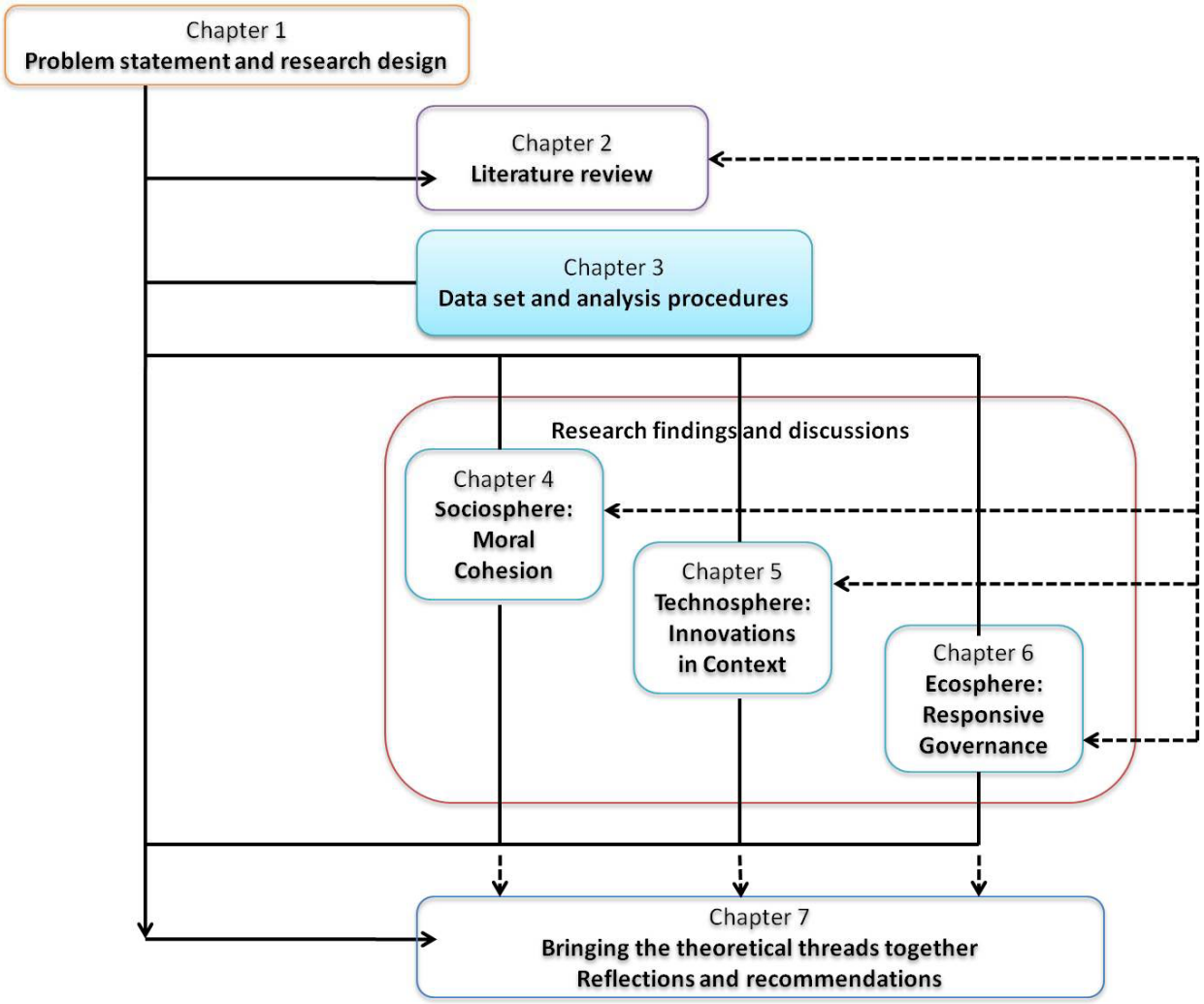
Chapter 1
Problem statement and research design
Chapter 2
Literature review
Chapter 3
Data set and analysis procedures
Research findings and discussions
Chapter 4
Sociosphere:
Moral
Cohesion
Chapter 5
Technosphere:
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Ecosphere:
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Governance
Chapter 7
Bringing the theoretical threads together
Reflections and recommendations

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 though 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 though 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	*Primary observations* are those in which you would note what happened or what was said at the time.	*Secondary observations* 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).	*Experiential data 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 (*cf*. 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). (*cf*. Table 1-1 in Section 1.6.7) and (*cf*. Section 3.7)
Posters and Leaflets (*cf*. 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 (*cf*. Section 3.6.3)	RQ2	34	Instructional content videos created for mobile phone use.	Experiential and secondary data	
Formal structured interviews (*cf*. Section 3.6.4.1)	RQ2, RQ3	WWITFA 2008: 22 ITFA SA: 17	Videotaped interviews with transcriptions.	Primary data	
Unstructured interviews (*cf*. Section 3.6.4.2)	RQ1, RQ2, RQ3	8	Digital recording with transcriptions.	Primary data	
Impromptu Informal conversational pieces (*cf*. 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 (*cf*. 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.

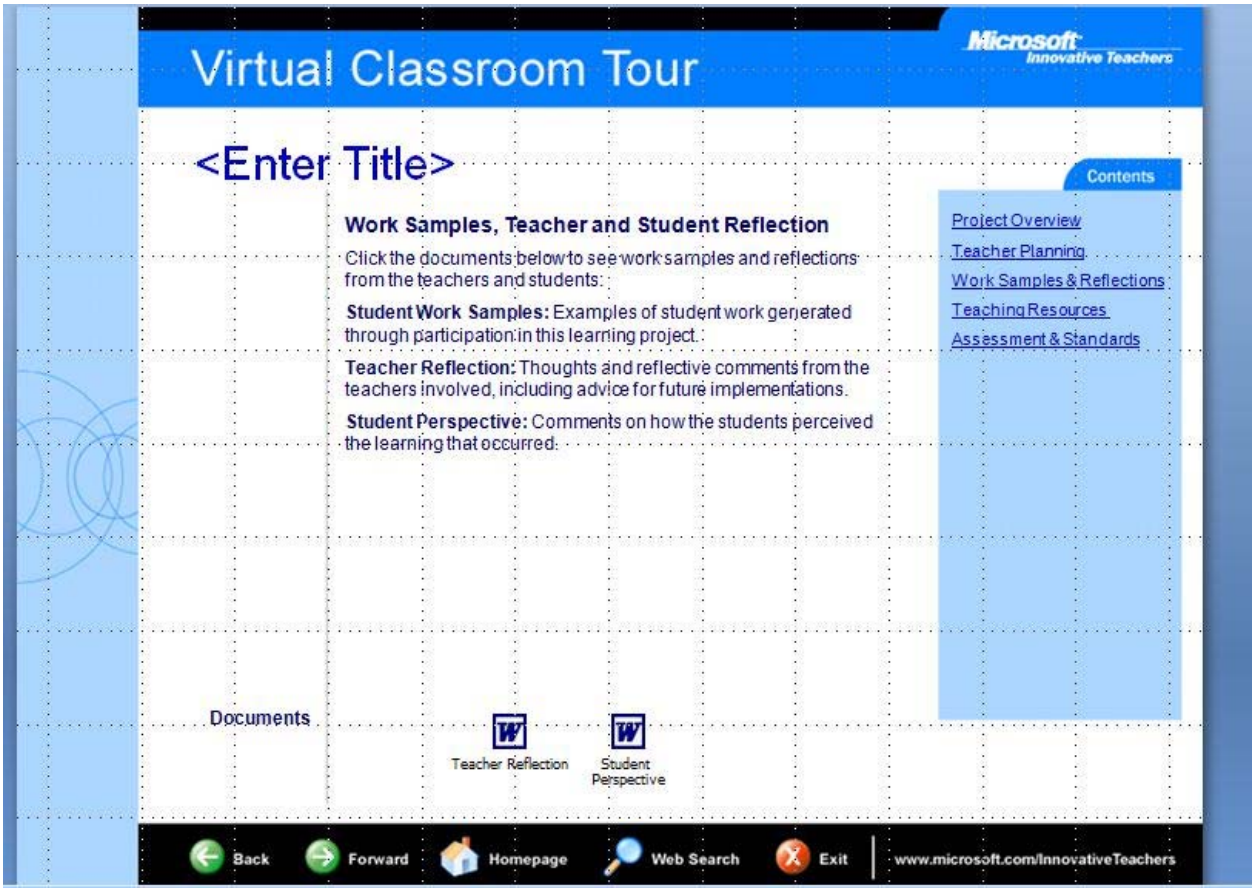


Figure 3-1: An example page of a Virtual Classroom Tour

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, Sarietjie 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.

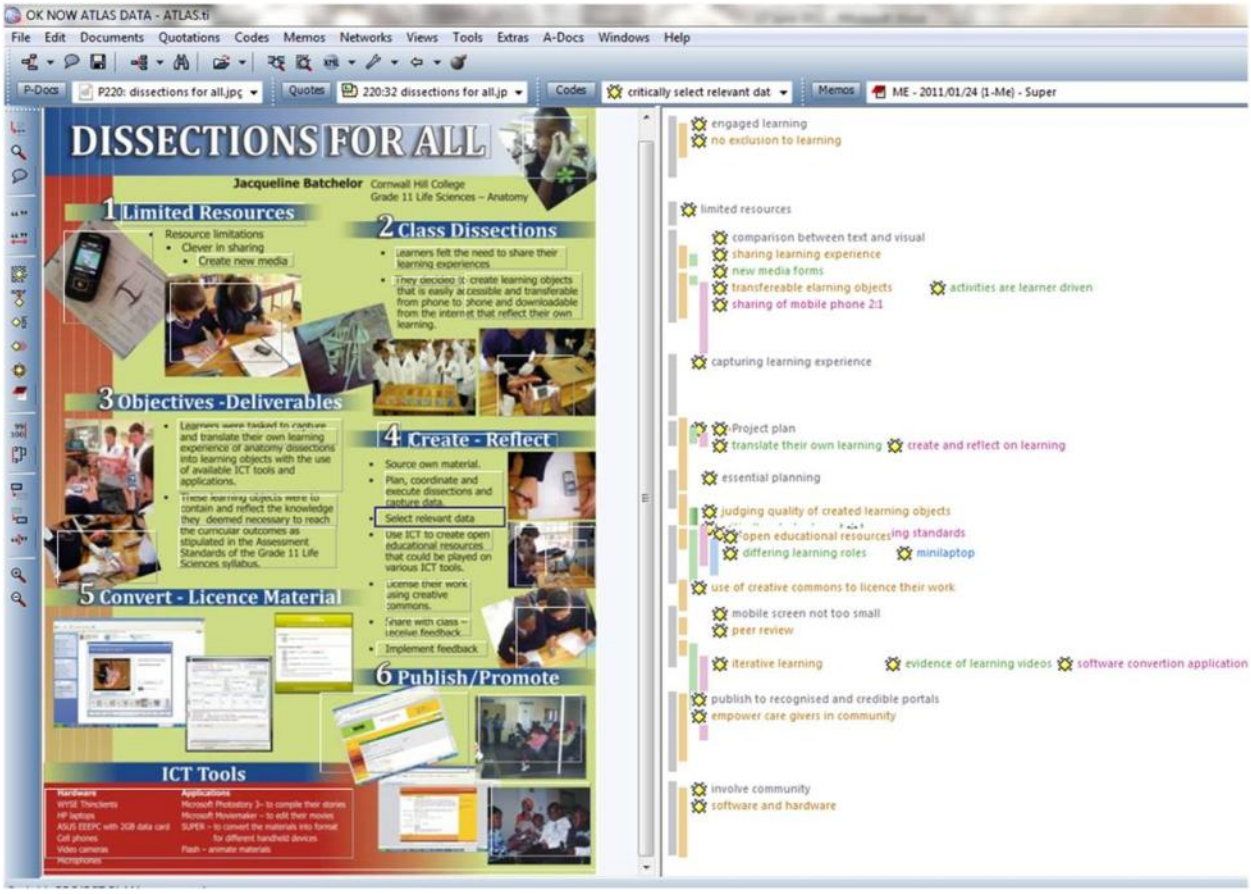


Figure 3-3: Poster entry from 2008 displaying codes

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.

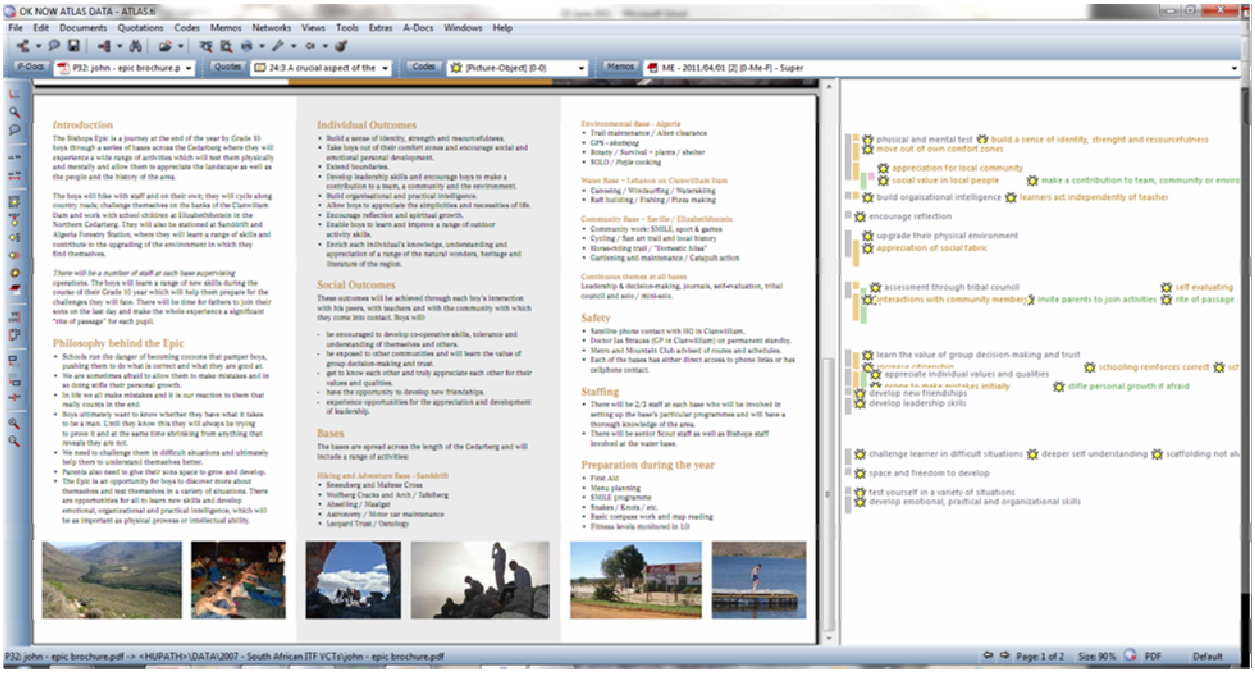


Figure 3-4: Pamphlet used as supporting material to an ITFA entry with relevant codes

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 3-4on 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.

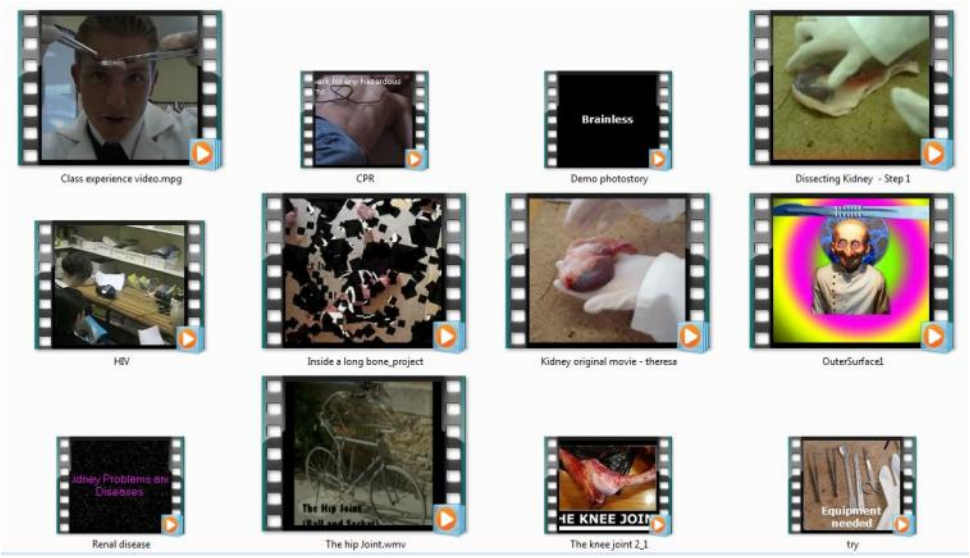


Figure 3-5: Multimedia curriculum aligned artefacts for mobile use

3.6.4 Interviews

As indicated in Table 3-4on 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, 2008Table 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 Skype™. The advantage of using Skype™ 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 Skype™ 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 Skype™ 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.

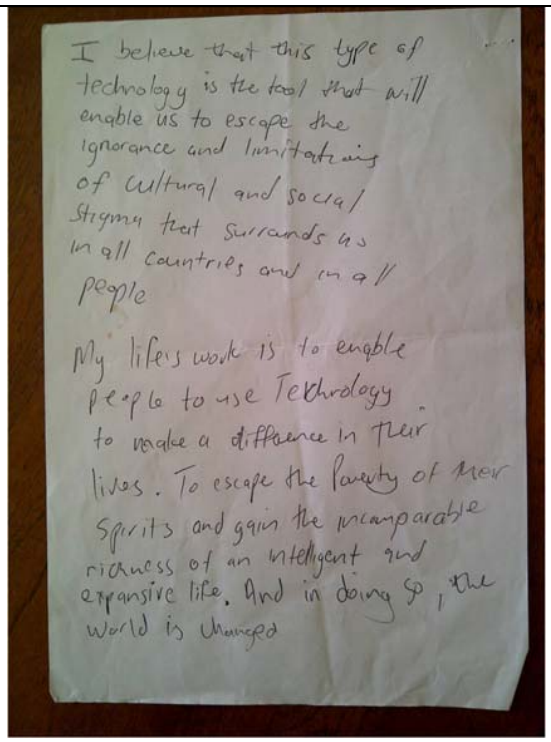
3.6.7 Impromptu informal conversational pieces

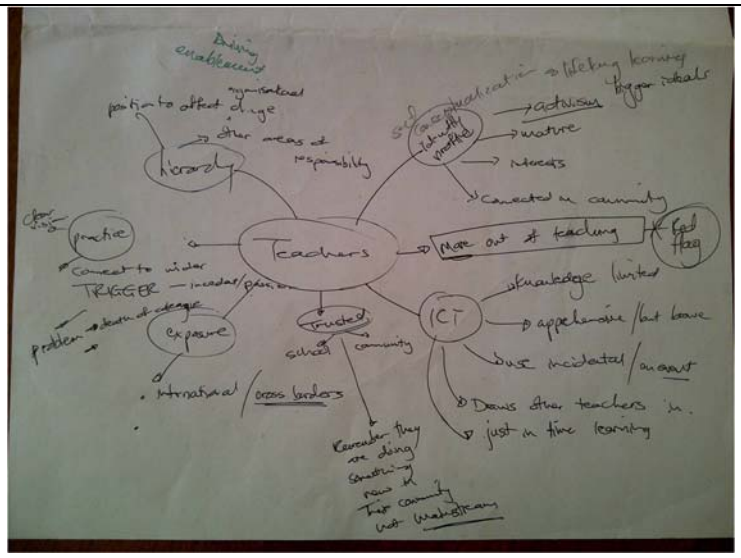
The informal conversation pieces are relaxed in nature and the conversations develop naturally. In this study a series of encounters during the course of the two day competition was used as a source of information. These encounters are generally short in duration and follow a pointed and direct line 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.

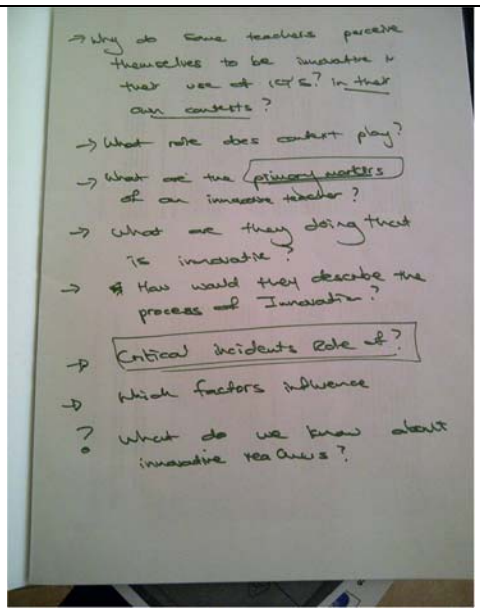
3.6.8 Innovative teacher workshops

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.

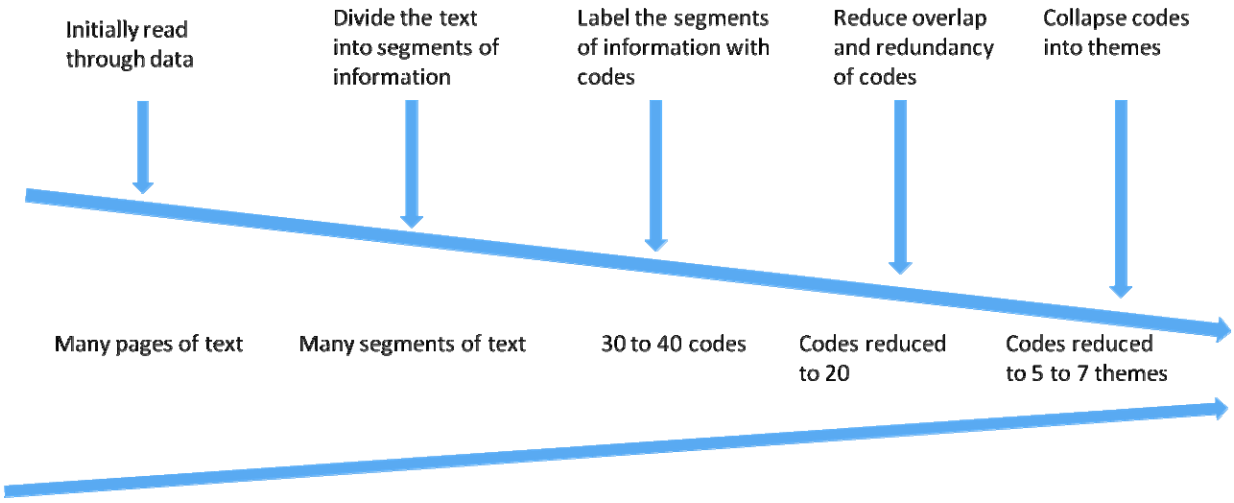


Figure 3-6: A visual model of the coding process in qualitative research (Creswell, 2005, p. 238)

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.

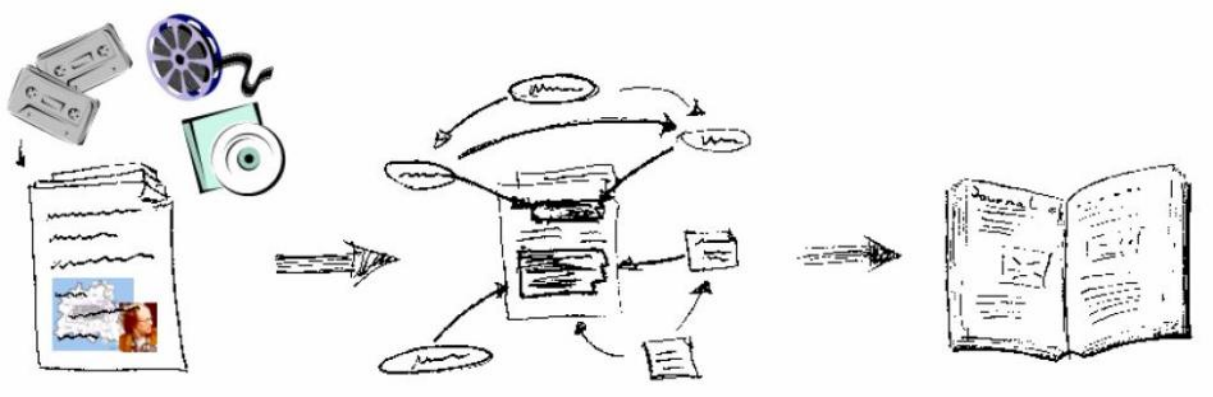


Figure 3-7: ATLAS.ti Text-Structure Text Process

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.

	The coding options in the primary document toolbar:
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).

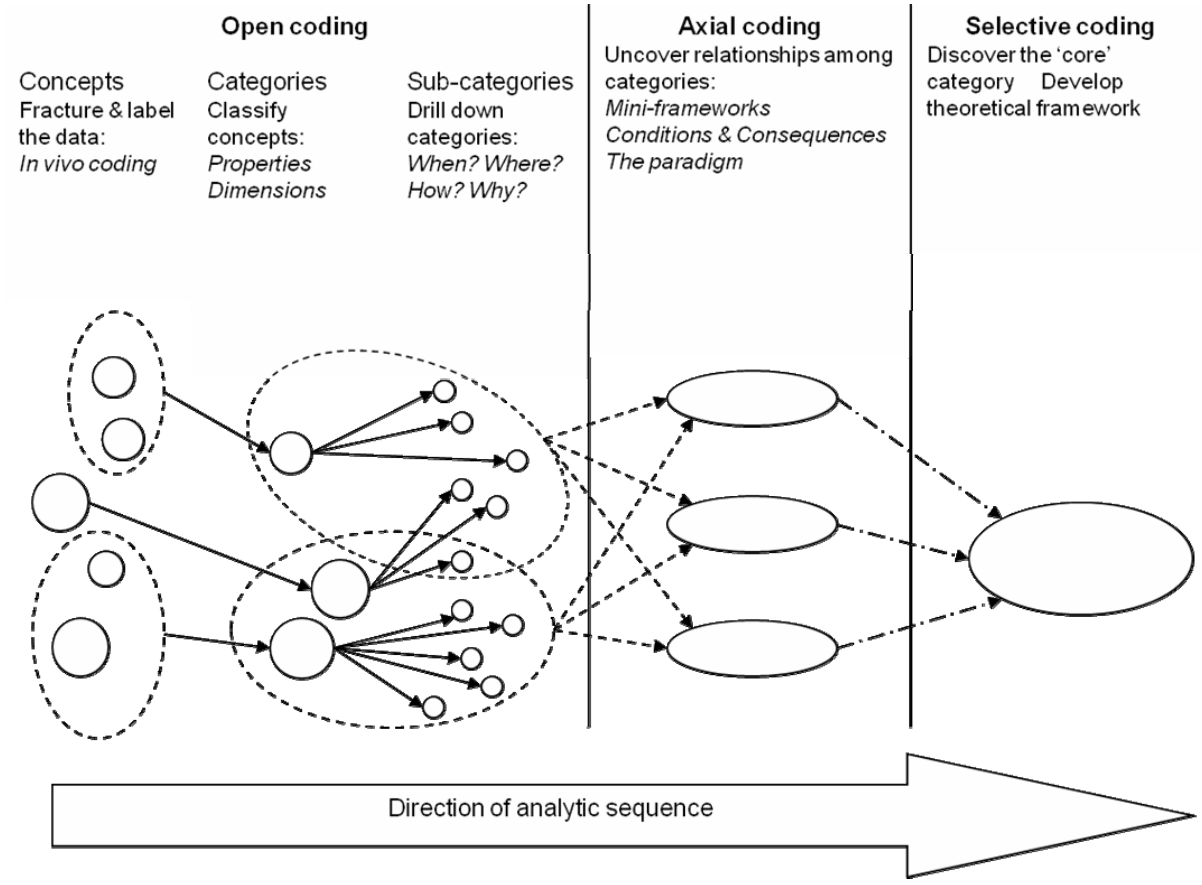


Figure 3-9: The Grounded Theory analytical process from Warburton 2005 (adapted from Harwood 2002, P. 76).

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.

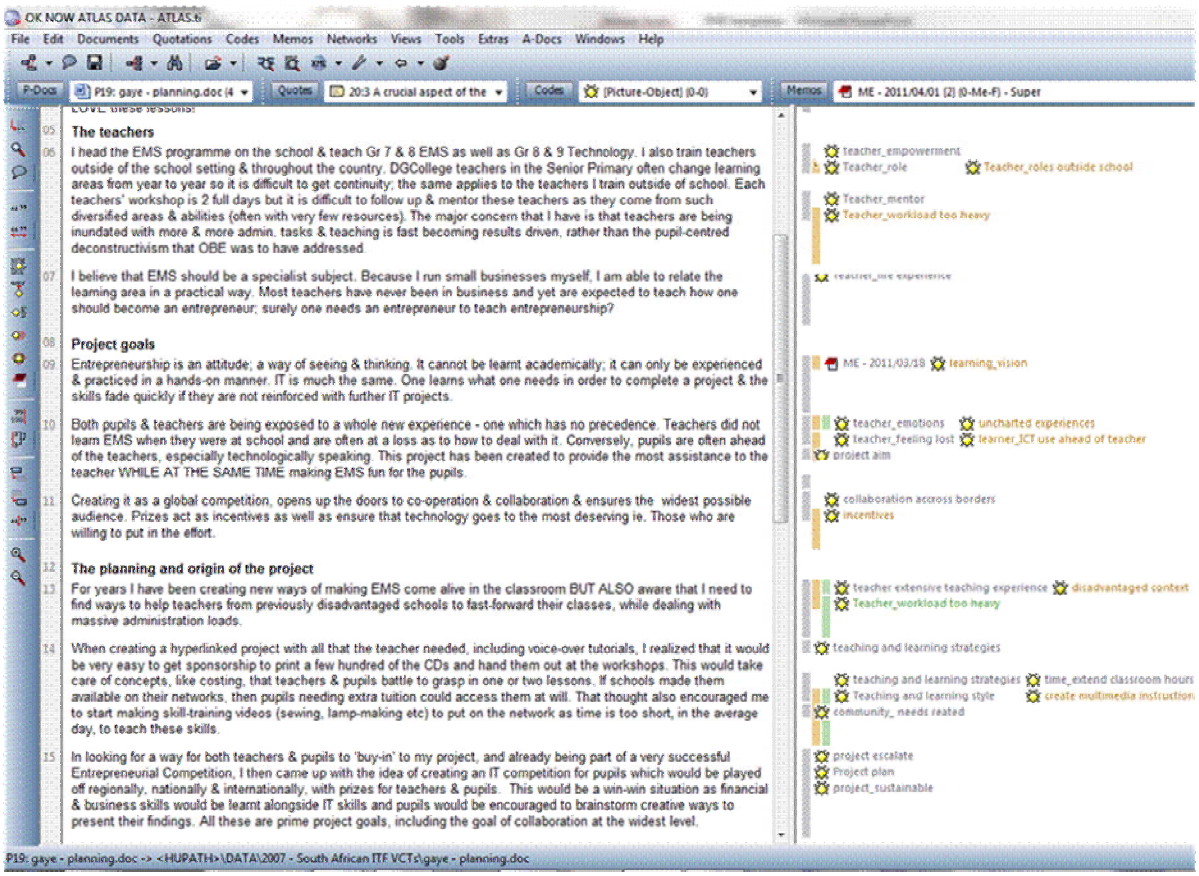


Figure 3-10: Generating codes from a primary document

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).

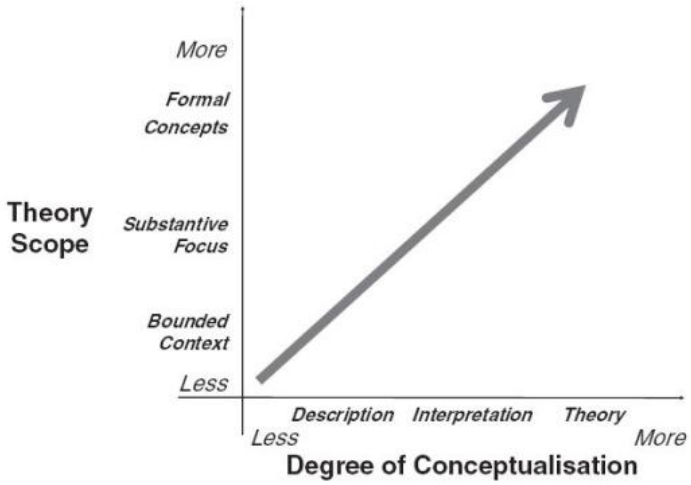


Figure 3-11: A framework for analysing Grounded Theory studies (Urquhart et al, 2010, p 366)

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.

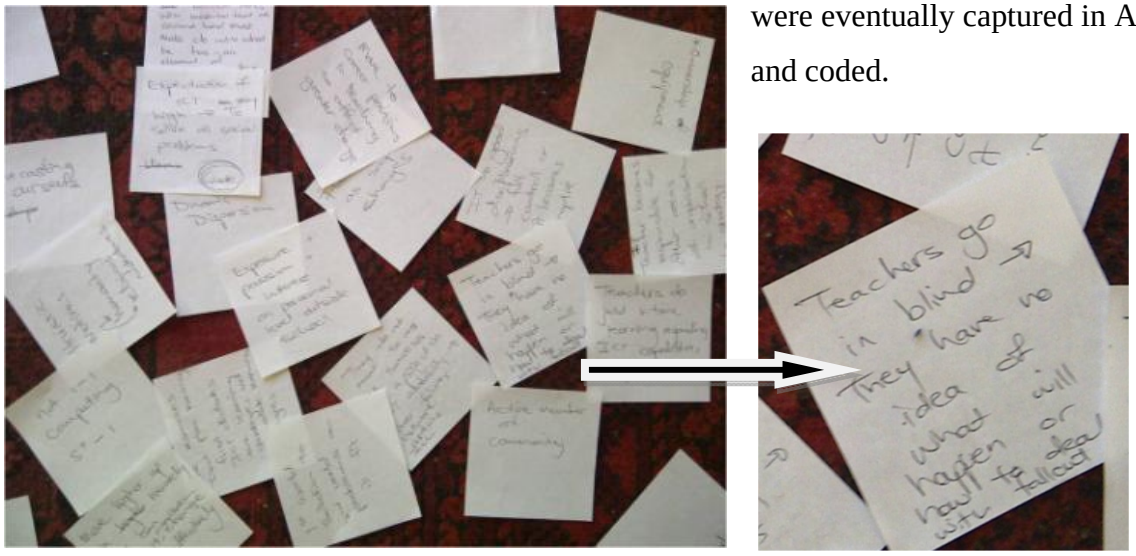


Figure 3-12: Sample of researcher's paper based memos

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.

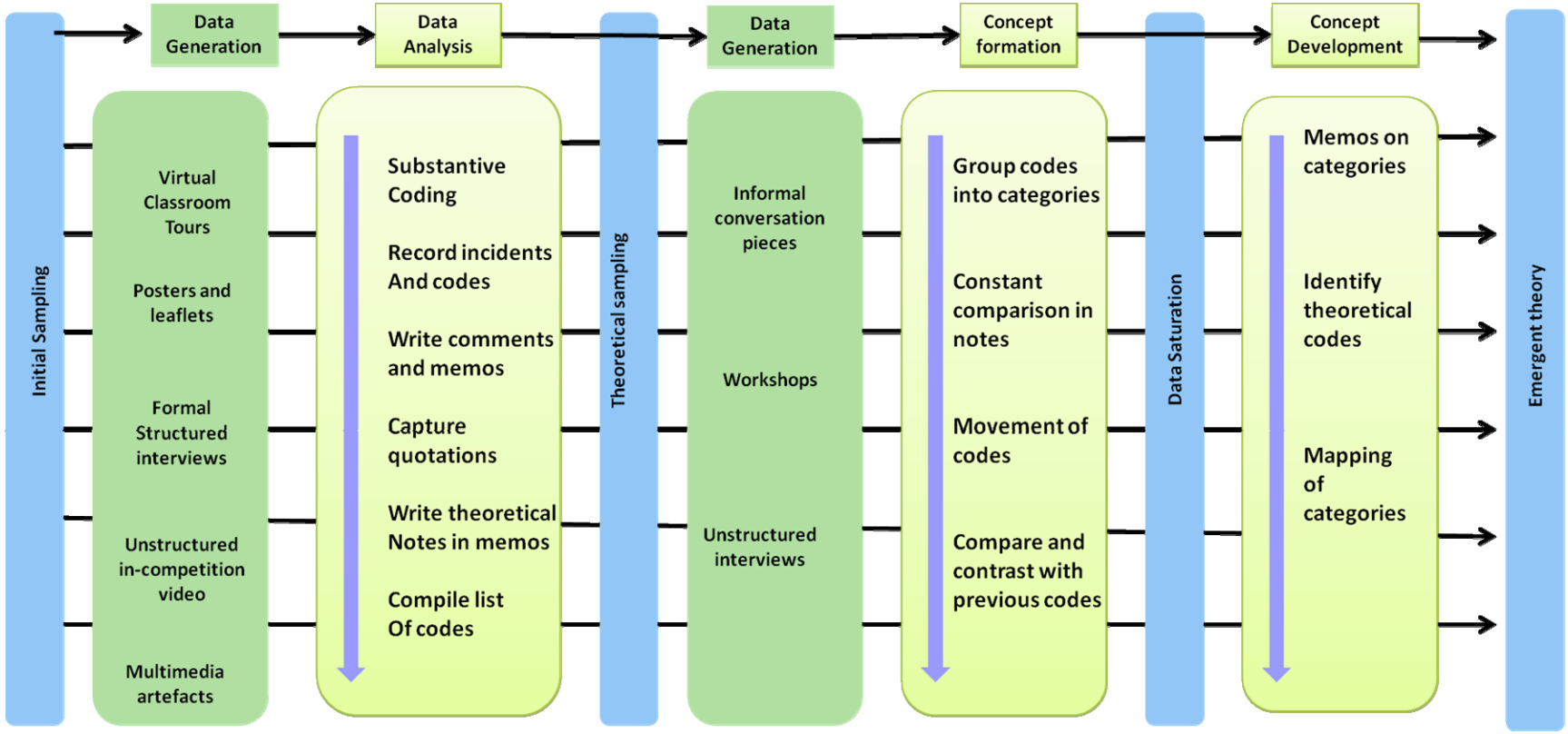


Figure 3-13: Map of the Grounded Theory process of this research

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 Table3-9 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	Technology implications	Innovation negotiations in context
Mobile delivery channels Design for mobile Technology bartering	Mobile Technology		
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	Innovation strategy	
Learner initiative Task orientation	Learner disposition		
Managing learning events Learner workload Project fatigue	Managing expectations		
Pedagogical reasoning Content considerations	Curriculum issues	Reflexive pedagogy	
Assessment renegotiated Track formative and summative evaluation	Assessment quandary		
Incremental steps Multiple roles	Unprecedented initiative		
Pedagogical leadership Self promotion	Self empowerment	Skills transfer	Responsive governance
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		

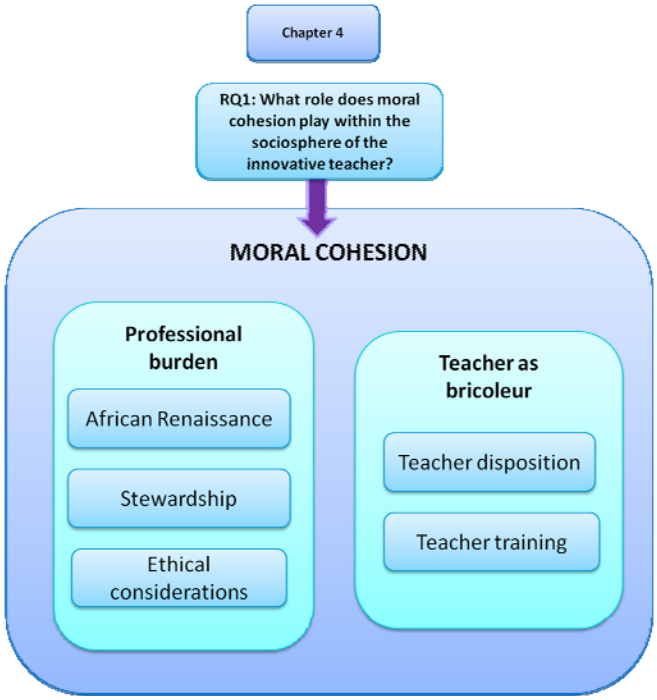
Engage with different forums Seek out conferences and platforms	Lobby for change		
Skills drain, teachers leave		Leave teaching	

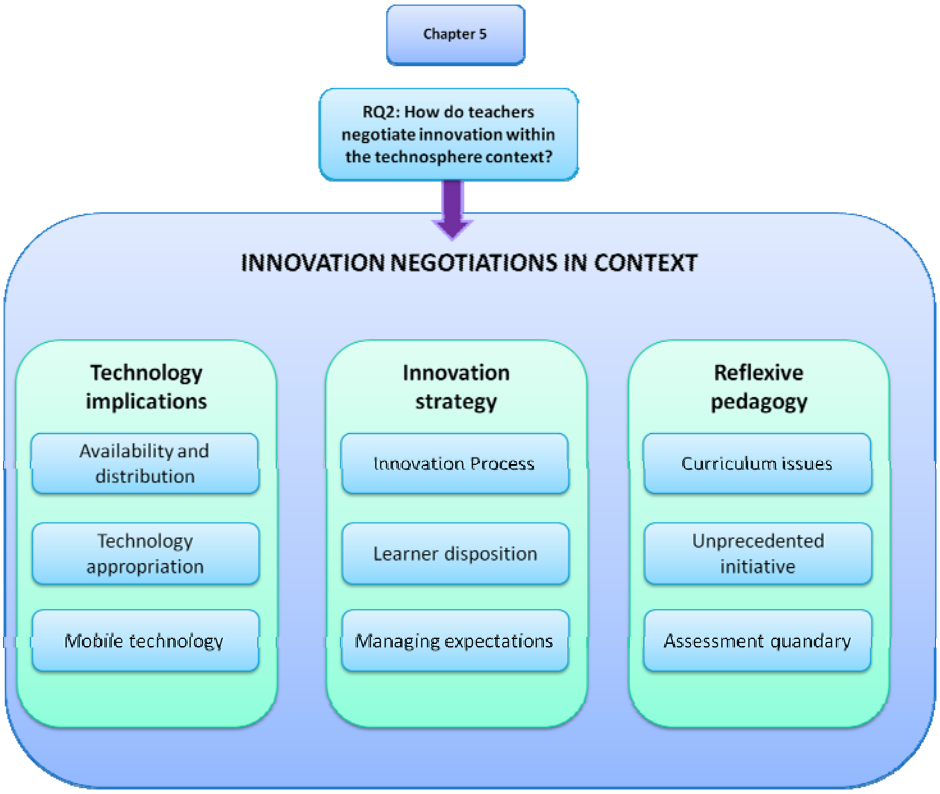
The result of the investigation into how innovative teachers' tacit knowledge manifest when they engage with emerging technologies to achieve pedagogical efficacy in a developing context is presented in the next chapters through means of an explanation, visual models and quotations. The resultant theory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


Chapter 4
RQ1: What role does moral cohesion play within the sociosphere of the innovative teacher?
MORAL COHESION
Professional burden
African Renaissance
Stewardship
Ethical considerations
Teacher as bricoleur
Teacher disposition
Teacher training


Chapter 5
RQ2: How do teachers negotiate innovation within the technosphere context?
INNOVATION NEGOTIATIONS IN CONTEXT
Technology implications
Availability and distribution
Technology appropriation
Mobile technology
Innovation strategy
Innovation Process
Learner disposition
Managing expectations
Reflexive pedagogy
Curriculum issues
Unprecedented initiative
Assessment quandary

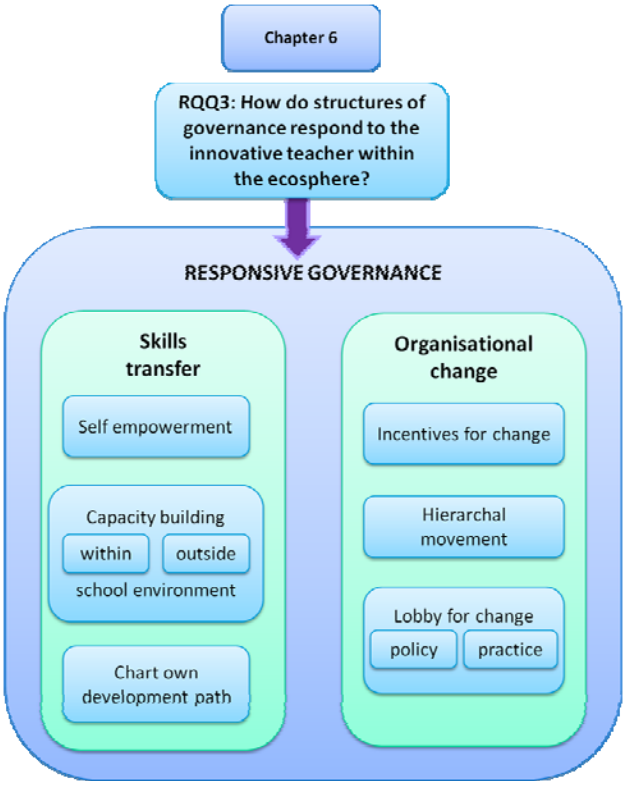


Figure 3-14: Map of research findings to be discussed in subsequent chapters

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.