachers often find themselves moved from their original position as subject teacher to areas with higher authority and more responsibility as documented by the innovative teacher Frans Kalp. He explains how his role within his school changed over the past few years:

My role as Technology coordinator was a natural progression from teacher in Electronics to a full time project coordinator and server administrator. My role as Technology coordinator is to sustain the high level of technology in our school and to upgrade every classroom to a classroom of the future (Frans Kalp, VCT 2009).

Task differentiation results in an increased workload for teachers who remain in their classes but who gain additional duties including initiating programs to support their colleagues with

integrating technology into their practice. Moving innovative teachers out of the classroom and the subject areas they originally taught can result in a loss of future innovative initiatives from these teachers. The dynamic partnership that exists between learners and teachers in their engagement through explorative learning, fuels the innovation process. To remove the teacher from the classroom environment results in the death of the partnership. Innovative teachers that have moved out of their classrooms to assist in managing technology or its integration, report a loss of enthusiasm for teaching as they miss learner interaction and the dynamic generative learning environment.

As teachers we recast ourselves. Our new skill set brings along new responsibility towards colleagues in the schools setup but at the same time it allows for less time in exploring new ways of learning. Even though I am finding that I am helping loads of other teachers get more comfortable and confident in their new skills, I find myself stagnating and not developing any new skills because I am too busy helping others. For the moment the reward for helping other teachers is still enough but there will come a time when I will need another challenge to keep me going (UI,2).

Apart from dealing with an increased workload, the added responsibility of developing and facilitating in-service training, innovative teachers also act within an advisory capacity to school leadership. An interview participant reveals:

I was invited to serve on the school IT committee planning in-service training events and advising on the acquisition of IT equipment and software purchases (UI,1).

Teachers that are innovative in their own learning area become responsible for other areas of the school organisation. Their access to structures of governance and recognised increased capabilities allow them to lobby for greater change in policies and practice.

6.4.2 Incentives for change

Various mechanisms are employed to coerce teachers into training opportunities to keep abreast of developments in their fields. Innovative teachers, however, lead the change on organisational level affecting policy and practice within their particular schools. They cite mainly intrinsic factors that keep motivating them to innovate; however, they do recognise additional incentives as playing a role as well. Tangible rewards, such as professional recognition and favourable professional assessment, contribute significantly to their continued efforts.

As a result of participating in this competition, our project has featured in the local papers and I have been approached by other schools to come and do presentations. My principal has also asked me to help with their technology strategy and I have been rated very high this year on my own assessment resulting in a salary raise. I am thrilled with all the attention my project has received and will definitely enter again next year (UI,7).

Rewarding innovation through tangible or intangible incentives to aid organisational change is consistent with findings in research conducted by Roberts. She states: “Possible incentives can include release time, stipends, mini-grants, teaching with technology awards, upgrades to current hardware or software, travel to conferences to present work, or support for publications that showcase technology adoption” (Roberts, 2008, p. 8).

6.4.3 Lobby for change

Innovative teachers engage with their leadership in an effort to influence policy. The area in which they are the most successful thus far is in making special arrangements to allow for the use of mobile phones in the classroom for teaching and learning. Most school in South Africa banned these devices citing reasons such as learner safety and misuse during lessons. Teachers, being well aware of the reticence of school principals, nevertheless approached them with the requests for more lenience. Thamsanqa Makhatini relates how he went about gaining permission from his principal and how his tenacity paid off with the management team more willing to allow other initiative in the future. He stated:

In my school, cell phones are not allowed at all. But for this project, it was supposed to be an exceptional case. I had to get permission for my class to bring and use cell phones during my class. The school management team (of which I am part of) was not very pleased at all. However, I explained the importance of the lesson using available technology to teach in an exciting way. They gave me a green light. I was happy that even the school management team alluded to the fact that technology is here to stay (Thamsanqa Makhathini, VCT 2008).

Annie Behari relates how she had to gain permission from her school principal as well as the learners' parents before being allowed to use mobile phones for teaching. The approach to lobby for change in policy manifests and is consistent across the dataset. She explains below:

At my school cell phones are not allowed because of the negative publicity. (Please note I asked permission from my principal as well as the parent to teach this lesson.) I taught my pupils to use cell phones in an educational way. I am glad to report that I had no discipline problems (Annie Behari, VCT 2009).

Requests to leadership is not limited to allowing mobile devices to be permissible for use in the classroom, teachers also request more resources to be allocated to their areas as Murphy Mugabi explains:

I will make a requisition to the school principal so that we can buy some software for our learners to use during project based learning. Because all the software we used in this project were trial versions and had so many limitations (Murphy Mugabi, VCT 2007).

Areas of additional influence stretch all the way to the top as this participant found herself being consulted by her principal:

I am also consulted by leadership. My principal has lots of questions and in that way I can influence their decision making (UI,5).

Linda Bradfield shares her vision for the future and identifies areas needing improvement. She also makes recommendations regarding the acquisition of additional resources in the form of technology hardware. She relates the gist of her conversation with the IT director:

Since coming back from The Pan African Event, I have had many meetings with our school IT Director. He has been very interested and supportive of my ideas. Within the next 2 years I would like to introduce Microsoft Multi-Point server, or the equivalent, in each of the Grade 1 and 2 classrooms thus allowing group projects to take place on a more regular basis (Linda Bradfield winner of the Pan African collaboration award, 2010).

This section considered innovative teachers and their interactions within their schools to affect organisational change. They tend to move higher up in the organisational structures of the school with additional duties and tasked with staff development programs relating to the use of ICT in the classroom. They actively lobby management structures to amend policy and their changed practice is used as a model for new initiatives.

The next section will look at teachers that leave their teaching posts when they redefine their personal goals.

6.5 TEACHERS LEAVE

The reasons that teachers leave the profession are well documented in literature. However, not much is known as to the reasons why innovative teachers leave their current positions other than Novotný's (2003) earlier research. He documented case studies of identified innovative teachers

within the Czech Republic. He articulates the frustration many teachers experience with the slow pace of change in school culture and mention five different outcomes as teachers tend to:

- Resign and escape from teaching.
- Stay at school and actively engage to modify the system.
- Some withdraw into their classrooms.
- Some are promoted to head-teachers and
- Some become strongholds of in-service training.

Within two years after being selected as a finalist in the Microsoft Innovative Teachers Award competition, innovative teachers tend to leave their particular school. Their elevated status and increased confidence levels motivates them to seek out better opportunities for themselves. They either move to a different school as a promotion or leave teaching altogether. The teachers electing to leave teaching choose a career path that allows them to remain within the educational profession. They are approached by organisations that are involved with pre-service and in-service teacher training programs. Innovative teachers pursue positions where they affect greater change in education. The findings pertaining to teachers leaving is consistent with the comments below:

Another instance involves a highly qualified teacher that was moved from a regular academic subject to teaching the subject of ICT because of knowledge of ICT integration into his subject area. Subsequently, even though he was very competent and innovative in his use of technology in the previous subject he felt stifled in the new curriculum as he lacked the content knowledge to safeguard his exploration of the curriculum boundaries. If I use ICT in the class, I will get promoted. If I use it well, I will get head-hunted out of education. That is my ultimate aim (U1,4).

It is thus evident that teachers leave to elevate or improve themselves or their conditions. The following section makes known how the emerging themes for this chapter combine and shape the final core category *responsive governance*.

6.6 RESPONSIVE GOVERNANCE

This section reflect on the previously mentioned themes of *skills transfer* and *organisational change* and how the innovative teachers need to be managed by governing structures within a school to capitalise on the change agent in their midst. As an overview to this section Figure 6-5: Building theory: *Responsive Governance* as emerging core category with expanded themes is presented below.

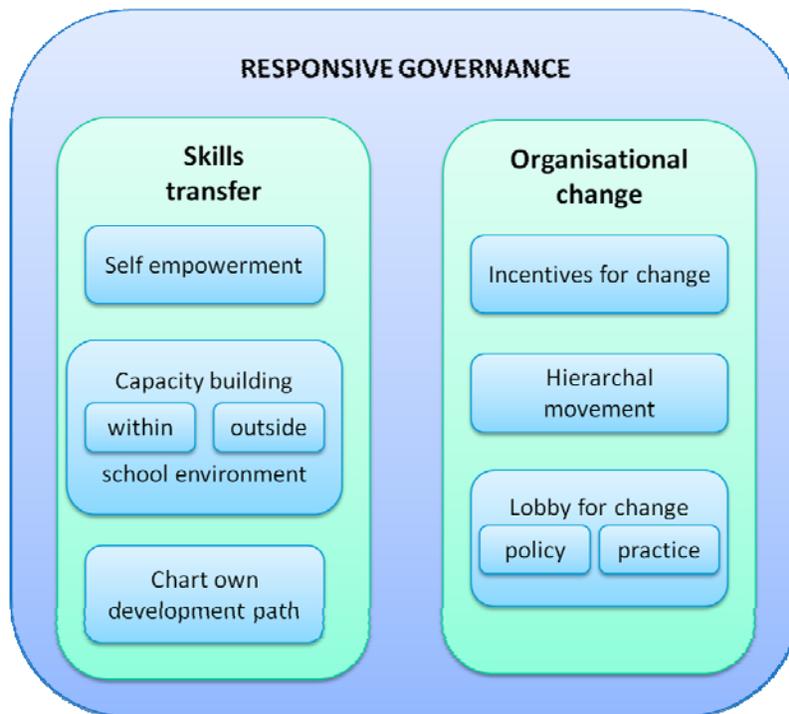


Figure 6-5: Building theory: *Responsive Governance* as emerging core category with expanded themes

The value of innovative teachers to their schools lies in their ability to be innovative and engage with emerging technologies in amending their pedagogical practices despite the numerous limitations they might face. The confines of contexts cannot be underestimated and the relevance of their solutions carry more value as they are able to contextualise training and tailor it to the needs of each individual teacher rather than an outsider coming in to engage in in-service training. These teachers are intimately familiar with the teaching conditions, the abilities of their learners and their own school culture.

Innovative teachers function not only as innovators within their own teaching and learning spaces, but are part of a larger learning system. Their personal visions and mental models are accommodated into the organisation, resulting in organisational change.

School governance structures should take note of the following guidelines put forward by Tidd, Bessant and Pavitt (1997) in Table 6-7 below. Even though the list was originally drawn up more than a decade ago and focused on large organisations, the relevance to organisational leadership is persistent. Components such as vision, the will to innovate, structuring effective teams with the focus on individual development and the cultivation of a creative climate put forward and later supported by Nijhof, Krappendam and Looise (2002) as areas requiring strong leadership.

Table 6-7: Components of the innovative organisation (Tidd, et al., 1997)

Component	Key Features
Vision, leadership and the will to innovate	Clearly articulating a shared sense of purpose with strategic intent and management commitment.
Appropriate structure	Finding the balance between organic and mechanistic options in designing for contingencies.
Key individuals	Champions, gatekeepers and other roles which can energize or facilitate innovation.
Effective team work	Appropriate use of teams requires investment in team selection and building.
Continuing individual development	Long term commitment to training to ensure high levels of competence and the skills to learn effectively.
Extensive communication	Internally in three directions: upwards, downwards and laterally. Within and between external organisations and external parties.
High involvement in innovation	Participation in organisation-wide continuous improvement activity.
Focus on the learning	Internal and external customer focus – a total quality culture.
Creative climate	Positive approach to creative ideas, supported by relevant reward systems.
Learning organisation	Processes, structures and cultures which help institutionalise individual learning.

Schools are very similar in their hierarchical structures and tend to be very stagnant. For the innovative teacher to be accommodated within the structures of the organisation, a unique position tends to be created. The teacher is moved out of the classroom and tasked to formalise

tacit knowledge and mental models on technology integration and generative learning into learning objects, artefacts and training sessions in order to support staff development and growth. The key is to first recognise and then reassign innovative teachers to bring about organisational change. However, innovative teachers can become overburdened in the process and Novotný, sounds a note of warning to school leadership highlighting the vulnerability of innovative teachers:

“Those who implement innovations are often under heavy pressure from their environment. This is especially alarming with those who simultaneously undergo a transition on their own, of their behaviour and their working conduct. They often have to combat their own doubts and with the resistance of the system. The demands they impose upon themselves may become too extensive” (Novotný, 2003, p. 4).

Governing Body and Leadership of the school encourages creativity and innovation that will benefit the learners (Fiona Beal, VCT 2010).

Hanrahan, Ryan and Duncan (2001) caution against the formalisation of spontaneous in-service learning into institutional agendas as they found the outcomes to be unspecified and hard to measure. This results in a lack of enthusiasm from staff involved in the process and further influences the success of future training events. It therefore comes as no surprise that Sullivan and Glanz (2006) found some evidence that school leadership is, in some cases, reluctant to change in response to innovative teachers being in their midst and that they also lack the vision to strategise their deployment outside their own subject areas. The following statement was made by a workshop participant:

Integration of innovative teachers into the schools is sometimes problematic. Because they are taken out of the classroom to assist other staff in integrating ICT in to their lessons, their direct colleagues experience an amount of pressure due to additional classes that have to be picked up(IC,89)

Responsive governance is all about carefully managing the expectations of innovative teachers and how to best employ their highly valued skills to bring about organisational change. At the same time a shared vision for the school must be clearly communicated and each staff member needs reassurance as to their own inherent value to the organisation:

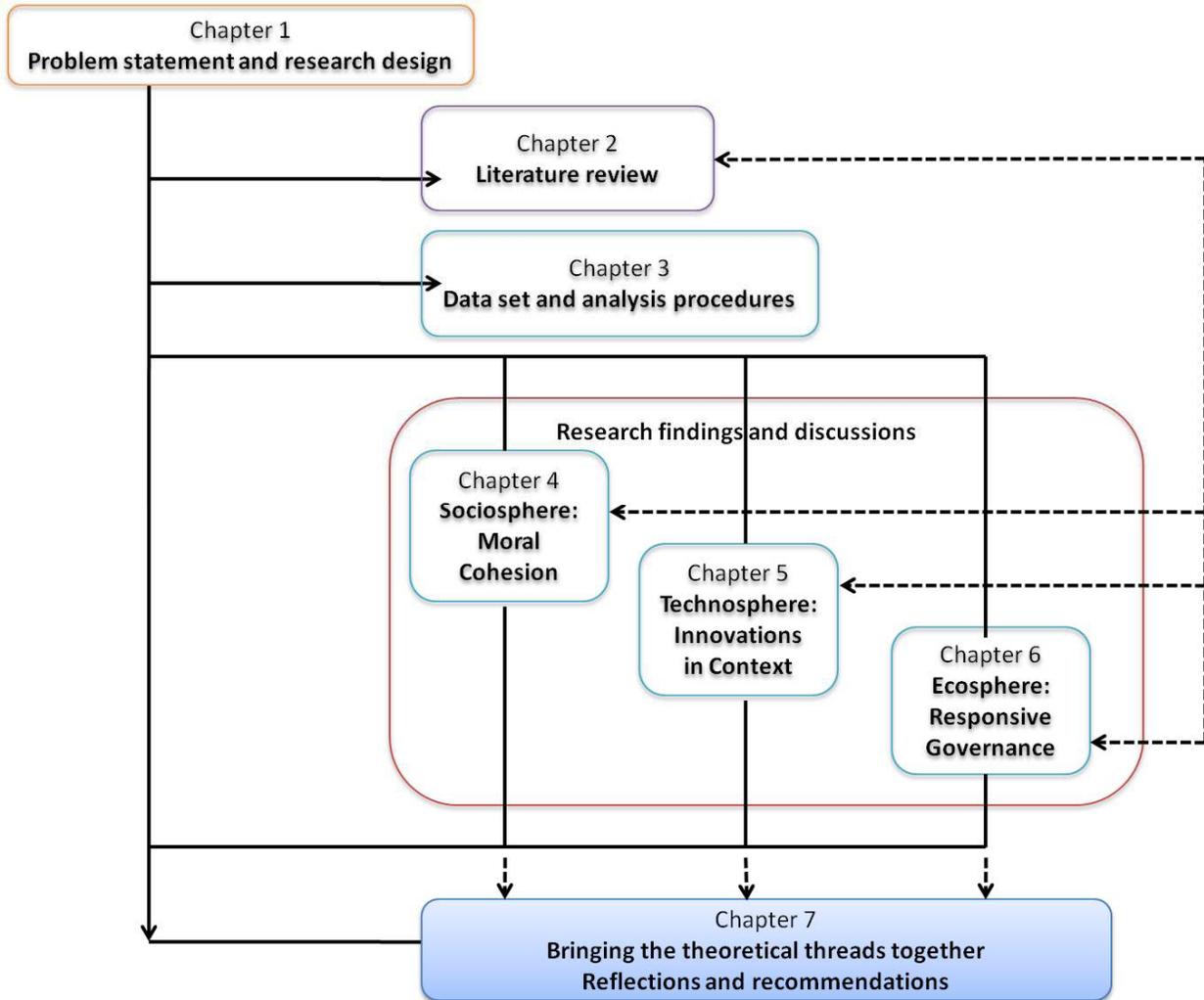
Hernández-Ramos states that “...when the reform involves technology, we now know that the true possibilities for transformation come not from the technologies themselves but from the

deep changes in school organisation and in teacher's beliefs and pedagogical practices that the introduction of technology may catalyse" (Hernández-Ramos, 2005, p. 51).

6.7 SUMMARY

This chapter on the ecosphere revealed *responsive governance* as the core category to emerge from analysed data considering innovative teachers' use of emerging technologies in their practice. Data were analysed using various instruments as illustrated in Table 3-4 on page 92. The themes *skills transfer* and *organisational change* were presented with their expanded sub themes in quotes from participants and in the researcher's reflective comments.

The final chapter concludes with the researcher's reflections and recommendations for future research.



CHAPTER 7. CONCLUSIONS AND REFLECTIONS

*If educational theory goes beyond its proper limits,
if it pretends to supplant experience,
to promulgate ready-made formulae that are then applied mechanically,
it degenerates into dead matter.
If, on the other hand, experience disregards pedagogical thinking,
it in turn degenerates into blind routine
or else is at the mercy of ill-informed or unsystematic thinking.*

Emile Durkheim (2002)

7.1 INTRODUCTION

The aim of this chapter is to provide a synopsis of the research by revisiting the research questions and subsequently presenting the developed substantive theory. This investigation pursued a Grounded Theory Method of exploring innovative teachers' pedagogical efficacy in their use of emerging technologies. Contained in this chapter are methodological and personal reflections that influenced this study as well as a critical account of the quality of the research. The chapter concludes with recommendations for further research.

The next section provides an overview of the research study by outlining the main events in each chapter.

7.2 RESEARCH PRESENTATION

The essence of each chapter is presented below:

Chapter 1 provided the background and research purpose which culminated in phrasing the main and subsidiary research questions. This interpretive study followed a qualitative research design with an inductive approach. The Grounded Theory Method was used to collect and analyse data. The study development phases were illustrated in Figure 1-9 and ethical considerations were explained.

Chapter 2 considered the body of literature to sensitize the researcher and the reader towards the main contributors in this field and their perspectives so that they could be revisited later in the study in a process of constant comparative analysis. Due to the complexity of learning environments a framework was constructed to situate the research within boundaries. Gardiner's model, which consists of three overlapping spheres namely the *ecosphere*, the *sociosphere* and the *technosphere*, was found to be the most appropriate choice when contemplating how innovative teachers conceptualize innovation and pedagogical efficacy.

Chapter 3 presented details of the research process by providing the rationale for selecting the Straussian Grounded Theory Method for gathering data and analysing data. Data gathering considerations as pertaining to the sampling process were discussed and actual data gathering instruments were employed in the research. The key analytical strategies which were used in the

systematic coding process along with the subsequent concept development were covered. Practical guidelines for data handling, as proposed by Coyne (2009), were followed. Finally, the emerging core categories with their expanded themes and a map of the research findings were presented.

Chapter 4 offered the findings from the *sociosphere* which primarily considered the complex character of innovative teachers' use of emerging technology in social settings, such as schools. The core category *moral cohesion* emerged from the engagement with data and contributions from literature were taken into consideration. The supporting themes *professional burden* and *teacher as bricoleur* were expanded upon. The key drivers in this sphere were found to be *African renaissance* and *teacher disposition*.

Chapter 5 focused on the second sub-research question which attended to the pedagogical shift within the *technosphere*. The core category *innovation negotiations in context* which encapsulates the themes *innovation strategy*, *technology implications* and *reflexive pedagogy* was expanded upon and discussed.

Chapter 6 presented the findings of the last sub-research question concerned with the *ecosphere*. *Skills transfer* and *organisational change* emerged as themes and tie in together with *responsive governance* as the core category in this chapter.

Chapter 7 concludes the research endeavour with the presentation of the substantive theory constructed from findings as reported in chapters 4, 5 and 6 and is presented as a series of illustrations. The researcher reflects upon aspects of methodology and identifies possible areas for future research.

This study was divided into phases (*cf.* Figure 7.1) in order to manage and keep track of progress and to maintain a steady pace towards developing a substantive theory on innovative teachers' pedagogical efficacy in their use of emerging technologies.

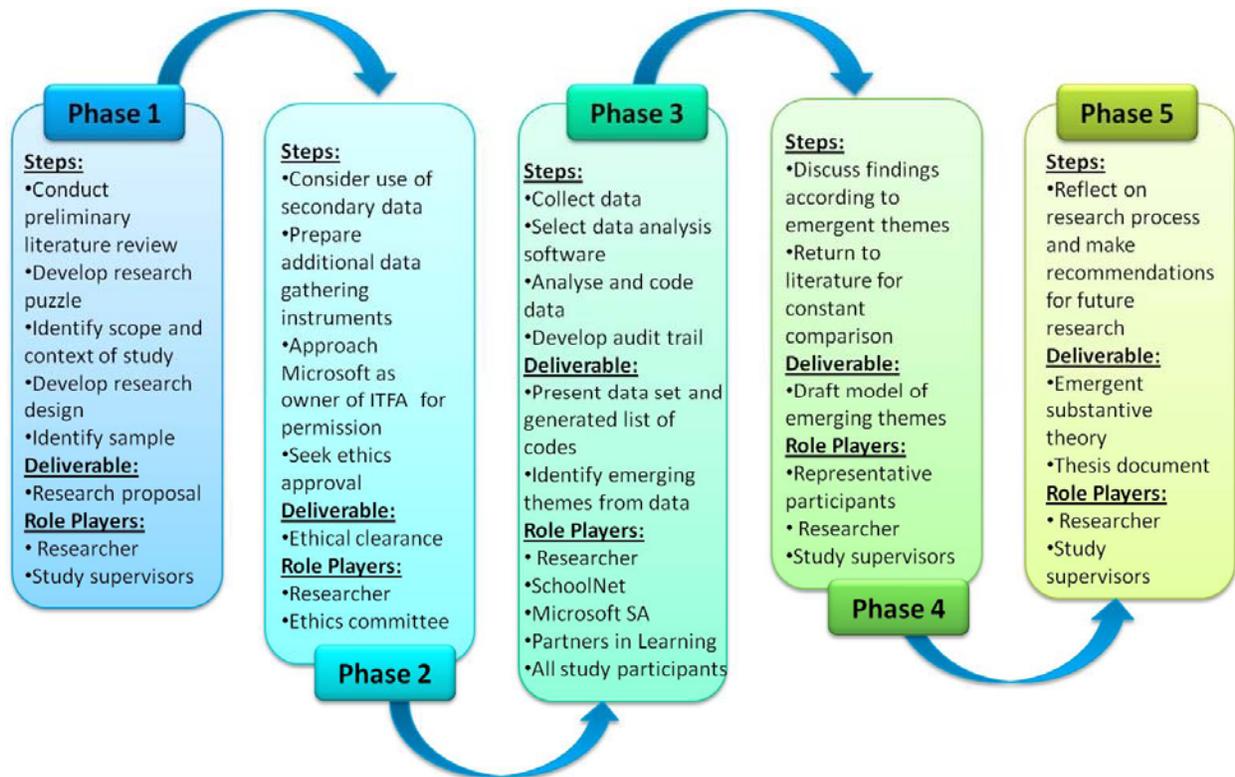


Figure 7-1: Research phases revisited

In retrospect, each phase proceeded as planned; however, phases 3 and 4 should ideally be divided into subsections to better reflect the prolonged period spent in analysing and interpreting data and the conceptualisation of the emergent theory.

The next section revisits the main findings and presents the substantive theory to emerge from the dataset and related literature.

7.3 NEW INSIGHTS: THEORY DEVELOPMENT

This section will first consider the core categories that emerged from each sphere as discussed in chapters 4, 5 and 6 before culminating in the presentation of the substantive theory which encapsulates the innovative teachers' pedagogical efficacy in their use of emerging technologies. This research study applied the Straussian Grounded Theory Method in gathering and analyzing data in accordance with the fundamental principles for conducting interpretive research as set out by Klein and Meyers (1999) and reflected in Table 1-3 on page 38. A conceptual framework was constructed to contain the research based on Gardiner's model called *the three interfaces of*

Adam (Zandvliet & Buker, 2003) which consists of three overlapping spheres named the *sociosphere*, *technosphere* and the *ecosphere*. Central to this model is the suggestion that people generally deal with three dimensions in their existence namely: other people in their social world or *sociosphere*; the man-made artificial world or the *technosphere* and the natural world or the *ecosphere*.

Innovative teachers, located at the centre of these spheres, are subjected to all three influences and the research findings are presented according to each of the spheres in the sections below before culminating in the substantive theory.

7.3.1 Summary of findings: Sociosphere

The *sociosphere* encapsulated the innovative teacher within specific educational context and explored influences that guide their decisions and actions as members of a larger community.

The sub research question that guided research in this section was:

RQ1: What role does moral cohesion play within the sociosphere of the innovative teacher?

The construct *moral cohesion* (cf. Figure 4-9) supports the notion of an interconnected society with innovative teachers acting as stewards of their communities. They apply their knowledge of new technology to harvest knowledge from members of their community and contribute their ideas and solutions to better the lives of the learners in their care. In addition to the ideas which emerged from the analysis of the dataset and subsequent to engaging with related literature, the concept of indigenous knowledge systems serve as a strong influence on stewardship. Knowledge gained from community experts guide innovative teachers and learners to make sense of the particular value they are capable of adding, through their more modern approach, to solve community problems. Innovative teachers also align themselves with the ideals of the African renaissance as reflected in policy documents and continue to find unique ways to harness resources such as emerging technologies to uplift and enlighten management, colleagues and learners whilst expanding their horizons.

Some uncertainty and additional considerations as to the use of technologies emerged within the theme *professional burden* as there is a distinct lack of appropriate guidelines to govern and direct the actions of both teachers and learners. Innovative teachers respond by setting their own generic guidelines which they clearly communicate to their learners in order to accommodate their changed practice. In the design of learning events, innovative teachers rely on their own repertoire of skills which emanate from a wide area of interest, not all of which are related to their duties as a teacher. Innovative teachers seize seemingly serendipitous exposure to training events, not all of which are related to the use of ICT in the classroom but also relate to areas of personal interest. The concept of *teacher as bricoleur* is an apt way to describe the dexterity with which teachers manipulate their skills when designing and executing learning events wherein emerging technologies are incorporated. The research also revealed the tendency of innovative teachers to hold strong personal convictions regarding personal fulfilment and the need to continually refresh oneself. These findings are substantiated with instances from literature.

This section revealed that innovative teachers' moral cohesion is dependent on their perception of the professional burden they carry as well as their multivariate skills. The concept of the teacher as bricoleur alludes to the educator using *whatever means* and *whatever is at hand* to equip learners with the skills required to make them contributing members of their community and the information society.

7.3.2 Summary of findings: Technosphere

In this study, the *technosphere* considered the pedagogical strategies which innovative teachers employ and how they continue to harness the increased capabilities of new technological tools available to them and their learners within their teaching and learning spaces. The sub research question for this section was:

RQ2: How do teachers negotiate innovation within the technosphere context?

The unequal distribution of technology resources in schools across South Africa, and also within different subject areas in the same school, increases the resourcefulness of innovative teachers to harness the full potential of the technology at their disposal. This technology can be the personal

property of the educator or in the hands of the learners. When attempting to manage learner expectations during innovative teaching events and projects, teachers have to pay close attention to the learner's workload to ensure that tasks are distributed fairly amongst group members. They need to step in to prevent project fatigue that can result in the learners losing interest and enthusiasm for future projects. It was noted that learner disposition was heavily influenced by social contexts and learning attitudes. Values, associated with new knowledge, develop in response to finding solutions to a situated problem. Learners became progressively empowered as projects unfolded and they acquired ICT skills which stretched beyond the scope of their specific tasks, awakening their initiative to explore and implement their own preferred outcomes. Said learners expressed the inclination to work on areas that interested them and they engaged in peer coaching and mentoring learners with weaker skills which resulted in a high level of skills transfer within group work. Learners also enjoyed the relative flexibility within the innovative teaching and learning environment and were gratified that their efforts were appreciated and validated by the community. Learners professed themselves to be far more socially conscious as their projects drew to a close.

Aspects of *pedagogical reflexivity* touched on aspects related to the curriculum where the rapid advance in technology and the multitude of devices with differing capabilities require continuous pedagogical renewal to ensure the currency of learning strategies. Examples were presented where teachers engaged with their learners in an effort to address the lack of suitable content by developing their own culturally sensitive learning resources within context. Due to the unprecedented initiatives and the eventualities teachers have to deal with when they engage in innovative activities, research revealed their strategy of dealing with changes. They tackled teaching practice changes in small incremental steps whilst applying their new tacit knowledge. Teachers described existing assessment instruments as inadequate and added that they could not do justice to the new knowledge manifested by learners. They therefore suggest that new instruments be developed in collaboration with learners with more emphasis on formative assessment strategies.

This section considered the way in which innovative teachers negotiate activities in collaboration with learners involved in the innovation process. Strategies for the constant renewal of pedagogical practices and the need for reflexivity included the appropriation of learners'

personal devices for learning where the disposition of learners had to be managed in accordance with their various capabilities. The unprecedented innovation initiatives resulted in the reconceptualising of assessment protocol as existing instruments were deemed to be inadequate to accurately measure learner engagement.

7.3.3 Summary of findings: Ecosphere

The *ecosphere* demarcates the learning surroundings within a school ecosystem. The tendency of innovative teachers to exploit technology in their learning environment affects organisational systems and requires responsive governance to aid organisational change.

RQ3: How do structures of governance respond to the innovative teacher within their ecosphere?

Innovative teachers are powerful *change agents* within a school environment and management needs to act in a progressive manner to utilise their skills to the full benefit of the organisation. In this regard a certain amount of freedom should be offered to innovative teachers to further explore their own practice whilst at the same time they should be tasked with additional responsibilities in growing organisational capabilities. Innovative teachers find themselves moving up in the hierarchical management structures of the organisation and various incentives are offered for them to keep abreast of new developments in their field. Besides empowering their colleagues through informal contact and support, they are required to formalise skills transfer in developing in-service training materials and to act as facilitators during training events. Innovative teachers used their increased status and power within the organisation to actively lobby for policy changes through participating in advisory committees and assisting in the drafting of documents that hold strategic, ethical and practical implications for the exploitation of emerging technologies within the organisation.

This section considered innovative teachers and their interactions within their schools to affect organisational change. With increased exposure to and involvement with organisations outside of the school environment and increased levels of self-assurance, innovative teachers tend to leave their academic positions to pursue other more promising employment opportunities. The

following section describes the construction of the substantive theory as a result of engagement in this research endeavour.

7.3.4 Construction of the substantive theory

Each of the chapters concerned with reporting the findings contributed visual illustrations that informed the formation of the final substantive theory. In Chapter 4 (*cf.* Figure 4-10) the interrelationship diagram identified the sub themes *African renaissance* and *teacher disposition* as the key driving forces manifesting in increased *stewardship*, whilst teachers grapple with *ethical concerns*. These sub themes are valid representation of the *moral cohesion* of innovative teachers in their engagement within their sociosphere.

Within the context of the technosphere, as fully discussed in Chapter 5, the figure which pertains to the *innovation negotiations in context* was the model of exploration learning (*cf.* Figure 5-6) as taken from *innovation strategy* (*cf.* Section 5.4). The remaining illustration from the ecosphere, representing *responsive governance*, was taken from *organisational change* (*cf.* Section 6.4) and reflects the 5 core disciples of systems thinking found at the heart of organisational learning. Figure 7-2 below presents a synopsis of illustrations pertinent to the research findings.

The visual map of building substantive theory is depicted in Figure 7-3 as presented individually in chapters 4 (*cf.* Figure 4-9: Building theory: *Moral cohesion* as emerging core category with expanded themes), Chapter 5 (*cf.* Figure 5-10: Building theory: *Innovation in Context* as emerging core category with expanded themes) and Chapter 6 (*cf.* Figure 6-5: Building theory: *Responsive Governance* as emerging core category with expanded themes).

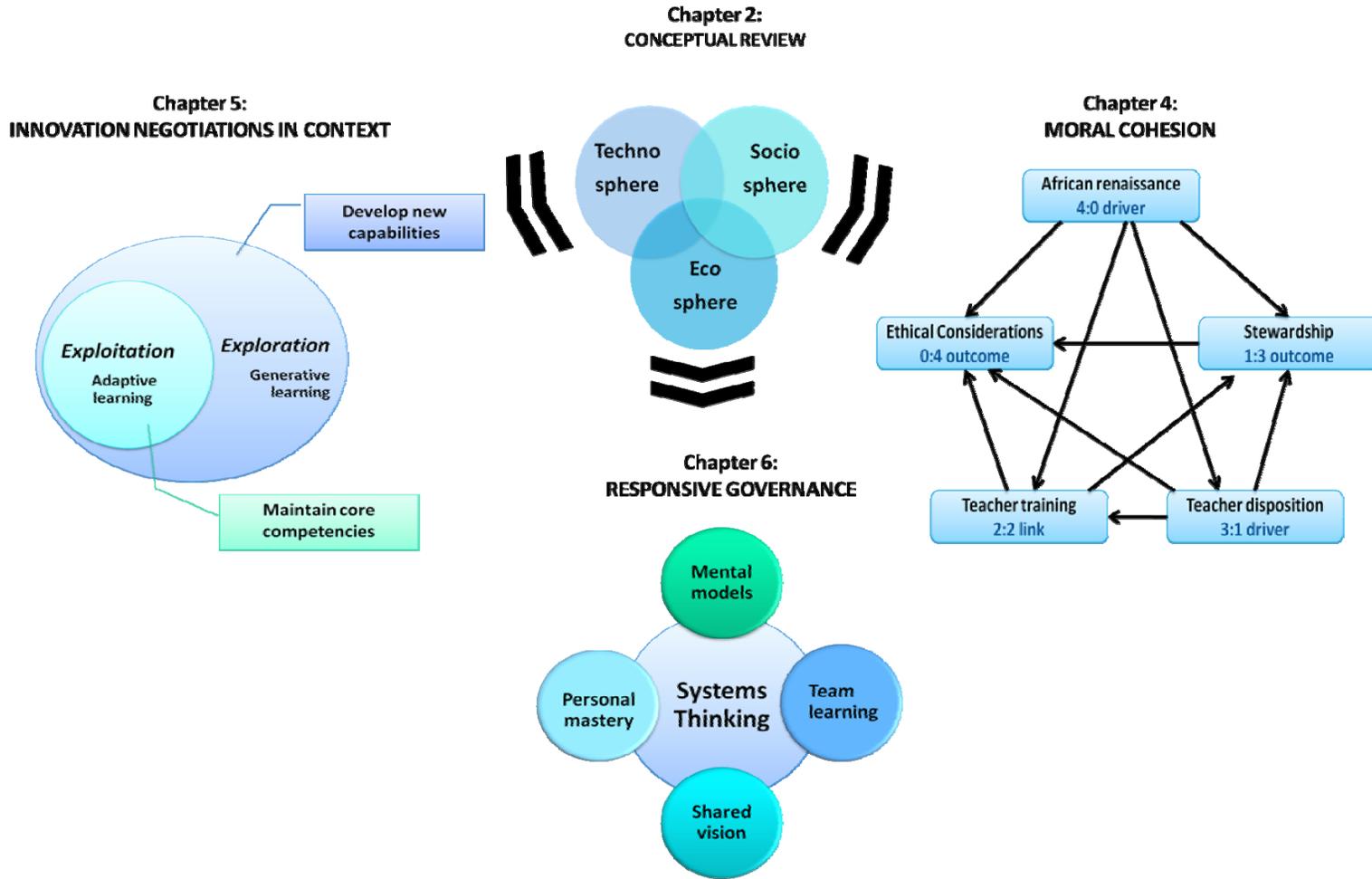


Figure 7-2: Visual synopsis of research findings

INNOVATIVE TEACHERS' PEDAGOGICAL EFFICACY IN THEIR USE OF EMERGING TECHNOLOGIES

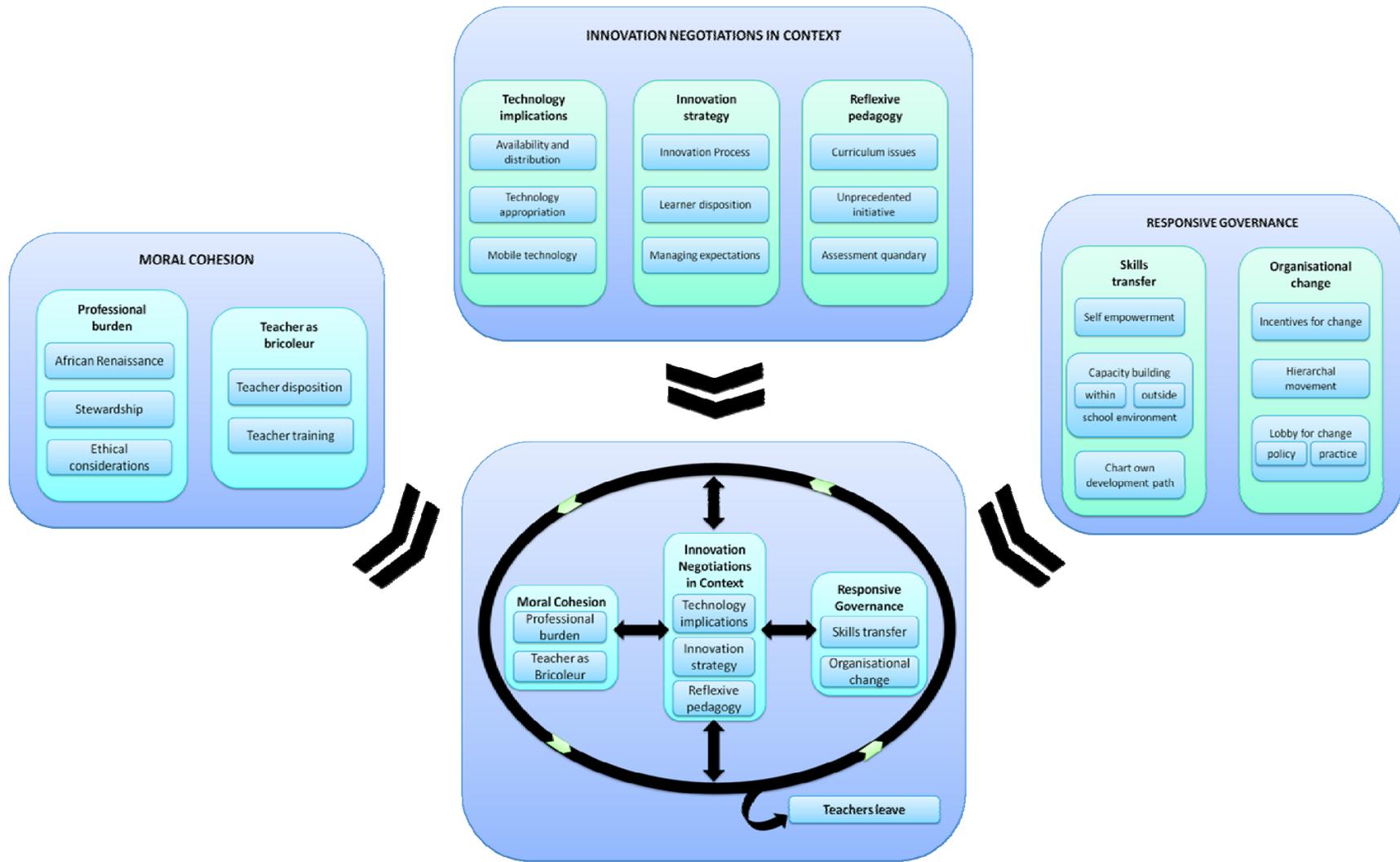


Figure 7-3: The visual map of building theory

The presented substantive theory (*cf.* Figure 7-4) attempts to address the main research question phrased at the beginning of this study:

How does tacit knowledge manifest when innovative teachers engage with emerging technologies to achieve pedagogical efficacy?

Teachers expressed a strong sense of kinship with the people of Africa and they strived, through their projects, to uplift and enlighten their fellow teachers and the learners in their care by expanding their horizons. Towards this aim they relied on members of their community and activated their own personal network of contacts that stretched well beyond the education sector. They gradually built their skills set through the pursuit of formal and informal training opportunities and struggled with difficulties such as utilizing their personal resources for work or with the level of technology availability to their learners after school hours. *Moral cohesion*, as the defining concept, encapsulated the innovative *teacher as a bricoleur* who carries the burden of their profession as they grapple with indigenous knowledge systems that influence their stewardship of their learners. These teachers must at the same time address the ethical concerns raised as a result of their changed practices.

The emphasis on context when negotiating innovation is framed by the areas of *technology implications*, *innovation strategy* and *reflexive pedagogies*. Managing learning events and learner expectations as part of the innovation process, whilst contemplating the learning opportunities presented by various technologies for use within the classroom, became part of the teaching and learning environment the innovative teacher was striving to navigate. The unprecedented nature of initiatives resulted in teachers collaborating with learners as equal partners in the learning process.

Maximising the influence of innovative teachers, by dispersing their capabilities across the school community as an organisation, is the responsibility of *responsive governance*. Teachers that reached finalist status in the competition found that their school responded by augmenting their job description with added responsibilities. Their stature within the community and educational bodies outside the school increased significantly. They were required to aid in staff development in both formal and informal instances whilst still increasing their own pedagogical

repertoire. They actively lobbied for change in their school's organisational structures and were invited to serve on committees tasked with the integration of technology into the classroom. It also became evident that teachers tended to leave teaching to elevate or improve themselves or their conditions but continued to remain active within the educational profession.

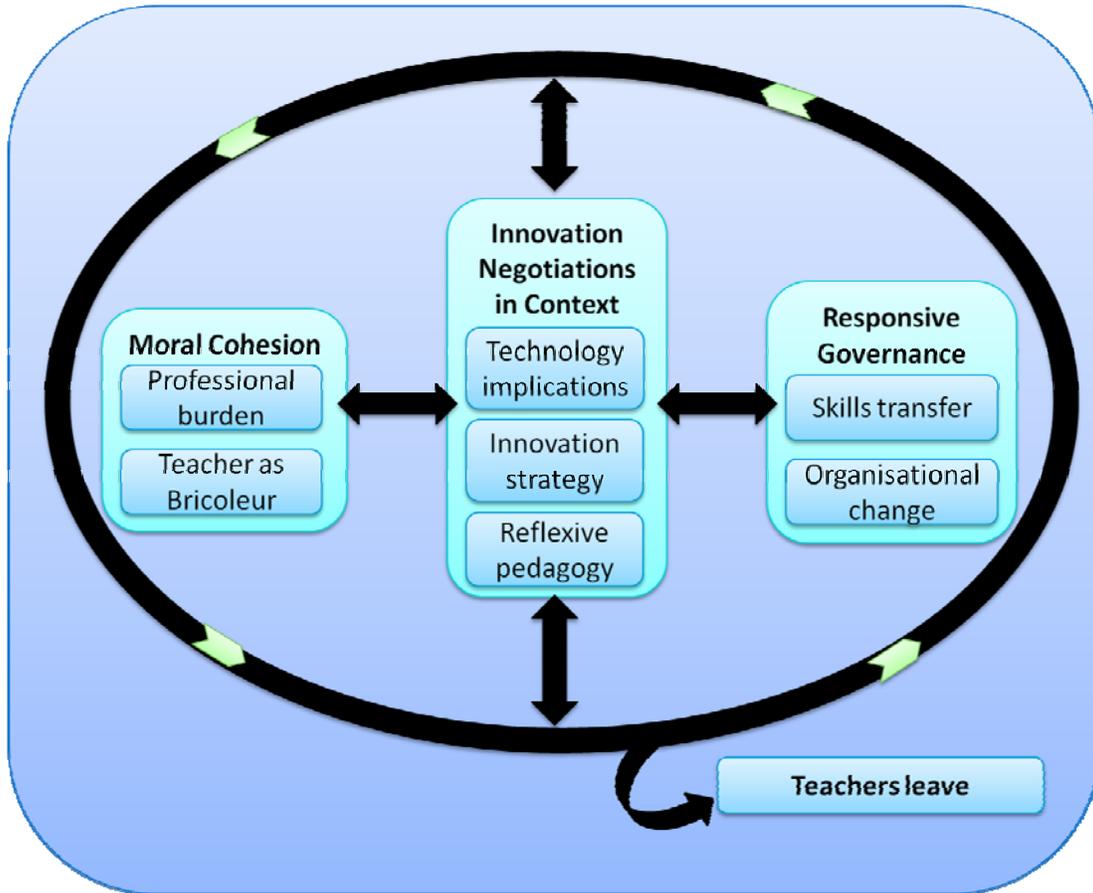


Figure 7-4: Substantive theory of innovative teachers' knowledge manifestations when using emerging technologies to achieve pedagogical efficacy.

In the past two decades the focus of innovation has shifted. It now consists not so much in merely mastering content and perfecting specialised learning but in enabling schools in particular to provide positive learning experiences, to increase willingness and ability to learn, to promote stable personalities and to offer social experiences all with the use of emerging technologies. The function of teaching has become more important than subject-based educational reform.

7.3.5 Substantive theory: Possible practical implementation

Teachers rely on their existing knowledge in the enactment of their duties as professional individuals. They draw from their repertoire of skills developed through trial and error over a long period of time. For teachers to become more innovative in their use of emerging technologies, the expanded substantive theory as depicted in Figure 7-3 could be used to identify areas in their personal development that require more attention. Teachers can therefore pay closer attention to their own professional development and select appropriate training opportunities in an effort to become more innovative in their use of emerging technologies.

The substantive theory as presented earlier in Figure 7-4 can also be of value to school management structures. They can use it to identify the teachers in their midst that demonstrate potential for development and they can respond more appropriately to the innovative teachers as change agents.

7.3.6 Methodological contribution

The substantive theory being offered is the result of following the systematic Straussian Grounded Theory Method of analysing data, conceptualising emergent themes and finally framing the results in a visual manner. The use of this method in the domain of Computer-integrated Education is a novel approach especially pertaining to the practice of innovative teachers.

Consulting literature prior to entering the research field remains a contentious issue as discussed in Section 1.6.5.2. For the purposes of this research, literature was used in three ways. The first was to sensitize the researcher and the reader towards the research problem and related literature. The second and more controversial use of literature in following GTM was to construct a framework for the analysis of data and the presentation of the findings. This approach is not aligned with generally accepted guidelines when conducting grounded theory studies but a natural extension of the approach adopted by Diaz and Andrade (2009, p. 46) in which they encouraged researchers to take previous experiences into account and draw from existing literature to structure a preliminary theoretical framework.

The pre-existence of embedded categories within the Microsoft Innovative Teachers Forum Awards competition entries lent itself perfectly to adapt Gardiner's Three Interfaces of Adam, as seen in Figure 2-1, to accommodate areas necessary to consider when investigating the innovative teachers' practices hence the socio-, eco-, and technosphere constructs. The adoption of a framework in which to consider data analysis and through which to present the research findings is a fresh approach and a natural extension of the systematic design of GTM as presented by Strauss and Corbin with their prescriptive procedures. The framework designed for this research study was utilised as a device that enabled not only the analysis of data but was also a mechanism to present the actual findings in the field.

The third and last consideration pertaining to the use of literature remained true to the spirit of GTM research where it is considered as an additional data source. Literature was consulted continuously throughout the data collection and dissemination process in constant comparative analysis, thus additional insights gained from literature were included in the emergent theory throughout the study.

The main methodological contribution of this research study is in applying Straussian GTM in the domain of Computer-integrated Education as well as the extension of the procedure to use a framework constructed prior to entering the field as a mechanism for analysing and presenting the research findings.

7.4 REFLECTIONS

This section will provide details of the researcher's personal reflections on the applied methodology, how the researcher experienced different aspects of the methodology and what valuable lessons were learnt whilst applying the Straussian methodology of Grounded Theory.

7.4.1 Making sense of methodology

In an effort *to make sense of methodology and understand particular personal research perspectives and agendas*, Swann and Pratt (2003, p. 6) constructed several questions to guide fellow researchers to frame their particular study, express underlying assumptions and declare tacit biases. These questions are first posed and then discussed in relation to this research to

reveal the orientation of the researcher that acted as a guide in understanding the unfolding process of the study.

7.4.1.1 My Research Purpose

What is the purpose of educational research? What is educational research for? What are the characteristics of good research in education? Why do I engage in research?

This research study was characterized by two overriding interests. The first interest was to empower my fellow colleagues in the teaching profession in articulating their innovative pedagogical practice and the second interest was to illuminate the changes organisations, such as schools, can undergo by claiming innovative teachers in their midst. Management can use their innovative teachers' expertise and vision to provide pedagogical leadership and to facilitate changes in the teaching and learning practices of colleagues still entrenched in traditional modes of delivery and assessment. A more ambitious aim is to liberate the minds of teachers and learners on the African continent to take their rightful place as active participants in developing discourse about preserving their indigenous knowledge and challenging existing practices, whilst conceiving new approaches to teaching and learning with emerging technologies. I acknowledge these interests to be overambitious and in reality I might affect change in only a few areas, but to be committed to research is to work with a purpose towards a set goal of knowing something with a deeper level of understanding and making it accessible to others with similar interests.

7.4.1.2 My Research Identity

How do I characterise my research and myself as a researcher? How does the way I construe research, and myself as a researcher, affect the design and conduct of my research?

First and foremost I am a former teacher, a recognised innovative teacher within the boundaries of teaching and learning with varieties of ICT and a facilitator in innovative teacher development. I have received accolades on local, national and international forums for my innovative teaching practices. I am a mobile learning specialist who conceptualizes and executes learning events that pilot new technologies in formal teaching environments in collaboration with

research institutes and research partners. I work towards increasing awareness of the unharnessed potential that mobile devices present in the teaching environment. I encourage school leadership to be more active in articulating their stance on integrating emerging technologies in the classroom and support them by developing guidelines and policy when employing mobile technology in schools. I am an educational researcher with an interest in how the face of education is constantly changing. I share in the pressures teachers endure when required to continually adapt their practice as required by changes in practice and policy.

7.4.1.3 My Research Influences

What influence has my research had on educational policy and practice? What influence might it have in future? What form has collaboration taken in my research work?

My most significant contribution to the field of computer integrated education is in the area of mobile learning drafting policy and guidelines which included the setting of standards for teaching and learning with mobile phones as best practice classroom guidelines in partnership with NOKIA. I also collaborated in the drafting of e-safety guidelines for the National Department of Education. These guidelines pertain to the *acceptable use policies* of mobile phones in the formal school environment. My collaboration with fellow researchers has taken the form of mentorship and participation in ongoing studies of mobile learning user experience as well as in studies contemplating tutoring via the mobile phone using social Web2.0 applications. This has led to participation at conferences with the subsequent publication of short and long papers documenting the research process. My contributions have also stimulated debate and interest in the arena of educational policy and practice and future teacher development.

7.4.2 Delayed methodological mastery

Some reservations existed throughout the research as to the suitability of the Grounded Theory for this study. There are different applications of the Grounded Theory Method and all three methods had to be studied and fully understood before a decision could be made on how to best proceed and which one would be the most appropriate for the study. The choice to use the Straussian method of Grounded Theory was justified with the emergence of the initial core

categories. At some point one of my critical reviewers suggested changing the research design from a *Grounded Theory method* to a *case study* design because of the prolonged period of confusion that persisted. One of the greatest challenges I experienced during this study was to determine the adequate level of conceptualization needed. Recognizing patterns in data were essential to conceptualization and a more experienced researcher would be more adept at this skill. Glaser (2001) clearly upholds that the classical Grounded Theory is all about *conceptualization* rather than *description*. However, an issue that is yet to receive the attention it deserves is the acceptable depth of conceptualization expected in a Grounded Theory study. This issue requires the researcher to be sensitive to data emergence by constantly comparing data to data and incident to incident (Ng & Hase, 2008, p. 162).

7.4.3 Regarding coding

Because English is not my home Language, I found coding during analysis to be quite challenging. I initially agonised over different terminologies and words in an effort to choose the precise and correct code to capture a concept. I found my vocabulary store lacking the depth needed and I was not satisfied with the *many words* I sometimes had to use to capture *one* concept. However Glaser, with the assistance of Holton (2004), reassures that the inability to capture exact codes early on in a study is a phenomenon well documented in novice researchers and not unique to this study and therefore I was encouraged to persist in my efforts. I had to rely on continuous reading and verification of my approach in data analysis and had to redirect and revisit the data set numerous times. After reading an article on coding, I became aware that I was rather to focus on the processes than line by line coding. This was the turning point of the data analysis and the procedure of coding became much clearer after revisiting the data set. As the journey of engaging with the dataset moved along, I grew in confidence for the emergence of the key concepts brought to light the appropriateness of making the choice of adopting the Straussian Grounded Theory approach. The more time I spent coding, the less concerned I became and finally decided to rather use more words to capture the exact thought than to sacrifice clarity for the sake of brevity as the created codes could be revisited and reconceptualised at a later stage.

Another textual challenge was that my initial analysis focused on line by line coding accompanied by memo writing and quote selection, however, this approach was very time consuming and did not yield many relevant codes as I got bogged down in the details. On revisiting Strauss and Corbin (1998) I was reminded of the need to code actions and processes within the phenomenon. Instead of redoing all the previous codes, I decided from that point onwards not to be restrictive with the text but to look out for the behaviour captured within the dataset.

7.4.4 Theoretical saturation

The last challenge which faces the researcher using the Grounded Theory methodology is early closure of the data collection process. According to Glaser and Strauss (1967, p. 67) “theoretical saturation” is the criterion used to judge when to stop collecting data. In addition, Strauss and Corbin (1990) state that theoretical saturation can occur at three junctures in the research. Firstly, when no new data reveals new categories; secondly, when each category is richly and densely described and all of its properties have been revealed; and thirdly, when the relationships between categories are well established and validated by data. It is therefore suggested that researchers avoid premature closure by looking out for the point of diminishing returns where the data adds nothing new to what the researcher already knows about a category, properties and its relationship to the core category (Ng & Hase, 2008, p.164).

7.4.5 Mastering the software during data analysis

Despite access to the tutorials I still experienced great difficulty in grasping the fundamental aspects of coding, memoing and managing my primary documents. It is easy to underestimate the amount of time it takes to master the ATLAS.ti software package. This time consuming effort leave one with a feeling of vulnerability and the anticipation of doom. At one stage, after months of coding, I managed to lose some material after tidying my folders and inadvertently moving the root files of the primary documents. It took two days to recover the lost material as I had to reinstall primary documents one by one from previous backups. This time consuming and frustrating exercise could have been avoided if I had spent more time thoroughly studying the tutorials.

A great help in this time of uncertainty was a series of 12 instructional videos I downloaded from YouTube. These videos covered all the main aspects of ATLAS.ti usage (namely assigning documents, code management, networks, quotations, core elements, query tools, use of the margins and remaining objects) and are designed to run for about 4-5 minutes. The following link is to the video which explains how to go about doing axial coding. http://www.youtube.com/watch?v=s65aH6So_zY.

Whenever I got stuck or experienced some difficulty with an aspect of ATLAS.ti I reverted back to the manuals and the videos for troubleshooting. This was a great help and ensured that I kept moving forward in the analysis process. I must admit that I exported all the codes, quotes and memos on a regular basis in the form of a text document as a backup procedure. The research journey can be very lonely when experts are not readily available but online assistance is only a click away through social media in the form of mailing lists and support groups. The Glaserian Grounded Institute (<http://www.groundedtheory.com/>) provides access to seminars where you can post particular questions about Grounded Theory to the forum, however, as the name implies it is only relevant to those following the Glaserian method.

The Word documents became very useful at one stage as I was experiencing some difficulty assigning the multitude of generated codes to families. Having to scroll through in excess of 500 codes became too overwhelming and at that point I decided to print all the codes and cut them into separate little pieces as seen in Figure 7-5 below. I spent a morning sorting them into related groups as shown in Figure 7-6 below. This immediately gave me a sense as to where the areas of emphasis were and I returned to ATLAS.ti with a better idea of the categories and the associations between them.

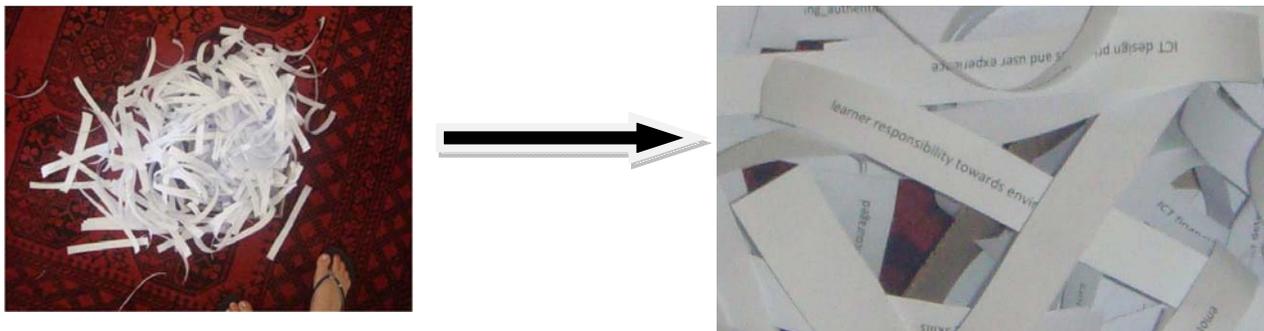


Figure 7-5: Snippets of code

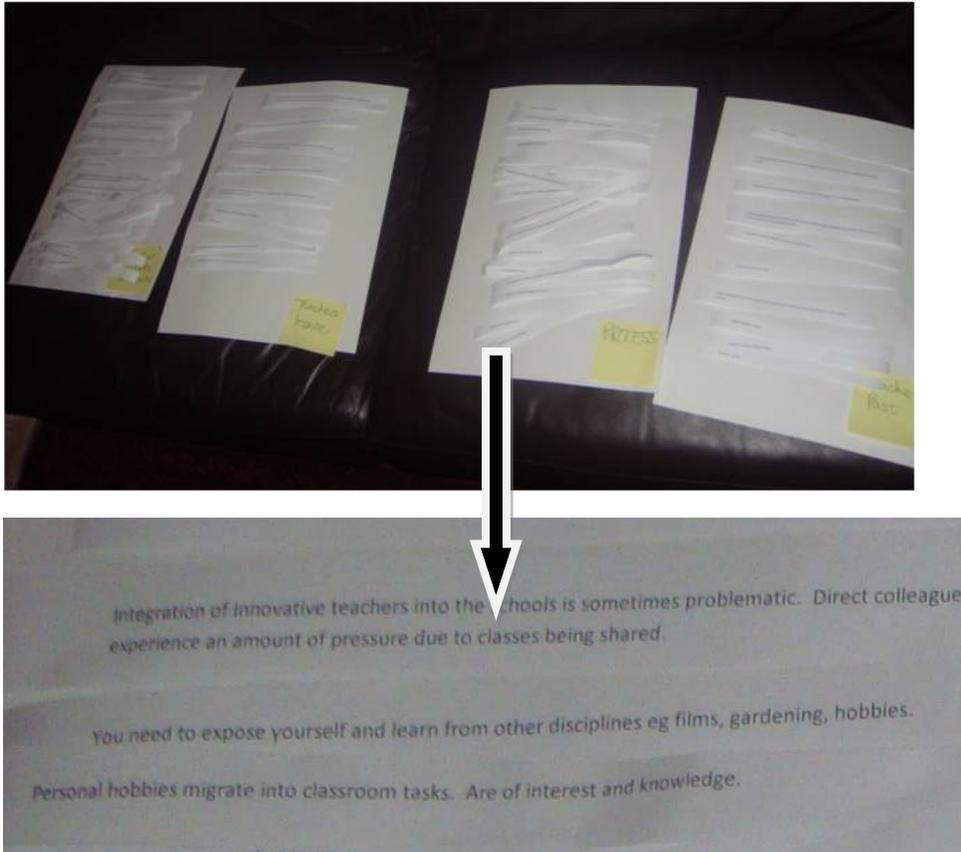


Figure 7-6: Ordered codes

Working with computer-aided qualitative data-analysis software (CAQDAS) has definite advantages as articulated earlier (*cf.* Section 3.4.1) but at the same time it can be very time consuming as technical aspects crop up time and again. Managing and overcoming these obstacles became more of a limitation and a barrier than an enabler and I had to decide whether to continue with ATLAS.ti after the initial coding, memoing and identifying of relevant quotes to use. The greatest difficulty I encountered was organising the codes into categories as the family manager does not remove a code from the list once it has been used. I found this to be very confusing as I had to wade through the same codes each time to formulate a new category. In the end my strategy was to export all codes to an excel document. In order to get a clear idea of where they belonged, I first sorted the codes into groups before turning to the family manager within ATLAS.ti.

7.5 JUDGING THE CREDIBILITY OF STUDY

The criteria used for judging the soundness of research depends on whether a *quantitative* or *qualitative* approach was followed. Researchers hold differing perspectives, supporting either the one or the other approach. In considering research, qualitative researchers reject the framework of validity commonly accepted in more quantitative studies in the social sciences. They reject the basic realist assumption that there is a reality external to our perception of it. It therefore appears to be illogical to judge the worth of qualitative data by considering whether an observation is true or false based on an external reality. Trochim (2001, p. 162) proclaims the need to consider the underlying assumptions involved in much of qualitative research and in Table 7-1 below proposes alternative criteria to evaluate qualitative research.

Table 7-1: Criteria for judging research quality from a more qualitative perspective (Trochim, 2001, p. 162)

Traditional criteria for judging quantitative research	Alternative criteria for judging qualitative research
Internal Validity	Credibility
External Validity	Transferability
Reliability	Dependability
Objectivity	Confirmability

As demonstrated above, the concepts of credibility, transferability, dependability and confirmability are more suited to establish quality in research. Each of these criteria, and how it was applied in this research, is discussed in the following section.

7.5.1 Credibility

The *credibility criteria* involve establishing that the results of qualitative research are credible or believable from the perspective of the participant in the research. The participants are the only ones who can legitimately judge the credibility of results because the purpose of qualitative research is to describe or understand the phenomenon of interest from their viewpoint. In this research the actual words and documents of the participants were used to illustrate and substantiate claims and interpretations made by the researcher. During subsequent theoretical

sampling episodes, participants were granted additional opportunities to review some of the interpretations and conceptualisations of the researcher and correct any misinterpretations or elaborate even further on identified issues.

It is essential to deal with issues of rigour when conducting Grounded Theory research in order to increase the credibility of the study. Given the variations in Grounded Theory methods, how the theory is applied across differing contexts, the level of subjectivity attached to it and the manner in which qualitative research is carried out as these are important in articulating the processes of how a substantive theory about a phenomenon is generated. Charmaz (*cf.* Section 3.2.4) proposed a set of common criteria when doing Grounded Theory research to increase the trustworthiness of the process and resultant findings. The decisions and actions taken in this research were matched to these criteria and presented in Table 3-2 on page 85.

7.5.2 Transferability

Transferability refers to the degree to which the results of qualitative research can be generalized or transferred to other contexts or settings. Transferability can be significantly enhanced by providing a thick description of the research context and assumptions central to the research. *Thick descriptions* have their roots in ethnography where it was important to describe a phenomenon sufficiently by explicitly stating the underlying cultural and social relationships enabling the research findings to be transferred to other times, situations, settings and people (Holloway, 1997; Lincoln & Guba, 1985). In this study the researcher made the contextual background to the projects considered for inclusion available and provided the actual words of the participants in quotes and documents. Even though the research participants were drawn from an annual competition, additional theoretical sampling explored notions beyond the scope of the competition and therefore the results will be transferable to contexts within the Pan-African region.

7.5.3 Dependability

In quantitative research reliability is determined by the ability to replicate the study and obtain the same or similar results. *Dependability* of qualitative research is a complex issue because of the inability to observe the same thing twice as each event is singularly unique because of ever-

changing contexts (Hammersley, 1990). It is problematic to control peoples' behaviour in natural settings and the research focus can be on many different aspects within the same setting. These settings are not stagnant and the researcher needs to account for these fluctuations and reflect on how these can affect the research approach (Cohen & Crabtree, 2006). This research was conducted over a period of 4 years, allowing ample opportunity to seek confirmation and clarification on developing concepts. Because of the rapid technological advancements in the environment of the participants, the research emphasis was on the tacit knowledge development of innovative teachers and less on the technology itself.

7.5.4 Confirmability

Confirmability refers to the degree in which the results can be confirmed or corroborated by others (Trochim, 2001). In quantitative research the criteria is described as the objectivity of the research. In qualitative research the researcher brings a unique perspective and an inherent subjectivity to the research. Techniques for establishing confirmability in qualitative research are to make use of access to a clear audit trail, triangulation and reflexivity. Using a single data set can never adequately shed light on a phenomenon and may jeopardize the credibility of the researcher and that of the study undertaken. In this research triangulation involved the use of multiple data sets in an attempt to validate the findings resulting in robust accounts rich in detail which generated a deeper understanding (*cf.* Table 3-4). The researcher documented a clear set of procedures for gathering, checking and rechecking data throughout the study (*cf.* Table 3-8).

One tool which is available to increase the trustworthiness of research is to conduct bracketing interviews prior to initiating interviews. These bracketing interviews allow the researcher the opportunity to be interviewed about the topic of study enabling him/her to be more fully open to the research encounter (Finlay, 2008; Leong & Austin, 2006). Bracketing interviews can be described as *reversing the researcher role* by asking another researcher to use the same set of question designed for use in the study and to administer it to you as the principal researcher. This interview is then transcribed and can be used later as the study progresses through data collection and interpretation. An interpretive research group can be used to analyse the bracketing interview to aid trustworthiness (DeMarrais, 2004). In reference to this study, a fellow PHD candidate familiar with the study was approached to fulfil the role of conducting the

interview and collaborated with the researcher to code it. The bracketing interview is a powerful tool and can aid the researcher to identify assumptions and interpretations to the extent that their own beliefs might interfere with the interpretations. The bracketing interview was also included in the dataset and, along with related literature, it was considered for analysis and interpretation.

The trustworthiness of the research was further enhanced by cross-checking different versions of events as reflected in the text, visual evidence and post-interview data. In order to increase the validity of the study, the following will be taken into consideration:

- Existing meta-data including competition entries, post competition radio interviews, media publications and competition blogs.
- Personal diaries and memos of reflection.
- Being a fellow entrant gave me unparalleled access to peer presentations. This allowed for first hand exposure to the entrant's thought processes at the time of presentation. Because of time constraints, the entrants distil the essence of their entry to a few short minutes. It therefore gives a glimpse as to what they perceive the essential contribution made by their project was.

This section considered criteria for judging the trustworthiness of qualitative research and considered aspects such as credibility, transferability, dependability and confirmability. Decisions made and actions taken during the research as well as the prolonged engagement was offered as evidence towards the trustworthiness of the research.

7.6 WRITING SEQUENCE OF THE STUDY

The non-verbalised but generally accepted form is to write Chapter 1 last, however in this study it was written partly in the beginning of the study revisited towards the middle and tidied up at the end. Much confusion reigned over the inclusion of a literature review as it is a debate highly contested in a Grounded Theory study. The section covering the research process forms the backbone of this study and gave it direction along with the research design. Initially it was captured in a chapter of its own before being integrated in Chapter 1. At this point I was beginning to feel very insecure as the complexities of doing Grounded Theory became more

apparent with noted discord amongst members of the research community (Borgatti, 2008; Fernandez, 2004; Luckerhoff & Guillemette, 2011; Onions, 2006). The data collection is not predetermined and is driven by the emerging theory, therefore the writing up of the thesis does not conform to the traditional format and this resulted in some confusion for the researcher. The writing up of the research findings did not follow at the end of data analysis but is interwoven as a continuum to develop the substantive theory. The chapters were therefore not written in a sequential way.

7.7 PERSONAL REFLECTION: COMMENTS ON THE PRAGMATIC SIDE OF THIS RESEARCH

My PHD research journey started in mid 2007 soon after completing my master's degree at the University of Pretoria (UP) under the guidance of Prof Johannes Cronje. My dissertation covered my participation in the MobileED (2006-2008) project aimed at designing formal and informal teaching and learning environments that are meaningfully enhanced with mobile technologies and services (Batchelor, 2007). MobileED is an open-source and open content initiative that creates the ability for all to access and, more importantly, contribute their knowledge to shared online information repositories. MobileED partners included the Meraka Institute of the South African Centre for Science in Research (CSIR), Cornwall Hill College, South African Department of Trade and Industry, Nokia and the Media Lab: University of Art and Design Helsinki, Finland. I presented my findings at the 2006MLearn Conference in Banff, Canada (Batchelor, 2006). This was my first entry into the world of academic conferencing and it provided a platform to not only showcase the work we were doing in South Africa, but to also interact with the experts in mobile learning. At the conference I was introduced to John Traxler, a renowned specialist in the field of mobile learning with an interest in developing contexts having worked on projects in the African continent. He was invited to visit South Africa to lead a workshop at UP, arranged by Prof Johannes Cronje, which was well attended. About four months after I started my PHD my supervisor and mentor, Prof Johannes Cronje, was offered the position of Dean of the Faculty of Informatics and Design at the Cape Peninsula University of Technology (CPUT). I found myself in the unenviable position of having to find another supervisor in order to proceed with my study. It was extremely difficult to find someone in the Faculty of Education willing to take on another student because of departmental restructuring,

increased workload as well as the lack of competencies in the area of mobile learning. I went through a limbo period in which I proceeded, without supervision, to look at new areas of mobile learning in developing contexts and worked on my own projects exploring design criteria for multimedia learning artefacts as articulated by learners working on dissection class projects (Batchelor & Botha, 2009a). It was during this time that my interest in teacher innovations with mobile technologies was triggered. I started to read publications focused on teacher interests and pedagogies around educational technologies and found a void in the research which I wanted to explore further. In March 2008 Prof William Fraser from University of Pretoria's stepped in with the understanding that he would guide me through the process of crafting the proposal and defending it at departmental level which took place in August 2008. Subsequently we started searching for a supervisor and co-supervisor that could assist as subject matter experts. We first approached Prof John Traxler from the University of Wolverhampton UK because of his expertise in mobile learning and affinity to and knowledge of the African continent and its researchers. Prof Traxler agreed to act as co-supervisor. It was, however, more challenging to find a local supervisor but midway through 2009 Prof. Marlien Herselman from the Meraka Institute, CSIR was appointed as supervisor. She is a highly competent researcher and was awarded the accolade of the South African Scientist of the Year in 2010.

The first step in the research process was to seek ethical approval for this study from the Faculty of Education Research Ethics Committee at the University of Pretoria. Because I was interested in researching the innovative teaching and learning practices of the participants to the annual Microsoft Innovative Teachers Awards, I approached Microsoft South Africa for their consent to use the multimedia entries for the competition as well as gaining access to interview the participating teachers. During the ten months I waited for the *letter of consent* from Microsoft Head Office in Atlanta USA (*cf.* Appendix B), I spent the time familiarising myself with the nuances of Grounded Theory. I also acquired the software package ATLAS.ti and started to familiarise myself with its functionalities making use of the tutorial provided online. I furthermore worked on the logistical issues of data gathering, handling and storing. As soon as the ethical process at the University of Pretoria was completed (*cf.* Appendix A), I commenced with the analysis of the first Virtual Classroom Tours.

7.8 LIMITATIONS AND RESTRICTIONS OF THE STUDY

Educational research is bound within a specific environment which comprises the learners, teachers and structures of management. Gaining access to schools across South Africa on a national level proved to be a prolonged and ultimately futile exercise and therefore this study focused mainly on the experiences of innovative teachers as captured and related through their entries in the Microsoft Innovative Teachers Award. A reservation regarding this research study was that the original dataset was generated through an annual competition. Although a large portion of the initial data set was coded, analysed and interpreted, theoretical sampling was used to fill in the gaps that still existed in the data with literature proving to be a rich additional data source. At no time were any learners or the management of schools approached for their input. Findings rest on the provided documentation of recorded events, the perceptions of the innovative teachers and the interpretation of the researcher. Transferring findings, which are rooted within the context of the Pan-African Microsoft Innovative Teachers Forum Awards competition, will be difficult to achieve but can be viewed as the starting point for further investigations.

In addition to the environmental restrictions of context and circumstance as given above, this research posed methodological limitations. The initial formulation of the research questions was found to be inadequate in addressing the research problem sufficiently and changed with the construction of the research framework as articulated in Chapter 2. The deepening of the researcher's engagement with the data finally resulted in reformulating the main and sub-research questions.

A limitation of a methodological nature was to conduct Grounded Theory Method research without a mentor. This *minus-mentoring* state, a term coined by Phyllis Stern, refers to a situation where researchers find themselves "doing grounded theory in a context where there is no one available to train them how to do it" (Glaser, 1998, p. 5). My own understanding of the use of this method grew as the study progressed. Initially I was bogged down in coding without conceptualising the data. I gained some comfort from the prescriptive guidelines proposed by Strauss and Corbin (1998) and managed to progress to the end of the study which culminated in

a substantive theory of innovative teachers' pedagogical efficacy in their use of emerging technologies.

7.9 POSSIBLE FUTURE RESEARCH

The following areas can be considered for future research:

- Due to the exploratory nature of this research and the contextual limitations associated with this work, future studies may seek to explore the extent to which the components of the substantive theory transfer to contexts outside the Microsoft Innovative Teachers Forum Awards and the African continent.
- Whilst a substantive theory is proposed in this research, additional investigation of the components of this model may aid researchers in designing new studies in proposing and testing hypothesis. Thus, one contribution is the provision of a conceptual framework for testing variables and reflexive processes under more controlled conditions.
- Another possible direction that will extend the findings is research that seeks to explore how individual teachers, at the subject area level within a particular school environment, can further organisational change through their use of emerging technologies in their practice. By looking closely at individual teachers' naturalistic and situated work practices, researchers should be able to capture how their practice can bring forth collective behavioural patterns within an organisation.
- The proposed substantive theory can also be broken down into separate nodes or components which can then be studied more in-depth.
- Future studies can determine the various patterns by which the components of substantive theory shift and stabilise over time.
- It remains important to continue research in the use of *emerging technology* as well as the *traditional use of ICT* in the education environment as this furthers our understanding of how to translate and transfer skills from the emerging to the traditional in a more sustained way.

7.10 CONCLUDING REMARKS

This research provided a substantive theory of the way in which innovative teachers' tacit knowledge manifests when they engage with emerging technologies to achieve pedagogical efficacy in a developing context.

In the epigraph of this chapter, Durkheim illuminates the

“discord that underpins the teaching encounter - a *doing* versus *thinking* conundrum. The key is for teachers to begin to see themselves as active participants in shaping how teaching and learning are conceived, to build upon their knowledge about being a part of society, and to generate new theories and practices (praxis) that can help transform and advance human nature” (Jaramillo, 2010, p. 38).



Charcoal drawing on cardboard: Diek Grobler 2006

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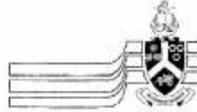
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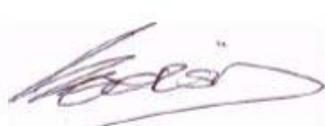
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Appendix A – Ethical Clearance Certificate



UNIVERSITY OF PRETORIA
 FACULTY OF EDUCATION
 RESEARCH ETHICS COMMITTEE

CLEARANCE CERTIFICATE	CLEARANCE NUMBER :	EM10/09/02
<u>DEGREE AND PROJECT</u>	PhD Innovative Teachers' Pedagogical Efficacy in their use of emerging technologies	
<u>INVESTIGATOR(S)</u>	Jacqueline Batchelor	
<u>DEPARTMENT</u>	Science, Mathematics and Technology Education	
<u>DATE CONSIDERED</u>	9 September 2011	
<u>DECISION OF THE COMMITTEE</u>	APPROVED	
<p>Please note: <i>For Masters applications, ethical clearance is valid for 2 years</i> <i>For PhD applications, ethical clearance is valid for 3 years.</i></p>		
CHAIRPERSON OF ETHICS COMMITTEE	Prof L Ebersohn	
DATE	9 September 2011	
CC	Jeannie Beukes Prof. M Nkomo	

This ethical clearance certificate is issued subject to the following conditions:

1. A signed personal declaration of responsibility
2. If the research question changes significantly so as to alter the nature of the study, a new application for ethical clearance must be submitted
3. It remains the students' responsibility to ensure that all the necessary forms for informed consent are kept for future queries.

Please quote the clearance number in all enquiries.

Appendix B – Letter of permission from Microsoft South Africa



Microsoft (S.A) (Pty) Ltd
3012 William Nicol Drive
Bryanston, Johannesburg 2191

PO Box 5817
Rivonia 2128
Johannesburg
Republic of South Africa

Tel: 0860 2255 67
International: +27 (0) 11 361-7000
Fax: +27 (0) 11361-7004
Reg. No. 1992/000839/07

www.microsoft.com/southafrica

9 June 2010

Dear Jacqueline Batchelor

PERMISSION TO CONDUCT RESEARCH TOWARDS A PHD (COMPUTER INTEGRATED EDUCATION)

I hereby grant permission for Jacqueline Batchelor, Student number: 82331792, to conduct research pertaining to past and current entries to the *Microsoft Innovative Teaching Forum Award* competition. Access is approved for materials available in the open domain as requested as well as recorded interviews and digital images of posters, notes, leaflets, and multimedia material presented and collected by various parties during the events.

The request regarding access to the participants as well as parties involved in the competition is approved within the ethical constraints as determined by the code of conduct binding educational researchers from the University of Pretoria.

Topic of Research: ***Emerging Educational Practice: A grounded theory study in innovative teachers' practices and pedagogical reasoning in teaching and learning with technologies***

Degree: ***PHD (Computer Integrated Education)***

Name of Institution: ***University of Pretoria***

Upon completion of the research project the researcher is obliged to furnish Microsoft Partners in Learning team with an electronic copy of the final research report.

Wishing you success in your academic pursuit.

Kind regards

Mteto Nyati

Managing Director

Directors: Mteto Nyati (Managing) Safeya Mahomed (Finance) Keith R. Dolliver (U.S.A) Benjamin O. Orndorff (U.S.A)

Appendix C - Interview questions

Questions to teachers during formal video taped interviews at the World Wide Innovative Teachers Forum Award in Hong Kong 2008

1. *What were the main challenges you were facing in your job before you introduced this project?*
2. *How did the technology support /help you to be more effective and what were the problems you had that were solved?*
3. *Name at least three advantages that this project brought to your job and to your students? (focus on the results)*
4. *Explain briefly why you consider this project as a major improvement in the learning process and explain the way you see the role of this project in future.*
5. *How do you see the effects of the changes you made on your students and on you as a teacher?*

Question during informal interviews

1. Why do you perceive yourself as an innovative teacher?
2. Describe your local community. How involved are they in the school/
3. What are the primary markers/traits of an innovative teacher?
4. Tell me your story about becoming a teacher.
5. What is your understanding of the innovation process?
6. What have you been doing in your practice that you consider to be innovative?
7. What are the greater influences in your teaching career?
8. How long do you still want to be a teacher for?
9. What other interests do you have outside of teaching?

10. What has been a memorable moment in your teaching?
11. Why do you see yourself as an innovative teacher?
12. How did you become an innovative teacher?
13. What is your perception of innovative teaching? Give a concrete example.
14. How do you create an environment to grow and develop skills in other teachers?

Appendix D – Example of the information contained in a VCT

SAVUKA! – Waking up – doing things for yourself

Background to the Project

School

Ikanyegeng is a combined school (Grade 1 -12). The school is situated in the township of Ratanang in Jacobsdal. Jacobsdal forms part of the municipality of Letsemeng in the Xhariep district of the Free State. (Only 15 km from the Northern Cape boarder)

The greater part of the almost 800 learners attending the school, comes from a low socio-economic background. Most learners are living with their grandparents; while there parents are working elsewhere.

Less than 1% of the learners have access to computers at home.

All of the 23 educators teaching at Ikanyegeng have received some form of computer training; they have varying computer competency skills. Only 6 educators own their own computers.

The teachers

Vanita Coetzee: I hold a BSc (Honn) and a Higher Education Diploma(*cum laude*) from the University of the Free State.

For the past 12 years I have been teaching in various phases in different schools. For the last 4 year I have been teaching, Mathematics, Life Science and Physical Science, Grade 10-12 at Ikanyegeng Combined School.

I received training to be a facilitator for the RADS peer support group and was also trained by the Education Department to be a lay councilor for the children in need at our school. I had to learn how to bead and do other art and craft projects. I received training in ICT as part of the eLapa project, for which Ikanyegeng was a pilot school and was very fortunate to attend the BETT exhibition in London in 1995.

Me Rapulane and Me Delpont respectively teaching Business Economics and Arts & Culture has of great support in transferring special skills to the learners.

Project goals

The main goal of the project was: **To become healthy, positive, enthusiastic and excellent South African citizens**

Other goals of the project were to:

Teach learners entrepreneurial skills so that they will be able to start a small business when they leave school.

To teach learners to manage themselves and their time effectively.

To teach learners that they can agents of change in educating the community about HIV/AIDS, drug and alcohol abuse.

To get learners involved in community projects.

To teach learners that they have a responsibility towards the environment and can create something useful from recycled or waste material.

The planning and origin of the project

The RADS group was invited by Free State Department of Education, Xhariep District, Department Special needs, and AURORA to become involved in a project FIGHT FOR LIFE.

Learners had to hand in a business plan explaining what kind of business they would venture into and how they would involve others learners as well as the community to prevent drug and alcohol abuse. The business envisaged was an Art and Craft business. At a special event the group was rewarded R500.00 worth of material to set up their business as their business plan was one of the top 5 business plans received And so “**SAVUKA!**” – Waking up. Doing things for yourself, was born.

Learners had to learn new Art and Craft skills, they had to learn how to manage a business and how to communicate their message to the community at large.

AURORA would see the business as successful if it could be sustained for 6 months.

The curriculum context of the project

The project mainly addresses Life Orientation as a learning area, but has strong links to all other learning areas.

The ICT context

ICT was not part of the project initially but was incorporated, when the need arose to manage and advertise the business better.

At first learners did the business plan by hand but soon realized that it was much easier to effect changes to it when they were using a computer. They then started to use Microsoft Word. Most learners had no previous experience of using a computer. A market had to be found and a selling price was to be established for each completed object. Learners was encouraged to make use of **Microsoft Excell** to capture the price of every small bead or other material that was used in producing their craft pieces. As one of the five finalists of the FIGHT for LIFE project learners had to hand in a portfolio to present to the adjudicators. Suddenly they realized that they had to provide evidence of all work produced. I taught them how to use the schools digital camera and how to download their pictures to the computer, soon they where happily snapping away. They also started to record the minutes of meetings and their attendance register electronically.

As part of the final adjudication at a gala event held at Kopano Nokeng learners were required to make a display of their work as well as a presentation in the form of their choice. The learners,

by now, really fascinated by the computers and technology decided to make their presentation in the form of a **Power Point** presentation and to round it off by singing part of the school song.

To me it was really exciting to see the learners play around with different backgrounds, effects on photos and transitions.

But the ultimate thrill came when an official of the Department of Education wanted to download this presentation from a memory stick and found that the presentation it was password protected!! I was totally astounded. I never taught them how to do it; they discovered it totally on their own!

For this event learners used **Microsoft PowerPoint** to create ID cards with their names, photos and the logo of the school. They printed and laminated the ID cards and are still proudly wearing them with their HIV/AIDS pins.

Xhariep educational district requested us to write a report on how we experienced the gala event and how we intended to extend to project. I decided to start a **blog** (www.icssavuka.blogspot.com) where learners could voice their opinions and be able to read how others experienced the project. This posed to be a great challenge as the school's internet lines was down for the last 10 months. Where there is will, there is a way!

Learners are now using my personal laptop to get access to the internet and blog!

Learners realized that they needed to advertise their products better. So we approached Mr. Thato Mokoena at the Xhariep Educational Resource Centre to assist us in setting up a **website** for the SAVUKA project, what a thrill to be able to upload your own website that you are in charge of on the internet!

Learners also created pamphlets on **Microsoft Publisher** to promote the project under other learners in hope that the number of learners involved in the project will grow.

The project management

I am facilitating the project and teaching learners the skills that they need to have to manage themselves, their business, and the communication to the broader community.

The group meets on a weekly basis, but also take some work home, as they are really dedicated to the project.

Unfortunately the school does not even have enough classrooms for normal teaching activities and therefore could not allocate a specific venue to us. We made use of the staffroom, the hall, the science laboratories, the library, the computer room, and any other available class we could find.

Learners are in charge of the project but often use the skills and input from educators and members of the community.

APPENDIX E – EXAMPLES OF TRANSCRIBED STRUCTURED VIDEO INTERVIEWS

Andrew Douch

Anywhere Anytime Biology Class

Scripted video

(Narrator) Embracing emerging technologies that student's find engaging has extended the classroom beyond physical walls and limitations of a time table, making it accessible to students anywhere anytime.

(Text)I am a true student. I am enrolled in life... I don't just learn because of the assessment ahead of me. I learn because I love learning. So when the assessment is over, I still see myself as a student. In Biology I learned more than proteins and DNA(which were really cool) I learned what it means to be engaged with the educated people who love learning – and there's NO reason why that should be over just because I have completed an exam. Assessment measures learning, it is the reason for it. I want to keep learning biology... I therefore still consider myself a biology student.. so don't say I'm not.

(Andrew)The tools that I am using such as mobile phones or cell phones, Mp3 Players or MSN. These technologies are things that students use anyway. They already have them they already enjoy them. You don't have to work very hard to encourage students to use them. I can imagine

a kid sitting at home and he has got facebook open here or MySpace, or MSN and they are having a conversation about the weekend with some friends and then over here we have the biology discussion board and they are answering questions about biology and it fits in with student's lifestyle. That must be the most significant thing. We are not introducing new tools we are not trying to implementing new things. We are using technology the students already have and already enjoy. We are just giving a valid educational context for those tools to be used. And that makes them very successful.

As a result of this new way of learning we have seen quite a significant increase in student performance on external exams. The other thing that is important is just student engagement. Over the past few years when we have used podcasts and discussion boards, MSN and so on, there has been a significant leap in student engagement. I am seeing students with a passion for learning that in the previous 16 years I haven't seen.

Uncut version

What were the main challenges you were facing in your job before you introduced this project? How did the technology support /help you to be more effective and what were the problems you had that were solved?

I guess I have always tried to help students learn as well as possible. The biggest challenges that I have faced is that firstly the curriculum is so crowded and it is quite difficult to get through the course in time and you have to cover everything but you do it fairly shallow just to get through things. The second thing we were looking at is that students are very busy. Because we cannot do everything in class time we are expecting them to do these things at home for homework. A lot of the time they just don't have time to do everything that is required of them. So that was again another threshold challenge. What we are really doing is letting them take content, take studies out of those too difficult times, the crowded class time and the crowded home time and into their commute time.

Name at least three advantages that this project brought to your job and to your students? (focus on the results)

Firstly it can be the student learning, the student performing on an external exam and we have always done well, we have always worked hard but As a result of this new way of learning we have seen quite a significant increase in student performance on external exams. We have seen them perform up to a 12% better than predicted. Every student in the class performed higher than what was expected. Because they are external results it makes them very reliable. It would indicate that our learners are achieving better as a result of learning in this new way.

The other thing that is important is just student engagement. Over the past few years when we have been teaching using podcasts and discussion boards, MSN and so on, there has been a significant leap in student engagement. I am seeing students with a passion for learning that in the previous 16 years I just haven't seen. There are always student who are keen and enjoy school but the level of enthusiasm for learning is something that I have not really expected to see and that has been really exciting. So whether they are performing better because they are more engaged or they are more engaged because they are learning better it is very hard to tell. In fact it is a bit of both they are probably learning better because they are performing better and they are performing better they are more engaged as well. are learning better . It is very difficult but I think both of those things are true. They are learning better and they are enjoying it more.

A lot of the things we are doing in education is because a teacher thinks it is a good idea. We will implement those things to encourage students to go down that path and that is sometimes hard work.I guess the the tools that I am using such as mobile phones or cell phones, Mp3 Players or MSN. These technologies are things that students use anyway. They already have them they already enjoy them. You don't have to work very hard to encourage students to use them. I can imagine a kid sitting at home and he has got facebook open here or MySpace, or MSN and they are having a conversation about the weekend with some friends and then over here we have the biology discussion board and they are answering questions about biology and it fits in with student's lifestyle. That must be the most significant thing. We are not introducing new tools we are not trying to implementing new things. We are using technology the students already have and already enjoy. We are just giving a valid educational context for those tools to be used. And that makes them very successful.

Angela Shrearer – Microsoft South Africa

How do you see the influence that new technologies have on changes made in schools around the globe?

I think we need to remember that we live in a world where technology is the way we communicate, the way we collaborate in the workplace that it is something we do every day and we need to support these learners that will be working in this world of technology and collaboration. We need to actually be able to support those learners so that they are prepared for this environment. Part of that is not really about the technology it is more about the learning experience that is created in a school and technology is merely used to support this learning process and project based learning working in groups.

How do you see the role of Microsoft in the process of innovating education?

I think that everybody that I have met in Microsoft that works in education is passionate about it and that is probably one of the most important things. Microsoft through this passion and energy is building an infrastructure and resources that is valuable for teachers.

Do you think that this is a good way of promoting new technologies and their role in the education system?

Definitely teachers have commented on the phenomenal experience and the opportunity to talk to teachers from around the world. They have spoken about that in many countries the challenges are very similar and to learn how other teachers around the world are dealing with this has been a rewarding experience for them.