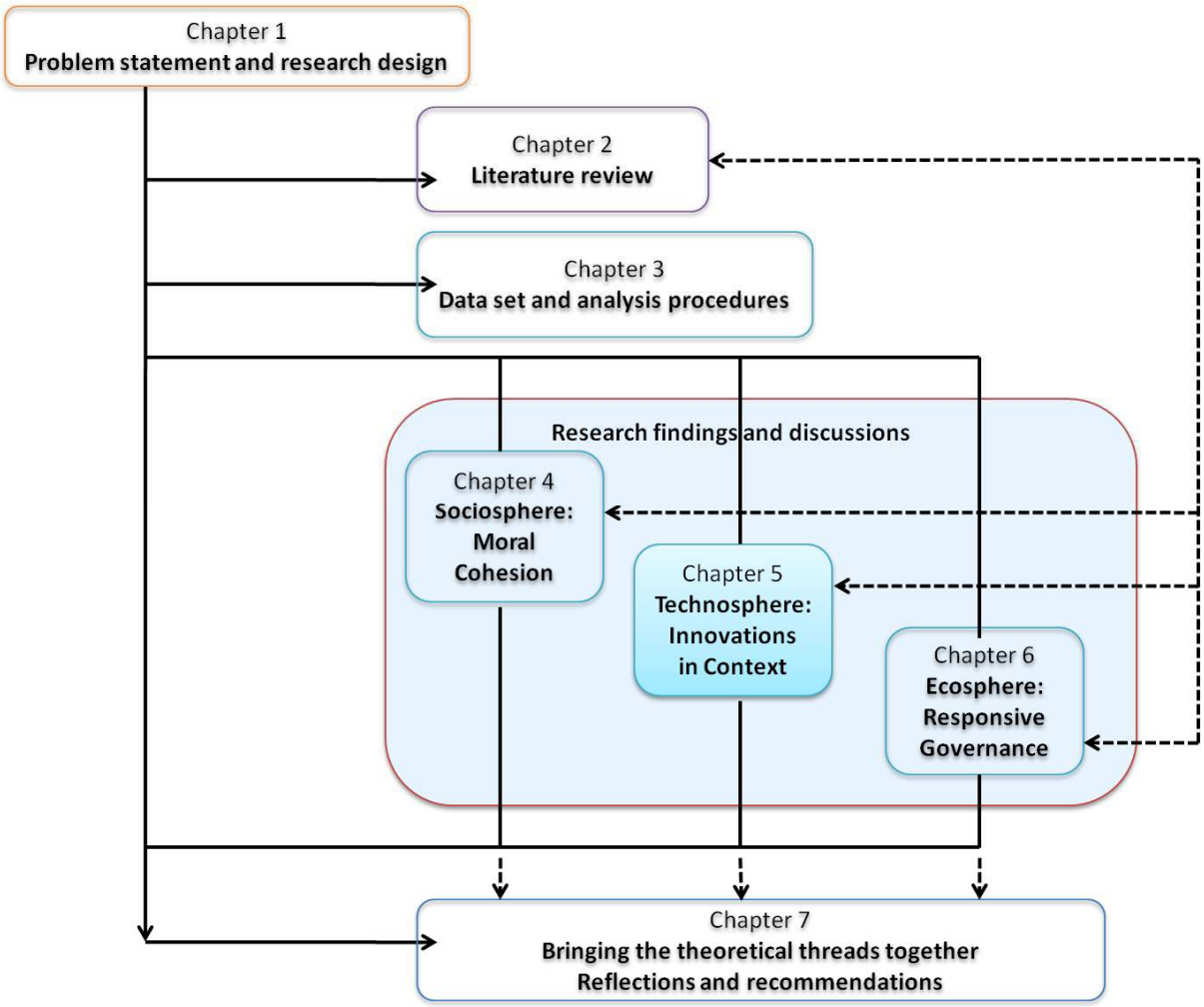

Chapter 1
Problem statement and research design
Chapter 2
Literature review
Chapter 3
Data set and analysis procedures
Research findings and discussions
Chapter 4
Sociosphere:
Moral
Cohesion
Chapter 5
Technosphere:
Innovations
in Context
Chapter 6
Ecosphere:
Responsive
Governance
Chapter 7
Bringing the theoretical threads together
Reflections and recommendations

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:

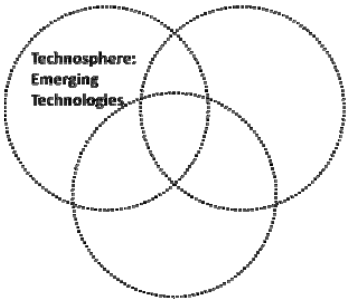
Table 5-1: Research puzzle for Innovation negotiations in context

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 though 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), T*echnology appropriation* (*cf.* Section 5.3.2) and M*obile 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 21st 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).

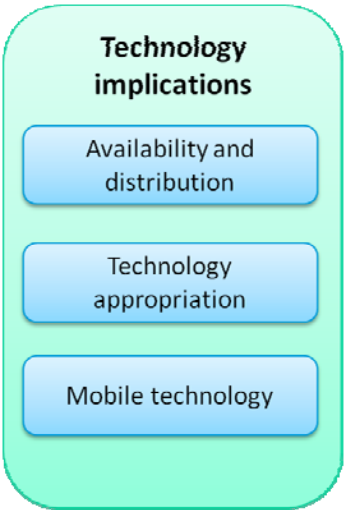


Figure 5-1: Expanded emerging theme: Technology implications

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 Lanser, 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

Teacher: Simpiwe Njoko 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.	
Teacher: Paul Wilton Learners work in groups when visiting the computer centre and have to share tasks and technology equipment during their visit. 	

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.	

Teacher: John Lanser 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 place in groups of two's or three's so that learners can assist one another.	
Teacher: Olalikan Adeeko 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.	
Teacher: Ali Kagone 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.	

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 Sarietjie 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,I 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 (Sarietjie 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 technolgies. 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.*

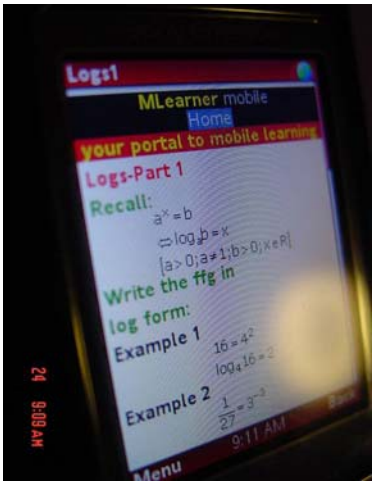


Figure 5-2:The MLearner.co.za displayed on a mobile phone

*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 o 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 devises 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).

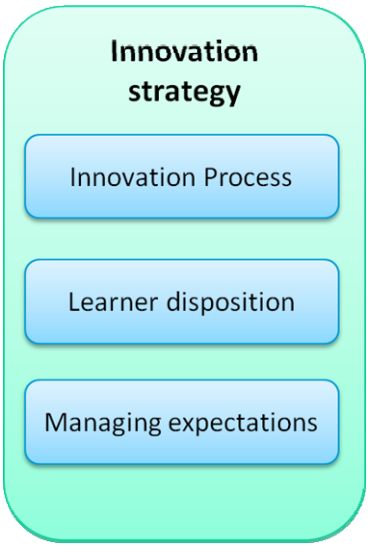


Figure 5-3: Innovation strategy as sub theme with expanded categories

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. Out 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 (UI,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.

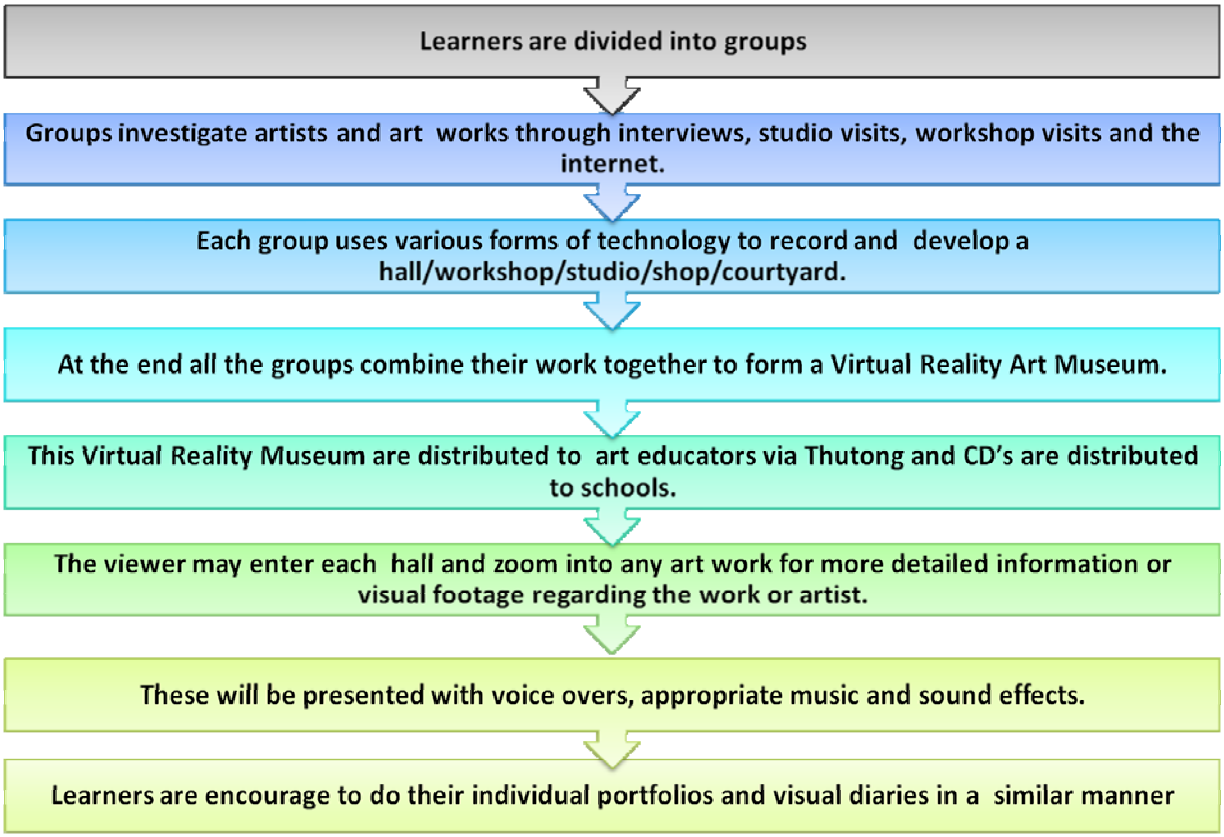


Figure 5-4: Learning process in the virtual art gallery: Anywhere art (Rae Gagiano)

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.

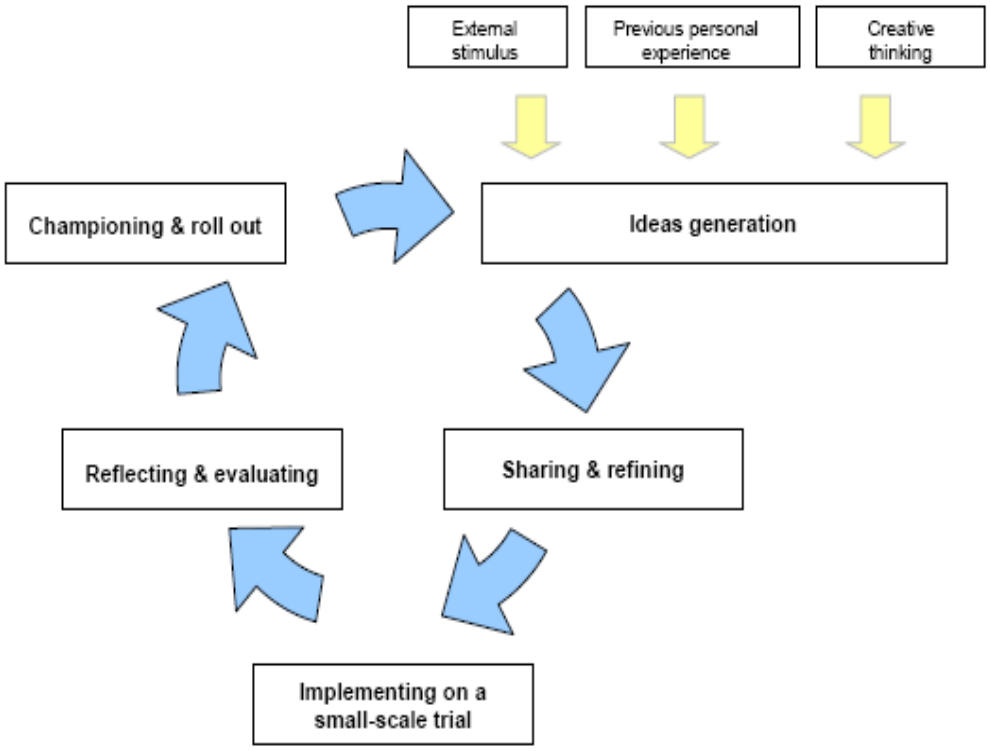


Figure 5-5 Innovation Process (OPM, 2008)

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 Argys 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.

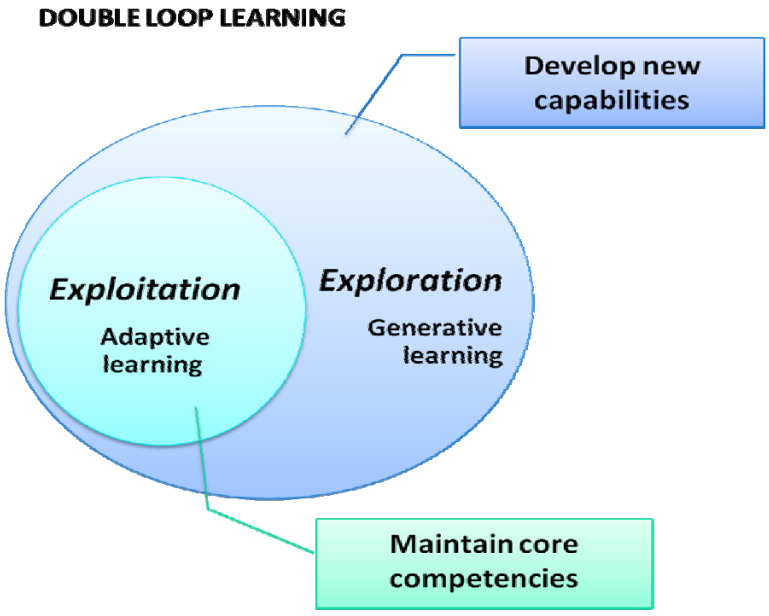


Figure 5-6: Process relevant to exploitation and exploration learning adapted form Argyris and Schön's (1978)

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. Sarietjie 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?*

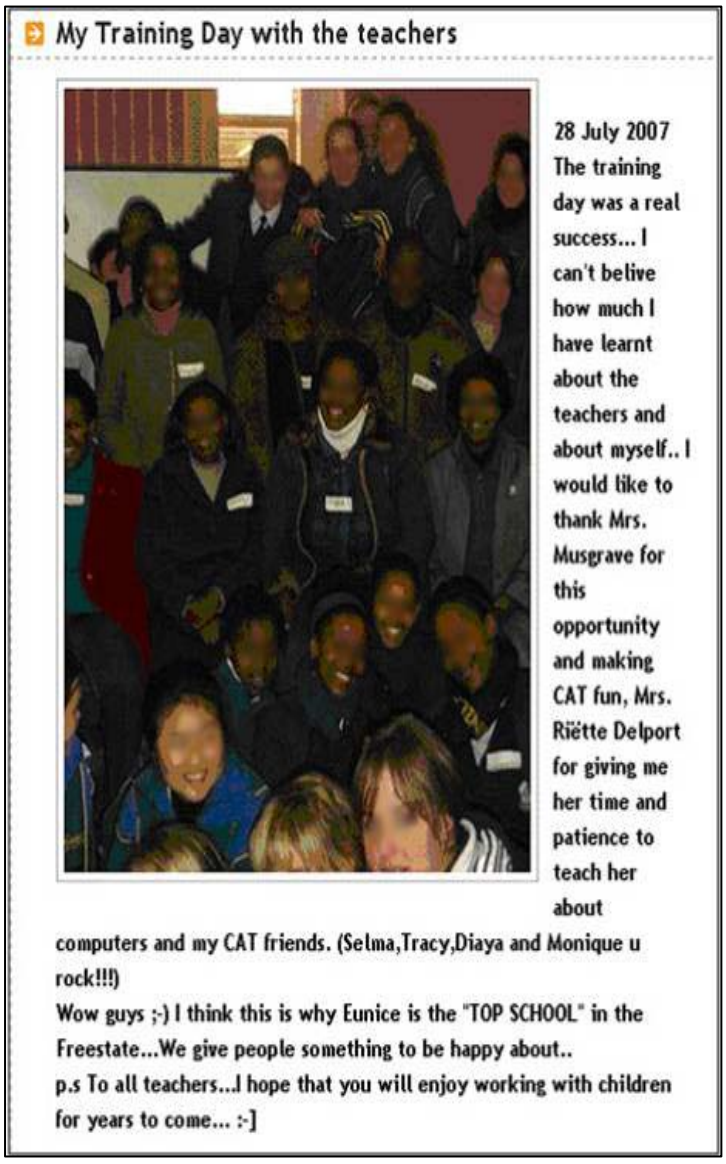
To instil in the learners a caring attitude, responsibility towards, and an understanding of what each of them can do to contribute to reversing some of the community problems..... The one thing I am very

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 Sarietjie 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.*

Sarietjie Musgrave recounts how her learners changed their own conception of their perceived limitations:


My Training Day with the teachers

28 July 2007
The training day was a real success... I can't belive how much I have learnt about the teachers and about myself.. I would like to thank Mrs. Musgrave for this opportunity and making CAT fun, Mrs. Riëtte Delport for giving me her time and patience to teach her about computers and my CAT friends. (Selma,Tracy,Diaya and Monique u rock!!!)
Wow guys ;-) I think this is why Eunice is the "TOP SCHOOL" in the Freestate...We give people something to be happy about..
p.s To all teachers...I hope that you will enjoy working with children for years to come... :-]

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-restraing 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 (*cf*. Section 5.5.2)		
Unprecedented initiative (*cf*. Section 5.5.3)		

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).

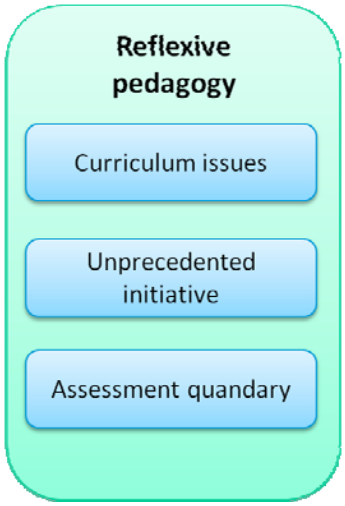


Figure 5-8: Expanded emerging theme: Reflexive pedagogy

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
Obliged 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 forster a sense of autonomy
Little communication: they are not given an opportunity to speak	Open spirit – open communication
Results: General pass rate : 35% Bad results	Results: 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. Fleshman (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.

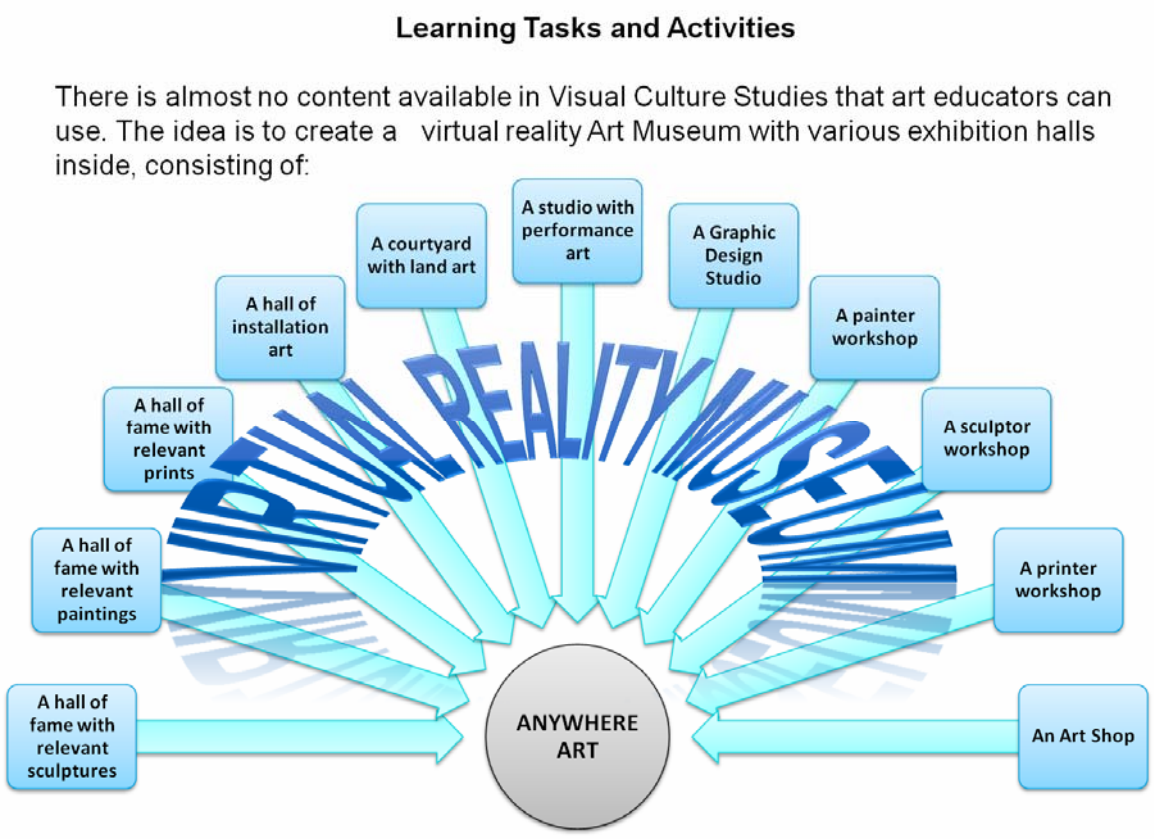


Figure 5-9: Poster section from *Anywhere Art* by Rae Gagiano

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 Lanser, 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: C*onnecting 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 unchartered 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.

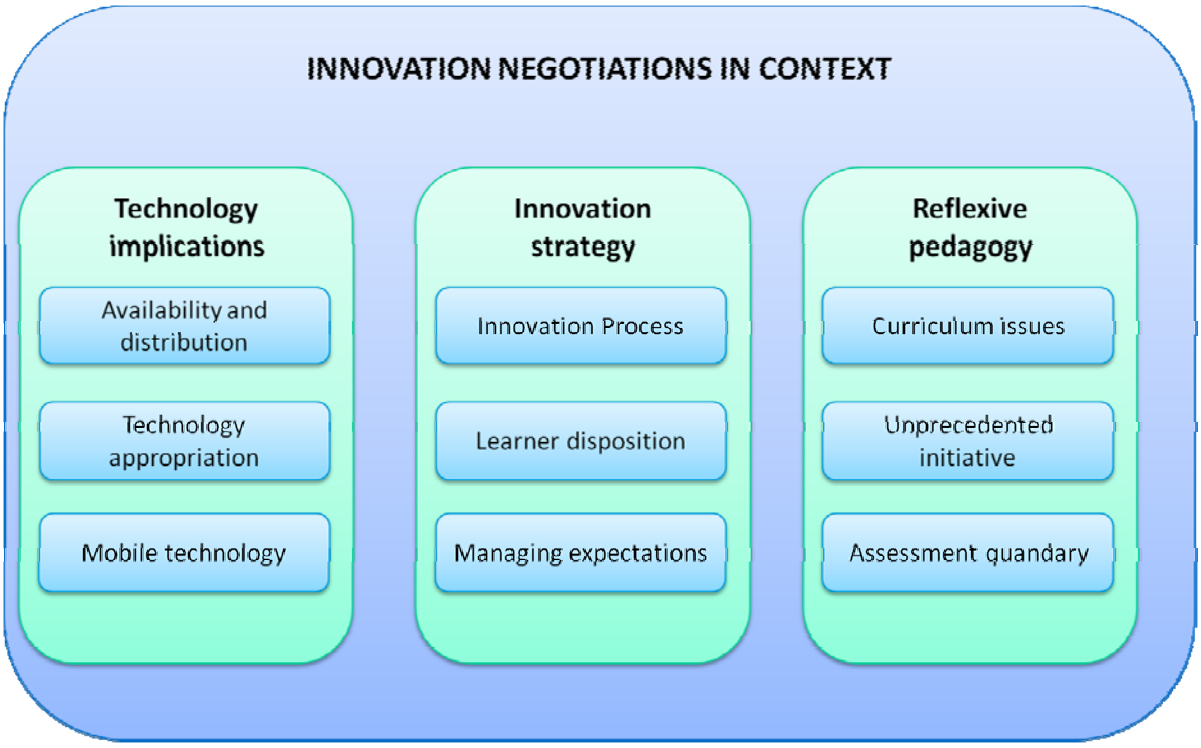


Figure 5-10: Building theory: *Innovation in Context* as emerging core category with expanded themes

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.* N*ext 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:

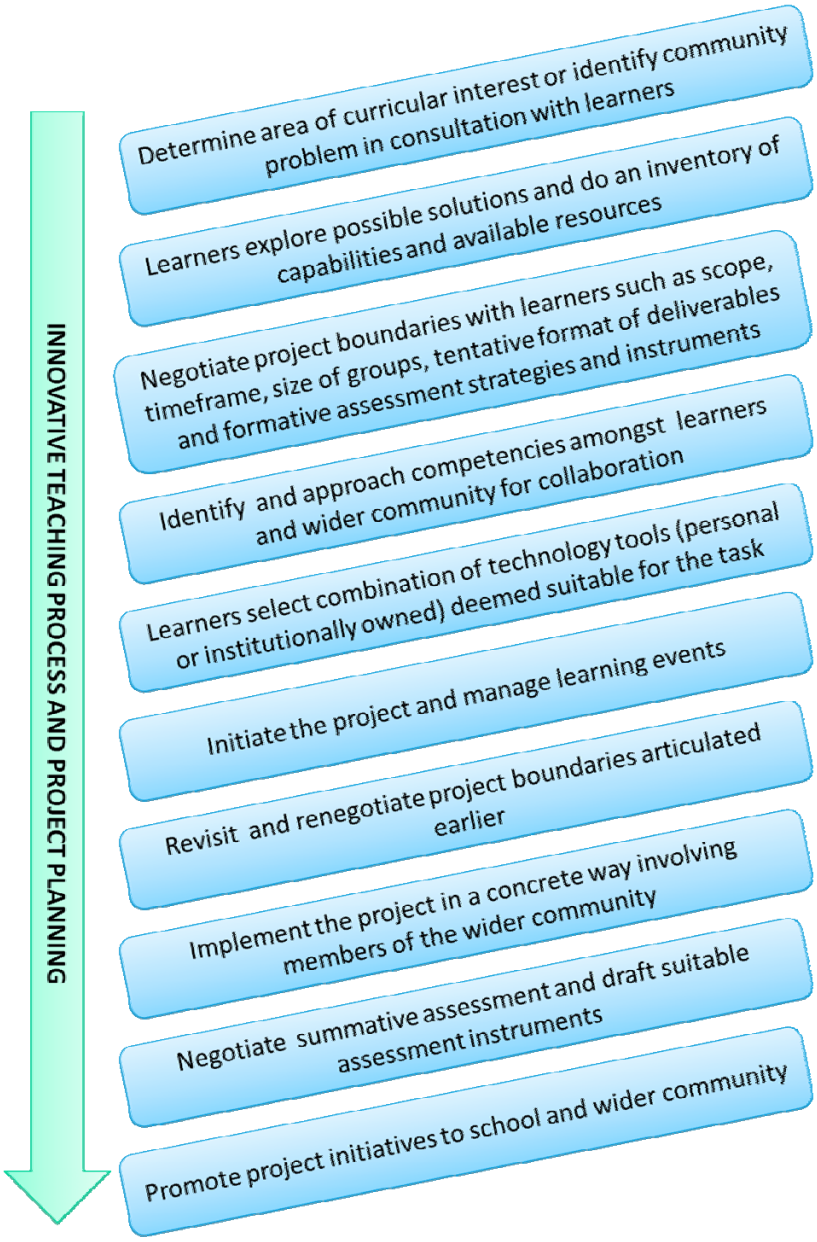


Figure 5-11: Innovative teaching process and project planning

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 form 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 though 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 though 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 communuty 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.