

**AN EXPLORATION OF GENERAL EDUCATION AND
TRAINING TEACHERS' DEMOCRATISATION OF THE
SCIENCE TEACHING AND LEARNING SPACE**

by

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ABSTRACT

This study explored the actions and perspectives of four practising Senior Phase teachers as they articulated and enacted their ideas, imaginings, and intentions to try out an “*alternative teacher practice*”. Such a practice, is one that infuses school science with critical science, as well as with a particular conception of democracy. In this regard, the study tries to locate critical science in education, and in classroom practice, and explore its link with authentic educational practices, if any, and how this could create affordances for learners to improve or change their own living conditions through learning science. The argument advanced is that infusing school science teaching and learning in this way – *holds the potential to transform teaching and learning contexts into actions for change*. The search for an alternative teacher practice was brought into reality through the affordances provided by the following five constitutive conceptual underpinnings, which theoretically framed the study: *Ubuntu, Democracy, Critical science, Subjectivity, and Democratic citizenship*. The study was thus informed by the following three research questions:

Research Question 1: *What are science teachers’ understanding of the classroom as a space for democratic living?*

Research Questions 2: *How do science teachers construct and enact the science classroom as a space for democratic living?*

Research Questions 3: *What reasons do science teachers give for constructing and enacting a science classroom as a space for democratic living in the way that they say they do?*

A qualitative case study research design, rooted in the participatory (advocacy) paradigm was employed in the study. This methodological framing allowed for the exploration of the theory-practice praxis embedded in the two key foci of the study, namely, critical science and democratic pedagogical practice. Permission to gain entry into the school was sought from both the teachers and the school principals. Purposive sampling was used to identify participants who showed strong commitment to searching for participatory learning approaches and opportunities for their students. This was based on their membership and participation in a local teacher network known as Project Citizen South Africa (PC-SA). PC-SA adopts a project based learning approach to classroom practice. The constitution of data was carried out in seven phases. The data generated and analysed was distilled from the following data sources: interviews conducted with teachers (individual and focus group); lesson observations (two to four per teacher); structured and semi-structured pre- and post-lesson observation interviews and field notes which were recorded during the course of the study. The analysis of data entailed the use of crucial descriptions, critical events narrative and positioning theory, to identify the storylines, positions, and speech acts evident in participants’ stories of their unusual practice.

With regard to the first research question regarding the four Senior Phase teachers’ understanding of a classroom as a space for democratic living, the following **four** conceptions came to the fore:

- *A space for independent learning – a space for learners to think and participate;*

- *A space for learning-centred practice - a space that promotes democratic practice, holistic practice, relevance for the learner, dialogic practice, differentiated practice, learner empowerment, social justice and inclusivity, and humanistic practice;*
- *A space for resourceful facilitation – a space where the teacher is a resource and learning guide; and*
- *A space for participative mediation as a tool(s) to enable/enhance learning.*

With regard to the second research question that aimed to explore how Senior Phase teachers construct and enact the science classroom as a space for democratic living the following *five* conceptions came to the fore:

- *By constructing and enacting **science learning as response** to the curriculum (pedagogy of response);*
- *By constructing and enacting **science teaching/learning as a multi-disciplinary practice***
- *By constructing and enacting **the science discipline as being context-driven;***
- *By constructing and enacting **the language of teaching and learning** as a medium to allow one to be and to bring one's beginnings into the world; and,*
- *By constructing and **enacting science teaching as conscious sustained co-action.***

The third research question which explored the reasons the four Senior Phase teachers gave for constructing and enacting science the way they said they did, reveal the following three concerns:

- *How to ensure the **democratisation of pedagogy and pedagogical spaces?***
- *How to **create affordances for learners to improve or change their own living conditions through their learning of science** (linking this to learner authority)? and,*
- *How to **build democratic dialogue** in exploring possibilities?*

The above three concerns provide an apt summary of the key concerns of this research study. The first concern, being about encouraging greater dialogue and 'action' in teacher practice, shows that these teachers' conceptions of practice is characterised by *reform practice*, *socially just practice*, and as *communes of practice*. The second concern, addressing the affordances of this *transformative practice*, shows how science learners can be afforded the opportunity to change their living conditions where they use the knowledge gained in science classrooms, and apply it to new situations, and in this way, promote change within their communities. Furthermore, teacher *practice as promotion of learner subjectivity* afforded learners the opportunities to reach beyond their self-interest and take responsibility for what happens in the space between themselves and others. The third concern, based on the *building of democratic dialogue*, shows how the science classroom as a space for democratic living, fosters sharing through the creation of a space where disagreement, difference and otherness are promoted, and where learners as unique individuals were involved in their own learning by talking from their own perspective or voice.

It is against the above backdrop that this study links the teachers practices to the notion of possibilities. This study has shown that to explore "*the possibilities of an alternative teacher practice*" requires co-imagined teaching and learning spaces that are underpinned by *collaborative teacher-learner co-action*. This requires that both *teacher authority* and *learner authority* be acknowledged and respected. For *threaded discursive practice to be sustained*, *reciprocal authority* must thrive, particularly in the presence of difference and plurality.

DECLARATION

I, Thomas Jafta, declare that:

1. The research reported in this thesis, except where otherwise indicated, is my original research.
2. This thesis has not been submitted for any degree or examination at any other university.
3. This thesis does not contain any other person's data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons.
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ETHICAL CLEARANCE



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08 September 2010

Mr. TD Jafta (200201889)
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Dear Mr. Jafta

PROTOCOL REFERENCE NUMBER: HSS/0213/010D
PROJECT TITLE: An exploration of GET teacher's democratisation of the science teaching and learning space.

In response to your application dated 7 May 2010, the Humanities & Social Sciences Ethics Committee has considered the abovementioned application and the protocol has been given **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the school/department for a period of 5 years.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

Professor Steven Collings (Chair)
HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE

cc. Supervisor- Dr. B Alant
cc. Prof. R Vithal
cc. Prof. M Odegaard
cc. Mr. N Memela

DEDICATION

This dissertation is dedicated to the memory of my father, Johannes Jafta, and my dotting uncle, Peter Jacobus Marais. It is also dedicated to my mother, Sophia Jafta, and to my family for their support, love, strength, and sacrifice.

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I also thank, and am grateful for the valuable insight and expertise provided by my co-supervisor, Professor R Vithal, who inspired me to look critically beyond what other researchers have said and done in my quest for new understanding.

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I also acknowledge the Project Sustain team of students who I learnt from, and collaborated with, and the team of researchers who worked tirelessly in supporting the students during the research weeks that were held for our development.

Lastly, I acknowledge my family who stood behind me, motivating me and kept me on track when times were both good and tough. A word of thanks goes to the members of staff at my school for standing in for me when I was writing up this thesis.

ABBREVIATIONS

DBE	Department of Basic Education
CAPS	Curriculum and Assessment Policy Statement
DET	Department of Education and Training
DoE	Department of Education
GET	General Education and Training
HOA	House of Assembly
HOD	House of Delegates
HoD	Head of Department
HOR	House of Representatives
NCS	National Curriculum Statement
OBE	Outcomes Based Education
PAM	Policy and Administration Measures
PB	Portfolio Board
PBL	Project Based Learning
PC-SA	Project Citizen South Africa
RNCS	Revised National Curriculum Policy
SA	South Africa
SLM	Socratic Learning Method
US	United States

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CHAPTER 1

PROLOGUE

The objective of this study was to explore Senior Phase science teachers' practices in the democratisation of their pedagogy and pedagogical spaces in a manner that was intended to encourage greater dialogue and 'action' on the part of their learners. In this context, teachers design and then enact teaching, learning and assessment practices that are underpinned by democratic principles and values. Pedagogy that is conceived in such a manner is one that advances the notion of "democratic living" (Rizvi and Saint, 1999; Henderson and Kesson, 2004) in a classroom learning community (see Chapter 3, section 3.4). Thus, the phenomenon under study is teacher practice that is based on the infusion of, firstly, science and a particular notion of democracy, and secondly, school science and critical science.

Based on this kind of infusion, this study intended to transform traditional and dominant teacher practice into transformative pedagogical practice that mainly aims to increase learner involvement in their own learning. Teachers could achieve this by implementing a notion of democracy within democratic physical and social spaces, and by implication, the need for and/or creation of, a space for democratic living. In this study, a 'space for democratic living' is a space to be provided, enabled, or created for it to be brought into existence in a school or other teaching/learning setting, a unique space that is a dynamic and humanly constructed means of achieving a need, and for this project, to advance active/meaningful learning and access to the curriculum for all learners. Such a space is consistent with the Biestian (2006) notion of a "disjunctive space" which is "a space of constant mutual transgression, of an order constantly and necessarily threatened by the very use it permits, and it is the very moment of disjunction that the subject, the user and abuser of space, comes into presence" (p. 46).

In this regard, this study did not set out to explore the ideals of democracy and what it should be like, rather, I was curious to understand what teachers say and do when extending or infusing a socio-political conception of democracy in their day-to-day classroom practice. Extending democratic principles and processes to teaching and learning spaces is a vital part of the learner-centred curriculum approach, namely, OBE and NCS (DoE, 2003) and the new CAPS (DBE, 2011). The four participating teachers four in this study claimed that their classroom practice was underpinned by democratic principles and values. In this context, the

teachers' invitational stance on classroom practice was largely intended to solicit greater involvement from learners in the teaching and learning process.

I attempted to locate critical science in education, and in classroom practice, and explore its link with authentic educational practices, if any, and how this created affordances for learners to improve or change their own living conditions through learning science. The phenomenon of critical science is key to bringing about a change in teaching practice. "A critical science approach helps people gain personal freedom from internal constraints such as biases or lack of a skill, or point of view, and to gain social freedom from external constraints such as oppression, exclusion, abuse of power relations (and marginalisation)" (McGregor, 2003, p.2). In this regard, classroom teaching changes from a traditional teacher-centred lesson design to a critical science approach where learning encounters are co-designed from a knowledge co-construction approach with learner action and involvement in mind through "power sharing" (McGregor, 2003, p. 2). According to the author, critical science "is concerned with power relationships, especially distorted power relations that make it easy for the elite to oppress others by controlling knowledge, access to power, meanings, and daily practices". She further finds that "sharing power, uncovering this power imbalance entails *exploring 'what is', in order to determine 'what could be'* [emphasis added]" (McGregor, 2003, p. 2).

It is from McGregor's (2003) notion of teacher-learner "power sharing" through co-designed learning encounters, and co-construction of school-based science knowledge, that I question teacher authority versus learner authority, as does Elsworth (1989). How do the teacher/learner co-responsibilities, as posited by McGregor through the notions of co-design and co-responsibility, impact on the educational relationship between the teacher and his or her learners? This question illuminates, and gives prominence to the need for respected and shared authority between the teacher and the science learner. This promotes greater learner critical and creative involvement in their own learning. Elsworth's (1989) concern, and hence her question, is whether the teacher-student relationship is possible, given, *inter alia*, the imbalance of power between them, and how people with power distort knowledge (teaching) to fit their own interests in an education relationship. Elsworth (1989) illuminates the extent to which we as teachers, because of our ascribed status and authority, foist our beliefs, values, and preoccupations onto our learners. Elsworth (1989) proposes a limited role for the teacher, one consistent with the purpose of this study, namely, a role confined to "building a coalition among the multiple, shifting, intersecting, and sometimes contradictory groups [...] a coalition for a

sustained encounter with currently oppressive formations and power relations” (Elsworth, 1998, p. 317). In this study, a ‘coalition’ was based on the building of democratic dialogue, fostering sharing through the creation of a space where disagreement and difference were promoted, and where learners as unique individuals were involved by speaking from their own perspective.

Beck (1994) argues that “much of the solution (in the teacher-student relationship) lies not in doing away with the teacher authority but in focusing on student authority as well: we need to think in terms of reciprocal authority” (p. 2). Beck (1994) posits that a degree of authority is inevitable, and that the teacher’s focus “should not be on eliminating it, but rather on developing increasingly egalitarian relations between teachers and students so that as far as possible the exercise of authority is reciprocal and matches the respective insights of the participants” (p. 7).

The purposive sampling of the participants in the study was based on their membership to a local teacher network known as Project Citizen South Africa (PC-SA). PC-SA adopts a project based learning approach to classroom practice. Members of the local network have been introduced and immersed in the key pedagogical aspects of this approach in the initial profession development course conducted for the first cohort of 38 practising school teachers in 2003.

The introduction of democracy in the teaching and learning practices of schools is not new, and it largely introduces a social bent to core science content interactions amongst participants in the classroom (Vithal, 2003; Boaler, 2001). The idea that learning is a social activity is widely recognised in educational literature (Dewey, 1916; Vygotsky, 1978; Lave and Wenger, 1991; Darling-Hammond, 1997; Rizvi and Saint, 1999; Biesta, 2006; Gilbert, 2006). However, what sets this study apart is that it *explores how this is made possible in a sustained and democratic manner in the school science classroom.*

This study explored the actions and perspectives of four practising Senior Phase science teachers as they articulated and enacted their ideas, imaginings, and intention to try out an “*alternative teacher practice*”. Such a practice would infuse school science with critical science, as well as with a particular conception of democracy. The argument brought forward in this study is that infusing school science teaching and learning in this way – one that is promoted through project based learning – *holds the potential to transform teaching and learning contexts into action for change.* Such teaching and learning contexts view the usual

terminology of a 'lesson' as a 'learning encounter', which is underpinned by a set of key concepts that are drawn from the available literature.

In the section below, I present and illuminate the key concepts that were identified and used in this study. I discuss how these concepts are connected to each other synergistically to counter dominant teacher practice. The word synergy is used here to mean the way in which, through acting together, the concepts achieve an effect that they are not capable of when acting on their own (Henderson and Kesson, 2004). The idea of their combined action, or synergy, is aimed at employing a multidimensional approach to exploring alternative teacher practice, which was attempted in this study to counter the dominant practice when working within a critical research tradition.

The literature regarding learner involvement in their own learning – through alternative teacher practice – reflects that such involvement is a blend of three basic motivations, amongst others: the need for creating the democratic person, the science teacher and his/her learners being human together, and the use of science learning in service of social justice. The argument advanced for the need for an alternative teacher practice is that such a practice can be brought into reality through the affordances provided by the notions of Ubuntu, democracy, critical science, subjectivity, and democratic citizenship. The five key constitutive conceptual underpinnings were used as a theoretical framework for learner involvement in science learning in this study. Each of these five underpinnings is discussed below (Figure 1.1).

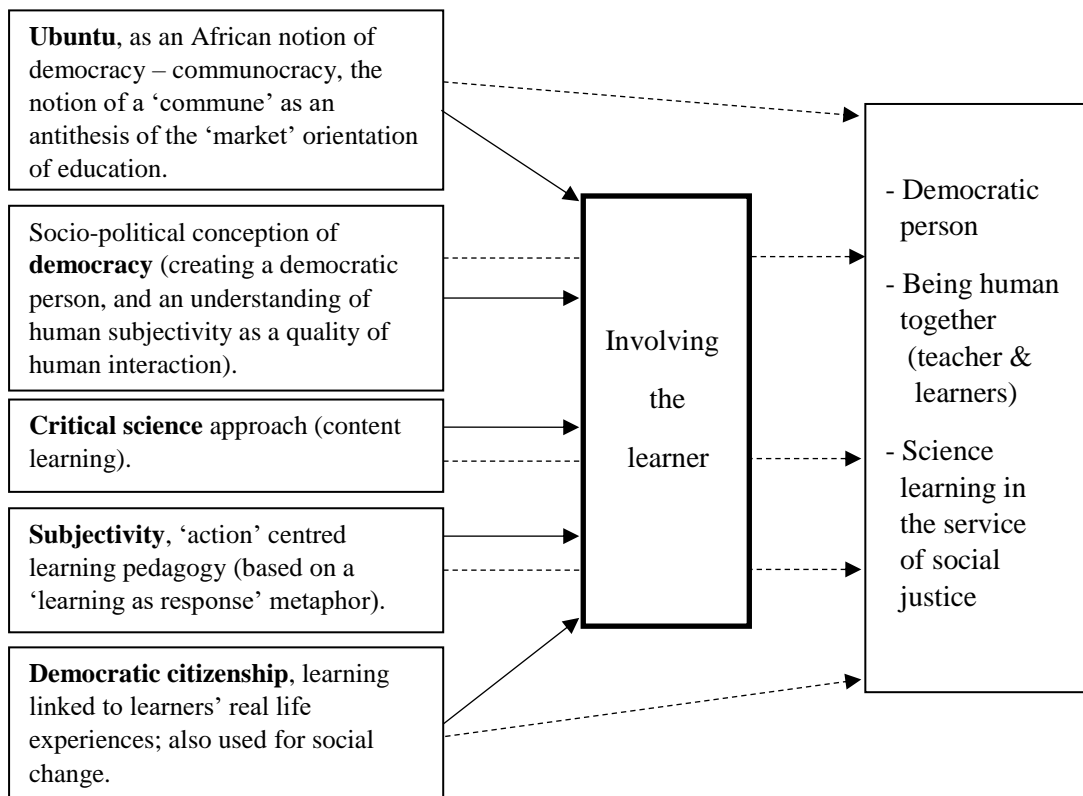


Figure 1.1 Theoretical framework for involving the science learner in their own learning (adapted from Nagda, Gurin & Lopez, 2003).

1.1. THE FIVE KEY CONSTITUTIVE CONCEPTUAL UNDERPINNINGS

Each of the five key constitutive conceptual underpinnings, as represented in Figure 1 above is discussed below.

1.1.1. Ubuntu

In adopting *Ubuntu* as part of the conceptual underpinnings, this study ensured that a ‘holistic’ learning endeavour was embarked upon, as opposed to the discrete effects of dominant teacher practices wherein learners accumulate isolated or decontextualised and meaningless facts that are unrelated to real life situations.

The notion of a commune, and communal activities, that are encapsulated in an African notion of democracy are essential for the purpose of social or collaborative learning contexts applied in Project Based Learning (PBL). As expressed by Diallo (2006), the reason for the communal type of learning encounters is that, “human need for social belonging, individual autonomy, and the desire to participate, is universal to all human societies,” including the

school classroom. The notion of Ubuntu was incorporated to humanise science and make it more popular with young people (Cerini *et al.*, 2003; Osborne and Collins, 2000), as science as a subject has been perceived by learners as detached from their everyday, real life experiences.

An African notion of democracy can be seen as a way to introduce the concept of ‘commune’ as an antithesis for ‘market’. It provides a sense of belonging and brings unity in life (O’Sullivan and Rusch, 2005). The act of learning in commune changes from a classroom practice in which the teacher engages the learners in teacher-centred technical tasks, to an educational relationship that is based on cooperative and collegial activity in which the relationship between teacher and learner is earned rather than being the result of an unequal power balance. The term ‘commune’ was deemed appropriate in this study as the principles of Communitarianism seem to best encapsulate the antithesis of the ‘marketisation’ of education, one that is intended to move against practice that is state-led, centralist and top-down. It is “A concept which captured the flavour of freedom, liberty and social justice for all, respect for diversity. Such a concept would build solidarity, brother/sisterhood, have a strong moral purpose underpinned by explicit values, be cooperative and collegial and create self-aware and motivated, socially responsible individuals in a democratic equitable society” (O’Sullivan and Rusch, 2005, p. 5).

1.1.2. A socio-political conception of democracy

Biesta (2006) introduces the idea of a socio-political conception of democracy within the education arena. As described by Biesta, and confirmed in this study, this conception of democracy requires three things from the school, the teachers, and leaders. Firstly, it requires an educational environment where learners have real opportunity to ‘begin’, and to take initiative. Secondly, it requires an educational environment that is not exclusively focused on the reproduction of subject matter in the curriculum, but rather one that allows learners to respond in their own unique way to the learning opportunities provided by the curriculum (hence the adoption in this study of a ‘learning as response’ metaphor instead of ‘learning as acquisition’). Lastly, it requires a different understanding of the curriculum itself, one in which the curriculum is not simply seen as a set of skills, knowledge, attitudes and values that need to be transmitted to the learners. Instead, different curricular areas are explored and used to provide opportunities for learners to bring their own unique ‘beginnings’ into the world. This can be viewed as human practice in which learners can participate and in which they can find

new ways to express themselves. It is a space where teachers show an interest in learners' initiatives, including their 'beginnings'. This is also seen as a practice wherein teachers and learners are able to be human together.

In this regard, a socio-political conception of democracy can be seen as both a way to construct a democratic person, and a way of viewing human subjectivity as a quality of human interaction.

1.1.3. Critical science

A critical approach seeks the improvement of human life, while critical science refers to the process that people engage with to improve human life in the science classroom. A critical science approach unites science for observation (evidence), and philosophy for the purposes of analysis and criticism (Yoo, 1999). The result of this union is improved living conditions for the science teacher and his/her learners during learning encounters.

PBL and critical science afford learners the opportunity to choose a socio-scientific issue as a topic for both the learners and the teacher to learn through power sharing, and through co-action, rather than through coercion. Critical science allows both parties to be human together, and allows each stakeholder to respect and acknowledge the other's authority on the topic chosen, and what each brings to the science classroom (the science content). Working in this manner, and as conscious human beings, the teacher is afforded the opportunity to be aware of and to change social reality conditions (as controllers of knowledge, access to power by virtue of their position), and liberate themselves and their learners from these.

In summary, critical science can be seen as a unique way to bring in subject content in the science classroom, as well as a way for teachers and learners to be human together in the process of getting to the desired outcome, which is improved teaching and learning).

1.1.4. Subjectivity

Biesta (2006) developed his notion of a political conception of democracy using Arendt's ideas on 'action' and 'subjectivity'. Notably, in a democratic school in which action is possible, the notion of 'action' described by Biesta (2006) (as derived from Arendt's (1977) notion of 'action') is not consistent with learner centeredness, which is viewed as self-expression without care for others. For Biesta, 'action' is anything but self-expression, it is about "the *insertion of one's beginnings* into the complex social fabric and about the *subjection*

of one's beginnings into the beginnings of others who are not like us” (Biesta, 2006, p.139, emphasis added). Biesta and Arendt’s conception of subjectivity and of the democratic person embraces an ‘action-centred’ approach to democratic education, one that focuses both on the opportunities for learners to begin, and on plurality as the only condition through which action is possible (Biesta, 2006). It is a way to ‘action-centred’ pedagogy that is based on a ‘learning as response’ metaphor, recognising the uniqueness of individuals.

The responsibility of schools in this situation is two-fold. Firstly, it is on each learner or individual. Secondly, responsibility also rests on ‘the world’, that is, the space for plurality and difference as the condition for democratic subjectivity. If learning is largely a social activity, as viewed in this study, wherein each learner can be a subject, then the notion of intersubjectivity is a real possibility when using the project based learning approach and the ‘learning as response’ metaphor in the science classroom.

1.1.5. Democracy and active citizenship

This conceptual underpinning places an emphasis on the need for teacher practice to contribute to the improvement of learners’ real-life contexts. It is also seen as a way to bring about authentic learning. The curriculum is to be “designed along the local context, using real problems as the starting point for critical reflection” (Oswald and Moriarty, 2009, p. 11). Performances, or authentic learning (Newmann, 1996), that demonstrate understanding require learners to use information appropriately in a new situation wherein they generate new knowing or knowledge.

Using a common way that members of the local network used to introduce project work, learners were afforded the opportunity to list and thereafter select one local community problem from those listed on the board by the teacher; this was done through deliberation, consensus or voting. The learner chosen problem, or topic, was then used as part of the science project based learning.

Project based learning provides opportunities for both teachers and learners to be human, to be a subject, to bring their own beginnings into the world, to take initiative, and to work as a learning community. “The emphasis is on connecting knowledge with community issues and action, and this requires students to undertake learning projects beyond the school so that they can actively learn by investigating issues in their community” (Oswald & Moriarty,

2009, p. 11). Learners using authentic learning are provided with “opportunities to acquire the dispositions required to participate in a democratic society” (Colley, 2005, p. 2).

School based science learning, as explored in this study, is intended to afford greater opportunity for science learners to be involved in their own learning in a way that is of interest and relevance to them. Like McGregor (2003), I hold the view that, for many school science practitioners, adopting a critical science approach and a particular conception of democracy (Biesta, 2006) was not even an option just over a decade ago. According to McGregor, “We have a heritage of a technical, I am expert, fix the symptom so people can cope approach” (p. 1) to teaching and learning. A critical science approach, including one that infuses democracy, makes us amenable to change because life is not stagnant, and, in order to keep pace with a rapidly changing world, our pedagogical practice needs to keep abreast with change to meet the needs of the 21st Century science learner.

1.2 Justification of the study

In advancing school learners’ optimal education in order to improve their learning gains, I wanted to find out how the classroom environment and teaching and learning practices promotes (or prevent) their involvement in own learning. In addition, my intention was to find alternative teacher practice that could assist both science teachers and learners generate “new ways of knowing and producing knowledge that challenge the common-sense views of socio-political reality with which most individuals have grown so comfortable” (Kincheloe, 2001, p. 372). Relatedly, and as an acknowledgement of a problem, the South African Department of Basic Education has acknowledged that, “Overall, the achievement of learners in the national systemic evaluations and international assessment studies has been disastrously poor and a cause for great concern” (EFA, 2010, p. 37). Following is a broad set of common-sense views of socio-political reality that reflect key areas that are of concern – and hence the current research project. The list is not exhaustive as the problem in education in general, and teacher practice in particular, is varied, complex and not easy to pin down, and, it could reside and be addressed within a single, or a combination of the following listed areas of concern.

Learning contexts that fail learners (Taylor, 1998). The education White Paper was concerned about what it referred to as “a precipitous decline in the quality of educational performance” at many colleges of education, and the White Paper also indicated that “the few science and mathematics teachers being produced there had such poor subject knowledge and

professional confidence that a ‘cycle of mediocrity’ was being perpetuated in their classrooms” (DoE 1995). The National Teacher Education Audit found that, the dominant approach to teaching and learning at the colleges of education was "authoritarian and content-based", the failure rate was high, and many of those who passed had no intention of teaching (Hofmeyer and Hall, 1995, p. 52).

In-authenticity of activities. The school context is considered to be an inherently inauthentic domain where knowing is said to be separated from doing, and where knowledge is uprooted from its proper context in a community of practice, and is presented as abstract, de-contextualised, formal concepts (Brown, *et al.*, 1989). Traditional education neglects the real life context of the learners, and their “first-hand experiences of local life and the political processes of understanding and shaping what happens there” (Gruenewald, 2003, p. 620), is still prevalent in our local schools. Educationists Lave and Wenger (1991) posit that all learning is situated in the context of a particular practice, that is, it is not separated from doing, and that “the activity in which knowledge is developed and deployed ... is not separated from and ancillary to learning and cognition. Nor is it neutral. Rather, it is an integral part of what is learned. Situations may be said to co-produce knowledge through activity” (Lave and Wenger, 1991, p. 8), and that, learning, including thinking and knowing, “involve relations among people in activity with, in, and arising from the socially and culturally constructed world” (p. 15). As long as schools teach “the scientific method as abstract from its political context we fail to teach an important way that scientific knowledge is created, thus discourage students from being active participants in the discipline” (Endres, 1997, p. 3). School teaching and learning as described here is deemed as being inauthentic and is said to be not fully productive of useful learning (Close, 1973).

A banking model of education. The increasing use of curricular approaches that ‘spoonfeed’ learners (Westheimer, 2008), and the problematic notion of “banking education” (Freire, 1970, p. 62) used by teachers using traditional or archaic teacher practices, is one with which they have grown comfortable. This model of education gives school learners a passive role, and therefore mirrors the structure of an oppressive society, reflecting two divided groups, a powerful all-knowing teacher, whose work creates oppressive passivity in learners (Aliakbari and Faraji, 2011). The problem that traditional education promotes is the teaching and learning of isolated and de-contextualised facts and concepts that are often unrelated to learners’ lives (Montgomery, 1994). The notion of “content fetish” is used to describe how such “learning should work through teaching and testing such facts” (Gee, 2008, p. 200). A lack of connection between ideas or concepts can lead to errors in understanding (Pines and West, 1986; Fedje,

1999). Such error can occur “if the subject decides the facts have to come before the application. In reality, as learners work with examples and apply information, they learn facts through the process of application” (Fedje, 1999, p. 14).

Education reform and implementation based on market principles. In the search for alternative classroom practices, we are reminded by Down (2006), in the context of re-imagining teachers’ work, that “we should not underestimate the hostile environment in which we currently work” (p. 45). In keeping with quest to wrestle education from the market, Down (2006) draws on the work of Welch (1966) in arguing that “the back-to-basics proponents are mounting ‘a moral-political campaign to wrest control of society from supporters of tolerance, difference and democratic self-expression and return to those who hanker for a more monolithic, certain and authoritarian world’” (Down, 2006, p. 40). In light of such a hostile environment, and, the stranglehold placed on education by the market, a dominant view of schooling – that is reflected in educational policies based on, or influenced by, dominant market forces – indicates “a new level of distrust in teachers’ judgments and in principals, parents and local communities” (Down, 2006; Meier, 2002). For Down (2006) it has the effect of cultivating social obedience and commonness of purpose and less democracy (Kincheloe, 2001), a manufacture of consent that leads to depoliticised citizenry (Chomsky, 1999), and the quasi science of testing (Meier, 2002), all of which allows moneyed interests to dominate.

Results-based philosophy. A results-based philosophy, including the impact of externally imposed standards, creates power dynamics in both schools and classrooms. This has the effect that, it “reduces opportunities for teachers and learners to engage with relevant, meaningful and critical work that draws from own lived experiences” (Drinkwater, 2010, p. 1). Other views that resonate with the above ideas, argue that, “just because students test well on standardised measures does not mean they are becoming good human beings” (Henderson and Kesson, 2004, p. 93). Performative types of teaching, learning and assessment as used in PBL offer alternative forms of assessing what learners know, can do, and be like “focus on critical thinking, defined as careful argumentation. This could address the primary criticism of such tests – that they drive an instructional focus on rote factual learning” (Yeh, 2001, p. 16). The problem of, and the rippled effect of, the ‘teaching to the test’ phenomenon comes in the way of good teaching and learning, and has the effect of marginalizing learners who are not good at effectively expressing themselves through ‘high-stakes testing’, and it encourages teachers to cheat and reduce their chances to learn or improve their craft (Heartel, *et al.*, 2008, p. 2).

Disregard of education/curriculum policy. It is becoming increasingly apparent that today's youth would need well-developed critical thinking skills in order to effectively manage the proliferation of information from own real life situation. Such skills are key for making ethical choices, and in the maintenance and development of participatory democracies (Marin and Halpern, 2011). In the context of schooling, education policy makes provision for critical and creative thinking on the part of the learner. Active involvement of school-based learners in their own learning has been a long-standing principle of education policy since the introduction of the new vision for education by the Council of education Ministries on the 29 September 1997. The White Paper on Education and Training (1995) "emphasised the need for major changes in education ... in order to normalise and transform teaching and learning in South Africa" (DoE, RNCS, 2002, p. 4). Education policy makes provision for active learner involvement, for critical and creative thinking on the part of science learners (DBE, CAPS, 2011) and for teachers to link school science learning to learners' real-life contexts (DoE, NCS, 2003). This begs the question: Why has this not been implemented?

Following is a brief discussion on the gap identified in previous research findings on teacher experiences with respect to urban science, science for action, and science education for social justice. With respect to the notion of urban science, the researcher, Calabrese-Barton (2001), related that "the kind of science they used and produced in the after-school science program", places the intervention outside the normal day-to-day school curriculum as an 'after school' activity. With Teacher G on the other hand, and in the current study, the intervention is located within the mainstream day-to-day learning activities of the school science curriculum, where much can be gained from entrenching alternative practice within daily practice. The use of an Arendtian (1977) idea for 'action' and Biestian (2006) notions of 'subjectivity' and 'intersubjectivity' promote sustained knowledge co-construction between the teacher and learner(s) through the use of threaded discussion and the Socratic method of questioning within a project based learning approach. The utilisation of a topic chosen by the learners, one that is identified by them and the local community – to be solved and then presented and arguments made and defended before an authentic audience at an annual showcase – promotes the use of school science learning in service of social justice. Such 'action' on the learners' part is driven by their interests, what is relevant to them, including reciprocated authority between the teacher (with respect the pedagogical authority), and the learner(s) (with respect to their knowledge on the content/topic they live with in their community). There is also a gap in the literature (Hodson, 2003; 2010; Bencze and Carter, 2011) in the way learning is viewed, that is, a learning as 'acquisition' metaphor where

knowledge is to be something to be collected or to be possessed once gained by the learner. This study adopted a learning as ‘response’ metaphor, where the learner is able to make particular kinds of responses to the curriculum offered by the school, through the posing of challenging questions to them. Each learners’ unique response affords him or her to take initiative and to be a subject, where others take up such initiative enabling each one of them to also bring own initiatives into ‘presence’, and thus also have opportunity to be a subject.

The aims of this study will be addressed through the following research questions:

Research Question 1: *What are science teachers’ understanding of the classroom as a space for democratic living?*

Research Questions 2: *How do science teachers construct and enact the science classroom as a space for democratic living?*

Research Questions 3: *What reasons do science teachers give for constructing and enacting a science classroom as a space for democratic living in the way that they say they do?*

After facilitating several democratic learning experiences involving critical science, what are the earliest beginnings of the members of the local Network of teachers? The participating teachers have been facilitating democratic learning experiences involving elements of critical science since 2003 immediately after the first cohort of 28 teachers participated in a 2-day Project Citizen (PC-SA) training program conducted by a trained representative of Project Citizen International. The cohort of school based practitioners responded to an advert placed in the local press, and it came at a time when teachers were grappling with the newly introduced Outcomes Based Education. About 50% of the trained teachers implemented this program with a selected group of learners during after school hours over a period of 3 to 4 weeks, in preparation for an annual show case (see Chapter 6, section 6.6, sub-section 6.6.6). After facilitating several democratic learning experiences involving critical science over the years, the active local Network members recruited other teachers for training in the workings of the PC-SA program.

This thesis constitutes ten chapters. Chapter 1 comprises the Prologue, where I present the five key constitutive conceptual underpinnings for an alternative classroom practice. In Chapter 2, I present the conceptual framework and literature review, which is comprised of two

sub-sections, namely, the critical theory approach, and democracy. Chapter 3 gives an outline of the conceptual background to the problem: a literature review. In Chapter 4, I present the problem of epistemology, which is made up of Part 1: the theoretical framing of the methodology, and Chapter 5 provides a description the problem of epistemology, which comprises Part 2: the problem of analysis in critical research. Chapter 6 is a discussion of the research methodology. Chapter 7 elucidates an understanding of the science classroom as a space for democratic living, while Chapter Eight concerns the enactment of the science classroom as a space for democratic living. Chapter 9 presents a discussion on project-based learning that creates affordances: Teacher G's story. The final chapter, Chapter 10, comprises the Epilogue, which deals with *exploring the possibility of an alternative practice*.

CHAPTER 2

CONCEPTUAL FRAMEWORK & LITERATURE REVIEW

Unlike other thesis which begin with a literature review, followed by the conceptual framework, I decided to begin with conceptual framework and then followed by the literature review. The prologue gave a brief outline of the main areas of focus in this thesis. This chapter is divided into two sections, namely, the theoretical underpinnings of this study, and the concepts that enabled me to locate the study within the field of science education in general. The section on theoretical underpinnings is divided into two sections:

Section 1: The critical theory approach; and

Section 2: Democracy.

In the first section, I begin by presenting the critical research approach. This is done by discussing the origins of critical theory and some of the current developments therein. The other sub-sections of this section consist of a discussion on critical theory and critical theory of education, followed by critical pedagogy and the Critical Science Theory, followed by a discussion on critical science in education. In the second sub-section (democracy), I provide a brief discussion on its general meaning(s), democracy in education, democracy and science, democratic citizenship and science, and a socio-political conception of democracy.

2.1. CRITICAL THEORY APPROACH

2.1.1. Critical Theory as a tool to provide a critique of positivism

The Frankfurt theorists introduced hegemony as a category of critique, and the deeper psychological understanding of false consciousness. This category, according to Endres (1997), serves as critique of positivist epistemology because of its susceptibility to being used to fulfil an interest in power, and its inability to reveal such misuses because its definition of rationality is too narrow. The target of the radical critique given by critical theorists is positivism and its use of science for “technological control of the environment and other human beings” (Endres, 1997, p. 2). Other critical theorists have demonstrated how the hegemonic influence of positivism, through the use of epistemology as ideology, has been applied in education (see Apple, 1990).

Giroux (1981), in his critique on the shortcomings of positivism, provides an account of ideology in education. His critique is based on the argument that “the prevailing positivist

consciousness has forgotten the function that theory once served. Under the prevailing dominant ideology, theory has been stripped of its concern with ends and ethics” (p. 43). For him, the “culture of positivism” (p. 42) has brought about a culture of complacency, particularly amongst those education workers who overlook the normative dimensions and the socio-historical context of their work, and in doing so, tacitly perpetuate the status quo. Giroux also introduces and argues for a critical theory of education (Giroux, 1981, 1988), a topic that is discussed later (Section, 2.1.2).

Habermas (1979) introduces the notions of ‘communicative action’ and ‘speech act’, which explicitly link epistemology with ethical claims. His concept of an “ideal speech situation” is one in which everyone has equal access to information and public debate. This is in contrast with traditional Critical Theory, namely, the notion of a rational society. His approach to epistemology as “universal pragmatics [...] is to identify and reconstruct the universal conditions of possible understanding” (p. 1). Habermas’ search for the conditions of all understanding was carried out with a focus on intentional effort that allows one to turn away from a merely grammatical or logical analysis of language towards a consideration of the actual roles and purposes that language fulfils. This intention and view of the truth and logical sense of sentences has ignored the purposes that language serves in particular contexts (Endres, 1997). According to Endres (1997), Habermas claims, firstly, that we are to include this pragmatic dimension in our study and use of language, and secondly, that we can identify universal presuppositions within this dimension. Endres draws on the work of McCarthy (1988) to help identify Habermas’ shift from a study of language to one of communication. He does this by stating that,

Habermas’s conception of universal pragmatism rests on the contention that not only phonic, syntactic, and semantic features of sentences but also certain pragmatic features of utterances – that is, not only language but speech, not only linguistic competence but ‘communicative competence’ – admit of rational reconstruction in universal terms (Endres, 1997, p. 5).

By way of his notion of “communicative action”, Habermas (1979) introduced a new way to look and think about truth, namely, to turn “our attention from logical rules of sense to the social context of speech” (Endres, 1997, p. 5). Below is a tabulation (Table 2.1) of Habermas’ work in action toward understanding ‘speech act’, in which he distinguishes three validity claims that the speaker makes.

Table 2.1 Habermas' distinction between three types of validity claims (Endres, 1997)

Types of validity claims	Characteristics of claims	Theme or definition of speech act
1. We make claims of truth for the propositions that we make.	Truth claims are directed at the objective (external) world.	Objective claim/norm.
2. We claim rightness about the norms or values at work in the specific interpersonal context.	Rightness claims are directed at the social world.	Social claim/norm.
3. We claim truthfulness in our own attitude in the speech act.	Truthfulness claims are directed at the subjective world.	Subjective claim/norm.

According to Habermas (1979), although the three kinds of validity claims are at work simultaneously in a speech act, only one of the claims is the explicit focus of communication (pp. 65-66). His notion of the “ideal speech situation”, is described as one in which rational dialogue and full participation by all persons involved is to occur free of any conscious or unconscious inhibitions (McCarthy, 1988, p. 308). Habermas’s notion of “communicative action” rests on genuine and rational debate or dialogue with others. In this regard, he argues that for debate about a norm to be viewed as legitimate, those affected by it must be able to take full part in the discourse without any internal or external coercion restricting that right (Habermas, 1993, p. 89). His notion of “lifeworld” is one in which all knowledge and norms of behaviour are embedded, and this refers to “the culturally transmitted and linguistically organised stock of interpretive patterns” (Habermas, 1987, p. 124).

For Endres (1997, pp. 6-7), both culture and language serve as the medium through which communicative activity occurs, fuelled by Habermas’s ‘universal conditions of possible understanding’. According to Habermas’s thinking, and following from the above discussion on language and culture, certain sub-cultures may become disassociated from their lifeworld and then may deny their natural basis in communicative activity, and assume a purely instrumental function (Endres, 1997, p. 7).

It is in this vein that Endres argues that Habermas’ notion of ‘communicative action’, which links epistemology and ethical claims, “can serve as a critique of ideology and provide guidelines for constructive action in education” (Endres, 1997, p. 5).

Habermas (1972) posits that “knowledge – and hence research knowledge – serves different interests that are socially constructed, and are knowledge constitutive, because they shape and determine what counts as the objects and types of knowledge” (p. 27). He holds that positivistic and interpretive paradigms are preoccupied with technical and hermeneutic knowledge respectively (Gage, 1989). Whereas in critical educational research, the “intention is political – the emancipation of individuals and groups in an egalitarian society” (Cohen, Manion and Morrison, 2007, p.26). Interests are said to have an ideological function (Morrison, 1995). To this effect, a technical interest is based on prediction and control with the result that, within a classroom context, it “has the effect of keeping the empowered in their empowered position, and the disempowered in their powerlessness – reinforcing and perpetuating the status quo” (Cohen, Manion and Morrison, 2007, p. 27). This is in contrast with an emancipatory interest, which has the effect of threatening the status quo. The task of this interest is to “restore to consciousness those suppressed, repressed and submerged determinants of unfree behaviour with a view to their dissolution” (Habermas, 1984, pp. 194-195).

Habermas’ early work helped education inquirers conceptualise three research styles. For the purpose of this study, only the ideology critique research style is focused on. This critique comprises the reading of ideology that is of interest in a study, and is viewed as “the suppression of generalizable interests” (Habermas, 1976, p. 113). Habermas’ view on ideology critique has been extended by other researchers as shown below.

According to Cohen, Manion and Morrison (2007), this suppression occurs in a situation where “systems, groups or individuals operate in rationally indefensible ways because their power to act relies on the disempowerment of other groups, i.e., that their principles of behaviour cannot be generalised” (p. 28). For these authors, who draw on the work of Guess (1981), the task of ideology critique is useful, particularly in education and for the purpose of this study, namely, it serves to “uncover the vested interests at work which may be occurring consciously or subliminally, revealing to participants how they may be acting to perpetuate a system which keeps them either empowered or disempowered, i.e., which suppress a generalizable interest” (p. 28).

Apple’s (1990) critique of positivism is aimed at its avoidance of controversies and power struggles in scientific work. Based on this, he argues for the important role played by ‘conflict’ in the scientific process. In his opinion, conflict is an essential part of the scientific method as it includes the need to disclose the research methods and research conclusions, and

present the same for rigorous public scrutiny (Apple, 1990). Apple (1990) illuminates how institutional level design curriculums make use of “systems management” methods, which “are grounded in a positivist picture of science that is directed at control and uniformity” (p. 106). He further finds that “systems management procedures are not interest-free. Their own constitutive interest lies primarily in, and has the social consequences of, effecting and maintaining technical control and certainty” (p. 110). Apple also directs his critique at the positivist notion of consensus, arguing that “the very normative structure of the scientific communities tends towards scepticism and not necessarily towards intellectual consensus” (p. 119). He views the need to disclose conflicts and controversies within science as important as critical understanding would otherwise be limited to those studying it.

Educators whose work is informed by Critical Theory are interested in overcoming domination and oppression of one person(s) by another, and in addressing or freeing those who are affected by this. Teacher and learner agency is an important aspect in the task of identifying and addressing the problem of domination and oppression, and in the use of a socially-situated approach to learning. A political orientation to agency is required to affect justice-oriented transformation in people’s lives, particularly within the school science classroom (Freire, 1970).

The section that follows moves the above discussion on critical theory to the arena of education, namely, Critical Theory of Education. In the discussion, I draw on one of the recent works by Giroux (1993) (*Living Dangerously*).

2.1.2. Critical Theory of Education

As alluded to in the previous paragraph, educators whose work is informed by Critical Theory are interested in overcoming the domination and oppression of one person(s) by another, and in addressing or freeing those who are affected by this. McLaren (1998), for example, posits that:

The critical educator (or researcher) [...] is most interested in what Habermas calls emancipatory knowledge [...that] helps us understand how social relationships are distorted and manipulated by relations of power and privilege. It also aims at creating the conditions under which irrationality, domination, and oppression can be overcome and transformed through deliberative, collective action. In short, it

creates the foundation for social justice, equality, and empowerment (McLaren, 1998, p. 175).

Within the critical research approach, the focus on emancipation sets out to critique and address dominating, oppressive and restrictive conditions within institutions, structures and systems in the broader society. A key aspect of critical tradition is transformation, which, in terms of education and classroom practice, is based on agency on the part of those affected by circumstances that they view as restrictive to their needs and interests. Traditional classroom practice fosters and requires obedience to those at more powerful levels in the hierarchy and bureaucracy of the local education system (Dewey, 1916; Shor, 1996). For the learner, the teacher is part of that bureaucracy, and in this study, other teachers who are at a level higher than the participating teachers are part of a bureaucracy.

For Giroux (1993), the agents, say within a school classroom, are many and constitutive of multiple and intersecting languages and ideologies, which for him is a necessary condition for teacher and learner agency. This is particularly the case as an environment is created for a “politics of identity outside of the dictates of a narrow separatism and essentialism” (p. 69). In terms of Biesta’s (2006) notion of political action, every learner gets an opportunity to ‘appear’ or ‘come into the world’ – a world that is made up of difference, disagreement, and plurality. Working in this new way, either as a whole group or multiple small project task groups, each learner is afforded the opportunity to ‘act’ or take ‘initiative’ in responding to the science curriculum. The learners are given the chance to co-construct knowledge with the teacher, and thereby work as “collective agents capable of both challenging existing (traditional) configurations [...and] offering new visions of the future” (Giroux, 1993, p. 63).

2.1.3. Critical pedagogy: What does it entail? What challenges are there in critical pedagogy?

A critical science pedagogy works on a continuum by encouraging students to move toward human agency (Ball, 2000; Freire, 1990), and by exercising agency through critical thinking, individual social action, and through group social action (Marri, 2005). Critical pedagogy engages learners in social problem solving by providing them with opportunities to think about which problems are worth solving, according to whom, to what ends, and in whose favour (Parker, 2001). The basic principles of, and information related to critical pedagogy include the following:

- A teaching and learning approach that is concerned with transforming relations of power that are oppressive and which lead to the oppression of people (Kincheloe, 2005).
- It tries to humanise and empower learners.
- This is most associated with the Brazilian educator and activist Paulo Freire using the principles of critical theory of the Frankfurt school as its main source.
- The prominent members of this Critical Theory are Adorno, Marcuse, and Habermas.
- It is concerned with the idea of a just society in which people have political, economic, and cultural control of their lives.
- It relates the school context to the social context in which it is embedded.
- It empowers learners to think and act critically with the aim of transforming their life conditions.

(Aliakbari and Faraji, 2011, p.1).

The above principles of critical pedagogy resonate with the broader aim and theoretical framework that underpins this study. The limitations of critical pedagogy are raised by Elsworth (1989), who argues that it lacks usefulness in assisting teachers to think through and plan improvements in actual classroom practice. Critical pedagogy has also been criticised as being rooted in its own modernist assumptions about progress and rationality, and that it fails to take issues of the environment and eco-justice into account (Bowers, 2001).

Kyburz-Graber (1999) argues that “Two of the main characteristics of environmental education as critical education are openness and uncertainty, with respect to both the content and the process of learning” (p. 417). The author also acknowledges that a critical approach to learning that is authentic “does not gloss over conflicts and controversial opinions but opens up discussion to further discourse” (p. 417). To Kyburz-Graber (1999), uncertainty appears to be a decisive factor that drives teachers to avoid authentic learning contexts. It is in this regard that she argues that critical environmental studies that are carried out through project based learning, and which focus on socio-scientific issues and democratic practice, must ensure the following:

- That learners are allowed to shape their environment in socially significant ways;
- That learners accept the environment as a challenge in taking initiative, independence, and responsible action;
- That activities allow for openness and uncertainty regarding both the content and the process of learning; and

- That learners experience participatory learning processes and reflect on them in the light of democratic developments in society.

(Kyburz-Graber, 1999, p. 143).

A Critical Theory of Education generally, and in the science classroom in particular, encourages science learners to move towards and exercise human agency (Ball, 2000; Freire, 1990). Learners are encouraged to do so through critical thinking and in collaboration with others (Marri, 2005). These ideas resonate with what this study set out to do, and therefore, the following section, Critical Science Theory, elaborates on how these ideas could be put into practice.

The discussion of Critical Science Theory deals firstly with a brief description of this theory, followed by a discourse on critical science in education. This is done in order to locate critical science in education, and in classroom practice, and to explore its link with authentic educational practices, if any. I also set out to explore how this created affordances for learners to improve or change their own living conditions.

2.1.4. Critical Science Theory

The phenomenon of critical science is key in bringing about changed teaching practice. A critical science approach “helps people gain personal freedom from internal constraints such as biases or lack of a skill or point of view, and to gain social freedom from external constraints such as oppression, exclusion, abuse of power relations [and marginalisation]” (McGregor, 2003, p. 2). In this regard, classroom teaching changes from the current dominant science teaching practice, namely, “banking education which anesthetizes and inhibits creative power” (Freire, 1970, p. 62), to a critical science approach where learning encounters are co-designed using a co-construction approach with learner action and involvement in mind. Classroom practice affords learners the opportunity to “reframe their thinking ... by giving (them) a voice - their personal voice - and by helping them see that this voice is valid and needs to be heard in the larger discussions of what society could be like” (McGregor, 2003, p 3).

The key concerns raised in this study are based on the current dominant science teaching practice of “banking education which anesthetizes and inhibits creative power” (Freire, 1970, p. 62). Others call such dominant practice “‘telling’ sessions, which are authoritarian, prescriptive unchanging, context blind and discriminatory” (Jansen, 1999, p. 4), and “the reproduction of traditional, transmission-oriented interactions and activities” (Ares, 2006, p.

6). It is against the backdrop of these key concerns that a critical science approach was adopted as it was deemed appropriate in the quest to free people from the anesthetising effect of the dominant practice discussed here. It also seemed appropriate in seeking and using an alternate and empowering practice. The infusion of critical science into the teaching and learning of school science is intended to bring about the needed transformation. A critical science approach requires teachers to think about improving or changing their pedagogical practices, rather than maintaining the status quo of the dominant science practices (McGregor, 2003).

As discussed earlier in the Prologue, McGregor's (2003) notion of "power sharing" between the teacher and his or her learners creates affordances for both learners' and teachers' learning. "The teacher has to learn how to relinquish authority to the students, who in turn have to be comfortable with assuming authority – control, making judgments, dealing with power, making and enforcing rules, etc." (McGregor, 2003, p. 4). Teachers and learners "need to see themselves as learners together and be aware of power relations and how this power arrangement affects the learning environment and process" (p. 4). This points to the need for co-designed learning encounters, and the co-construction of school science knowledge. This holds the key to freeing learners from classroom practice that is based on the interests of the teacher or the elite. Instead, practice should be underpinned by "critical science philosophies of relevance, personal meaning, and responsibility for one's own learning" (McGregor, 2003, p. 3). As discussed in the Prologue, Beck (1994) reminds us that both the teacher and the learners have authority, and that "we need to think in terms of reciprocal authority" (p. 2).

2.1.5. Critical science in education

Endres (1997) posits that "critical theorists, inside the educational field, link their accounts of oppression and hegemony to positivism as a method of social science" (p. 1). Critical theorists therefore reject positivism or traditional science as a method of social science because of its close association with notions of 'objectivity', 'control', and 'certainty' (Endres, 1997). The central tenets of positivism, as the object of critique, are outlined by McCarthy (1998, pp. 138-139) as:

- There is a 'unity of the scientific method' for humans as well as natural science.
- Scientific investigation, whether of social or non-social phenomena, aims at the discovery of law-like generalisations that can function as premises in deductive explanations and predictions.

- If the appropriate general laws are known and the relevant initial conditions are manipulable, we can produce a desired state of affairs, natural or social.

A positivist approach does not reflect any role for personal and political dimensions of scholarship, although it gives overt and exclusive attention to empirical observation and logical validity (Endres, 1997). A positivist view of reality and knowledge is that it “can simply reflect the world, [it] leads to the uncritical identification of reality and rationality: [where] one experiences the world as rational and necessary, thus deflating attempts to change it” (Agger, 1991, p. 109). This view goes against what critical theorists set out to achieve, namely, to develop “a mode of consciousness and cognition that breaks the identity of reality and rationality, viewing social facts not as inevitable constraints on human freedom [...] but as pieces of history that can be changed” (Agger, 1991, p. 109).

It is in this vein that Endres (1997) criticises traditional science for being ‘unreflective’ and ‘uncritical’ in not regarding oppression as an object that can produce genuine knowledge, and for its exclusion of value claims and normative concerns. However, for the author, critical theorists “fail to fully articulate their own epistemic criteria as distinct from those associated with positivism” (p. 1). Similarly, commenting on the work of critical theorists, Apple (1990) and Giroux (1981), Endres (1997) asserts that they “do not elaborate the ethical context of their own epistemology” (p. 1). It is against this backdrop that teachers’ day-to-day classroom practice was infused with critical science in order to address the problems of traditional practice, as highlighted by Endres (1997).

Critical science education has a strong link with authentic educational practices (Barton, 2001; Eilks, 2002; Gilbert, 2006), which is made by bridging the gap between school-based educational practices, and local community real-life experiences.

Drawing on the work of Sadler *et al.* (2006), Nuangchalerm (2010) defines socio-scientific issues as “controversial, socially relevant issues within science curricular [...that] have come to represent important social issues and problems which are conceptually related to science in a societal dimension” (p. 35). Nuangchalerm (2010) further posits that, as a result of socio-scientific issue-based instruction,

“Argumentation can transform idealized notions of science classrooms from repositories of science facts to environments that foster legitimate ‘peripheral participation’ (and that) students do not just learn about science or complete

science activities; they become more broadly enculturated into science and come to appropriate scientific practices. While scientific practice include conceptual understanding and skills, commonly promoted in science” (p. 36).

The author views the exploration of scientific controversies as a pedagogical approach that allows students to critically evaluate and debate competing scientific claims. In drawing on the work of AAAS (1990), the author asserts that “as students gather, interpret, and consider evidence of multiple defensible positions, they may begin to conceptualize science as a dynamic and complex enterprise” (p.36). For AAAS (1990), the student’s ability to argue varies, and those who display a greater quality of reasoning possess an advanced understanding of related science concepts. Nuangchalem (2010) also finds that “socio-scientific issues offer a way to explore the nature of science, bridge student and scientific literacy, interdependence of science and the society movement, and democratizing science in society”, and that this teaching approach “can make a connection between the goal of science education and student needs and fulfil them to (gain skills in) higher order thinking, discussion skills, inquiry-based learning, and understanding the nature of science” (p. 36).

In the context of environmental education, Down (2006) maps out some general guidelines and practices that might assist in the task of reimagining teachers’ work in a more socially just, democratic and sustainable way. Drawing on Beyer (1998), he asserts that “teachers’ work needs to emphasize critiquing current realities and participate in the recreation of our worlds” (p. 43). In addition, he agrees with Beckman and Cooper (2004) that “teacher’s work is critically bound up with the ideals of democracy and the values of ‘social cohesion’, empathy, caring, respect, reciprocity, and trust” (p. 43). Down (2006), drawing on the work of Shor (1992; 1987) and Freire (1998), summarises a set of values in terms of how teachers might begin thinking and acting on a vision of critical teaching – these values are participatory; affective; problem-posing; dialogic; researching; interdisciplinary; and activist (Down, 2006, p. 47).

McFadden (2006) posits the following tenets, which underpin a science and democracy approach to learning, namely:

- An increased role for socially responsive and responsible science education, one that includes attention to science-related social issues and makes consideration of the social uses of science and technology part of the science curriculum.

- Teaching science within the context of the personal and social concerns that now preoccupy our species.

(McFadden, 2006, pp. 2-3).

The above discussion firmly locates critical science within education in general, and within classroom practice in particular. Its intricate link with authentic educational practices enable classroom practitioners to bridge the gap that exists between learners' classroom learning, and their real life experiences. Working in this way creates affordances for learners to use the knowledge gained at school in order to improve or change their own and others' living conditions. In the following section, I discuss the concept of democracy, firstly as theorised broadly and as applied in education, and secondly, as conceptualised and used in this study.

2.2. DEMOCRACY

In this section, I briefly discuss the idea or notion of democracy in general with regard to the meaning(s), including a brief look at the history of democracy in Africa, the foundations of African Democracy, as well as the notion of 'communocracy' as the basis for African democracy. This will be followed by a discussion on democracy in education, and democracy in science, including some aspects of democratic citizenship. The section then concludes with a discussion on the fundamental underpinnings of a socio-political conception of democracy.

2.2.1. Democracy: general meaning(s)

As mentioned earlier in the Prologue, in this study I did not set out to explore the ideals of democracy and what it should be like, rather, I wanted to find out what was actually done by teachers in the creation of a space for democratic living. The call to democracy is an invitation to learner involvement through greater debate in a pedagogical and social space, and comprises the interplay between content and pedagogy. The critical questions concern the possibility and implications of extending the notion of democracy into the science classroom. These questions are: What are science teachers' understanding(s) of the classroom as a space for democratic living? And, how do science teachers construct and enact the science classroom as a space for democratic living? This study sought answers to these questions, and discussion within this and other subsections on democracy are thus intended to shed light on what the participating science teachers actually did to infuse their practices with democracy.

Theoretical advances in science, and across other disciplines, enables researchers in science education to begin to use theoretical frameworks from disciplines such as, *inter alia*, social studies, sociology, anthropology, mathematics, philosophy and psychology (Tobin, 1985). This study employed insights gained from other disciplines to inform and advance science learning and teaching that enables learners to be involved in the process. A variety of concepts as related to the term democracy are now presented. "Democracy is not something a society 'gets': democracy must be fought for each and every day in concrete instances, even long after democracy is first constituted in a society. If citizens do not engage in this fight, there will be no democracy" (Flyvbjerg, 1998, p. 5). It is not a fixed notion, as democracy "has to be constantly discovered, and rediscovered, remade and reorganised" (Dewey, 1937, p. 182). It is the basis for self-government, and is viewed as "the central tenet of our social and political relations. It is the basis for how we govern ourselves" (Apple and Beane, 1995, pp. 4-5). It is from ulterior motives that the central tenets and ethical anchors, such as 'democracy', tend to be converted into rhetorical slogans and political codes to gain popular support for all manner of ideas, and are thus fraught with ambiguity (Apple and Beane, 1995). Claims for democracy are used to further the causes of free market economies and school-choice or school enrolments, particularly in well-resourced schools, and to justify almost anything that people want to do (Apple and Beane, 1995). Apple and Beane (1995) go on to clarify that, "some people say that democracy has simply become irrelevant, that it is too inefficient or dangerous in an increasingly complex world. For these people, the democracy defence itself has become cumbersome or, perhaps, not sufficient to get them what they want" (p. 5). It is possibly just an illusion, and there looms the possibility of the illusion of democracy as authorities invite participation to 'engineer consent' for predetermined decisions (Graebner, 1988).

On the other hand, Henderson and Kesson (2004) developed six categories of skills or abilities considered crucial to what they call 'the democratic way of living': "understanding over knowing; self (student) planning/regulating/ evaluating; social wisdom and tolerance; technology; communication; and the definition of self" (p.103). It therefore appears that there is no one universal definition of democracy (Karumanchery and Portelli, 2005), and that democracy encompasses a "chaos of meanings" (Hoffert, 2001, p. 39). Hoffert (2001) also asserts that, "When we embrace 'democracy', we do not make our lives easier or clearer; we take on an engagement of demanding responsibilities, perplexing possibilities, and paradoxical choices" (p. 39). This complexity is observed in the tension that exists between two key democratic values, namely, liberty and equality.

In a democratic country, the government is responsible to “establish and maintain a fair and secure order in which individuals can maximally pursue their self-defining activities” (Hoffert, 2001, p. 34), whereas the government is also equally committed to the equality of all human beings. It is against this background that an African notion of democracy is explored, as discussed below.

2.2.2. African conceptions of democracy

Oyekan (2009) finds that “The clamour for democracy all over the globe is not accidental. Those who go about such business of agitating for democratization are convinced that no society truly desirous of development can ignore democracy” (p. 214). The author contends that Africa will develop better if the leadership question is addressed first, as a gap exists between the anticipated gains of democracy, and the reality that exists on the ground. He argues that “the universal features that define democracy are requisites for development everywhere” and that there are “peculiar factors that stringently inhibit the manifestation of this relationship in Africa” (Oyekan, 2009, p. 214). These factors, and the gap discussed earlier, are due to a failure in leadership in Africa. Oyekan (2009) offers the following reasons for the many divergent meanings of the concept democracy, reasons that he argues make it difficult to present an objective definition of democracy:

Democracy has become, in current usage, another word for political decency and civilisation. It is an idea that has become a moral concept thereby drawing the patronage of various regimes that proffer it more for the sake of survival than true commitment to its ideals. Democracy is difficult to define due to the ideological connotation. For example, the ideological tussle the socialists and the capitalists has engendered a situation in which regimes become tagged democratic not necessarily because of its participatory tendencies but mainly due to its ideological persuasion (Oyekan, 2009, p. 215).

For Oyekan (2009), it is imperative to seek out the ideal definition of democracy in Africa. He thus draws on the work of McGowan (1991) to explain why this is so. He avers that, “If democracy is not properly defined people would live in an inextricable confusion of ideas, much to the advantage of demagogues and despots”, and that, “it leaves us in the danger of refusing something that we have properly identified and getting in exchange something that we would not want at all” (p. 215). Additionally, the author believes that the problem in Africa is the inability to differentiate between democracy as content and as form. As content, “refers to

democracy as the rule of the people, including all its features listed earlier, without which there is no democracy. By form, it refers to the various ways it manifests itself in each society, tendered by cultural peculiarities” (p. 221). Oyekan (2009) further explains that:

- “Those with financial muscle or power use this to manipulate the process in their own favour” (ibid, p. 218).
- “Protocol and formalities of democracy take time to arrive at decisions, which may at times prove fatal” (ibid, p. 219).

On the reason why democracy cannot deliver on its exaggerated promises, Owolabi (1993) asserts that “African culture is not in congruence with democracy [and...] having realized that the days of colonialism were numbered, the West discovered that it could not survive without exploiting the reserves of the third world countries. One way by which the West can successfully realize this goal is to step up its cultural Imperialism and promote its democratic culture as the ideal culture” (p. 115). This indicates that democracy is to be seen as an instrument of continuous exploitation by the West and antagonistic to native culture (Oyekan, 2009). Adelman, (1998) argues that the history of democracy in Africa is not a happy one, and that if, with Post (1991, p. 36), we understand it to mean “the ineffable right of all of us as human beings, without distinction of gender, race, nation or class to control the decisions that determine our daily lives and future prospects”, it follows that there is a large democratic deficit in Africa.

Additionally, he notes that the culpability of Africans themselves in this is to be assessed in light of the destructive influence of external agencies. He contends that the “top down control instituted by colonial powers under the guise of democracy corrupted and destroyed local customs and traditions, and disrupted prevailing social relations reconstructing them as customary law that bore little or no relation to African history” (p. 76). Adelman, (1998) argues that “African societies are amongst the most pluralist in the world, comprising as they do a diversity of tribal, ethnic, cultural and religious groups, different traditions, and people divided along urban and rural lines” (p. 73).

Diallo (2006) introduces the notion of ‘Communocracy’ as an African form of inclusive democracy, and explains the philosophical foundations of African ‘Communocracy’, which he argues hold the potential to remedy the many economic and political crises in Africa. He views the idea of African ‘Communocracy’ as the most accurate way to think in terms of Western democracy. The author also finds that the “road blocks to this African form of inclusive

democracy” resides at the roots of the economic and political crises in Africa, and that “these crises can be traced back to the colonial origin of the African state and the devastating legacy of five centuries of unfair relations [...and] remedies will be sought by reaching back to the indigenous, pre-colonial form of African political philosophy” (Diallo, 2006, p. 1). Such long term foreign and failed colonial influences on needy African states were designed to oppress them and were thus not intended to serve Africa’s best interests, but to serve their own exploitative colonial interests (Diallo, 2006). It is for this reason that Diallo (2006) posits the notion of ‘communocracy’ as the basis for African democracy, and as an alternative to address the ‘chronic political instability’ in Africa. He contends that Africa has strong social systems and a political heritage to build on, which include, *inter alia*:

- Post-Apartheid African renaissance – which serves as a trigger to look within the tenets of Africa’s indigenous political philosophies for a model for inclusive democracy that is rooted in the local reality and experience.
- Southern African community philosophy of Ubuntu – describes the essence of being human through other human beings. It used as the basis to find ways toward reconciliation and reconstruction. It is a universal concept that embraces all humanity within the circle of the human race, (i)t is a philosophy that transcends ethnic and racial boundaries, religious affiliations, ideological and political limits (Koka, 2001).

(Diallo, 2006, p. 2).

According to Diallo (2006), and flowing from the above accounts of communal activities, human need for social belonging, individual autonomy, and the desire to participate is universal to all human societies. Of the three aforementioned, participation is particularly significant as without it human life is meaningless. In politics, participation can either be direct or through representatives (Diallo, 2006). The author claims that political participation in traditional African society is ensured through the representatives of the various age sets, secret societies, guilds or trades, clans and family elders. Additionally, political organisation is decentralised due to the diverse ethnic groups each with a high level of autonomy. Diallo emphasises that these conditions foster the development of ‘communocracy’, a concept introduced by local philosophers. According to Koka (2001):

Communocracy is a socio-political concept, that is, in essence and application, deeper than the Greek version of democracy. It is a concept of today and tomorrow’s global village. It contains the elements of universality and inclusiveness in its scope and operation (p. 11).

The concept of African communocracy, according to Diallo (2006), makes it possible for the characteristic of unity in life to co-exist side by side with that of diversity in culture, beliefs, and practices. Notably, unity in life does not deny the diversity of human cultures, languages, habitats, socio-political, economic and production systems.

2.2.3. Democracy in education/schools

Arguing for democracy in schooling, philosopher Gutman (1987) asserts that the democracy in schools provides the foundation for protecting our civil and political freedoms as adults. The democratisation of the teaching and learning space can no longer be part of some form of ‘hidden’ curriculum, but needs to come into view within the context of the new educational milieu. The hidden curriculum can be defined as “all the other things that are learnt during schooling in addition to the official curriculum” (Meighan, 1986, p. 66).

Regarding the idea and effect of the hidden curriculum, researchers Marsh and Willis (2003) argue that: “parts of the environment that are unplanned or even un-plannable [...] (such as [...] conventions for social relationships that form the overall, but constantly shifting, milieu of the school) seem to exert a more subtle but far greater influence over what students learn than does the official curriculum itself [...] and] hidden curriculum problems can only come into view when the educational milieu is part of the deliberations” (p. 11). Educationalists posit that “attitudes and values necessary for the continuation of a democratic society can be promoted in schools” (Gollnick and Chinn, 2002, p. 30). Democratic schools and classrooms result from explicit attempts by teachers to create opportunities and arrangements intended to bring democracy to life. Such arrangements include, firstly, the creation of appropriate structures and processes through which life in the classroom or school is enacted, and secondly, the creation of a curriculum that will engage learners in learning experiences that promote democracy (Apple and Beane, 1995, p. 9), and “good learning” (Claxton, 1989, p. 181). The focus of this study is based on what teachers say and actually do in their classrooms, and why they do what they do in the creation of a classroom that promotes democratic living.

Given that science content and skills are centrally predetermined, the study assumes that a teacher’s job does allow him or her some room to manoeuvre and that he or she has some degree of freedom and choices that are open to him/her for the way he or she may operate or mediate learning in the classroom. According to Claxton (1989), teachers’ practice involves decision-making, and certain values and attitudes are embedded in every decision(s) a teacher

makes. Even when a teacher's sense of freedom is limited, it becomes more important to not to lose sight of it, nor the opportunity and responsibility to create teaching and learning opportunities that will engage learners in learning experiences that promote democracy. However, advocates of democratic classroom practices shed light on the value of providing learners with opportunities for choices and increased ownership over the learning process (Vithal, 2004). As learners progress through school, this ownership is particularly important as they are later required to make critical decisions that would affect both their high school and post-secondary school lives. The DOE (2001; 2004) acknowledges the challenges that teachers face when new ideas for change are introduced to instil a democratic culture in schools. Few such programmes have succeeded in enhancing the relationships in the school community in a sustainable way.

Embracing democracy in teaching and learning spaces through relationship-driven teaching practice, as explored in this study, would shed light on this matter for future investigations, and for education stakeholders who wish to promote democratic values in learning environments. It is against this backdrop that the following questions arises: Is democratisation good for the learning of science? Are there any studies that show that it is good for school-based science learning? A wealth of literature on democratic principles and ideas tracing back to ancient Greek times exists, but, according to Henderson and Kesson (2004), there is no rich narrative heritage on how democratic ideals are experienced on a daily basis in cultural sites such as the workplace, community or school. Henderson and Kesson (2004) argue that the Deweyan conception of "experience" holds the key to relating such ideals to everyday occurrences. This idea is succinctly articulated by Jackson (2002):

What Dewey found to be attractive about the notion of experience in the first place was its breadth of coverage [... he was] openly committed to the goal of social betterment through the continued criticism of ongoing social practices and cultural traditions (Jackson, 2002, pp. 53-54).

The 'breadth of coverage' of one's lived experiences reveals, to a large extent, how democratic ideals are experienced on a daily basis, and indicates a generative and generous life (Henderson and Kesson, 2004). Hence, to be generative is to serve as an agent of human growth. A generative educational experience allows for the on-going "development and fulfilment of self, while [its opposite ...] stunts and starves selfhood by cutting it off from the connections necessary to its growth" (Dewey, 1985, p. 302). The use of the term democracy by the above

educationists and education theorists (Apple and Beane, 1995; Dewey, 1985; Henderson & Kesson, 2004; Vithal, 2004) reflects a more instrumentalist view of the term democracy, that is, it is used to bring about or create the democratic person.

2.2.4. Democracy and science

In the UK's context, Levinson (2010) offers an overview of contemporary techno-scientific questions and the tension placed on science and technology's responsiveness within the public domain. The author argues, on the basis of the work of Bybee (1997), Hurd, (1998) and Laugksch (2000), that: "nouns such as 'democracy' and 'citizen' are slippery, historically contingent and context-specific, particularly when combined with the umbrella term of scientific literacy" (p. 71).

Levinson offers a set of different descriptions of democracy, namely: associative, representative, deliberative, and radical. However, he warns others of the danger associated with the common or rhetorical use of these descriptions of democracy,

It can come to disguise problems and contradictions which, if ignored, might lead to the persistence of antidemocratic practices and ultimately disempowerment of different constituencies of the public in decision-making on scientific and technological issues (Levinson, 2010, p. 71).

Teachers' infusion of democracy within classroom learning encounters is meant to invite and increase learner involvement in, and to promote ownership of, science learning. This is done in an attempt to humanise science and make it more popular with young people (Cerini *et al.*, 2003; Osborne and Collins, 2000), as the subject of science has come to be perceived as detached from learners' every day, real life experiences. Levinson (2010) acknowledges, however, that democratic practices in science, and particularly science education, "raise some difficult questions in a subject that in recent school curricula has been highly framed (Bernstein, 1977) [... which] attempts to humanise science [... and] come up against strong epistemological objections in conflating the socio-political milieu in which science is done from the quality of knowledge and evidence demanded in establishing truth claims (Haack, 1997)" (p. 71). Drawing on the work of Donnelly (2004), he further finds that,

Unlike the humanities, science is instrumental; it enables prediction and control, which go beyond any values we might attribute towards its procedures. The 'potentialities of the material world are not to be altered by any number of social

values, though of course such values may well influence which possibilities are realised' (Donnelly, 2004) (Levinson, 2010, p. 71).

The author points out how, within the objective world of science, values cannot be completely separated from the scientific enterprise. Human subjectivity has a role to play in the construction of science knowledge, and hence the humanisation of science was attempted through the incorporation of social aspects of knowledge construction, as conceived in this study. In relation to this shift in focus for science education, the author draws on the work of Dawson (2000), Donnelly (2006) and Thomas (2000) to posit that,

Not only are the technical details of scientific and technological issues frequently at a level of complexity that would confound any layperson, but the interweaving of social, economic, political and ethical matters attendant on most contentious issues deepens the problems of what democratic participation can realistically mean (Levinson, 2010, p. 71).

A discussion on the availability/existence of literature on democracy and its role and impact on science teaching and learning follows. In my literature search, one article that stood out in exploring and highlighting the concept of democracy in science education was *Science education for democratic citizenship through the use of the history of science*. In this article, Kolsto (2008) argues that, “under certain conditions, cases from the history of science should be included in the science curricular for democratic participation” (p. 977). In the article he uses a historical case study to illustrate a well-known case from the history of science, namely, Millikan’s and Ehrenhaft’s ‘battle over the electron’. Kolsto (2008) further discusses the nature of science in the context of science society interactions, and he argues that this is important when participating in democratic debates on socio-scientific issues. He pursues this stance in support of several educational organisations and science educators who have argued that insight into the nature of science needs to be included in science curricula to promote citizenship and democratic participation (AAAS 1989; Driver *et al.*, 1996; Millar and Osborne, 1998; NRC, 1996; OECD, 2001). Additionally, Kolsto (2008) highlights the need to prepare current and future citizens for democratic participation, as most people’s contact with science occurs through the many socio-scientific issues that they are confronted with as individuals or as members of society.

He clarifies that the history of science has the potential to contribute to insight into the procedural, contextual, and conceptual aspects of science. According to Kolsto (2008), science

that promotes democratic participation refers to science education aiming to prepare students for active, informed, critical and responsible participation in situations where insight into different aspects of science might improve the quality of their participation (Kolsto, 2001). Kolsto (2008) concludes by asserting that,

The use of narratives from the history of academic science needs to be combined with examinations of contemporary socio-scientific issues that include post-academic science and controversial science in the making. Such a balance between historical and contemporary case studies is crucial for a science curriculum for democratic citizenship (p. 996).

What new thrust does this endeavour bring to science teaching and learning? Through the notion of a ‘democratic space’, as defined in Chapter 1, the study set out to give prominence to the learners’ voice in science teaching and learning interactions. The study thus explored ways in which teachers can create opportunities for democratic living. In this study, I assumed that such an opportunity would promote the learners’ voice in order to mitigate, *inter alia*, the science achievement gap (Edyburn, 2006). It was also targeted that this endeavour would promote learning-friendly forms of social control with authority from within a teaching and learning relationship. The notion of democratic space provides opportunities for, and invites science teachers to begin to engage in the kind of transformative and liberating education that is imperative for the future (Kyle, 2006; Roth and Désautels, 2002). This kind of science classroom space allows the teacher to create opportunities for the learners to be at the centre of educational practices where the learners initiate most of the discourse in the classroom in the presence of a supporting teacher guide. In such a context, the learner rather than the teacher asks the questions. This context also requires the consideration of plural accounts of phenomena, and a context that permits deliberative dialogue or dialogic discourse. In this instance, dialogic discourse would require the use of learner presentations and/or small group discussion.

2.2.5. Democratic citizenship and science

Extending democratic principles and processes to teaching and learning spaces is a vital part of the new learner-centred curriculum approach, namely, Outcomes Based Education (National Curriculum Statement (NCS), DOE, 2003). The integration of democratic principles into classroom practices is not new as this has been done since the early 1990s within the United States (US) (Oliva, 2001; Tanner and Tanner, 1995). Drawing on the work of the above two

curriculum theorists, Pryor (2004), posits that “common core knowledge (e.g. mathematics, social studies, science) could be enhanced by a parallel pedagogy – the integration of democratic principles into classroom practices” (p. 2, brackets in original).

According to Pryor (2004), the history of democratic classroom practice was initiated in a US context in the early 20th century by educators who developed teaching strategies that promoted students' independence through freedom of thought. Such practice was new in a period that favoured methods such as recitation and memory-based activities. Pryor (2004) explains that not all policy makers were in agreement regarding the integration of democratic principles into classroom content teaching and learning, opting instead for democratic principles, namely: liberty and freedom; justice and fairness; and equality and equal opportunity, which were to “be implemented as a ‘standalone’ approach in which teaching about democracy is a separate core content area” (p. 2). For Pryor (2004), the use of the above three principles of democracy “as a basis for instructional decisions constitutes democratic classroom practice” (p. 1). He points out that “teachers remain committed to teaching the state-mandated content standards, however, interest in modifications of instructional decisions to include democratic principles remains high” (Pryor, 2004, p. 2).

My belief is that one of the key tasks of science teachers is the problematisation of science and technology (Roth and Désautels, 2002). The assumption here is that, in the words of Roth and Désautels (2002), “it is through this problematization that we can reappraise the role of science education in the service of an informed and engaged citizenship” (p. 2). It is for this reason that the issue of democratic citizenship is highlighted below as a key educational outcome. Youth today are citizens, and they regard themselves as such (Alderson, 2000). As citizens, they also have an authentic voice, which must be heard (Article 12, United Nations Convention on the Rights of the Child, 1989). In order to avoid an unproblematic presentation of science and technology in the development of an informed and engaged citizenry, Roth and Désautels (2004) draw on the sociology of scientific knowledge and adopt a stance that differs from conventional science education, particularly as it is portrayed in the literature on scientific literacy. They contend that,

One must begin with the notion of an active and critical citizenry and then problematize science and technology in its service [...and] describe science and technology as being built on contingent practices [...they become] subject to

interrogation of the assumption that underlie their moment-to-moment decision-making processes (Roth and Désautels, 2004, pp. 3-4).

This is a necessary step to take as it has the effect of bringing about change and to create space for people to the following:

Deconstruct the arbitrary social hierarchy of knowledge that put scientific knowledge on top of the epistemic heap, and rehabilitate other forms of knowledge including common sense, local expertise, and indigenous knowledge as a powerful resource in the debates over socio-technical controversies (Roth and Désautels, 2004, pp. 3-4).

The authors argue that the various forms of scientific knowledge are marked by contingencies (material, symbolic, economic, social, etcetera) that constitute the local conditions of their production. They further maintain that the so-called universal character of scientific knowledge is a kind of mystification.

Levinson (2010) clarifies that,

The citizen uses the resources of science to try to address socio-political, as well as individual issues. These resources involve negotiation with scientific experts where scientists would have to be committed to the same enterprise, i.e. shared perception of social purpose ... socio-political issues such as the need for a sustainable society, concerns for social justice and human rights, and inclusivity (Levinson, 2010, p. 75).

According to Levinson (2010), in a UK context “throughout post-industrial or late-modern societies, the curriculum links between science and citizenship for informed decision-making have become ever closer” (p. 69). For him, in the UK and countries with parliamentary democracies, “there has been evidence of a breakdown of trust between citizens and policy-makers, including [...] issues of science and technology”. He further holds that,

Distrustful publics will respond negatively to the introduction of new technologies thereby threatening the nation’s competitiveness as a knowledge economy. This has resulted in attempts either to remediate the problem through greater transparency in policy-making and/or to find new concepts of citizenship and polity (Levinson, 2010, p. 70).

With regard to the use of school science as a vehicle for learners’ democratic participation, particularly through the issue of techno-science, Levinson (2010) raises the

following question, if science could be used in this way, “what kind of science is presupposed in this bigger picture?” (p. 75). On the basis of this question, he explicates that,

Critiques of mainstream school science have portrayed it as a capitalist machine for enhancing the quest for corporate profits; that an unsatisfactory re-hashing of the grand narrative of science; and ‘value-free’ (Levinson, 2010, p. 76).

Based on this explanation, Levinson (2010) elaborates on four different frameworks for democratic participation in techno-scientific issues, reflecting science-society interactions, and how incorporating these frameworks in a school context could be addressed.

For him, the move from a school-based study of content-led science to, amongst other things, socio-scientific issues, “are a response to recognising the social, technological and ethical aspects of contemporary science through an enhanced understanding of the nature of science” (p. 76). His review of the relevant literature focused on one of the main purposes of the “socio-political aspects of reforms [in the UK], namely the democratic one, that science education towards scientific literacy should provide the means for informed citizens to participate in democratic decision-making on contemporary techno-scientific issues” (p. 76). Levinson (2010) identifies (on p. 78) four different teaching and learning frameworks of education for democratic participation in techno-scientific issues, namely:

- Scientific knowledge and democratic participation: the deficit framework;
- The dialogic and deliberative framework: interactions between experts and interested parties;
- Participation in knowledge production: science education as praxis; and
- Participation through conflict and dissent: moving towards scientific citizenship.

(Levinson, 2010, p. 78-103).

The above frameworks are viewed effective in terms of the affordances that each allows, or the constraints that each pose on effective decision-making for participants regarding issues that affect them. Levinson avers that the first two have a constraining effect on decision-making as they fail to acknowledge the political barriers and the way that science policy is implemented. The latter two frameworks, on the other hand “enhance the possibilities for critical democratic participation but they involve a radical re-orientation of present science curriculum policy and different ways of producing and using scientific knowledge” (p. 110). It is for this reason that the latter two are elaborated further in this section in order to draw insights

for use in this study. The distinguishing features of science education as praxis are listed as: knowledge is distributed; knowledge is interdisciplinary; relationship between expert and lay knowledge; scientific literacy; citizenship action and authenticity; and science as emergent knowledge (Levinson, 2010, pp. 100-101).

The distinguishing features of participation through conflict and dissent are summarised below:

- Democracy as a system of enabling a struggle between competing, or agnostic interests, and, is therefore oppositional, rather than a move towards consensus or overlapping interests (Rawls, 1993);
- Conflict is core to a pluralist democracy;
- Educating political emotions is about developing a sense of social justice and the ability to feel anger on behalf of injustices committed against those in less powerful social positions rather than on behalf of one's own pride;
- Elucidating the distinction between moral and political anger; and
- The development of political literacy.

(Levinson, 2010, pp. 104-106).

While the above had a positive effect on curriculum change and supported discussions in citizenship and science, “they did not go far enough in reflexively deconstructing the assumptions behind scientific literacy in schools and the barriers for democratic practice (Roth and Desautels, 2004), as exemplified in the frameworks of science education as praxis and conflict and dissent” (p. 108). With respect to students’/pupils’ voice, Levinson (2010) posits that, “Since the inclusion of Article 12 in the UN Convention of the Rights of the Child, there has been considerable research on student voice work” (p. 109). He explains that the UN Convention has initiated a lot of research that has explored the importance and role of student participation in learning, particularly in science. He elaborates on the research conducted, for example, pointing out that schools “need to work within a perception that ‘power relations are unequal and problematic’ (Robinson and Taylor, 2007, p. 8.). He further maintains that “normative goals of research in student voice to challenge those structures that hinder opportunities for equality of voice and transformative processes of empowerment” (p. 108) are necessary.

Levinson (2010) cautions that, “if the school system in the UK, with its top-down managerial structures, is likely to inhibit productive deliberative democratic discourse, then

schools are unlikely to be appropriate vehicles to enable this participation to take place, despite the rhetoric of science education reforms” (p. 109).

Similarly, the participants in this study had been using a particular set of democratic principles to underpin their own teaching practice since the year 2003, and had obtained similar benefits for their learners. The integration or infusion of democratic principles in the school core content areas by the participating teachers was effected through the use of a project-based learning approach to classroom practice. This was done through inviting their learners to take part in greater debate or dialogue in each lesson, and in this way, these teachers promoted learner involvement in science learning, and in the creation of democratic citizens through a non-instrumental and non-individualistic conception of democracy.

This conception of democracy is what makes these participants’ alternative teacher practice unusual. A socio-political conception of democracy, as defined by Biesta (2006), and a view of democratic education is conceptually different to that which is envisaged, or used, in what Pryor (2004) discussed earlier. This touches on an approach in which teaching and learning is about democracy, and hence it refers to an instrumental conception of democracy education in schools.

2.2.6. Socio-political conceptions of democracy

The fundamental underpinnings proposed by Biesta (2006) are presented in the following section. Traditionally, the relationship between education in schools and democracy has been understood as that of preparing the youth or ‘newcomers’ for their future participation in democratic life (Biesta, 2006). This is done to either equip the youth with the right set of knowledge, skills, dispositions, and values, as well as to prepare the youth for democracy through participation in democratic life itself. According to Biesta, (2006), both these approaches, therefore, seek to develop democratic citizens in the best manner possible.

“In this respect, both of the above listed approaches display instrumentalism and individualism in their approach to democratic education” (Biesta, 2006, p. 126). There are limits to what schools can do in attempting to teach democracy in this way. The reason for this is that there are other factors that work against such attempts, namely, “If the internal organization of a school is undemocratic, this will undoubtedly have a negative impact on students’ attitude and dispositions towards democracy” (Biesta, 2006, p. 124).

The author decries the instrumental use of the term democracy within education, particularly in the construction of the democratic person. The question for Biesta (2006) is whether this is the only possible way to understand the role of education in a democratic society. He suggests that how we respond to this question depends on our views of the democratic person. As opposed to Emmanuel Kant's (1992) individualistic conception, and John Dewey's (1966) social conception of the democratic person, the author focuses on Arendt's (1977) work to identify the notion of a political conception of democratic subjectivity. This conception enables us "to go beyond the idea of education as the producer and the safeguard of democracy" (Biesta, 2006, p. 126). Arendt's (1977) notion of subjectivity is rooted in her notion of the 'active life' for which she distinguishes three key dimensions, namely, labour, work, and action. These three dimensions are elaborated on below, drawing on the distinctions and elaborations made by Biesta (2006) on Arendt's work,

Labour is the activity that corresponds to the biological process of the human body. Work [...] is the activity that corresponds to the 'unnaturalness' of human existence; it has to do with production and creativity and instrumentality. It is concerned with making and therefore 'entirely determined by the categories of means and end'. Action [...] is the activity 'that goes on directly between men without the intermediary of things or matter' (Biesta, 2006, pp. 132-133).

The latter dimension, namely, action, is key in what Biesta (2006) identifies as a political conception of subjectivity. For Arendt (1977), to act means to take initiative, to begin something new, to bring something new into the world. For her, the human being is characterised as an "*initium*", as a "beginning and a beginner", as she believes that we continuously bring new things into the world through everything we do (p. 7). It appears that for Arendt, subjectivity is directly linked to action, namely, "to be a subject means to act, and action begins with bringing one's beginnings into the world" (Biesta, 2006, p. 133). For Arendt, action as beginning corresponds to, among other things, the fact of birth as with each birth something uniquely new comes into the world for each unique individual. However, in order for each person as a unique individual to act, and to be a subject, others are needed to respond to each person's beginnings or initiatives. Drawing on Arendt's work, Biesta (2006) develops his political conception of subjectivity in asserting that,

When [...] I begin something and others do take up my beginnings, I do come into the world, and in precisely this moment I am a subject. The problem is, however, that others respond to my initiatives in ways that are not predictable, because we

always act upon beings “who are capable of their own actions”. It is [...] precisely the “impossibility to remain unique masters of what we do” that is at the very same time the condition – and the only condition – under which our beginnings can come into the world (Biesta, 2006, p. 133).

According to Arendt (1977) and Biesta (2006), action, as opposed to work, is not possible in isolation, “to be isolated is to be deprived of the capacity to act” (Arendt, 1977b, p. 188). In this sense, the need for other(s) and plurality is key for action. In other words, to act means to take initiative, to begin something new, or to bring something new into a world populated by others who respond to our beginnings or initiatives in ways that we have no control over. To emphasise this point, Biesta (2006) asserts that,

As soon as we erase plurality, as soon as we erase the otherness of others by attempting to control how they respond to our initiatives, we not only deprive others of their actions, but at the same time, we deprive ourselves of our possibility to act, to come into the world, and to be a subject. (According to Arendt) we would have left the sphere of action and would have entered the domain of work (Biesta, 2006, p. 134).

The above discussion on human subjectivity provides us with an understanding thereof as a quality of human interaction, as Arendt (1977a) maintains that subjectivity only exists in action – “neither before nor after” (p. 153). Action and subjectivity, in this instance, can be compared with the performing arts because performing artists need an audience to show their “virtuosity” (p. 153), “just as acting men need the presence of others before whom they can appear” (Arendt, 1977a, p. 154). It is in this context that Biesta (2006) argues that,

Individuals might have democratic knowledge, skills and dispositions, but it is only in action – which means action that is taken up by others in unpredictable and uncontrollable ways – that the individual can be a democratic subject (Biesta, 2006, p. 135).

The above idea of subjectivity can be seen as a social conception of subjectivity, but Biesta (2006) holds that it is a political conception when he asserts the following,

Not any social situation will therefore do [...] Arendt relates subjectivity [...] to the life of the polis, the public sphere where we live – and have to live – with others who are not like us. It is precisely here that we can see the link with democracy, in that democracy can precisely be understood as the situation in which everyone has the

opportunity to be a subject, that is, to act and, through their actions, bring their beginnings into the world of plurality and difference (Biesta, 2006, p. 135).

Expanding on Arendt's notion of 'action', Biesta (2006) links action with democracy in asserting that,

To act, that is to be a democratic person in a world of plurality and difference, is therefore as much about doing and saying and bringing oneself into the world, as it is about listening and waiting, creating spaces for others to begin, and thus creating opportunities for others to be a subject (p. 139).

Notably, in a democratic school – a school in which action is possible – the notion of action discussed here is not consistent with learner centredness if learner centredness is viewed as self-expression without care for others.

Accordingly, "action is anything but self-expression; it is about the insertion of one's beginnings into the complex social fabric and about the subjection of one's beginnings into the beginnings of others who are not like us" (Biesta, 2006, p. 139). Arendt's notion of subjectivity and of the democratic person embraces an 'action-centred' approach to democratic education, one that focuses both on the opportunities for students to begin, and on plurality as the only condition for which action is possible (Biesta, 2006). The responsibility of schools in this situation is two-fold: firstly, for each learner or individual, and secondly, for "the world", that is, the space for plurality and difference as the condition for democratic subjectivity. Flowing from the above is the need for schools to overcome what might obstruct opportunities for learners to act in the 'Arendtian' sense of action. It is then for the school to find innovative ways to implement a set of requirements, as identified by Biesta (2006), and that they be implemented within the day-to-day school routines so that the experience of democracy is 'lived' and becomes real. A political conception of the democratic person, as discussed earlier, does not require a curriculum that produces a democratic person, instead, it demands schools in which democracy, understood as action-in-plurality, is a real possibility. In initiating learners' own beginnings, schools may embark on this task in different ways as Biesta (2006) points out that, "There is [...] no blueprint of what a democratic school might look like, and there is no guarantee that what works at one point in time in one situation will also make action possible in other times and places" (pp. 140-141).

A notable distinction at this juncture is the shift away from the traditional approach to democratic education to an Arendtian emphasis on action, and that subjectivity only exists in action where we come into the world through the ways in which others respond to, and take up our new beginnings. The former asks: how can individuals learn to become a democratic person, whereas for the latter, the question of learning is not about *how to be a subject?* but rather, *what can be learned from being/having been a subject?* (Biesta, 2006).

The learning at stake here is learning from and learning what it means to act, to come into the world, to confront otherness and difference in relation to one's own beginnings. To understand what it means to be a subject also involves learning from those situations in which one has not been able to come into the world, in which one has experienced for oneself what it means not to be able to act. Such an experience of frustration could, after all, be far more significant and have a much deeper impact than the experience of successful action (Biesta, 2006, p. 142).

We are reminded as teachers that not all learning encounters will afford all learners an opportunity to act, and that learners are not to be compelled to do so. Rather, the teacher is compelled to be vigilant in taking note of the learner(s) who is unable to respond or act within the curriculum offered by the school. The inability of the learner to act may not be his fault. This point raises the need for reflection on the part of schools, learners and teachers on situations in which action was possible, and in which action was not possible. Two critical features of the larger study that this chapter is drawn from, are, as discussed below, democratic space, and learning encounters, both created by the teacher. Pursuant to the above discussion is the need for reflection as a key constitutive component of teacher designed learning encounters.

2.3. SUMMARY OF CHAPTER 2

This chapter dealt with the key theoretical underpinnings of the study, namely, a critical research approach, and democracy. These two theoretical orientations of the study were used to explore the phenomenon of teacher practice. The insights gleaned from the theoretical underpinnings point out that the teacher's role is such that he or she must respect and have compassion for co-learners. The teacher should be conscious of his or her own perspective of life, learning and knowing, and he or she should be keen to learn of other's perspectives. The learner's role is to engage in dialogue, reflective writing, listening and sharing using their own

language (McGregor, 2008, p. 2). The next chapter deals with the conceptual background to the problem, namely, the literature review.

CHAPTER 3

CONCEPTUAL BACKGROUND TO THE PROBLEM: A LITERATURE REVIEW

Classroom practitioners often use the terms ‘teacher practice’ and ‘teaching practice’ interchangeably, and refer to them as though they mean the same thing. An additional term, ‘school practice’, is also used to refer to the work of the teacher within the school or the confines of the classroom. Consequently, the literature on the work of a school teacher reflects that there are currently a number of conceptions on what such work is, what it entails, and how it is described, namely, *teacher practice*, *teaching practice*, *practice teaching*, *classroom practice*, and *pedagogical practice*. Some definitions touted by researchers, for example, Beresford (1960), indicate what a teacher does on a full-time basis at school level, whereas others, such as those used by Stones and Moss (1972), point to what a teacher does in preparation for his or her full-time work at a school after completion of such preparatory work at a tertiary institution. However, none of the above terminology regarding the work of a teacher differentiates between the general work and the role of the teacher, whether inside or beyond the confines of the school, and that which is related to classroom practice in particular. For the purpose of this study, I have narrowed down the above terms to two concepts, namely, teaching practice and teacher practice.

It has to be clearly noted at the outset that the literature is not explicitly clear on the meaning of either teaching practice or teacher practice. It appears from the literature that these two concepts of a teachers’ work do not restrict the teacher’s work and role to the confines of the school classroom, which I will clarify below. The use of the terms ‘teacher practice’ and ‘teaching practice’ often depend on the context in which they are used, and depend on whether the person is still a “student in training” (Beresford, 1960, p. 38), or a whether he or she is a qualified and licensed teacher. The term ‘teaching practice’ is used from time to time as a specific kind of practice or profession that a teacher engages in with his or her learners within a school – regardless of the stage of the teachers’ growth and development, specifically in terms of whether they are still in training or are a qualified teacher.

In this study, I use the term ‘teacher practice’ to refer to the work and role of qualified teachers, in other words, practising teachers working on a full-time basis within the school classroom and beyond. The work and role of practising teachers, namely teacher practice, is the concept under study in this research.

Teacher practice is there to inspire advance learning. “One of the most valuable attributes of the successful teacher is the habit of observation in order that he may be sensitive to responses of pupils, to fatigue signs, to insipient restlessness and so on” (Beresford, 1960, p. 38). This study pays particular attention to, and has an interest in the kind of teacher practice that promotes greater learner involvement, and one that is sensitive to learners’ responses to the science curriculum offered by the school. This places emphasis on the work of qualified and experienced teachers, who are able to affect such change.

3.1. PROBLEMATISING ‘TEACHING PRACTICE’

The use of the term ‘teaching practice’ has been used as early as the 1960’s by Beresford (1960), who explains that it refers to “students in training,” and that “almost universally throughout the Commonwealth University teaching practice takes the form of: A short preliminary period of two to three weeks spent in schools at the beginning of the course (which is followed by) a period of continuous teaching practice lasting some eight weeks during the middle period of the course” (p.183). Stones and Moss (1972) assert that “Teaching practice occupies a central place in teacher education” and that “there are different aims [regarding the] effectiveness and the methods and purpose of the assessment of teaching practice. These need thorough research [... as] effective teaching practice must involve the teacher education institutions, the school and the students in a concerted and unified effort on the conception of its aims and objectives” (p. 446). The *Report of the Working Party on Teaching Practice* (University of Exeter, 1974) notes that “The present conception and rationale of teaching practice are misconceived and lead to the perpetuation of outdated methods tending to restrict development and stifle innovation” (p.3). Notably, this report uses the term ‘practice teaching’ – yet another term to denote the work of the school-based classroom teacher, and it illuminates the problems that are highlighted by Stones and Moss (1972). Locally, a 1985 *Preliminary Report on Teaching Practice* by the Faculty of Education, University of Durban-Westville concluded that: “Apparently there are many discrepancies between practices advocated at University and (a) those enforced during teaching practice, and (b) those used by practising teachers” (p. 4). This report makes a distinction between teacher training practices (which it refers to as ‘teaching practice’) and those used by qualified teachers in the school situation (or ‘practising teachers’). It also informs us that numerous discrepancies exist between the two.

I use the term ‘teacher practice’ to refer to the work and role of qualified teachers, in other words, practising teachers in the school classroom and beyond. Teacher practice in

science appears to be determined by the teachers' perspective of how this subject should be taught to his or her learners. There are those teachers who equate the subject of science with the notion of a 'body of knowledge' that is to be taught to newcomers through the transmission of knowledge, from him or her, to learners. Contrariwise, there is another view in which it is asserted that "science is a body of concepts and purposes" (Millar and Driver, 1987, p. 56). From this position, teacher practice takes on a different hue where greater emphasis is placed on a process approach to the teaching and learning of school science.

Close (1973) recounts an additional variation of how science is viewed, one that is based on the idea that a distinction can be made between facts and concepts. This view holds that "concepts provide an intellectual shorthand which helps to organise large amounts of factual information" (p. 16). This view is in fulfilment of science as a body of 'purposes', and it holds that "facts should be taught in context, and in relation to broad concepts" (Close, 1973, p. 16). Educational theorist Gee (2008a) argues "that the theory of learning in many schools today is based on 'content fetish' [which] is the view that any academic area [...] is composed of a set of facts or a body of information and that the way learning should work is through teaching and testing such facts and information" (p. 200). The author argues that we have reached "a central paradox of all deep learning" because,

It won't work to try to tell newcomers everything. We don't know how to put it all into words, because a domain of knowledge is ... made up of ways of doing, being, and seeing, ways complex enough that they outrun our abilities to put them all into explicit formulations. When we do put what we know into explicit words, learners often can't retain them or even really understand them fully because they have not done the activities or had the experiences to which the words refer.

And that,

Simply turning learners loose to engage in the domain activities won't work either, because newcomers don't know how to start, where to look for the best leverage, and which generalisations to draw or how long to pursue them before giving them up for alternatives. Of course, we can hardly expect learners to reinvent for themselves domains that took thousands of people and hundreds of years to develop (Gee, 2008b, p. 201).

He further finds that the above paradox has caused those involved in education to reach for "post-progressive pedagogies", that is, pedagogies that combine immersion with well-designed guidance" (p. 201). Current work on curriculum development views science as a

human activity where knowledge is seen as personally and socially constructed, rather than being seen as 'objective', and revealed theories are seen as provisional, rather than being seen as absolute (Mossom, 1989, p. 33). Other researchers view knowledge as situated within cognition on the part of the learners themselves (Lave and Wenger, 1991).

In this study, I focus more on a socio-political and sociocultural view of knowledge and learning, one that views the learner as an active meaning maker who brings his or her own prior conceptions to bear in interpreting new information. Teacher-created 'opportunity to learn', as I use the term, is based on the co-creation of science knowledge, a process in which learners are supported with appropriate learning 'scaffolds' so that they can eventually use their own agency to make their own meaning. It is assumed that 'opportunity to learn' in the manner described here would require an appropriate theory of learning for it to counter the stranglehold that traditional teacher practice has in the South African school situation.

This view of knowledge and science pedagogical practice is required in order to replace current dominant and traditional forms of teacher practices discussed in other sections of this study. Examples of traditional practice found in the 'current situation' in schools is presented below. Mossom (1989, p. 55) draws on the work of Close (1973) to identify and list examples of traditional practice, namely:

- *Concept adoption* rather than concept formation, where 'adopted concepts are taken over ready-made by rote memorisation', and the concepts learned in this way are 'repeated when necessary but are nothing but empty verbalism and are no use to the child in interpreting new situations' (Mossom, 1989, p. 55).
- "*Meaningless verbalism* which can be recalled at will but in a given problem situation the chances are that the relevant concept will not be available as the learner does not appreciate the significance of the concept in a useful situation. This probably means that there are vast stores of 'average' citizens who are under-utilising their accumulated knowledge because they are unable to transfer it to a different situation" (Mossom, 1989, p. 55, emphasis added).

Working in this context, as described by the above authors, would mean that underachievers are persuaded to work under pressure from the teacher, which causes a situation where the educator instructs the class as a whole and does not take care of the individual differences in the pupils' learning.

3.2. TRADITIONAL PRACTICE

Brady (1985) posits that “the term ‘traditional’ has been used in the pejorative sense by teachers (and progressive education theorists) to describe a style of teaching that is archaic, inflexible, and completely lacking in innovation” (p. 17). Traditional practice, as described by Mossom (1989), presents a more technical approach to the practice of teaching and learning, a view of the school teacher’s work that has long been discredited, as discussed in this study. Bruner (1974) maintains that, “Pedagogical theory [...] is not only technical but cultural, ideological and political. If it is to have its impact, it must be self-consciously all of these” (p.122).

In this study, depreciatory or valueless teaching styles that place school learners in positions that requires them to be inactive, unquestioning, passive, voiceless or obedient during science lessons are consistent with teacher practice that is said to be ‘traditional’. Teacher practices that promote this non-involvement of the learners in the process of teaching and learning include, inter alia, teaching as ‘telling’; teacher classroom design as ‘an architecture of control’; the classroom as a space for the teacher to assert his or her authority to transmit knowledge to the learner as a consumer; and the teacher hammering their own views into learners’ heads (Shor, 1996, p. 11). ‘Traditional’ in this sense refers to practice that has been with us for more than a hundred years, that is, John Dewey (1916) registered his deep frustration then: “Why is it, in spite of the fact that teaching by pouring in, learning by a passive absorption, are universally condemned, that they are still entrenched in practice?” (p. 38). Mossom (1989), in her work entitled: ‘*Science teaching by means of the process approach in the primary school*’, identified modern interpretations of ‘traditional methods’ of science teaching. She identified two types of such teaching methods.

The first type of traditional’ practice is drawn from Brady (1985), namely, an exposition model, which can be viewed as a modern interpretation of ‘traditional methods’, and which is defined as a teacher-centred model of teaching. This model focuses on the expository methods of narration and explanation, which for her includes the use of practice and revision to consolidate learning (Mossom, 1989, pp. 59-61). The second type of ‘traditional’ practice is based on Wolfinger’s (1984) findings, namely, an exposition-with-interaction model wherein the teacher both presents information verbally and asks questions to determine whether that information is understood (Mossom, 1989, p. 61).

A concern for this study is that within our local context, ‘traditional’ teacher practice still abounds and is deeply entrenched, as recounted by Sigamoney Naicker (2006). She holds that, “Within the South African context it is common knowledge that bureaucrats and public service government officials pay scant respect to disciplines that examine knowledge itself, its origins and nature” (p. 2). She argues that educators’ concept and understanding of the production of knowledge are at odds with the new vision for local education. Her position on the state of poorly trained teachers during the period of interregnum has contributed to the understanding of ‘epistemological issues’ and how they impact teacher practice and education transformation in South Africa. Naicker’s (2006) work, as cited below, illuminates the current stranglehold that ‘traditional’ teacher practice has on our local school situation. Her work is relevant, particularly with respect to teachers’ disregard for existing curriculum policy requirements, and classroom practices that alienate or ‘shelter’ learners from their own community and cultural experiences (Hawes, 1979). According to Naicker (2006),

Educationists, publishers and other stakeholders run the risk of reproducing the status quo. At a time where there is a wonderful opportunity to create space within a developmental and interventionist state for creativity, imagination and adaptive minds to the specificities of diversity, knowledge production and training in most spaces is lacking a sound theoretical framework. Sound theoretical frameworks provide the intellectual tools to understanding assumptions, models, practices and tools of the new policy (p. 5).

It is against this backdrop that this study searched for an alternative form of practice. ‘Traditional’ practice has become dominant in the South African schools context with Shor (1996) arguing that the dominant teacher practice bestows unlimited authority upon the teacher. In this study, I questioned unlimited or absolute teacher authority, however, teacher authority that is balanced with learner authority within a democratic social space, and one that promotes co-designing and co-construction of meaning, is consistent with the aim of this study. This led me to explore more transformative (McGregor, 2008), progressive or post-progressive (Gee, 2008b) approaches to teacher practice.

3.3. TRANSFORMATIVE OR PROGRESSIVE PRACTICE

The concern of this study is dominant and traditional teacher practices that encourage the transmission of knowledge by the teacher through, for example, ‘persistently hammering’ isolated or unrelated facts and information into learners’ heads. This form of ongoing ‘symbolic violence’ no longer has any value, neither for the learner nor to education (Gee, 2008b). It

usually goes hand-in-hand with ‘symbolic control’, which, in the words of Geertz (1990), refers to the “plans, recipes, rules, instructions [and] ‘programs’ for the governing of (learner’s) behaviour” (p. 49). The teacher’s role in the transmission of knowledge to learners, and the rules for accomplishing such a role, is described by Bernstein (1990) as,

The process of learning how to be a transmitter entails acquiring the rules of social order, character, and manner which become the condition for appropriate conduct in the pedagogic relation. It is these rules which are a prerequisite of any enduring pedagogic relation. In any one such relation the rules of conduct may to different degrees permit a space for negotiation Bernstein (1990, pp. 65-66).

In a classroom context, as in the above quotation, the learners’ role is viewed as being the ‘recipient of the teacher’s discourse’ (Freire, 1985, p.48), and to supply the teacher with the right answer (Jones, 1997). Non-traditional or transformative practice, alternatively, according to Ares (2006), is underpinned by “three generative processes: autonomy, responsibility, and contribution to classroom practice” by school learners, because “they are integral to a movement toward full participation in classrooms” (p. 1).

Ares (2006) elucidates on the trio of generative processes that fundamentally underpin transformative practice,

In addition, they are important in inclusive transformative practice because they provide avenues for exercising power (e.g., responsibility), and for shaping practice in ways that are inclusive of participants’ lived experiences (e.g., contributions) and their cultures and languages (e.g., autonomy) (Ares, 2006, p. 1).

School transformative teaching and learning spaces, as posited by Ares (2006), are those where teachers co-create teaching and learning opportunities that shape classroom practice, and are spaces that co-determine the what (content) and the how (conduct) of learning involved in a manner that allows for improved learner autonomy, contribution and responsibility. For Ares (2006), the above generative processes include changes in learners’ autonomy, or having control over and responsibility for decisions about their learning; responsibility for production of knowledge and practice; and contribution to the practices of the community. The term ‘generative’ is consistent with transformative practice, and is used by the author to indicate that the above trio of processes “build on prior experiences and foster students’ and communities’ dynamic, flexible knowledge and skills that support success in

future activity”, and that “issues of both learning and agency are essential to this definition” (p. 3). An increase in one, or all of the triad of generative process is integral to learning and to learners’ increased levels of involvement and ‘action’ in the classroom and community of learning. Regarding the ways of enacting transformative practices in the classroom, Ares’ (2006) argument is that teachers’ lack of a foundational theory of learning prohibits them from possessing the necessary theoretical tools to translate their educational ideas into action. This view is consistent with that held by Naicker (2006, p. 5) regarding teachers’ poor training and lack of “understanding of epistemological issues and how they impact thinking, practices and transformation in general.”

Drawing on the work of Courts (1997), Ares (2006) asserts that teachers can bring transformative practices into life in the classroom “through (the use of) a valid and constructive theory of learning [...] designed to meet the individual needs of different students as students evidence such needs” (p. 4). In terms of the need for an anchoring framework to translate educational ideas into transformative action, particularly in the classroom, Ares (2006) argues for the use of socio-cultural and situated learning theories because they “provide a useful framework from which to examine classroom processes by focussing attention on the concrete, material activities and interactions that underlie practice. They can support identifying classroom processes that afford opportunities for transformation of conventional classroom activities” (p. 4). Her use of the above two learning theories as an underpinning framework to enact transformative practice is useful for practitioners because “it bridges critical aims of education and processes that structure it” (p. 3). In so doing, teachers’ classroom practice is able to connect politics and educational processes, and promotes greater learner involvement through learners’ increased ‘responsibility’, ‘autonomy’, and ‘contribution’.

It is against the backdrop of the above insights that this study set out to find an alternative form of classroom practice, one in which school-based science has a much broader aim than the mere successful rote learning of isolated facts. In Ares’ (2006) words, I argue for a broader aim for education, one that is consistent with the new vision for education locally,

Transformative (school classroom) practice has as its project social transformation, so the aims of education are not simply successful learning, but learning grounded in and emerging from critical examination of the social order and one’s place in it. The aim, further, is action in service of social justice as a consequence of school (science) learning (Ares, 2006, p. 5).

McGregor (2008) posits that there are three types of education or orientations to the curriculum, namely, transmissional, transactional, and transformational. She also sheds light on the differences between these orientations, “They differ on several dimensions: control and sharing of power, what counts as legitimate knowledge and how meaning should be constructed, the intended learning outcome, and attendant pedagogical approach” (p. 1). In a transmissional orientation, power rests in the hands of the teacher; the focus is on the content and subject matter; and the teacher’s role is that of an expert that transmits information in a one-way relationship to the students; whereas the students are seen as clients or consumers whose role is to master the content presented to them (McGregor, 2008, p. 2).

From a more transactional orientation to the curriculum, teaching practice moves closer to a collaborative approach of power sharing where the focus is on problems and their solutions using content generated by the teacher and the students. The teacher is an expert, a facilitator, mentor, and guide. For the learner, what the learner and teacher know counts as knowledge (McGregor, 2008, p. 2).

And lastly, in the transformative orientation, teaching places the student at the centre as co-learners; the focus is such that teacher and learner both take on a more critical, multidimensional view of society, far beyond the formal classroom. The teacher’s role is such that he or she must respect and have compassion for co-learners; is conscious of his or her own perspectives of life, learning and knowing; and is keen to learn about others’ perspectives. The learners’ role is to engage in dialogue, reflective writing, and listening and sharing using their own language (McGregor, 2008, p. 2).

3.4 TEACHER PRACTICE CONCEIVED AS INSTANCES OF FACILITATING DEMOCRATIC LIVING

Rizvi and Saint (1999), in “*Learning for Democratic Living*”, argue for a move from political democracy to the process of ‘democratic living’. They posit a framework for democratic living in which they posit that “democratic living requires that the principles of equality, freedom, pluralism and human dignity permeate and invigorate our ... educational institutions and all other aspects of our social and spiritual being” (p. 2). Such a framework advances the notion of a democratically mindedness which means: “that individuals and communities are able to resist and renegotiate oppressive relations of power and to take control over decisions that fundamentally affect their lives” (p. 2). This involves, according to the

authors and at the school classroom level and in terms of to envision what it means to be fully human; and to actively work together to discover/create new sustainable and just ‘realities’ ... involves qualitatively redefining the mainstream perception of power: from something to be grabbed, hoarded, and used to dominate/threaten others to something to be generated (from within ourselves), shared and used to inspire/empower all life” (Rizvi and Saint, 1999, p. 2). With respect to the notion of democratic living and education or schools, the authors assert that, “the vast majority of subject matter in schools today is taught in isolation, so segregated and disconnected from the rest of one’s experience that it has no relevance or applicability for the actual conditions of life”, where the following, amongst others, holds:

- The time-consuming and mind-consuming process of ‘acquiring’ isolated facts and useless skills has a destructive impact: the individual loses his own soul, his appreciation of things worthwhile, his desire to apply what he has learned, and the ability to extract meaning from future experiences;
- There is no space for the learner to frame what s/he wants to learn or to even question the legitimacy of what is being taught;
- Enforced quietness and acquiescence prevent pupils from disclosing their real natures.
- By denying children’s diverse thoughts, talents, desires and imaginations, and utilizing mechanized modes of instruction teachers fail to nurture each child’s unique individual potential; and
- The lack of both physical and mental freedom not only inhibits the creative thinking processes necessary for conscious democratic living, but it also promotes a kind of debilitating passivity in which children grow up feeling as hopeless and helpless about their ability to control their own destiny and positively impact society.

(Rizvi and Saint, 1999, p. 2).

The authors aver that one of the key qualities of democratic living is equality. They posit that “when we speak of equality, we speak of both diversity and transformation, that is, we envision pluralistic, just, and meaningful systems in which the differences among people are valued and nurtured and feelings of inferiority/superiority are discouraged. (p. 6). On the context of education, and classroom practices in particular, they argue for change towards a democratic pedagogy, arguing that “schools never set out to give all children the opportunity to think, challenge, question, and create for themselves and their societies” (p. 7).

Drawing on the work of Linda Darling-Hammond (1997) regarding ‘democratic pedagogy’, they posit *inter alia* that “democratic classrooms emphasize engagement, ownership, autonomy, diversity, deliberation, critical thinking, and open expression throughout the learning process” and that “notions of authority and leadership are also redefined: students’ natural drives towards self-esteem, self-responsibility, and self-discipline replace the hierarchical relationship between teacher and students”, and that “teachers can begin practicing democratic pedagogy by challenging the non-democratic processes that infest

schools/classrooms today and by working together to critically examine their own visions of democratic living” (p. 12). They hold that “New participatory processes of learning, unlearning and relearning must therefore be initiated to liberate our whole selves from the current ‘institutionalizing’ and ‘compartmentalizing’ structures and to regenerate the knowledge frameworks, identities and relationships necessary for democratic living” (p. 12).

Education theorists, Henderson and Kesson (2004) on the other hand, draw on the work of Dewey (1989) to advance their argument with respect to ways in which school teachers ought to be ‘facilitating democratic living’ in their classrooms. They posit that, to approach democracy as a way of life, or as a ‘moral standard for personal conduct’ (Dewey, 1989), is to extend a democratic outlook to one’s daily living and teaching-learning interactions (Henderson and Kesson, 2004). They argue that “educational quality is linked to instances of democratic living” rather than having “students test well on standardized measures”, and that, “just because students test well on standardized measures does not mean they are becoming good human beings” (Henderson and Kesson, 2004, p. 93). Standardised tests, according to the authors, “drive an instrumental focus on rote factual learning”, whereas in the hands of democratic teachers, such tests could be a useful tool because “the tests would inform curriculum judgement, not to be used as a substitute for judgement. The master would be the educator, not the state-minded test. Educators’ central evaluative concern would be on how well they are facilitating democratic living in their classrooms” (p. 93). On the ways of facilitating democratic living in the classroom, Henderson and Kesson (2004) assert that:

Facilitating democratic living in the classroom requires **subject** matter instruction in a context of democratic **self** and **social** learning. The relationship between these three dimensions of student learning is depicted in figure 1 below ... The framework encourages a balanced approach to traditional subject centered concerns and progressive student-centered and society-centered advocacies ... (it) offers a general test of how well a course of study is functioning as an instance of democratic living (pp.93-94).

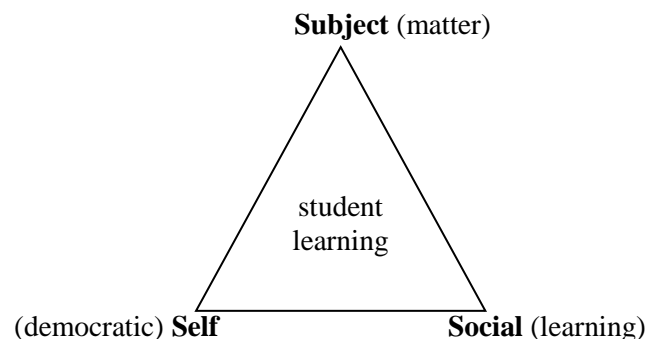


Figure 3.1. Three dimensions of student learning (Henderson & Kesson, 2004)

The above 3S student learning framework requires that educators consider the relationship between ‘consciousness about the nature of the self and social learning embedded in particular

subject matter instruction' (p. 94). Informed judgment is required to transform courses of study into instances of democratic living. The authors posit that the use of the 3S student learning as a point of reference, enables subject teachers to pose a number of critical questions about the curriculum offering, namely:

- How does the curriculum address subject-matter learning in a context of democratic self and social learning?
 - If the curriculum lacks this proper 3S balance, why is this the case/
 - Is there a 'hidden' curriculum problem?
 - What are learners learning about self?
 - What are they learning about social relations?
 - What are they learning about content, and how does this content relate to self and social relations?
 - How does the model help substitute democratic responsibility for traditional authority as a referent for educational work?
- (Henderson and Kesson, 2004, pp. 93-94).

3.5 THEORISING TEACHER PRACTICE

In this study, the aim was to foster learner involvement in all aspects of science learning by arguing, like educationists Hawkins and Pea (1987), Lemke (1990), and Pea (1993) for the need to reorganise science learning encounters so that learners "come to be able to 'talk' science and to produce and interpret speech acts involved in participating in scientific activities, rather than just 'hear' science" (Pea, 1993, p. 273). I argue for the ubiquity of learning in all aspects of collaborative activity within a "community of practice" (Lave and Wenger, 1991), and a learning "commune" (O'Sullivan and Rusch, 2005). In the quest for an alternative teacher practice, I further argue for the development of meaning by learners through the use of material, objects and texts that they encounter while constructing the Portfolio Boards (PBs) used in Project Based Learning. Planning learning encounters that allow all learners to be involved depends on how you view or define learner involvement. According to Fijo (2010), learner involvement "could be viewed by the level of academic challenge for the students, or their ability to actively collaborate with other students and the teacher" (p. 1). The author's view is that, although learners may be involved, or give the impression that they are involved during the learning encounter, "it is hard to qualify the degree of (involvement)", and key for him is the idea that "while using technology (or other teaching and learning assistive devices) may be engaging (or involving) in and of itself, it is important to evaluate the level of engagement and its role in the learning (and teaching) process", or whether or not such tools or devices are able to "enhance or promote higher-order thinking skills" (p. 1).

On the need for learner involvement that enhances or promotes higher-order thinking skills, the author explains that,

Higher-order thinking by students involves the transformation of information and ideas. This transformation occurs when students combine facts and ideas and synthesize, generalize, explain, hypothesize, or arrive at some conclusion or interpretation. Manipulating information and ideas through these processes allow students to solve problems, gain understanding and discover new meaning (Fijo, 2010, p. 2).

Learners' higher order thinking through teachers' use of the Project Based Learning (PBL) approach affords learners the opportunity to be involved in their own learning. PBL integrates higher order thinking through its use of a variety of collaborative learning activities that allow for small group tasks in which three to four learners, and the teacher, work together on a specific sub-topic. Working in this PBL way, learners' collaborative learning efforts at the sub-topic level, where each learner has an opportunity to 'begin' or 'appear', are escalated to the larger topic level of discussion in which the chosen topic is addressed and solved. The teacher plans a set of learning encounters, each of which are designed with learner involvement in mind. In the PBL approach, learners invest more of their time and effort, leading to greater involvement in their own learning (Jafta, 2006). As opposed to traditional teacher practice, which would impose the lesson topic onto the learners, the PBL approach affords learners the opportunity to be self-immersed in the teaching and learning process because they are affected and live with the problem in their own community. Such learner involvement through teachers' unusual classroom practice usually begins and then progresses from a transitional form of involvement, leading to a transformational level of involvement. The term transitional implies that the learners transition away from the dominant forms of teaching and learning, which do not pay attention to their interests, thinking, or experiences regarding the lesson topic, and thus promote low-order thinking on their part.

The learners thus transition to a new mode of learning, learning to respond to challenging questions, learning to think for themselves, and learning to narrow the gap between their home life and their science classroom life. Transformational learner involvement, according to Fijo (2010), refers to teacher practice, the use of learning assistive devices, or teaching and learning support material – each of these, “transforming the learning process for the (learner) and often containing some form of higher-order thinking skills” (p. 2).

An example of the transformative involvement of the learner is when PBL affords him or her the opportunity to design a survey or interview data collection form to find out the extent of the local community's problem while working as a member of a small collaborative group. The learners work as a small group where the PBL learning encounter enables the group to collaboratively design, write, and edit their interview or survey form. PBL enables the different working groups to "combine their ideas, compose, analyse and evaluate writing, all within one space. This engagement is transformational in that it takes various elements of the writing process and combines them into one experience, allowing the process to become collaborative, rather than just an individual experience" (Fijo, 2010, p. 2). The co-construction of the Portfolio Boards (PBs) from the beginning, during, and after the learning process drives the 'learning as response' process. It also drives the co-construction of prerequisite knowledge, skills and dispositions, the design and planning, and it shapes the production process of the PBs themselves. Jointly, they each provide the energy that drives the learning process. From this practice, one can argue that "a project focuses your attention on a specific challenge and concentrates your energy" (Malcolm, 1992, p.23). PBs, both singly or flexibly conjoined as a single unit, serve as powerful and persuasive visual artefacts (or 'mediation device') that are used to augment and extend learners' thinking about problems in science content learning. What makes this kind of practice unique is that learners do not first learn science content and then develop or construct the project or artefact of their learning gains afterwards.

Davies (2001), alternatively, maintains that "Educators are learning important lessons about how to involve students and others in ways that support student learning" because, "(w)hen students communicate their learning using a variety of work samples, they go beyond what grades, numbers and scores alone can show; they are able to examine the depth, the detail, and the range of their own learning to figure out their strengths and what they need to work on next [as] this is all part of learning to self-monitor – an essential skill for self-directed, independent, lifelong learners" (p. 1). Davies (2001) further states that involving students in communicating their learning signals a shift in roles and responsibilities for both teacher and learners, as outlined below,

Instead of searching for evidence that students have learned, teachers now help students find evidence of their own learning. Instead of waiting for a teacher to judge their work, students now collect, organize, select, and reflect on evidence of learning so they can show proof of their learning. Instead of waiting for a summary judgment such as a report card or the large scale assessment results in the local paper, parents and others now look at the evidence of learning,

listen to students explain what they've been learning, and give feedback about the learning to students. More people have an opportunity to understand what is being learned and to support students as they learn (Davies, 2001, p. 2).

According to the author, such a shift in roles and responsibilities occurs over time as teachers learn and gain expertise involving students in their own learning. Learners who have experience in communicating about their learning process are better able and prepared to have meaningful conversations with others, and are more ready to be partners in collecting evidence of their learning (Davies, 2000; Stiggins, 2000). This has been observed before, during and after the annual PC-SA showcase.

Other forms of involving learners in their own learning include the Socratic Learning Method (SLM), which, according to Lam (2011), is in keeping with the notion of learning for life, and teacher planned science learning encounters. The true goal of SLM, according to the author, is to afford learners an opportunity to examine their beliefs and any new information that they encounter. The assumption is that, if SLM is exercised frequently through a series of systematic questioning by the teacher or a learners' peer(s), learners will become independent learners with curiosity and sensitivity toward new information, and will gradually develop a mental habit of active inquiry and vigorous thinking (Lam, 2011). Another practice is that postulated by Béres (2008), whose argument is that a "not-knowing" stance – one that privileges learner and participant knowledge, encourages sustained dialogical interaction. In adopting such a stance, one that has 'positioned' the teacher, in terms of his traditional role, as someone who is all-knowing with respect to the subject of science, the teacher is able to temporarily feign ignorance by visually and bodily displaying and/or communicating verbally or non-verbally to the learners that (a) he or she is really interested in what the learner says or does, (b) he or she has not heard or seen what the learner is offering by way of a response to the teacher's questioning, (c) within a reasonable time frame, he or she is willing to carefully listen to, and take into account, all that the learner is prepared to contribute to the topic discussed, and that (d) there are always different ways of viewing the world as science knowledge will remain contested as and when new discoveries are made. The construction of artefacts drives the pedagogical process right from the beginning up until the presentation thereof before an authentic audience (done by a representative group from the learners' community of learning at an annual showcase).

According to Fedje (1999), learning to use and process information will always be more valuable than the acquisition of mere facts, and when a person is confronted with these ideas about facts and application, “connections begin to form between the notions of learning facts and applying facts”. She holds that,

An error in understanding can occur if the subject decides the facts have to come before the application. In reality, as learners work with examples and apply information, they learn facts through the process of application (Fedje, 1999, p. 14).

Pea (1993) draws from other researchers to argue that the creation of communications and the interpretation thereof “are the reciprocal processes of human conversational action through which the meaning of symbolic action involving talk, deixis, and such representations as diagrams and formulas get negotiated” (p. 268). Democratic space, such as that discussed and conceptualised in this study, elicits and invites learners to engage more in ‘talking’ science through the creation of a “conversational space”. In this space, learners can co-negotiate meaning with peers and with their teacher. Drawing on the work of others (Schegloff, 1992, Suchman, 1987), Pea (1993) sheds light on the way that learners negotiate meaning within a conversational and nurturing space, namely, through “using interactional procedures such as gestural indications of misapprehension, requests for clarification and elaboration, commentaries, repairs, paraphrases, and other linguistic devices for signalling and fixing troubles in shared understanding (p. 269). An Arendtian (1977) conception of ‘action’ is based on her notion of the ‘active life’ for which she distinguishes three key dimensions, namely, labour, work, and action. Her third dimension of ‘action’ is described by Biesta (2006) as “the activity that goes on directly between men without the intermediary of things or matter” (p. 133). Arendt’s conception of ‘action’ is key in what Biesta (2006) identifies as a political conception of subjectivity.

For Arendt (1977), to act means to take initiative, to begin something new, to bring something new into the world, and she links subjectivity directly to action. According to Biesta (2006), “To be a subject means to act, and action begins with bringing one’s beginnings into the world” (p. 133). In this instance, it needs to be “action that is taken up by others in unpredictable and uncontrollable ways – that the individual can *be* a democratic subject” (p. 135) and is thus a social kind of subjectivity for both learners and the teacher in the science classroom.

In employing Pea's (1993) ideas regarding communication and interpretation as reciprocal processes of human conversational action, for Biesta (2006), communication is not viewed as "one-way meaning transmission and reception of communicative intentions [...] but as two-way transformative communications [...] in which meanings emerge in the space between two interlocutors" (p. 268). Pea's (1993) ideas regarding meaning-making add practicality to Biesta's (2006) socio-political conception of subjectivity within a teaching and learning context. She proposes two generative meaning-making mechanisms that are viewed as integral to the conversational learning process, viz. meaning negotiation and appropriation. Stacey and Gooding (1998) have questions about collaborative learning, and argue that it may not produce any significantly enhanced learning outcomes in comparison to other types of learning. However, others argue that collaborative learning "is applied too liberally without the requisite structuring or scripting to make it effective" (Anderson *et al.*, 1996, p. 10). This is especially relevant to the way that the participating teachers applied this learning, as explored in this study. This study is cognisant of the argument that no one learning approach works for every learner, and hence other interactive learning approaches have been incorporated to involve learners in science learning encounters.

The participating teachers' practice, and practices of members of the local network, were enacted largely through the use of 'purposeful conversations' (Burgess, 1988), and 'collaborative conversations' (Hollingsworth, 1992), as they co-mediated learning using the Project Based Learning approach.

Teacher practice, also referred to as pedagogic work by Singh (1999), is largely constituted by principles of power and control. Vithal (2003) holds that "The notion of theorising a pedagogy is important in the effort to rescue it from its prescription connotation for practice" (p. 340). There is thus a problem in prescribing a method for practice, which has occurred in the local teacher training program contexts of the recent past (fundamental pedagogics), including the cascade model used for the introduction of C2005 and OBE in 1997/8 and the RNCS 2001. Thus, the problem of prescription for practice has become ensconced and continues to be so today in current classroom practice. In this study, which was underpinned by a critical perspective, there is no single classroom practice or method that can be followed. The reason for this is that a critical pedagogy includes and is based on different kinds of reflections made by practitioners both singly, or within a community of practice such as the local Network of teachers discussed in this study (Vithal, 2003).

Within the context of the methodological framing of this study, a view of teacher practice, as teacher praxis, is idealised as part of the ‘co-imagined situation’ (which is discussed later in Chapter 4, Section, 4.1) as a way for practice to be informed by theory and vice versa. Teachers who view critical pedagogy in this way bear the hallmark of a professional practitioner, one who engages in research and is informed by many kinds of (teacher) reflections within a science community of practice, for example (NETF, 2003). Teacher reflections conducted in the manner described here have the potential of opening up possibilities for providing more than one description of practice. In the words of Vithal (2003), “a critical pedagogy must offer some means by which teachers can take hold of the ideas and work with them, or take the risk of forever remaining in the realm of theory in imagined situations” (p. 341). In terms of this study, the participating teachers and I had the opportunity to co-imagine, co-construct, and then try out aspects of an alternative and new practice in the context of the workings of the local network. A trial version was carried out before enacting the same in the real and arranged situation back in our own classrooms with our subject learners (a move from theory to practice). We then later had the opportunity to jointly reflect on what we did in enacting this unusual practice that is linked to the notion of ‘democratic living’. The co-reflection involved sharing and describing our own experiences at subsequent engagements of the local network, it also included jointly composing a training manual to describe such practice as suggestions for initiating new members who required training in this practice (a move from practice to informed theory). The notion of teacher praxis, as idealised and discussed in this study, was used by the members of the local network in the manner described here. According to Vithal (2003), providing descriptions of practices and requiring reflections on those descriptions offer one an opportunity “to unify the battle between theory and practice” (p. 341).

3.6 CHAPTER SUMMARY

This study explored creative ways to enact the kind of teacher practice that promotes greater learner involvement, and creates real opportunity(s) for science learners to take initiative, and to actually encounter learning for themselves in the presence of other and plurality. Problematising ‘teacher practice’ has assisted me in narrowing down the phenomenon being explored in the study. It has also assisted me in theorising how teaching and learning science at the school classroom level could be transformed in a manner that encapsulates the notion of ‘democratic living’ in the classroom. This transformation would

promote greater learner involvement in their own learning through co-action with their peers and the teacher. The next chapter deals with the problem of epistemology, namely, part 1: the theoretical framing of the methodology.

CHAPTER 4
THE PROBLEM OF EPISTEMOLOGY. PART 1: THEORETICAL
FRAMING OF THE METHODOLOGY

The methodological framing employed in this study addressed the theory-practice praxis embedded in the two key foci of the study, namely, critical science and democratic pedagogical practice. In this regard, this chapter explores the theoretical aspects of what it means to do research based on:

- (a) A critical research approach,
- (b) The infusion of a critical perspective into science education, and
- (c) A practice that is unusual, and not yet well established.

In the paragraphs that follow, I give a description of critical theory by first discussing its origins, and then briefly discussing some of the current developments in critical theory. This is followed by a discussion on the infusion of a critical perspective into science education, and, lastly, I discuss an unusual practice.

Critical theory is associated with the Institute for Social Research, which was established in Germany in 1923, and is known as the Frankfurt School. The original members were of this school were Theodor Adorno, Max Horkheimer, Herbert Marcuse, Friedrich Pollock, Leo Lowenthal, and Walter Benjamin (Kellner, 1989; Agger, 1991). A major modern representative of the Frankfurt School is Jurgen Habermas (1971, 1980, 1987), a descendant of the Frankfurt School and a student of Adorno and Horkheimer. The current leaders of critical theory are, amongst others, Giroux (1993, 2009), McLaren (1998, 2005), Endres (1997), Kincheloe (2005) and Marri (2005), and the most recent proponents of critical theory are put forward by Aliakbari and Faraji (2011). According to Kincheloe and McLaren (2005), the two key aims of critical research are *deconstruction* of hidden assumptions and biases, and *transformation* in those areas that suppress, dehumanise or restrict human social life. Regarding the need for transformation in those areas that place limits on human potential, Kincheloe and McLaren (2005) posit that:

Research that aspires to the name 'critical' must be connected to an attempt to confront the injustices of a particular society or the public sphere within the society. Research thus becomes a transformative endeavour unembarrassed by the label

'political' and unafraid to consummate a relationship with emancipatory consciousness (p. 305).

This study is unashamedly socio-political in combining this notion of democracy with critical science as the core theoretical underpinnings, as mentioned earlier in this chapter.

Critical theory, according to Giroux (2009), refers firstly to the legacy of theoretical work developed by certain members of 'the Frankfurt School'. Giroux asserts that, on the part of the members of the Frankfurt School, "while one cannot point to single universally shared critical theory, one can point to the common attempt to assess the newly emerging forms of capitalism along with the changing forms of domination that accompanied them" (ibid). There was also an attempt on their part to "rethink and radically reconstruct the meaning of human emancipation, a project that differed considerably from the theoretical baggage of orthodox Marxism" (p.27).

Secondly, the concept of Critical Theory "refers to the nature of Self-Conscious Critique, and to the need to develop a discourse of social transformation and emancipation that does not cling dogmatically to its own doctrinal assumptions" (ibid). In other words, Critical Theory refers to both a "school of thought" and a process of critique (Giroux, 2009). He further posits that:

[Critical theory] points to a body of thought that is ... invaluable for educational theorists; it also exemplifies a body of work that both demonstrates and simultaneously calls for the necessity of ongoing critique, one in which the claims of any theory must be confronted with the distinction between the world it examines and portrays, and the world as it exists (Giroux, 2009, p. 27).

One of the central values of the Frankfurt School is "a commitment to penetrate the world of objective appearance" (Giroux, 2009, p. 27). This is promoted as a way to expose the underlying social relationships that the world of objective appearance so often conceals, and in doing so, we are able to expose social relationships that take on the status of things or objects through critical analysis. By examining notions such as teaching, and education resources, for example, "it becomes clear that none of these represents an objective thing or fact, but rather all are historically contingent contexts mediated by relationships of domination and subordination" (ibid). In this regard, he further argues that:

In adopting such a perspective, the Frankfurt School not only broke with forms of rationality that wedded science and technology into new forms of domination, it also rejected all forms of rationality that subordinated human consciousness and action to the imperatives of universal laws (ibid).

Drawing on Breine (1979/80), Giroux explains that the Frankfurt school argues against the suppression of “subjectivity, consciousness, and culture in history”, and “it stress[es] the importance of critical thinking by arguing that it is a constitutive feature of the struggle for self-emancipation and social change” (p. 28). Furthermore, the Frankfurt school maintains and describes that “it was in the contradictions of society that one could begin to develop forms of social inquiry that analysed the distinction between *what is* and *what should be*”. The Frankfurt school also found that people’s thoughts and actions should be based on their compassion and empathy towards others in their suffering (Habermas, 1980, cited in Breine, 1979/80).

On the infusion of a critical perspective into science education Vithal (2003) postulates that, in developing a research design, and in order to produce the corresponding required data for a research that claims to be critical, “the problem of methodology from the perspective of theory is two-fold” (p.46):

- Firstly, it is in finding a research design and process that allows for the investigation of alternative teacher practice or theory-practice relations; and
- Secondly, it is in acquiring or developing an appropriate methodology for researching an approach that embeds a critical perspective.

With respect to the implications of examining a particular theory and its related practices, Vithal (2003) proposes that we construct “a set of relationships between three (inter-related) ‘situations’, namely, *the current* situation, *the imagined hypothetical* situation, and *the arranged* situation” (p. 46). It is the interface between these three situations that brings to bear the theory-practice relation model, which is diagrammatically represented in Figure 4.1 below. The implication of the second requirement is that one should adopt an appropriate methodological framing, one that is guided by critical theory.

The model is used for a research design exploring stable practice that is different from conventional practice (of teachers other than those participating in this study), rather than changing practice from the conventional practice (of teachers in the study). The participating four teachers were recruited from the 35 members, of a local Network of teachers known as

PC-SA, who were trained initially in 2003 to participate in a training programme for three days on '*Project Citizen*' which requires that learners do project work on real-life societal problems chosen by them. Since its inception, the local Network of teachers and I as members have been using action oriented learning approaches to engage a small team of school learners outside school hours in project work in preparation for the annual showcase. Some members of the local Network implemented the approach learnt and used in PC-SA in their day-to-day teaching of socio-scientific issues in the preparation for the annual PC-SA showcase (See Jafta, 2006). The work done with the learners in the way described here is underpinned by democratic principles and, to some extent, critical pedagogy. It is against this backdrop that my utilisation of the model differs from what Vithal (2003) originally proposed.

The use of the model discussed above differs in that I was researching across as opposed to Vithal's (2003) project which engaged in researching down. The imagined hypothetical situation was largely imagined by the researcher, whereas the current project the hypothetical situation was co-imagined by the participating teachers and I during the meetings of the local Network members. The four teachers' practice is underpinned by democratic principles and incorporates project work and some aspects of critical pedagogy since 2003, and this eliminates the need to first develop the participants before implementing the project as Vithal did in her work. This aspect helps in minimising the problem of imposition as was the case with what Vithal did. One of the four participating teachers in this study located the intervention in the heart of the school curriculum, instead of doing it as an additional activity that is implemented outside the mandated school curriculum, and through this yielding rich data for bringing about the required change in teacher practice.

Vithal used her theory-practice relation model to explore alternative educational practice, or theory-practice relations, within mathematics education.

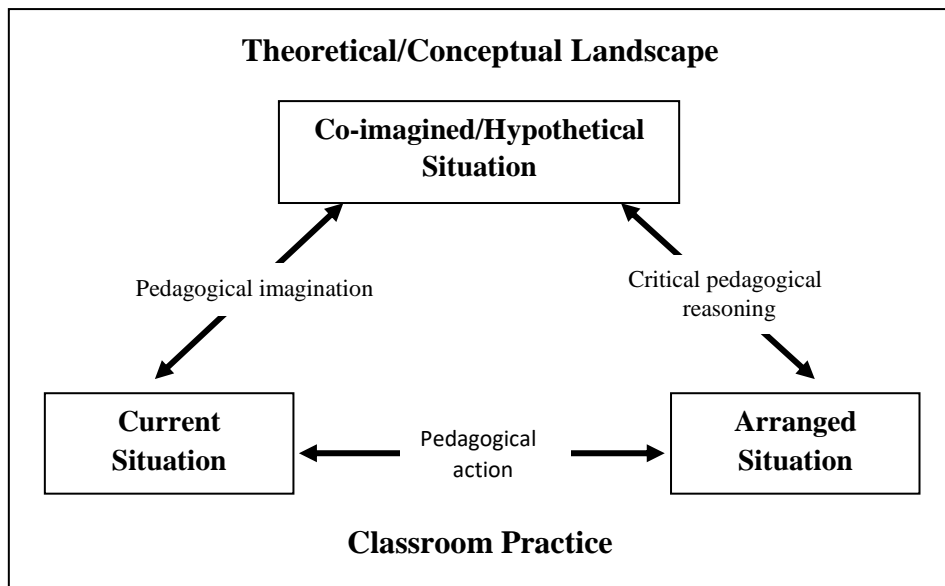


Figure 4.1 The current, co-imagined hypothetical and arranged situations, and the connections between these. Adapted from Vithal (2003).

This model is briefly described below.

The ‘current situation’ refers to the dominant science practices, or *what is*. It refers to the problematic situation that is in need of change, as well as teaching practices that could be described as undemocratic. In such a situation there is no choice or negotiation in the approach to the curriculum or classroom practice. The discussion on the local context (that is, curriculum, school culture, conventional classroom environment and learning experiences – discussed in section 4.1, subsection 4.1.2) fit into the current situation. The ‘arranged situation’ refers to a form of teaching practice (which deviates from dominant practice) that does not currently exist, or *what ought to be* or *what could be* (Vithal, 2003). Therefore, this situation is a new or rearranged situation that is created to try out an unusual or novel practice, that is, this is where the co-imagined situation is actualised. In this situation, choice and negotiation become key features in arriving at an alternative curriculum approach. Research Question 2 is about the arranged situation.

The ‘co-imagined situation’ refers to the theoretical landscape that is informed by notions of democracy and science, and the ideals of critical science. This situation reflects some notion of what the imagined ideal practice would be like. Research Question1 is about the co-imagined situation. Additionally, the agreed nature of the intervention within PC-SA features in the co-imagined situation where the meetings of the Local Network members served as a ‘professional learning community’ for their ‘continuing professional teacher development’.

According to Vithal (2003, p. 70), the above three situations are “connected through the qualities of the research process referred to as (i) *pedagogical imagination*, (ii) *pedagogical action* and (iii) *critical pedagogical reasoning*”. In other words, the three qualities of the research process that are visually and diagrammatically represented in Figure 4.1 above indicate the kind of co-operation that is required between the different role players involved in conducting research. In the process of generating data with the participants through participatory research, the qualities of research reflect the level or kind of co-operation that occurs between the participating teachers and the researcher (Skovsmose and Borba, 2004). In other words, “What qualities does such a co-operation bring to critical research?” (p. 215). Vithal (2003) talks about the notions of ‘potentiality’ and ‘transformacy’ with respect to the features and connections between the three situations in the above model. The notion of potentiality, that is, researching an innovative practice, or *what could be*, provided the participants and I as members of the Local Network to co-imagine such a transformed practice, and take an actual current situation and transform it through the use of an arranged situation. The notion of transformacy, according to Vithal (2003), refers to “the potential a research process carries for change in each of the situations” and that “as a result of organising an arranged situation for research, the current situation may never return to its original form” (p. 71).

As illustrated in Figure 4.1 above, *pedagogical imagination* refers to the creative process of conceiving an alternative to the current situation. An alternative in teaching practice is largely motivated by a concern with distorted power relationships that make it easy for some teachers to oppress learners by controlling knowledge, access to power, meanings, and daily practices (McGregor, 2003). Uncovering this power imbalance, or affirming power-sharing, if any, entails finding out *what is* so you can determine *what could be* (Rehm, 1999). As an example of this process, the members of the Local Network and I – at its scheduled monthly or quarterly meetings – shared ideas, dreams, visions and wishes of alternative pedagogical practices by developing training manuals which have been revised to a third edition level, and the sharing of lesson plans on what each have tried out in own school classroom, as done in a teachers’ ‘professional learning community’. Learning gains made from such a ‘community’ were then tried out when doing Project Citizen with a small group of selected learners in a particular Grade or a group of learners from different subjects and/or Grades working after school hours, or, when working with a whole class of learners from a single Grade as part of the day-to-day teaching of the mandated school curriculum as Teacher G did. As a result of

Teacher G's continuing professional teacher development, the notion of transformacy enabled her to impact on the current situation, as well as the arranged situation. According to Skovsmose and Borba (2004), "Critical research processes refer to changes, i.e., the current situation starts to be altered. It is likely that the pedagogical imagination will develop and, therefore, the imagined situation will be modified as well. The same is the case with the arranged situations" (p. 221). The actual development of school practice with respect to (for example) the current situation (CS) is illustrated by the trajectory CS₁; CS₂; C₃; ... as a result of the impact of a changed imagined situation, and as a result of changes in the current situation. This argument holds, or could be made, for each of the other two quality of research processes to account for the bidirectional arrows that connect the current, imagined and arranged situations.

Similarly, a current situation that is problematic can be rearranged or re-created to become an 'arranged situation' through *pedagogical action* (Vithal, 2003), a research process which is also referred to as "practical organisation" (Skovsmose and Borba, 2004, p. 215). According to these authors, the "practical organisation" as a process represents a pragmatic version of the *pedagogical imagination* process, and the qualities of the practical organisation can be discussed with a focus on co-operation with others (p. 218). In this regard, choice and negotiation become key features in arriving at an alternative curriculum approach or classroom practice that deviates from dominant practices. A variety of pedagogical actions involving the research participants, school management, administrators and the learners' parents may contribute towards constituting an arranged situation. Such actions include practical planning activities that are necessary to establish such a situation. The practical planning activities that may be impacted upon when an alternative approach to teacher practice is being actualised include "additional resources, changes in time-tabling, assessment practices, and other organisational features of classrooms and schools" (Vithal, 2003, p. 71). This pedagogical action, in a way, is a tool that brings about a change from the *current* to an *arranged* situation. Vithal (2003) maintains that there are other things that happen in a school, and any new practice must also accommodate those things. Any change in an arranged situation hinges on other aspects of school management and administration. It is in this vein that *choice* and *negotiation* become key features in arriving at an alternative approach to curriculum or to classroom practice – one that deviates from the dominant practices. An example of this key process includes, *inter alia*: each teacher deciding whether to enact an alternative practice through PBL by using a small group of learners after school hours so that it does not disrupt the regular day-

to-day mandated school curriculum, or, whether one would enact an alternative practice within the mandated school curriculum making is an integral part of the day-to-day teaching, learning and assessment. The first option is adopted by most PC-SA members, while a handful of the members – who are more passionate and resourceful, and get more support from peers and their school management – adopt the latter option. Some school managers have shown their support for the workings of the *Project Citizen* approach to teaching, learning and assessment by way of attending the annual showcase held by the Local Network members – where a team of five learners per school present their projects before an audience, and defending arguments made. In such a case the process of negotiation with the school administrators becomes easier, and the innovative practice is enacted in the arranged situation.

Critical pedagogical reasoning, alternatively, and as illustrated in Figure 4.1 above, “designates an analytical strategy because it refers [...] to the process by which an imagined hypothetical situation inspires the creation of an arranged situation [and] in turn, contributes to an understanding of the imagined situation itself” (Vithal, 2003, p. 71). Such reasoning refers to an “analysis of both theory and practice in reciprocity” (p.71). As an analytical process, it represents “reflections on pedagogical actions based on pedagogical imagination, and hence opens varying potentialities available in the data produced in the arranged situation” (p. 71). This quality of the research process is known as “explorative reasoning” (Skovsmose and Borba, 2004, p. 219). According to them, *explorative reasoning* “designates the analytic strategy of investigating imagined educational situations based on observations of particular arranged situations” (p. 219). As a particular analytical process, it “represents a reflection on pedagogical imagination based on practical organisation” (p. 219). These authors further argue that, “the basic characteristic of doing critical research [is that] in explorative reasoning, we want to draw conclusions about a situation that is not the one in which the empirical material is gathered” (p. 219). Rather, according to them, “explorative reasoning is a strategy for looking ‘through’ the arranged situation in order to provide a better understanding of the imagined situation [...] it is a strategy for analysing possibilities that have not yet been acted out” (p. 220). They hold that it is through *explorative reasoning* that *pedagogical imagination* “can be qualified and developed” (p. 220). In other words, *critical pedagogical reasoning* and *explorative reasoning* make analysis possible, and this is where teacher practice, in the arranged situation, speaks back to the theory or the ideals of democracy and science, or critical science, and thereby serves as an example of the reverse process from the arranged situation to

the co-imagined situation. Each of these processes allow the generation of alternative narratives on teaching practice that could happen in the reality of an ‘arranged situation’.

So, ‘pedagogical imagination’ (which draws on the *imagined situation*) is the creative process that allows us space for creativity, whereas ‘pedagogical action’ enables us to move from a problematic situation (*current situation*) to a desired or alternative one. This is done by trying out an *arranged situation* that makes provision for choice and negotiation with respect to teacher practice. Critical pedagogical reasoning, or explorative reasoning, allows us to analyse the things that we have been doing. Research Question 3 is about critical pedagogical reasoning.

The data collection methods of the study (subsections 6.6.1 and 6.6.2) fits in the co-imagined situation, while the others (subsections 6.6.3 to 6.6.5) fit in the arranged situation of the model. The data interpretation methods accord with the critical pedagogical reasoning quality of research process (Section 6.7), while the synthesis method in the discussion (Chapter 10) fits in with ‘explorative reasoning’ which the same as critical pedagogical reasoning.

Below, I illuminate each of the three situations and how these were used as ‘research tools’ to leverage the needed change in school-based science classroom practice in order to understand teachers’ democratic pedagogical practice.

4.1. UNPACKING THE THREE SITUATIONS AS ‘RESEARCH TOOLS’: LEVERAGING THE NEEDED CHANGE TO UNDERSTAND TEACHERS’ DEMOCRATIC PEDAGOGICAL PRACTICE

This study utilised the aforementioned three situations as ‘theoretical tools’ for thinking and talking about researching democratic and critical science practices, which were unknown and not established as pedagogical practices in the existing school situation. In this study, the participating teachers, as members of a local network of teachers called PC-SA, and I, as the researcher, co-imagined and conceptualised *an alternative pedagogical practice* that infused both critical science and a particular notion of democracy into ‘current’ science teaching and learning. For the members of the local network, the co-imagined practice constituted a realm of ideas on alternative practice. The infusion of the ideals of an alternative science practice in the co-imagined situation were informed by the ‘current’ or ‘actual’ situation (characterised as a domain of dominant practice). These ideals were then transplanted into the ‘arranged’

situation in order to transform it “in service of social justice as a consequence of school [science] learning” (Ares, 2006, p. 5).

4.1.1. Theorising the co-imagined situation

The theoretical background ideals of an unusual practice were co-imagined by the researcher and the participants as members of the local Network known as *Project Citizen South Africa* (PC-SA), which was formed in 2003.

This could be considered to be the ideal pedagogical practice that occurs in a particular kind of social situation. In this study, the co-imagined or ideal is the notion of critical science, and science and a socio-political conception of democracy are used because not just any social situation would do for the ideal planned learner ‘action’. I used these approaches in this study because they provided the ideals that I wanted to see in practice in an arranged science classroom situation. The arrangement of the interlinked situations of the methodological framing enabled me to explain the methodology in a way that remained true to the ethos of a democratic and Critical Science Theory. Likewise, the co-imagined practice assisted me in representing the ideas I had about democracy and critical science as these were the ideals that I set out to investigate when I went to observe the participants teaching in their classrooms in a new and arranged situation.

The ideals of critical science, and science and democracy were co-constructed and co-designed during the process of the local network engagements, and hence the concept of a co-imagined situation was implemented. McGregor (2003) expounds on the manner in which classroom teaching changes from a critical science approach. She elaborates how learning encounters are co-designed from a knowledge co-construction approach with learner action and involvement in mind.

The learning that was done by the research participants and me, together with the other members of the local network, was deepened through the different methods used for professional development on the ideals discussed in this section. The co-imagined situation was a “professional learning community” in which teachers “develop own expertise in [Project Based Learning underpinned by a set of clearly defined ideals] in order to determine their own development trajectories” (DBE, ISPFTED for SA, 2011-2025). In their search for an alternative practice in science, the network members drew on McGregor’s (2003) work in the

following ways: the use of learning plans to provide a vehicle for power sharing, and making lessons about constructing science concepts rather than the transmission of knowledge or facts.

Additionally, teaching was based on beginning with the nuances of a broad universal concept that facilitated learners' selection of issues that could be analysed from a broader level. This afforded them opportunities to get involved, to debate, share ideas, and to talk about science based on a topic (socio-scientific issue) that affected it. For learning encounters, the teachers used a description of the process to be used to ensure critical learning (McGregor, 2003). This was done because the critical science approach required that the teachers think about improving their pedagogical practices, rather than maintaining the status quo of the current and dominant science practices (McGregor, 2003). Hence, from a critical science approach, an alternative practice is one that allows learners to decide what they need to know, do, and think based on their prior knowledge (McGregor, 2003). Critical science was appropriate for this study as it enabled the practising teachers to deal with the changing complexity of daily life, and to go beyond the customary dominant teaching approach.

The use of science and democracy, alternatively, is an approach that links science-society interactions and the connections through which resources, information, competence and knowledge are exchanged (Kolsto, 2008). Regarding the notion of science and democracy, I also drew on the work of Roth and Désautels (2004), Kyburz-Graber (1999), Down (2006), and Biesta (2006) in the ways that are discussed below. The network drew on Down (2006) for ideas on infusing science and democracy into their practices in the following ways:

- Teaching practice was participatory;
- The teachers' affective attributes were developed through social interaction;
- Opportunity was created for problem-posing;
- Teaching and learning was situated in the themes, knowledge, culture conditions, and idioms of the participants;
- A multi-cultural approach to teaching and learning was adopted;
- Practice was largely dialogic; and
- The participants were allowed to make meaning from their experiences and to act on them.

(Down, 2006, p. 47)

The co-imagined situation afforded the teachers the opportunity to try out these ideals in order to transplant these into the arranged situation in their classrooms. Infusing democracy and science in the manner described above was done, in part, to afford science learners opportunities to ‘act’ and reflect on their co-construction of meaning with their teachers and peers. In environmental studies and socio-scientific issues, democratic practice must ensure the following: that learners are allowed to shape the environment in socially significant ways; that learners accept the environment as a challenge for initiative, independence, and responsible action; and that openness and uncertainty are allowed regarding both the content and the process of learning (Kyburz-Graber, 1999). The members of the local network drew on Down (2006) and began thinking, talking and acting on practices which were unknown and not yet established as part of their existing classroom practices.

The network members infused the following principles of democracy into their science teaching practices:

- They promoted research where learners co-researched with the teacher
- They enabled learners to work in an interdisciplinary way; and
- They promoted student activism by inviting them to effect change in society from the knowledge they gained.

(Down, 2006, p. 47).

In embracing a socio-political conception of democracy, as conceptualised by Biesta (2006), the study explored the notion of ‘subjectivity’ as it was applied in classroom teaching and learning practices by the local network members. This conception of democracy, according to the author, suggests a different way of understanding how democracy and science, and critical science, could be enacted by teachers in a science classroom.

The ideal of ‘subjectivity’ was taken from the theoretical landscape in order to inform a particular notion of democracy, one that is based on social subjectivity, and one that is based on the kinds of responses that teachers or their learners make to challenging questions posed to them. This view of teaching practice is important because the Project Based Learning (PBL) approach that underpins the pedagogical practices of the network members was based on challenging and driving questions posed by the teachers and their learners.

This ideal was enacted by the network members when they drew on Biesta (2006) in the following ways, where the role of the teacher was:

- To provide opportunities for their learners where different curricular areas are explored and used for the particular opportunities they provide for learners to bring their own unique beginnings into the world;
- To create situations in which learners are able and allowed to respond to the curriculum as the practice allows for particular kinds of responses;
- To show a real interest in the initiatives and beginnings of their students, and allow them to respond in their own unique ways;
- To create learning encounters and an educational environment in which learners have a real opportunity to begin, to take initiative; and
- To spend time and effort on finding the delicate balance between the child and the curriculum so that there are real chances for their learners to undertake something new, something unforeseen by them (the teachers).

(Biesta, 2006, p. 139)

The co-imagined situation served as the realm of ideas where the research participants and I, as members of the local network, co-imagined and co-designed ideas for teaching using an unusual science practice. Working in the realm of the co-imagined, and its inspirational role, enabled the network members to infuse their science teaching practices with democracy. This was done because a critical science approach required that these teachers think about improving their pedagogical practices rather than maintaining the status quo (McGregor, 2003).

An alternative practice was co-constructed and tried out in the co-imagined situation via a conducive space (called a democratic space) that provided an opportunity for each Network member to take initiative, ‘act’, ‘appear’ or to ‘come into the world’ of democratic pedagogic practice. The concept of democratic space, as described in this study, is the kind of ‘public space’ created by the teacher in or outside of the science classroom for pedagogical purposes. It is in this democratic space that the teacher creates a learning encounter that will afford the science learner with an opportunity to act, to be a subject, to take initiative, and to respond to the science curriculum offered by the school in a particular kind of way. It is also an invitation to the science learner to move into a space where two-way dialogue is meant to be nurtured, in which an opportunity to act and be a subject is provided, and where there is commitment to listen to differing view-points and to resolve matters related to pedagogy, or andragogy.

Similarly, and as discussed earlier (Chapter 1, Section 1.10.8). Lefebvre (1991) points out that “space is a product” (p. 26), and Schutz (1997) asserts that “social space is a social product” (p. 1). The local network members co-created a collaborative social space in which they could co-imagine and work in the realm of ideas for an alternative practice. For them, a democratic space was a goal and a product, and they were each contributors to the outcome or product of such a space. In relation to the teachers’ understanding of democratic pedagogical practice, the co-constructed democratic space is not “a dynamic means of control, and hence of domination, of power” (Lefebvre, 1991, p. 26), rather, it is a dynamic and humanly constructed means of achieving the need to advance learning achievement and access to the curriculum for all learners (Schutz, 1997).

The concept of a democratic space is built on Biesta’s (2006) notion of disjunctive space, which “is a space of constant mutual transgression, of an order constantly and necessarily threatened by the very use it permits, and it is the very moment of disjunction that the subject, the user and abuser of space, comes into presence” (Biesta, 2006, p. 46). He asserts that such a space provides us with an understanding of space, which is neither objectivistic nor phenomenological. His argument is that the place where the subject ‘comes into presence’ is not simply an environment or context ‘outside’ of the subject, but is intricately linked with the subject coming into presence and *vice versa*. This study, therefore, explores the creation of a particular kind of space that recognises the unique situatedness of each individual and their unique relationship to others “within a community of equals, and where everybody has the same capacity to act” (Arendt, 1958, p. 242).

The teachers and I did not expect a simple transition to follow or occur when taking these co-imagined ideals into a new or arranged situation, and particularly not so from a critical approach. Ares (2006, p. 1) posits that, “while critical theory offers important insights and calls to action in teaching, the translation to practice can be difficult to negotiate for a variety of reasons”. The co-imagined practice is constitutive of all the ideas that I had about democracy and critical science, and hence these are also the ideas and ideals which I set out to look for when I went to observe the teachers’ practice in their classrooms.

The adopted methodological framing is useful for its flexibility in terms of the linkages between the three situations because what pertains to the one is directly related to what holds true in the others. The researcher is then able to reiteratively network the ideas in the one in a

manner that advances the ideas or actions needed to be built upon, or enacted, in the others. There is thus a constant reflection on the others while working on a specific situation.

4.1.2. Theorising the Actual or Current Situation

The actual or current situation describes the context or actual situation before it was changed. This was done in order to observe what the status quo was before it was rearranged. In order to learn how to change the current situation, it was necessary to have a better understanding of the actual situation, and how to move it into the arranged situation. The actual situation is the one that normally exists in schools, one that is not informed by democratic practice. I wanted to know how the participating teachers were going to enact democratic practice in the science classroom. I decided not to interpret this practice in a manner that portrayed that they did not know or understand what they were doing.

This stance was used because in a critical science approach, there is no deficit notion in terms of teachers (McGregor, 2003). In the following section, I present the following six constitutive aspects of the ‘current situation’, namely:

- The school context;
- Teacher education;
- Science education;
- The curriculum;
- Science classrooms; and
- Dominant practice.

The school context

Specifying the current actual situation creates an imperative and provides a means of contextualising the research site and its participants. It thereby opens this situation to scrutiny of its positionality within broader societal considerations (Vithal, 2003). Viewing the actual situation in this way enhances an understanding of the background and justification for the study, the research relations and the actions engaged, and the outcomes of the study.

The legacy of apartheid is such that schools were racially segregated and named according to the respective racial groupings at the time, namely, Indian, Coloured, White, and African. The various departments were known respectively as the House of Delegates (HOD),

House of Representatives (HOR), House of Assembly (HOA), and Department of Education and Training (DET) for those schools that were outside the different 'homelands' arrangement.

In each of these different school types, there was an inequitable distribution of resources, and each had entrenched practice through laws that were strenuously implemented. This was done, in part, to divide and control, to protect White privilege and power, and to ensure Afrikaner dominance (Naicker, 2006). This is "a legacy of a tradition that saw teachers and principals as technicians in an educational machine, delivering the syllabus through set texts and procedures" (Malcolm, 2008, p. 56). Today, post-apartheid era schooling is still evident, and school communities are still largely situated along the old racial lines as vestiges of the old era. However, with the new post-apartheid era, racial integration of formerly segregated communities has enabled a gradual movement of families to areas that offer better amenities such as better resourced schools. The result is a greater diversity of both learner and teacher population, particularly in ex-HOD, ex-HOR and ex-HOA schools. An increased learner population in the above targeted schools has placed a strain on the physical and human resources of schools.

Deep contrasts exist in South African society, and in the living conditions, in general, of a large sector of the population. In relation to schooling, issues such as unemployment that is over 70%, and an HIV incidence of 50% pose a challenge to what schools can or cannot do for their learners. Regular break-ins at schools by local residents, and schools that have no photocopiers, phones, library, and only infrequent visits from Education Department advisors in deep rural schools (Malcolm and Dhunpath, 2008, p. 251) place a strain on what teachers can do to produce good learning outcomes.

In an urban context, the author paints a different picture as in some parts of a city such as Durban, traditionally White areas are rich and luxurious; while others, traditionally Black areas, are meagre and poor. Tragically, the informal settlements, which are poor and comprise collections of illegal, makeshift shacks that people live in while they look for work and a future, are unplugged from the city (Malcolm and Dhunpath, 2008, p. 251). The above excerpts capture the kinds of school contexts experienced by the participants in this study, including those of their learners. The actual school context is organised according to strict controls with accountability measures that place teachers under pressure to deliver quality teaching and learning, irrespective of the level of resource provided or available in the school. These controls are in the form of time required for a task, 'time on task', with the need make every moment

count. The teacher is to account for progress in terms of the year plan and term plan, and must report on daily progress towards each of these.

The notion of ‘time on task’ is interpreted by the teacher as the need to ensure that topics and sections of the term’s work are covered, regardless of the learners’ pace of meaning-making, interest, or need for responding to content presented by peers and the teacher, hence the push to cover all of the content. Teachers are set on fast-tracking their daily lessons because their schools are organised in such a way that they promote teaching where the teacher progresses as far as possible on the timeline. There is no priority on where the learner is at in terms of learning. The evidence of each teacher’s work, which is for accountability purposes, is based on learner achievement through test scores from assessments of learning. The notion of time on task has different meanings for practicing teachers, Heads of Department, the deputy principal, and the school principal as each has a different role to fulfil in each school’s functionality. The roles are thus compartmentalised, with each responsibility level being fixated on its own level. It thus becomes easy to identify or level blame at the specific department or teacher that is not performing as defined in the Policy and Administration Measures (PAM) document, which legislates the duties of each teacher in the different levels discussed above.

At the level of classroom functionality, there are numerous aspects of teaching as a dynamic process that are the responsibility of the level one teacher, and that need to be accounted for the hierarchical nature of school functionality allows little room for the practicing teacher to be creative other than to perform and deliver through an ‘orderly’ set of sequential steps or stages of getting the work done, and accounting for it with test scores. Orderly here refers to the ‘back to basics’ approach of the *Foundations for Learning Campaign* (DoE, 2008) introduced in the Foundation Phase (Grades R to 3), which includes the provision of support materials (developed by the National DoE).

The aim of this campaign was to ensure that each day, each teacher would teach the prescribed basic level of content and skills in a particular way. Time on task in this case leaves the teacher with few options to ensure success in teaching and learning. The South African School’s Act (No. 84 of 1996) ensured that corporal punishment was outlawed, yet some teachers still resort to this practice in various forms, as policing this Act poses a challenge for the Department of Education.

Home-school partnerships are non-existent as parental support of the school going youth depends on adult literacy rates. In 2008, 8.7% of the adult population was totally illiterate and 13.7% of the adult population was functionally illiterate as they had dropped out of school before completing Grade 7 (EFA Report, 2010), translating to 6.2 million adults that were either totally or functionally illiterate in 2008. What teachers do in the school classroom is also dependent on the type of learners in the school, their home backgrounds, and what schooling is about for them.

Two of the participating schools were located in a township and were ex-DET schools, one on the outskirts of Pinetown, and the other was in kwaMashu, an area north of Durban. With regard to the other two schools, one was an ex-HOD school in the area of Umhlathuzana just outside the city of Durban, and the other was an ex-HOR school just outside the city of Durban.

Teacher education

Following the general elections of April 2009, the organisation and administration of the education system underwent its first major alteration since 1994. Restructuring was done to ensure that balanced attention was given to improving access and quality in all sub-systems of the education and training system. This was done in order “to raise the poor learning performance levels in schools and attend to major priority skills needs in the economy, which are two of the most complex and intractable legacies of South Africa’s troubled historical and racial injustice and oppression” (EFA Report, 2010, p. 3).

Teacher qualification is one of three quality indicators used to report on progress towards the EFA goal of quality education. Educators in South Africa (SA) are considered appropriately qualified if they have obtained a Senior Certificate (now the National Senior Certificate) at the end of Grade 12, as well as obtaining thereafter a minimum of three year’s appropriate or professional training. Much has been invested by the state (with ELRC support) in teacher education to raise the qualification levels of teachers, for example, the year 1990 reported 53% of qualified teachers in the system, and in 2008, there were 94.4%, qualified teachers yet anomalies remain. A National Education Evaluation Development Unit (NEEDU, 2010) report argues that the education system is failing our learners.

The teacher development approaches used placed insufficient emphasis on teacher knowledge and content, and insufficient emphasis on feedback and evaluation from the

teachers themselves (DBE, 2010). Teacher development workshop sessions focused on subject matter content, and the rest of the teaching and learning related matters were taken as part of the 'hidden curriculum' of teaching practice. For district officials, the poor educator performance is due to the reduction of staff, increase in workloads and a lack of incentives and promotional opportunities, and that teaching has become stressful for teachers (Simjee, 2006). Teachers are a major contributor to the quality of learner performance. To overcome the legacies of apartheid, including current anomalies, the Department has made use of a much criticised and flawed cascade model for teacher development. This was done to overcome the human resource shortage discussed earlier.

Other improved methods for teacher development that were developed and used conduct re-skilling and up-skilling of the large number of educators in the system. The recently mandated framework, the *Integrated Strategic Planning Framework for Teacher Education and Development in South Africa* (ISPFTED in SA, 2011-2025) promises to further transform and regulate teacher development in SA. A key feature of this framework is that of *Continuous Professional Teacher Development*, which targets currently practising teachers, who are required to take responsibility for their own continuing professional development, with support from the department. The notion of professional learning communities is one that enables teachers in each subject to plan and discuss pedagogical practice based on their own needs – a kind of collaborative process and practice found in the local network where teachers have been co-imagining the ideals of teaching and learning practice since 2003.

Science education

The South African view of science education in the school context is as follows: “Scientific knowledge is tentative and subject to change as new evidence becomes available and new problems are addressed. The study of historical, environmental and cultural perspectives on science highlights how it changes over time, depending not only on experience but also on social, religious and political factors” (Department of Education, 2003, p. 11).

In contrast, science education in the apartheid era in South Africa is described as “racist, eurocentred, sexist, authoritarian, prescriptive unchanging, context blind and discriminatory” (Jansen, 1999, p. 4). The latter view of science education ignored contributions made to science by other members of society. Science teaching methods were reduced to ‘telling’ sessions

wherein learners were encouraged to be obedient and passive. In post-apartheid South Africa, a number of education policies were developed and implemented to counter the ravages of the apartheid era. Notably, the flagship Outcomes Based Education (OBE), followed by Curriculum 2005, the Revised National Curriculum Policy (RNCS), the National Curriculum Statement (NCS), and lately, the proposed Curriculum and Assessment Policy Statement (CAPS) were implemented.

Science education, as encapsulated in the different versions of rapid curriculum transformation, disempowered teachers as they were no longer in a position to keep track of the required changes. Science education in SA can be characterised as posing a challenge for science teachers as they continually attempt to identify their problems in science teaching, for example, bringing in microscopes to teach practical work in science is of no help to a teacher who has no equipment, as in some schools the science equipment remains stored and locked away in the school for weeks and months without being used.

According to Muwanga-Zake (2006, pp. 2-3), teachers' problems, such as the inability to teach practically, are underpinned by their lack of understanding of science concepts and processes. Additionally, his work reveals that teachers continue to demand science equipment even though there is evidence of unused equipment, and that practical approaches are undermined by the lack of familiarity with science apparatus, as well as the irrelevance of curricula, particularly in rural settings.

The above observations are consistent with the shortage of skilled science teachers, a problem linked to low science graduation rates from teacher education institutions, and with the low enrolment levels for science education programmes at these institutions.

The curriculum

The new curriculum [Curriculum 2005 (DoE, 1996); RNCS (DoE, 2002/3); NCS (DoE, 2003/4/6) and CAPS (DBE, 2011)] make provision for active learner involvement and critical thinking. The underpinning principles of the RNCS are social justice, a healthy environment, human-rights, and inclusivity [RNCS, Grades R-9 Schools (DoE, 2003)]. A noticeable change to the apartheid education system is the inclusivity principle, which is seen by the Department of Education as dealing with,

A number of social justice and human rights issues, and at the same time taps into the rich diversity of our learners and communities for effective and meaningful decision-making and

functioning for a healthy environment. Schools are encouraged to create cultures and practices that ensure the full participation of all learners irrespective of their cultures, race, language, economic background and ability. All learners come with their own experiences, interests, strengths and barriers to learning which need to be accommodated (RNCS, Grades R-9 Schools, DoE, 2003, p.6).

The new curriculum envisages a new kind of learner who will be "imbued with the values, and act in the interests of a society based on respect for democracy, equality, human dignity, life and social justice" (NCS Overview, DoE, 2002, p.8). The NCS promotes life-long learning, and seeks to create learners who are confident, literate, numerate and multi-skilled, compassionate, with a respect for the environment, and the ability to participate in society as critical and active citizens (NCS Overview, DoE, 2002). The science curriculum in the apartheid era was manipulated and used as an instrument of propaganda and indoctrination (Pillay, 2006). Extending democratic principles and processes to teaching and learning spaces is a vital part of the learner-centred curriculum approach in Outcomes Based Education (NCS, DoE, 2002). Teachers are guided by the curriculum to develop 'lesson plans' (RNCS Overview, DoE, 2002). The term lesson plan,

Describes concretely and in detail teaching, learning and assessment activities that are to be implemented in any given period of time. It could range [...] from a single activity to a term's teaching, learning and assessment [...] it includes HOW (i.e. teaching style, approach and methodology) teaching, learning and assessment activities are to be managed in the classroom (RNCS, DoE, 2003, pp. 2-3, emphasis added).

Lesson plans are designed in order to fulfil the teachers' role as interpreter and designer of learning programmes and materials (Norms and Standards for Educators, DoE 2000). The curriculum is intended to be a participatory curriculum that is relevant and addresses local issues (DoE, 1999). Regarding learning, all learners come with their own experiences, interests, strengths and barriers to learning, which need to be accommodated (RNCS, Grades R-9 Schools, DoE, 2003). The teacher's role is also publicly known: "The teacher will understand and interpret provided learning programmes, design original learning programmes, identify the requirements for a specific context of learning and select and prepare suitable textual and visual resources for learning. The teacher will also select, sequence and pace the learning in a manner suitable to the different needs of learners" (DoE, 1999, p. 69). On the challenges inherent in education policy implementation, Inbanathan Naicker (2005) argues that "... education policy may be said to be 'symbolic policies' which 'create a vision of the ideal situation (and that it)

... will remain simply a vision if the policy documents are not supported by ... teacher development and support” (Naicker, 2005, p. 88).

The new vision for education calls upon educators to take on new roles and ensure that effective learning takes place (Department of Education, 2001). However, the critics of OBE in South Africa maintain that its language is too complicated for the majority of teachers who cannot speak, read and write English well enough to put OBE into practice (Vinjevolt, 1999). According to the Curriculum Review Committee (2000), the training programme was weak and sporadic, and contained a fatal design flaw (the so-called cascade model) and thus had very little impact on teachers, teaching behaviours, and teacher understanding. Training became information sharing sessions rather than intensive capacity-building exercises.

Science classrooms

Schools are also encouraged to create cultures and practices that ensure the full participation of all learners (RNCS, Grades R-9 Schools, DoE 2003), and enable learners to have respect for the environment and the ability to participate in society as critical and active citizens (RNCS, Overview, DoE 2002). Some observers have claimed that the majority of schools were not ready for OBE due to backlogs in infrastructure and facilities, a lack of the culture of teaching and learning, and that these factors would cause learner achievement to drop even further (Taylor, 1999). Classroom dynamics such as classroom practice, classroom management, and curriculum practice are each based on the authority of the teacher as to the extent to which each is enacted. Classroom management practices are largely focused on the modification of learner behaviour for the sole reason of promoting dominant pedagogical practices. Curriculum practice is based on the notion that all knowing is certain, involving few or no risks as the training of the teacher is deemed to be of good service. Therefore, the work and service of the teacher is to be provided to the learners, who are often referred to as customers. These customers are a homogenous group, and the service is packaged as a one-size-fits-all. Furthermore, teachers question learners, who are only allowed to respond at the end of the lesson – often providing the exact words uttered by the teacher on a given topic.

In Malcolm’s (2008) words, “the student is unlikely to question the teacher [...] because of a tradition that says ‘The teacher is always right’. The student, instead, chooses to accept the teacher’s knowledge for the sake of exams, but reject it for living. The teacher is allowed to be right in a limited context and science is kept in its place” (p.15).

The classroom layout resembles ‘church row seating’, with a writing board in the front of the classroom, and a teacher’s desk, chair, cupboard and locker all positioned in the front next to the writing board, depending on the size of the room and the number of learners in the classroom. The number of learners ranges from 15 to 25 in an ex-HOA school, to 50 to 70 in an ex-DET or ex-DEC school.

The term laboratory is used and has different meanings for teachers from different school-types and their learners. These meanings range from a conception based on a fully equipped science laboratory with lockable storage facilities, to a conception that is based on an ordinary classroom designated as such with none of the above listed equipment or features.

Dominant practices

Educationalists have expressed the need for a transition to be made from pedagogies of knowledge transmission to pedagogies of knowledge construction (Zohar *et al.*, 1994). The former was a key feature of the apartheid era type of education, and is characterised by the spoon-feeding of learners with facts and concepts, or through the use of some other reproductive approach to science education. These include “banking education which anesthetizes and inhibits creative power” (Freire, 1970, p. 62); “‘telling’ sessions that are authoritarian, prescriptive unchanging, context blind and discriminatory” (Jansen, 1999, p. 4); and “reproduction of traditional, transmission-oriented interactions and activities” (Ares, 2006, p. 6).

A large number of practising teachers are products of the apartheid style teacher training and are close to retirement age within the DoE’s current work force. Some teachers in this category have not kept up with new developments in subject content and pedagogical practices. The largely reproductive approach to teaching and learning that they have been trained to use ignores the diversity of learners, their cultural backgrounds, beliefs and languages.

As discussed earlier, the traditional one-size-fits-all instructional approach was common practice in schools, and the homogenous treatment of learners was part of such practices. From my participation-based observation as a seasoned school teacher, dominant practice in the actual current situation is, amongst other things, largely associated with or as a result of time rather than learners’ learning. This drives what and how lessons are taught; how assessment is carried out; and it implies that learners’ real-life experiences and context are not made part of their learning because the prescribed content in the textbook is viewed as the most important thing to teach the learners. This is what I believed prior to carrying out my Masters’ study.

The result is that teacher practice is informed by what works best for him or her, given the personal and physical resources that are at hand, and, any new approaches that are mandated by policy without proper training and support. Within this context of classroom practice, these teachers have relied on their own past teaching experience, which is largely another form of dominant practice. The result is that the status quo is maintained by the current situation. According to Sigamoney Naicker (2006), science teachers in the apartheid era, and beyond, taught science content in the same way year after year to all of their learners due to lack of training or poor training by education personnel who “did not possess sound understandings of epistemological issues and how they impact thinking, practices and transformation in general [...] the lack of knowledge has led to routine and control, instead of being open, reflective, and critical and creat[ing] new meanings (Naicker, 2006, p. 2). This stance ignored the diversity of learners, their cultural backgrounds, beliefs and languages, particularly within and amongst the different racial classifications that existed at the time. A traditional one-size-fits-all instructional approach is practised by some teachers, one that views learners as a homogenous group whose responses to the school curriculum are taken to be mostly similar.

Any problems related to learning through such an approach is viewed as the fault of the learner, whereas the success of learning through such an approach is largely viewed and attributed to the role or achievement of the teacher. Questioning is very limited, and, if used, it is often directed at the learners who are considered to be ‘clever’. A response from such a learner or group is usually taken as the whole class’ response, and the lesson usually proceeds with the responses of a few learners in a classroom. This is done in most cases in the interest of time, and completing the lesson before the learners are dismissed to attend another teacher’s lesson.

Flowing out of such predominant pedagogical practices is a view of teaching and learning that accounts for ‘learning’ and ‘failure’ in different ways, rather than viewing each as achievements that are enabled by the learning environment that the learners are in (Ares, 2006). While a learner-centred approach to education is framed in policy, as indicated in earlier sections of this study, the dominant practice in the science classroom instead gives primacy to learning disjointed or unrelated ‘facts’ that have no bearing on learners’ lives. This is a practice that is largely aimed at covering everything and doing everything in the textbook, which ensures that learners are mostly "sheltered" from other educational influences within their community (Hawes, 1979, p. 1). Classroom practice concerns the teaching activities used to

deliver science as designed in the lesson plan of the teacher, and as enacted in a way that would fulfil his aim and objectives, which are time-bound, and which would make him feel good about his practice.

Traditional teacher practice is based on the notion that learner progress or achievement is dependent on marks or test scores that allow the teacher to determine what good learning gains should look like for the learners in a particular lesson or topic taught. Teacher practice is informed by what works best for each teacher given the personal and physical resources that are at hand. If new approaches are mandated by policy without proper training and support, teachers often relied on their past experience.

Teaching styles that dominate in the current situation are summarised below:

- Preference or circumstance permits the curriculum (i.e. the content and methods of what is taught) to be determined and organised by others.
- The teacher-consumer surrenders to the textbook/mentor/peer the responsibility to define, analyse and develop the curriculum.
- They may follow the teacher's manual verbatim without consideration of worth of each topic/activity to the learners in a particular school/classroom.
- They may not consult other teachers/experts to explore alternative methods and resources.
- They do not participate in the creative process that brings a curriculum to life.

(Sparks-Langer *et al.*, 2004)

4.1.3. Theorising the arranged situation

The actual situation describes the context, or actual situation, before it was changed. I went into the actual situation with the purpose of changing or rearranging it. This was done because I needed to know what the status quo was before it was rearranged. In order to learn how to change the current situation, it was necessary to have a better understanding of the current or actual situation, and how to move it into the arranged situation. This situation, the dominant practice, normally exists in schools and, from the point of view of this study, is not based on or informed by democratic practice or critical science.

The methodological framework adopted for the study allowed me to first explore the teaching practices in the actual situation, and how these related to the learning outcomes, and based on that, this was used to inform pedagogical action that was different to what normally existed or happened in the participating schools. This study attempted to analyse an unusual

practice – one that infused critical science and notions of democracy – which was an arranged practice that occurred in an arranged situation, and one that rearranged the current situation in order to transform it. It is against this backdrop that this sub-section presents a discussion on the ‘arranged situation’. I used a methodological framework that was developed out of trying to engage a critical perspective in education.

In this study, I was interested to see how the participating teachers were going to go into the classroom and be free to do what they were doing. As indicated earlier in this section, whatever they did, I decided that I was not going to interpret it in a manner that indicates that they did not know or understand what they were doing. This stance was used because in a critical science approach, there is no deficit notion(s) regarding teachers.

The actual situation provided a reality check, particularly for the purpose of the study, which was to bring into a new or arranged situation something that was not part of the normal, day-to-day classroom practice, namely, the infusion of notions of democracy and science, and critical science into science teaching and learning practices.

The arranged situation described what was actually done first, prior to the classroom visits or observations, secondly, during the classroom visits and observations, and finally, after the classroom observations. These actions were underpinned by democratic practice. The actions that were undertaken prior to the classroom observations included that of negotiating access to the teacher’s classrooms, and interviewing each teacher prior to the classroom observations to listen to what each one had to say about this unusual practice (research question 1).

The actions undertaken during the classroom observations included interviewing each teacher immediately before the lesson to be taught for each of the two to four lessons (research questions 1 and 3), and then immediately after the lesson was taught, observed and video-recorded (research questions 2 and 3). The actions that occurred after the classroom observations included a focus group interview with all the teachers at a common venue after all the classroom interviews and observations were conducted (research questions 1, 2 and 3). This also included participation in the local network’s annual showcase in which its members participated (not for data generation purposes).

Armed with the insights gleaned from the dominant traditional pedagogical practices, including the tried-out ideals of new and co-imagined pedagogical practices, the participants

and I went into the classroom and innovated by implementing something unusual in terms of classroom practice. The unusual practice was implemented by the research participants in the arranged situation. I wanted to find out what this was like in actual teaching practice as enacted by the participants, that is, their understanding of it. Hence, the three interlocking situations of the methodological framing of the study had a bearing on all the actions undertaken in the study. This was the case because this study was informed by critical science and a particular notion of democracy in science approach.

The arranged situation was particularly useful in the SA context because we are engaged in curriculum transformation that is based on hypothetical speculations. This transformation is implemented through curriculum policies whose consequences are not known in the diversity of science classrooms (Vithal, 2003).

4.2. CHAPTER CONCLUSION AND SUMMARY

This chapter dealt with the way in which the participating teachers, through co-imagination with the researcher, embraced change with the aim of bringing into reality an alternative science classroom practice. The methodological underpinnings of this study offered the means and tools by which these teachers could transform their classroom practice. The participating teachers used the co-imagined ideals and worked with them in order to step out of the realm of theory into the realm of actual and tried-out practice. The next chapter deals with the problem of epistemology part 2: the problem of analysis in critical research.

CHAPTER 5
THE PROBLEM OF EPISTEMOLOGY PART 2: THE PROBLEM OF ANALYSIS IN
CRITICAL RESEARCH

The analysis of the data in this study was done in a manner that was fitting for research that embeds a critical perspective in education. The methodological underpinnings of this study, as discussed in the previous chapter, provided the means and appropriate tools used to transform dominant classroom practice. This chapter deals with the meaning-making process through the use of the constitutive notions of crucial description, explorative reasoning, narrative analysis, and Positioning Theory. Each of these tools for analysis are discussed in the sections that follow.

5.1. CRUCIAL DESCRIPTIONS

Firstly, the “data was organised into crucial educational case description” (Vithal, 2003, p. 337). The process of producing a detailed, crucial description of the phenomenon under investigation, within an ‘arranged situation’, allowed me to provide first-hand information on what actually occurred or did not occur for those who were not there to witness what happened. The notion of ‘crucial descriptions’ assisted in providing descriptions of practice and reflections on those descriptions (Vithal, 2003), rather than prescriptions of practice, a notion that is problematic for this study. The crucial description allows us to “[see] what each participant – the teacher, the learners, the researcher – did, and we also got to see what each could do” (p. 354).

It is against this backdrop that the analysis of the data hinged on the notion of a ‘crucial description’ through which the reader is informed about what the participants actually did in infusing science teaching and learning with both critical science and a notion of democracy. According to Vithal (2003, p. 108), “descriptions are couched in particular language and discourses, and represent interpretations. They are neither neutral, objective nor value-free” (op cit). Vithal (2003) posits that, by producing a description, the researcher is able to achieve the following:

The researcher reveals [...] the theoretical framework in which she is operating. Creating a description of the educational practices that unfolded in the arranged situation in a way that enables critique [that] may be called a crucial description because it is: 'A description of an educational practice which makes it possible for an outsider to make a critique of a certain theoretical position in (science) education' (Vithal & Skovsmose, 1997) and it serves [...] to connect theory to practice on the one hand, and the theory-practice relation to research on the other hand (Vithal, 2003, p. 108).

Secondly, according to the author, “It may be argued that such a description of educational practice is essential, because the reader relies on the researcher’s eyes to look into the classroom. A crucial description is inextricable to any research that is undertaken from a critical perspective because an educational theory that makes critique a central feature must also attempt to realise this possibility in the descriptions of educational practices. It is a description that somehow allows an outsider to feel, see, and experience a classroom setting in which theoretical ideas are interpreted into practice and from which theoretical ideas are created and critiqued” (p. 108).

According to Vithal (2003, p. 340), crucial descriptions have played an important role in allowing us to “capture and include the dissenting and negative voices, not so that they can be reconciled in the pedagogy, but so that they can have an equal presence, and become part of the pedagogy”. With respect to the transformational angle of this study, the enactment of an unusual practice by the participants in order to change to a practice that involves learners, Vithal (2003) postulates about the process of pedagogy construction:

Typically pedagogies are produced and discussed in terms of ‘what could be’ or ‘what should be’ rather than for a situation of ‘what is’. In this sense pedagogies project into a future education setting, enunciating educational principles and practices and giving theoretical underpinnings for these. However, in creating and describing an arranged situation out of which arises a detailed description, it is possible to develop a pedagogy from this arranged situation and make suggestions for and to project toward ‘what is not yet’. These are [...] instances of arranged situations created to enable us to make more grounded critique and reflections for particular pedagogies which we advocate (Vithal, 2003, p. 340).

Vithal’s insights into researching ‘what could be’ are based on the provision of detailed descriptions of an unusual educational practice, one that takes place in an arranged school science classroom situation for the purpose of bringing about a desired change in practice.

These insights provided the key aspects that were needed to inform the way I carried out the data analysis from a critical approach to research. An unusual practice, as explored in this study, is aimed at bringing about change in the way that science is taught and learnt in the school classroom. Skovsmose and Borba (2004) posit that “critical research does not just address what is the case. It also deals with what is not the case but could be brought about” (p. 215).

5.2. EXPLORATIVE REASONING

The methodological framing adopted for this study, as discussed in Section 5.2, is constituted by three different, interlinked and fluid situations, which articulate with each other through specific types of research processes. One of these research processes, namely, *explorative reasoning*, is an analytic process that is used for reconsidering the ‘imagined situation’ in the light of experiences that are related to the ‘arranged situation’. This indicates to the reader that in this study, there were situations that enabled co-operation between the researcher and the participants as they talked about and addressed innovative classroom practice.

Such co-operation resonates with the participatory paradigmatic stance of the study. The co-operation between the researcher and the teachers is discussed by Skovsmose and Borba (2004) in terms of qualities of research. For them, explorative reasoning, as a quality of research process, “designates the analytical strategy of investigating imagined educational situations based on observations of particular arranged situations” (p. 219). It is also a particular type of analytical approach that is used to analyse research data generated through critical research. To this end, the authors posit that:

In order to draw conclusions about the feasibility of the imagined situation, we have to analyse our observations in a particular way. Our observations are linked to the arranged situation and also limited by this situation, but some of our analysis concern the imagined situation. We are not simply interested in [...] generalising from data representing the arranged situation [...] In particular, it is relevant to make conclusions about the imagined situation based on what we have observed with respect to the arranged situation. In this way this latter situation turns into a window through which we may better grasp and qualify the imagined situation (Skovsmose & Borba, 2004, p. 219).

In light of the above quote, explorative reasoning provides an opportunity for co-operating parties to reflect when addressing change in classroom practice with respect to the other two processes related to critical research. These two processes are pedagogical imagination (the process that helped us to create imagined situations, with the current situation as the point of departure), and practical organisation (the practical planning of tasks and processes that helped us create arranged situations, which used the current situation as a point of departure) (Skovsmose and Borba, 2004). The authors further find that,

The analysed 'data' are not the observed data. Direct observations concerning communication in the classroom might be presented in forms of transcripts. But it makes sense to ask what would happen if, say, the teacher asked the students a different question and the communication thus took a different route from what is seen in the transcript (Skovsmose and Borba, 2004, p. 219).

The authors argue for the use of 'invented dialogue' as a way to specify and present the 'not-experienced' alternatives with respect to classroom practices, and to present these in narrative form. Such narratives, according to the authors, are realistic because "to a great extent they follow actual dialogues from the classroom [in arranged situations], but some parts of the narratives demonstrate possibilities which nobody in the actual classroom made use of" (p. 219).

Additionally, for them, narratives represent possibilities in the sense that "we are investigating aspects of the imagined situation through observations of the arranged situation, as narratives are produced by experiences in the arranged situation" (p. 219). The authors suggest the writing of "a narrative in the form of a dialogue that never took place", and then an analysis thereof, which "may provide new understandings of educational possibilities" (p. 220). Explorative reasoning is useful as an analytical aspect of critical research, and is relevant because it serves as a means to qualify and develop pedagogical imagination. It is also useful when the researcher has no prior knowledge of the kinds of changes to be made in classroom practice.

5.3. NARRATIVE ANALYSIS

Narrative analysis, and narrative writing, searches for the way in which participants make sense of their lives by representing them in story form in a manner that appeals to them. This is done for a particular reason, and is compelling (Henning *et al*, 2004). Teacher narratives are constructed on the basis that each should be realistic, meaning that “to a great extent they follow actual dialogues from the classroom”, and are written in the first-person format because such narratives “are effective means for giving an understanding of how the self evolves over time” (Atkinson, 2007, p. 226).

Henning *et al.* (2004) hold that self-narratives may be used to obtain useful information for participants in order to “come to the desired understanding of the self as a meaning-maker with a place in society, culture and history (p. 226).

Qualitative researcher Wolcott (1994), who focuses on case study analysis procedures, advances the importance of first forming a description from the data, and then relating the description(s) to the literature and cultural themes (Creswell, 2007). Wolcott’s (1994) data analysis strategies are summarised by Creswell (2007) below, and are indicative of an analytical strategy that is applicable to each strategy:

- Highlight certain information in description (sketching ideas);
- Identify patterned regularities (reducing codes/categories to themes);
- Contextualise based on the framework emanating from the literature (relating categories to the analytical framework in the literature); and
- Display findings in tables, charts, diagrams, and figures; compare cases; compare the findings to a standard (displaying the data).

(Creswell, 2007, p. 149)

5.4. POSITIONING THEORY

The Positioning Theory discussed in this section offers the current study coding frameworks for data analysis that complement the other forms or ‘tools’ for analysis used in the study. Positioning is defined as “the discursive process whereby people are located in conversations as observably and objectively coherent participants in jointly produced storylines”, and there “can be interactive positioning in which what one person says positions another [...] there can be reflective positioning in which one positions oneself” (Davies and Harré, 1999, p. 37). Harré and van Langenhove (1999), alternatively, posit the notion of a tri-

polar base of Positioning Theory. This comprises a tri-polar relationship between positioning, storyline, and speech act, which is essential for conversation, and which is the conceptual base of the theory. According to the authors, examples of classroom storylines are: the school science community, a simulated scientific community. They also explain that examples of speech acts are: re-voicing, argumentative claims and counter-claims, and pronoun choice.

Educational implications, according to Forman (2008), include (a) teachers may be able to use familiar classroom discourse forms while simultaneously encouraging students to assume greater responsibility for engaging in authentic scientific argumentation (a hybrid discourse), and (b) case studies of expert teachers provide examples of effective discursive practices for the socialisation of disciplinary roles, such as constructor, and the critique of claims in rhetorical practices within science classrooms.

The Positioning Theory tools can assist in the analysis of the ways that teachers enact an unusual teacher practice, particularly, how they position themselves and their learners, who they teach and learn from. I was interested in understanding what teachers say, and do, including the reasons they give for doing what they do in enacting an unusual practice through, *inter alia*, 'reflective positioning'.

Davies and Harré (1990) assert that "the main relevance of the concept of positioning for social psychology is that it serves to direct our attention to a process by which certain trains of consequences, intended or unintended, are set in motion. But these trains of consequences can be said to occur only if we give an account of how acts of positioning are made determinate for certain people" (p. 6). The authors add that "with positioning, the focus is on the way in which discursive practices constitute the speakers and hearers in certain ways and yet at the same time is a resource through which speakers and hearers can negotiate new positions" (p. 14).

5.5. CHAPTER CONCLUSION

A combination of tools for the use of data analysis, as done in this study, assisted me in making sense of the large data set produced by this qualitative and case study research. Positioning Theory enabled me to understand and describe the ways that teachers enact an unusual teacher practice, particularly how they position themselves and their learners in their co-action within learning encounters. Positioning Theory, when blended with narrative analysis and crucial description, provided me with affordances to capture the teachers' actual understandings and enactments of their unusual practice. Explorative reasoning provided me

with the tools to understand what is in order to explore ‘what could be’, and to look beyond what was actually said and done by the participating teachers. In the next chapter, which deals with the research methodology, I discuss in detail the research design used to explore the teachers’ unusual and new science classroom practice.

CHAPTER 6

RESEARCH METHODOLOGY

Chapters 4 and 5 touched on the epistemological issues pertaining to the methodological and analytical framing of this study. This chapter presents in detail the research design used to explore how GET science teachers infused school science with critical science, and a particular conception of democracy. In trying to situate itself within the broader spectrum of qualitative research, the chapter begins with a discussion on qualitative case study, and qualitative inquiry, what it means to have critical theory as an overarching framework, data constitution, access negotiation with the teachers, and the research sample. This is followed by an outline of the design that was purposefully adopted in this study to address the following research questions:

Research Question 1: *What are science teachers' understanding of the classroom as a space for democratic living?*

Research Questions 2: *How do science teachers construct and enact the science classroom as a space for democratic living?*

Research Questions 3: *What reasons do science teachers give for constructing and enacting a science classroom as a space for democratic living in the way that they say they do?*

The various stages of the research are presented and discussed, paying particular attention to the research sites, data sources, data generation process, and the data analysis process. The chapter culminates with a brief discussion of the researcher's stance, limitations and challenges, ethical considerations, the issue of validity and how this was met in this study, and closes with a summary of the chapter.

6.1. WHY A QUALITATIVE CASE STUDY ROOTED IN A PARTICIPATORY PARADIGM?

As intimated in earlier chapters, this is a qualitative case study of the public school classroom practices of four Senior Phase natural sciences teachers who were members of a local network of teachers. The practice of this network, Project Citizen South Africa (PC-SA), is underpinned by democratic principles, and it uses a Project Based Learning (PBL) approach

when designing and enacting learning encounters. It is located within a participatory/advocacy paradigm.

This study adopted a participatory (advocacy) paradigm, as well as elements of ethnographic case study design through the use of Critical Theory as an overarching framework. In a participatory/advocacy paradigm, issues such as oppression, domination, suppression, and hegemony are studied and addressed where “the researcher provides a voice for the participants, raising their consciousness and improving their lives” (Creswell, 2007, p. 22). Key features of advocacy/participatory research practice are summarised below to include the following:

- It is recursive and dialectical focusing on change in practice;
- It is focused on helping individuals free themselves from constraints in the media, language, work procedures and relationships of power in educational settings;
- It ensures that change occurs by unshackling people from constraints of irrational and unjust structures that limit their self-development, self-termination and self-reliance; and
- It is practical and collaborative as it is inquiry ‘with’ others.

(Creswell, 2007, p. 23)

A case study approach was deemed suitable for the study to achieve the above goals and to challenge the strangle hold of dominant practice, one that does not identify, solicit and integrate the diverse views of learners in classroom teaching practices. Case studies are said to look at a phenomenon “in its real-life context, usually employing many types of data” (Robson, 2002, p. 178).

In this study, I explored four cases of public school science teacher practice and its transformation through the envisioning of new possibilities (Creswell, 2007; Fay, 1987). These case studies explored onsite the actions and voices of four practicing teachers as they articulated and enacted their ideas, imaginings, and intention to try out an alternative teacher practice, one that infused school science with critical science, as well as with a particular conception of democracy. According to Sharan Merriam (1999):

A case study design is employed to gain in-depth understanding of the situation and meaning for those involved. The interest is in process rather than outcomes, in context rather than a specific variable, in discovery rather than confirmation [...] Case studies

are ... intensive descriptions and analyses of a single unit or bounded system (Smith, 1978) such as an individual a program, event, group, intervention or community (Merriam, 1999, pp. 18-19).

The ‘bounded systems’ within each of the four different participant’s classrooms enabled me to gain a first-hand, in-depth understanding of each case in order to portray the richness of each case, including the richness of the multiple cases with regard to the phenomenon under study. In this regard, the data generated in this study enabled me to challenge the status quo, and to empower participants to influence change in the school classroom and beyond.

6.2. WHY QUALITATIVE INQUIRY?

Qualitative researchers believe that human behaviour and action “is best understood as it occurs without external constraints and control” (McMillan and Schumacher, 2010, p. 322). In this regard, inquiry aims to,

Understand, and also explain in argument, by using evidence from the data and the literature, what the phenomenon or phenomena that we are studying are about. We do not wish to place this understanding within the boundaries of an instrument that we designed beforehand because this will limit the data to those very boundaries. In this way our understanding will also be dependent on those very boundaries (Henning, 2004, pp. 3-4).

According to Henning (2004), research that is qualitative denotes a type of inquiry in which the qualities, characteristics or properties of a phenomenon are examined to gain better understanding and explanation (p. 5). Henning places specific emphasis on explanation as, according to her, “to get to an interpretation of this experience, you need to be thoroughly equipped as a social scientist, that is, able to use your existing knowledge [theory] to explain what you have encountered in the data” (Ibid, p. 9). In other words, qualitative inquiry should move beyond the level of mere exploration and description of people’s experiences, to the level of explanation. She further clarifies that,

In moving beyond exploration and description [...] you can start to take the understanding that comes from description to its logical next level, namely: explanation [...] although I agree that you have to be able to try and understand, it is logical that true understanding also implies explanation (Henning, 2004, p. 9).

Within this type of inquiry, in order to solicit understanding and then explanation of participants' views or actions, a variety of data needs to be generated, documented and analysed through the use of data generation methods used in qualitative research. According to Henning (2004), it is a multifaceted method involved in the exploration, description, interpretation and explanation of the phenomenon under investigation that enables the researcher to develop a holistic view thereof. An interpretative stance was chosen for its power to "shape the individuals studied, the types of questions and problems examined, the approaches to data collection, data analysis, writing, and evaluation, including the use of information, in order to change society or add to social justice (Creswell, 2007, p. 30). Ethnography enabled me to describe and interpret the shared and learned patterns of values, behaviours, beliefs, and language of a culture-sharing group (Harris, 1968; Creswell, 2007). The ethnography focused on a particular cultural group, namely, four GET science teachers. The purpose of this study, as derived from the research questions, aimed to:

- To present an overall picture of teacher's understandings of enactment of an alternative classroom practice to the dominant current practices;
- To provide a description and explanation of (and existence/absence of) alternative teacher practice(s); and
- To hypothesise possibilities for changed teacher practice(s) for school science pedagogical practice(s).

The focus of the study remained on teacher practice, which included both the teachers' espoused practice(s), and their actual practice, and the reasons they gave for what they actually did in their day-to-day classroom actual practice(s). In Table 6.1 below, I present the link between the above objectives and my actions as a researcher.

Table 6.1 Linking purpose to researcher actions per research question

	Researcher actions per research questions	Purpose
RQ 1:	To find out what teachers say about infusing a notion of democracy, and critical science into their day-to-day classroom practice (through interviewing, audio recording).	To present an overall picture of the teachers' understanding of their enactment of an alternative classroom practice to the dominant current practices.
RQ 2 and 3:	To observe how they enact such alternative form of teacher practice (by classroom observation, video recording). To solicit their reason for doing what they actually did (through interviewing, video playback & audio recording).	To provide a description and explanation of (and existence/absence of) alternative teacher practice(s). To hypothesise possibilities for changed teacher practice(s) for pedagogical practice(s) of school science.

6.3. DATA CONSTITUTION

The constitution of data was carried out in seven phases, as illustrated in Figure 6.1 below. The data generated and analysed was distilled from four main and interrelated sources, namely, interviews conducted with teachers (individual and focus group), lesson observations (two to four per teacher), as well as the data generation instruments used, namely, structured and semi-structured pre- and post-lesson interviews, video-recorded classroom observation, classroom observation schedules, a focus group interview, and field notes that were recorded during and after the lessons observed for each teacher. While all of these sources of data have a place in the research, the classroom lessons that were observed were given priority as it was in this context/area that awareness was raised, which should facilitate the empowerment of change that critical science and democracy promises.

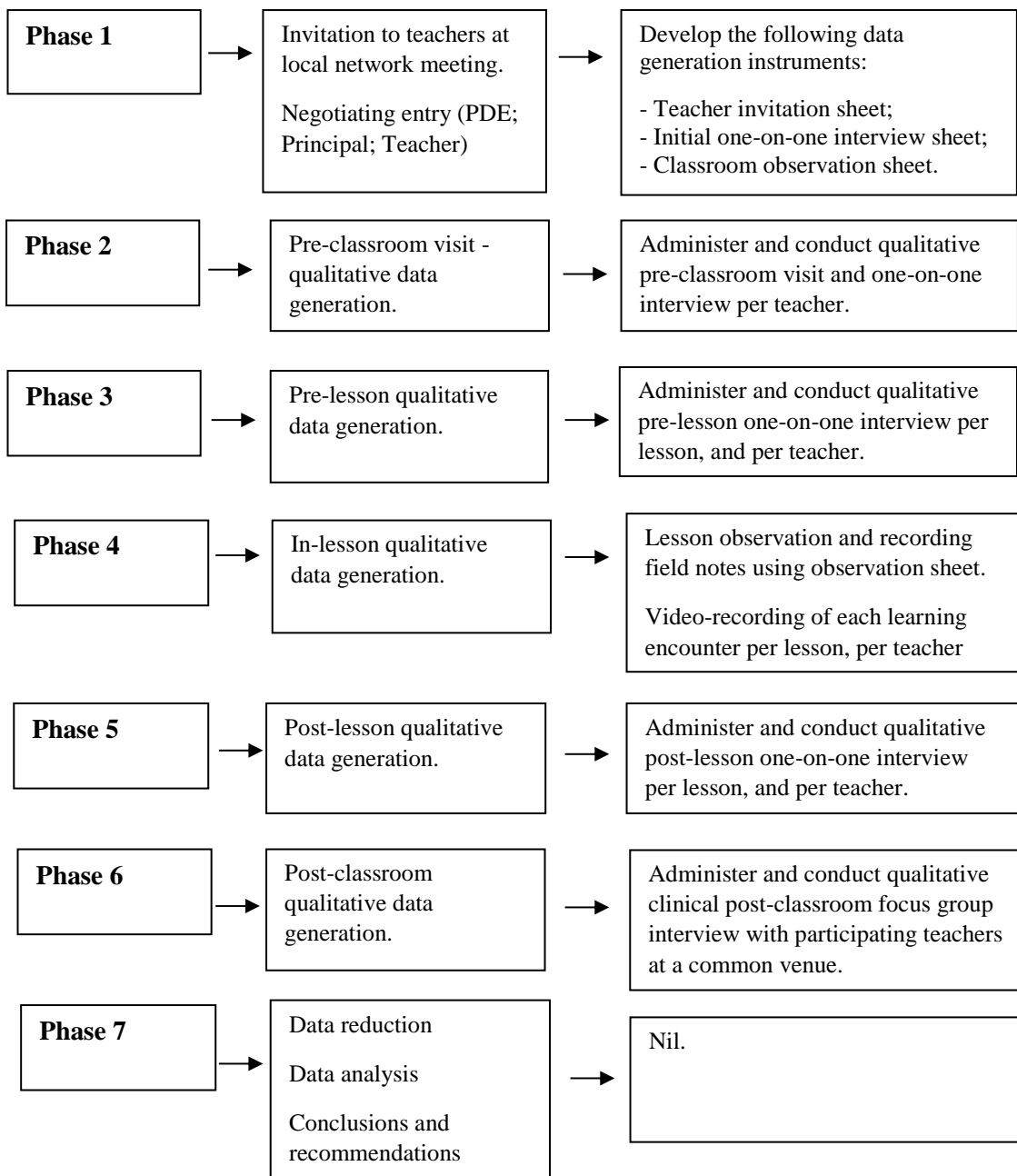


Figure 6.1 A series of phases in which the research was conducted

6.4. ACCESS NEGOTIATION WITH TEACHERS

The negotiation for access to any research site is considered to be the first vital step for the success of any research project. In classroom-based research, it is required that the researcher(s) obtain permission to gain entry to the school from both the teachers and the school principals. For the research to be worthwhile to both the teachers and researcher, close co-operation is key at all stages of the project (James and van Laren, 2009). A formal letter was used to obtain consent from the school principals at each research site, and to introduce myself

and the nature and purpose of the study, including the conditions for teacher participation in the study.

Additionally, James and van Laren (2009) hold that there are ethical issues centred on participants' rights, risks, confidentiality and trust, and that there is a power relationship intertwined with the process of negotiating this access (James and van Laren, 2009). I was also attentive to the idea that the research inevitably invaded the privacy of the schools and of the selected teachers' classrooms, hence the criteria used for the selection of teachers were disclosed to the PC-SA network teachers, who responded positively to the invitation to participate in the study. The conditions and particulars for participation were carefully articulated to the teachers, who offered to participate, and consent was obtained from those teachers who accepted the conditions for participation. The access to the privacy and space of the consenting teachers' classrooms included the process of them being observed and video recorded in their classroom and during interview sessions.

In the current study, the researcher and participants were well known to each other as members of the local network (PC-SA). Hence, shared power between the researcher and the participants was an ideal that was understood and strived for in all aspects of the study. The quality of the research process was enhanced by negotiations. Researchers need to be aware of the power relationships at play, the manner in which participants are approached, including the feelings they experience during the process of negotiating access and the dynamics that are in place (James and van Laren, 2009). The idea of power sharing was key as it enhanced what I was looking for regarding the teachers' understanding of critical science, and science and democracy, and how this was practiced in science lessons. The sub-sections that follow elaborate on what I did in the data production phases of the study, which required me to interact with the participants that were recruited.

The various steps included in the five phases of qualitative data production of the study, including the corresponding technique, and instrument and purpose, are presented in table form (Chapter 6, Section 6.3, Figure 6.1). This study used qualitative methodology to explore teachers' understanding, ideas, actual practice, and the reasons that they gave for what they did in their practices. This methodology enabled us to develop categories from the data to be produced (Merriam, 1998).

6.5. RESEARCH SAMPLE

The unit of analysis for this study was a particular group of four practising school teachers in the Department of Basic Education (DBE) and the General Education and Training (GET) bands. This unit of study was also the unit of analysis, meaning that each teachers' classroom was the actual unit of analysis because it provided the space within which the phenomenon under study was enacted in order to yield the research data. The group of participants who formed the sample of the study was recruited using a purposive sampling strategy. The target population from which the sample was selected was a local network of practising school teachers known as Project Citizen South Africa (PC-SA). Qualitative sampling "is selecting small samples of information-rich cases to study in-depth without desiring to generalise to all such cases" (Cohen *et al.*, 2007, p. 340).

In this sampling strategy, participants were recruited for their participation "on the basis of their typicality or possession of the particular characteristics being sought" (p. 115). This sampling method was adopted as I planned to recruit participants who would provide the required information in order to obtain a complete and thorough understanding of the phenomenon under study.

This sampling strategy is also referred to as convenience sampling as the participants were selected because of their performance and accessibility to the researcher, who was also a member of the local network. Therefore, I was 'researching across', which makes it easier to gain access to the participants through the quarterly meetings of the local network. The participants and their schools were selected based on convenience due to their close proximity to me as the researcher. Table 6.2 below reflects the demographic information of the participants in the study. School based educators from both primary and secondary school level were invited to participate in the study.

Purposive sampling was used to identify participants who showed strong commitment to searching for participatory learning approaches and opportunities for their students. Two educators, each from the local primary and secondary school level were invited to participate. Schools were informed using a prepared written statement, and teachers were then invited to participate based on this information. A selection of teachers was made based on a set of criteria. The school head was also to be informed. The table containing the above criteria and characteristics of the sample of teachers is shown below (Table 6.2).

Table 6.2 Characteristics of the teacher sample

Learning Area/Subject	Natural Science, Life orientation, Human & Social sciences	
Gender	Male =0; Female =4	
School setting	State-aided public schools	
School type	Primary	High
Grades	7	8,9
Demographics of participants		
Age:	40-49 years	
Teaching experience	10-19 years	1 teacher
	20-29 years	3 teachers
Years working with PC-SA	7-10 years	
Ethnicity	Black	2 high school teachers (With single learner population group – Black 100%; culturally diverse)
	Indian	1 primary school teacher (With mixed learner population – Black 70 and Indian 30%; culturally & linguistically diverse)
	Coloured	1 primary school teacher (With mixed learner population – Coloured 80% and Black 10%; culturally & linguistically diverse)

The strengths of purposive sampling are that it is less costly and time consuming, it assures high participation rate, and assists in obtaining the needed information. Its weaknesses include the fact that the results depend on the unique characteristics of the sample, and the results cannot be generalised (p. 140). Following is a discussion on what I actually did when taking the co-imagined ideals of the co-imagined situation into an arranged situation. In terms of the data constitution discussed earlier (Chapter 6, Section 6.3), the phases listed below do not correspond exactly with those listed in Figure 6.1, while phases 2 to 6 thereof formed the gist of what I did, when taking the co-imagined ideals, into an arranged situation.

6.6. ON TAKING THE CO-IMAGINED IDEALS OF THE CO-IMAGINED SITUATION, INTO AN ARRANGED SITUATION

6.6.1. Phase One: Interview – Audio-taped teacher interview prior to the lesson (teacher understanding of practice)

I conducted one-on-one interviews with each participant at a pre-arranged, suitable location that was negotiated over the phone. This was done to solicit each teacher's initial views of the concept of democracy using a structured interview schedule (Appendix C). The participants agreed for the interviews to be held at their own schools, and a suitable room was identified for conducting the 20 minute interview. This interview was conducted because I was interested in what each participant had to say about an ideal practice, one that entrenches democracy in science teaching and learning practice. I also wanted to record their initial responses and reasons that they gave for their practice. This was also done before the application of the co-imagined ideals because I wanted to get each teacher's views on the co-imagined ideal as both the participants and I were unsure as to what such a practice would look like. It was also important to obtain their preliminary views on what the practice would look like, which was to be used for me to prepare ways to capture this practice when the time came in the phases that followed. This was done as I wanted to know what each teacher had to say about the rearranged practice before I observed it in practice.

The methodological framing made such critical pedagogical reasoning possible by allowing me to access and use this data, which was based on each teacher's own understanding and interpretations of the co-imagined ideals. This was also carried out because in the co-imagined situation, the local network members were not certain about what the ideals of such a teaching practice would look like in actual practice. I wanted to find out, *inter alia*, what such practice looks like, sounds like, and feels like for each teacher before I actually observed it in the classroom. The interview method helped me to generate the data because interviews allow for purposeful discussion on a specific topic, namely, democracy in science teaching and learning practice at the school level, assumedly in a democratic learning space (Schurink, 1996). Tape recordings were made of all the interviews conducted, and transcripts were made of these.

6.6.2. Phase Two: Interview – One-on-one semi-structured interview pre-lesson

The purpose of this interview was to personally listen to what the teachers had to say about an ideal practice that is underpinned by democracy and critical science in the science classroom, which I refer to as a democratic space. This is a pre-observation, semi-structured interview based on a set number of questions. The questions were intended to solicit from the teachers a range of goals for the up-coming learning encounters. Goals were set out for teaching and learning, the teaching and learning process, about thinking, what the teachers wanted to show about themselves, to show about their learners, and about the task administered (Appendix D).

Phase 2 data was produced in the classroom seven minutes before the lesson, as arranged during recruitment and access negotiation. The data generated from the interview allowed me to find out what each teacher had to say about the unusual practice that she was about to teach for each of the various sequential lesson types, namely, (a) choice of topic by learners, (b) co-exploration of the learner chosen science topic (over an extended period of time, and depending on the amount of research to be conducted), (c) co-construction of portfolio boards, and (d) presentation of the portfolio boards (trial presentation at school, and actual presentation at a showcase). Specific data was solicited from each participant through the interview schedule (Appendix D). This kind of data was necessary because I wanted to know what the specific ideas and ideals of an unusual practice was, as understood by each teacher, that is, their espoused theory. Then, armed with this, to observe how this theory was enacted in a science classroom in the phase that followed, which is presented below. In a critical science approach, in relation to (a) above, the teacher starts by teaching the nuances of a broad, universal concept and then facilitates the students' selection of issues that can be analysed from this broader level (McGregor, 2003). The ideals of democracy and science, alternatively, require that local social issues create meaningful contextual knowledge that does not gloss over conflicts and controversial opinions, but rather opens up the discussion to further discourse (Klafki, 1996).

I was able to establish with each participant a measure of solidarity and support in the process, as it was a first for each participant to have a peer and co-creator of the idealised practice spend extended time with them in a rearranged situation. They were also applying a practice that was not yet known to either of us, which strengthened the need for solidarity. However, there was still an imposition, particularly for those staff members and learners in the other classrooms that were not part of the study. In the participating teachers' classrooms, I

was introduced as a member of PC-SA, a project that was known to the school through previous projects conducted by the teacher in previous years since 2003. I gained first-hand experience of each classroom visited, and observed the participants use their 'voice' to democratise the research. The use of interviews promoted the co-construction of knowledge. Qualitative interviewing tends to be seen as involving the "construction or reconstruction of knowledge more than the excavation of it" (Mason, 2002, p. 63). My role was both as researcher and as colleague in this phase, which enabled me to construct a safe environment. This helped the participants to explore issues using their own vocabulary and ideas. Power was shared in this phase, and initially, I did not debate or share ideas with the participants until the data production was completed.

Classroom observation followed immediately after the interview. In the seven minutes used for interviewing, the learners were allowed to get ready for the lesson, which was to be video-recorded, because I, as the 'visiting' peer from a local network, was keen to see what the teacher and learners did in this school. Hence, the pre-lesson observation interview was necessary to get a whole understanding of each individual participant.

6.6.3. Phase Three: Classroom observation – Video-recording of the teacher's practice

The use of classroom observation allows researchers to investigate the process of education in natural settings, to stimulate change, and to verify that change occurred (Anderson and Burns, 1989). Descriptions of teaching and learning practices illuminated by classroom observation are found to provide improved understanding and better models for improved teaching (Good and Biddle, 1988). The participating teachers were observed for a minimum of three one hour sessions devoted to teaching science through Project Based Learning (PBL) (Phase 4 in Figure 6.1, Section 6.3). The data generated from the classroom observations of each participant were based on each of the different sequential lesson types discussed above in Phase 2. The video recordings were made for each participant during the teaching and learning sessions to collect data on the nature of teaching and learning interactions.

The video recordings were made to be used in the next phase below, and to allow each participant to view their own recorded lesson in order to answer questions posed about these. Handwritten notes were made to capture the non-verbal behaviour of the participants during the teaching and learning process. How the learners participated and responded to this way of learning would be observed and videotape recorded. The classroom observations were

conducted using an observation schedule (Appendix G) in order to verify the self-reported data obtained from the participants during the individual semi-structured interviews. Unstructured observation was chosen as it allowed me to write descriptions of what I saw happening in the classroom, and I could choose to focus on two or three aspects that seemed worth pursuing (Bertram, 2004). An adaptation of Newton *et al.*'s (1999) observation schedule allowed me to produce data that is both descriptive and textual (including numerical data if and when needed). Each teacher was observed at least five times.

The data collection, through the use of the multiple data production instruments, assisted in checking the accuracy of the findings. Site visit data included “notes of observations and interactions within the social site during visits” (Carspecken, 1996, p. 40). This was constitutive of records captured in the observation schedule designed and used for the study (Appendix G). The observation schedule comprised a record of entries that were made some time after the events had taken place. This recording from memory should be done soon after the observation has taken place and records impressions gathered during informal observation periods (Carspecken, 1996).

6.6.4. Phase Four: Interview – Video-taped teacher interview, post-lesson

This section details the one-on-one semi-structured interview that took place post-lesson. The interview session involved videotape playback in order to allow each participating teacher an opportunity to first view, and then make a selection in order to comment by responding to the semi-structured questions posed by me (using interview schedule, Appendix E). Each participant was asked to identify an incident(s) (again pertaining to each of the different sequential lesson types) which he or she considered to be an example of the ideal of an unusual, rearranged practice or democratic ‘action’ oriented practice. Once such a critical incident was identified by the participant when she indicated that the video playback be paused at a specific point in order to allow her to give a brief account of the particular incident identified as one that is unusual or democratic practice in a science lesson. The teacher’s descriptions of the incident(s) identified, together with the reasons given for it being as such were audio-taped and transcribed for later use. This was done because I wanted to hear the reasons given by each teacher for doing what they actually did during the unusual lesson, after having actually done it with their learners.

About 20 minutes were used after each lesson taught to conduct the one-on-one interview sessions. These interviews were conducted immediately after the lesson taught in Phase 3 above, either immediately after the lesson, if time was set aside for this, or at some time after the lesson when the teacher had a free session on that day. Hence, the post-lesson observation interview was used to get first-hand data on the unusual practice carried out, and through the accounts given, to listen to the reasons the participants gave for their selection(s). This allowed me to further prompt for deeper meaning with regard to their choices and reasons. The video playback served as a medium for conducting the one-on-one interview, which was captured through the use of an audio tape recorder. I kept the terminology ‘*democratic space*’ in view of the practice of democracy and critical science. The interview was therefore focused on the democratic space(s), using some of the following prompts: *So...why do you consider it to be a democratic space? Why is it democratic, what constitutes a democratic space? How do you create it?*

6.6.5. Phase Five: Interview – Videotaped focus group interview with teachers

The need for a focus group meeting and interview in Phase 6 (Figure 6.1), was motivated by the following argument. After reading the transcripts, I was still left with some gaps in the participants’ meanings, as gleaned from the data transcribed from Phase 4 above. I needed to reconcile any contradictory conceptions present in the data or that emerged from the transcripts. Thus my proposition was that a focus group interview was to be used to obtain synergy in the views of the participants on the phenomenon under study, namely, performance democracy in science classroom teaching and learning practices. Synergy in this case refers to combined or co-operative action.

The focus group interview session was held in order to capture the nuances of the combined teacher meeting and discussion (using the focus group interview schedule, Appendix F). This allowed the participants to clarify any points of perceived disagreement or lack of finality or consensus between themselves, or any misconception in the responses that I may have had. The notion of performance democracy is one that emerged because each of the participants accounted for the action on their part in the teaching and learning practice in implementing the ideals of democracy and critical science. From their point of view, democracy was not some concept written down or contained in a chart fixed onto the classroom wall, as observed in some teachers’ classrooms, but a conception thereof that should be practiced through enactment, that is, what the teacher did, said, modelled, and lived out in their

“we relations” with the learners. Enacting such a notion of democracy fosters learner involvement in the science teaching and learning process.

This interview was part of the conditions for participation. A focus group meeting was held after school hours for one hour at an off-site venue so that the participants could be unencumbered by their school related duties. All four participants agreed to the date, time and venue, as these were negotiated with them prior to the actual meeting. However, a second session was agreed to (and held) four days later by three of the four members as one of the members called on the day to indicate that she could not attend due to illness. Unstructured interview questions (2 or 3) and one leading question were posed, which the teachers talked discussed. The focus group interview allowed me to not only observe their interaction, which is a process of profound importance to qualitative investigations, but also to gain access to substantive content. This “intentionally created conversation” (Berg, 2001, p. 72) encouraged all of the participants to respond freely on the topic under discussion, as illuminated by me as the researcher, one that emerged from my preliminary analysis of the research findings.

It also allowed participants to reflect and rethink their own views (Finch and Lewis, 2003), particularly so because although each teacher may have had similar co-imagined ideas for practice in the co-imagined situation, each may have had different ways of putting these into practice. As the researcher, I wanted to find out what this practice was said to be like, that is, the teachers’ understanding, as well as how it was actually enacted in a science classroom. It was also vital to ascertain the reasons that the teachers had for doing what they actually did in applying the unusual practice. The participants’ viewpoints were emphasised because they were interacting with each other rather than me, which also helps to eliminate my subjectivity as the researcher from the research (Berg, 2001). A focus group was used because a particular concept or phenomenon could be examined while being removed from its context, so helping to clarify the basic elements and structures of the phenomenon such as the one identified for this study. The criticism levelled at the focus group interviews was that the group dynamic put pressure on the participants to conform to a particular point of view (Finch and Lewis, 2003). The turn-taking sequence for the group discussion was emphasised so that everyone had a chance to participate or respond. Disagreements and agreements were to be respected and valued, and a diversity of views was welcome.

6.6.6. Phase Six: Observation – Annual Showcase of the local network

The PC-SA network hosts an annual showcase, which affords its members a platform to send their selected five-member learner team to present their school topic on a selected community issue. I participated in the showcase as a commentator, and also posed questions to the learner teams after their presentations because members of the network largely participated in this role at that level.

This kind of role allowed me to pose challenging questions to some of the learners who presented at the showcase, and to get direct and first-hand information on the learning gains made by the participating learners. This is important as it allowed me to observe and obtain insight into the effect and quality of learning outcomes that were produced as a result of applying an ideal teaching and learning practice that was unusual. My role in this particular showcase was largely to record on videotape the verbal presentations made by a team of 5 learners per school. Each participating school team was accompanied by a free-standing set of 4 interconnected portfolio boards that were used as a visual product or artefact based on their chosen topic. These portfolio boards also displayed their project work that was completed according to pre-established performance targets and guidelines.

The presenting schools' team of learners each took turns to present their project work before a panel of independent judges, including the audience, which was comprised of learners, teachers from participating schools, and special and invited guests.

For the showcase, each school team of learners constructed a set of interconnected Portfolio Boards (PBs), whereupon they applied the knowledge gained in the science class on their chosen topic. The PBs served as artefacts of a constellation of school classroom pedagogical transactions. Their inclusion as data was based on the premise that these artefacts, "like assessments and the routines that surround them, do far more than provide information; they shape people's understanding about what is important to learn, what learning is, and who learners (and teachers) are" (Moss, Girard and Greeno, 2008, p. 296). The use of an alternate form of assessment – assessment for learning, or assessment of learning – was more appropriate than the traditional pen and paper tests or examinations, which "fail to take into account current knowledge on effective teaching and learning, and which are coupled with practice focussing on passive absorption of knowledge [...] defined by what is efficiently testable" (p. 342).

Not only did the above artefacts serve as a final product for presentations or to evaluate the extent to which pre-existing assessment targets had been achieved, they also served as ‘documentary assessment’ (Jordan and Putz, 2004) that produced an enduring record of local or situational evidence. Moss, Girard and Greeno (2008) assert that “it is important to remember that documentary assessments are always interpreted and used in particular local contexts that shape and are shaped by them” (p. 296). How, then, are teachers’ understanding and actions enabled or constrained by the assessment practices in which they engage? My argument is that there is an inextricable link between the processes of assessment for learning and teaching, and that PBs as artefacts, which are a product of both of these processes. Therefore PBs contain evidence that is inherent, discursive and documentary as a result of a particular kind of teacher practice that produced it.

Each school team was given about fifteen minutes to make a persuasive presentation before an authentic audience, a panel of judges who did the scoring using a common score sheet, and group of commentators who first commended the group for their work and who posed simple yet challenging questions that were based on what was displayed and presented on the decorated PBs. The team of learners took turns to respond to the questions posed. The role of the teacher was minimal in this instance, and he/she was only there to support his/her learner team before and after the presentation as he/she reflected with the team after the presentation.

Each participating team was awarded with a token and certificate for participating within the primary school and secondary school categories for participation. For the purpose of participation at a national level, a position 1, 2 and 3 grading was awarded by the scoring panel of judges for each of the two categories of school participation.

In exploring the arranged situation through the use of the various constitutive aspects of this situation, as discussed above, the participants and I were able to bring into a new or arranged situation something that was unusual, something that was not part of the normal day-to-day science classroom practice. Data that was generated in this way, and from within this situation, was then organised and prepared for analysis.

6.7. HOW DATA WAS ANALYSED

The process of data collection, data analysis, interpretation and report writing, according to Creswell (2007), “are not distinct steps in the process – they are interrelated and often go on

simultaneously in the research project,” and that, “undeniably [...] writers craft each study differently, using analytic procedures that evolve in the field” (p. 150). In this study, data analysis, and to a lesser degree, interpretation, began initially from day one during the on-site visit interviews conducted with each of the four participating teachers. They were then reviewed again later on the same day back at my desk when transcribing the interviewed audio recordings generated from each participant. Using Dey’s (1993) words, I had to “learn by doing” qualitative data analysis, a process that “can be overwhelming” (Patton, 1980) given the voluminous data that was generated. Interpretation, alternatively, involved making sense of the data, and it played a central role in this study, which was located in a participatory paradigm, and one that adopted a critical approach. This aspect of the analysis is discussed at the end of this section, as I turn, next, to the data analysis strategies used in this study.

The analytical strategy used in this study draws from different forms or approaches to data analysis, as discussed earlier in Chapter 5. This began with the notion of “crucial description” (Section 5.1), the use of “tools” from qualitative data analysis and case study analysis, narrative analysis (Section 5.3), Positioning Theory (Section 5.4), and “explorative reasoning” (Section 5.2) as a quality research process.

A brief discussion is outlined below on how each of the above forms of data analysis were used in this study. Crucial description as a form of data analysis was used in this study to provide detailed descriptions of teacher practice, and reflections on those descriptions, as these were enacted by each of the participating teachers within an arranged situation. That is, a description is provided of what each teacher said and did, including the reasons given for affecting these in order to bring an unusual practice into reality. A crucial description is useful in the sense that it allows the reader to gain first-hand information of what was done. The reader is also given an opportunity to see what was done in a classroom setting where a new classroom practice was enacted by the participating science teachers with their learners. This enactment concerned the five conceptual underpinnings of this study, or the theoretical framework for learner involvement in science learning, as reflected in Figure 1 in the Prologue.

Writing up what each teacher said and did, and the reasons each gave for what they said or did was done in the form of a narrative. This form of writing assisted me in capturing the teachers’ own exact words. Narrative analysis, alternatively, assisted me in searching for the idiosyncratic ways in which each participant made sense of his or her own life. Their ideas and characterisations of own practice were represented in story form, and in a manner that appealed

to them, for a specific reason, and because it was compelling (Henning *et al.*, 2004). The participants' conversational style of interacting with their learners in a whole class discussion, or at times with an individual learner, and in a sustained manner through threaded discussion afforded me the opportunity to capture, in narrative form, those teacher-learner threaded discussions (as reflected in Figure 1 of the Prologue). Narrative as a form of data analysis was used to explore the way in which the teachers' practice involved their learners in own learning.

Davies and Harrés' (1999) conceptualisation of positioning was used to describe the relationships and interactions of people jointly engaged in "purposeful conversation" or activity. This form of analysis complements the above forms of analysis as it focuses on describing what the teacher, and the learner(s), actually did and said within the teaching and learning encounters that occurred in the science classroom. Positioning Theory as a form of data analysis was used to provide a description of the teacher-learner relationships and interactions as they co-acted and co-constructed meaning through science teaching. It also displayed a "discursive process" wherein the teachers involved their learner(s) in discussions as "subjectively coherent participants in jointly produced storylines" (Davies and Harré, 1999, p. 37). Positioning Theory, in combination with the other three analysis forms, was used to analyse the teachers' transcribed data. Critical events from the teacher narratives were identified, and then these were further analysed by identifying the teachers' storylines(s), and position and speech act(s) that were evident in their stories with regard to teacher practice.

Explorative reasoning, as a form of data analysis, was used in this study to help me place an emphasis on the exploration of change in teacher practice. Critical practice and research, according to Skovsmose (2011), "is to address not only the given situation, but the imagined situations as well [and] it is important to consider what could be done differently, acknowledging the constraints that condition the particular teaching-learning process" (p. 23). In this study, I used "explorative reasoning" as a form of analysis to explore the available "imagined" data obtained from what transpired in the realm of the ideal or co-imagined situation. This was done while reflecting on the problems that exist in the "current situation" in order to present what *could be*. I used actual data generated through this study to develop a fictional account of "what could be", rather than "what is", for changed teacher practice that is informed by the infusion of both critical science, and a particular notion of democracy.

According to Gee (1999), the tools of research are designed to describe and explain what the researcher deems to be important and to exist in a particular domain. The forms of data analysis and their relevant tools are listed and discussed below.

Data management began where the transcribed data generated was organised into computer files and folders earmarked for each research site and participant. These files were then later converted into workable and manageable text units, which were chronologically sequenced from lesson one to four or five, depending on the lessons each teacher wished or chose to be observed, and in relation to the sequenced learning encounters within the common PBL approach used by each teacher. The text units were also used to organise and prepare the data for analysis.

Data analysis in qualitative research, according to Creswell (2007), “consists of preparing and organising the data for analysis, then reducing the data into themes through a process of coding and condensing the codes, and finally representing the data in figures, tables, or a discussion” (p. 148). Besides this general process used by researchers, with variations thereof, it is helpful to have a procedure for analysis in terms of the core elements of qualitative data analysis, namely, “the central steps of coding data, combining the codes into broader categories or themes, and displaying and making comparisons in the data graphs, tables, and charts” (Ibid, p. 148). With respect to the phenomenon under study, the initial step of coding the data refers to reducing the data into meaningful segments and assigning names to the segments. This is the first of a number of different phases or steps in the data analysis process, depending on the approach to inquiry adopted for a study.

6.8. RESEARCHER’S STANCE: LIMITATIONS AND CHALLENGES

The potentially holistic nature of ethnographic research, for example, requires that it be a constitutive condition of the ethnographer’s method that allows for a continual “stepping in and stepping out” of the field situation (Forsythe, 2001, pp. 71-72). Ethnography is based on the creative tension inherent in the oxymoron “participant observation”. Therefore, the researcher needs to balance the cultural immersion required for meaningful participation with the critical distance required for observation and analysis.

This is relevant because in this study I was what Nader (1972) calls “studying [across],” with the participants, with whom I shared membership in the local PC-SA network. As the research fieldwork progressed, I found it increasingly difficult to reconcile the roles of

participant and observer because of the epistemological and practical tensions between the “relativist understandings of ethnographic data” and my insider role in the workings of PC-SA” (Forsythe, 2001). My insider role in the work, and as member of the common local network’s (PC-SA) cultural and disciplinary assumptions were embedded in every stage of development. However, my peers’ approach to creating a democratic space for teaching and learning in their classrooms was not the same as I what I would do in my classroom.

When the time came to “add in” the results of the data analysis, fundamental contradictions arose. The perspectives of the participants, which privileged their own unique approach to doing PC-SA work with their learners, was to be respected and acknowledged as it was enacted without that being influenced by my own approach.

My perspective on the way this ought to be done is not to be conflicted with the observed and transcribed findings, which views the participants’ perspectives as being different, but equally valid (pp. 105-107). Forsythe’s work provides an excellent example of the potentially holistic nature of ethnographic research, which this study is not. Her reflexive awareness of positionality avoids any pretences of impartiality and neutrality, rather, she argues for a stance of epistemological awareness. My role was to critically reproduce the perspectives of the participants where my critical researcher role should be a continual “stepping in and stepping out” of the field situation (Forsythe, 2001, pp. 71-72).

A critical aspect of my researcher role is sensitivity to the lurking questions of power: who has it, who does not, how does it circulate around research situations, and with what consequences? This issue is relevant here, given the democratic approach embraced by the study, and the commitment to uphold and achieve internal validity regarding the application of the concept and value of democracy. Power, in this case, was shared between the participants and myself as the researcher. An inherent, unequal situation cannot be avoided between the researcher and ‘the researched’, as the participants may not have the researcher’s skills and knowledge. An important consideration in designing the study was for me not to exploit any participant during the research process, and hence build up reciprocity and negotiation to facilitate open dialogue and power sharing.

It is against this backdrop that I have had to constantly guard against pre-judging the work of the participating teachers firstly, against my own standards of work regarding our common practice as members of the local Network. I considered the mere viewing of my peers’ work, in terms of the construction of PBs, as informally or partially assessing their work.

Therefore, this could be construed as being judgemental on my part because member school teams, in the context of the annual showcase, have been embroiled in trying to outdo other teams in the construction and presentation of PBs by their school's learner teams. This is in contrast to the normal monthly or quarterly network meeting engagements involving the co-imagining of alternative forms of classroom practice that is much more collaborative, user-friendly and supportive of each other's growth.

With respect to the data analysis and interpretation, I concur with Vithal (2003), who asserts that "any attempt to understand what happens in classrooms always produces only a slice of that reality. Many different readings can be made. It is a partial view because of where the researcher's lens focuses" (p. 149).

6.9. ETHICAL CONSIDERATIONS

A major ethical dilemma in research is that professional scientists intent on conducting research are required to strike a balance between the demands placed on them in pursuit of truth, and the participants' rights and values potentially threatened by the research (Cohen, Manion and Morrison, 2007). It is important that all research follows certain ethical principles. These principles are: autonomy, non-maleficence, and beneficence (Durrheim and Wassenaar, 1999, p. 60). The autonomy of all of the participating teachers was respected, and all information or responses supplied by them were treated with strict confidentiality. The research will be of benefit to all of the participants. Their prior and informed consent was obtained first, and each participant received a clear explanation of what the research expected of them so that they would be able to make an informed choice to participate voluntarily in the study (Bertram, 2004).

The participants were informed that they were free to withdraw their participation in the study at any point in the course or duration of the study. They were also assured that their identities would be protected or withheld when the research results are published. I also guarantee that once the analysis of the data is complete, it will be kept in a safe place for five years and then discarded to avoid wrongful use by other researchers. Transcripts of primary data sources were shared with each participant for member-checking to ensure the accuracy of the data. The observed data were coded into different categories and then analysed to identify changes (if any) regarding what the teachers said they did, what they actually did, and the reasons they gave for these. The interviews with the teachers, and the use of field notes, were

used to interpret these changes (or lack of change). Hence, the classroom observations and the broad categories used to code the data produced were used as the basis for one-on-one interviews at a later stage of the study. It was in this stage that the teachers presented an argument(s), through the reasons they provided, for their observed choices and actions.

In approaching this educational research, I consider it to be far from a neat, unproblematic and neutral process, and “regard it as a shot through with actual and potential sensitivities” (Cohen, Manion and Morrison, 2007, p. 131).

The social context of the study makes it sensitive, and my role is to consider the likely or possible effects on the participants of the research product, conduct, outcomes, reporting, and dissemination. The importance of research ethics is ‘situated’, that is, contingent on particular situations rather than largely on ethical codes and guidelines (Simons and Usher, 2000).

6.10. VALIDITY CONCERNS

Validity is the touchstone of all types of educational research (Cohen, Manion and Morrison, 2007, p. 134). The notion of authenticity is key in a critical paradigm, and the term ‘understanding’ is more suitable than ‘validity’ in qualitative research (Maxwell, 1992). My participation in the research does not make me completely objective about the community I was researching, and hence another person’s perspective is as equally valid as my own. To this end, the criterion of validity attaches to accounts as opposed to the data or methods employed in the study (Hammersley and Atkinson, 1983). Critical, here, is the meaning that participants give to the data, and the inferences drawn by the researcher from the data produced.

In the section below, two types of validity are addressed: catalytic validity and democratic validity, inclusive of democratic participatory validity.

6.10.1. Catalytic validity

Lather (1991) argues, in particular, for catalytic validity – a type that is relevant to this study given its emancipatory intent. This type of validity separates critical research from interpretive or naturalistic research. For her, this form of validity should be appropriate to one’s own intention and should be consistent with one’s theoretical and methodological orientation. Catalytic research “represents the degree to which the research process reorients, focuses and

energizers participants towards knowing reality in order to transform it, a process Freire refers to as conscientization” (Lather, 1991, p. 68).

Recognising the researchers’ active role and involvement in the research process, Lather posits that:

The argument of catalytic validity lies not only within recognising the reality altering impact of the research process, but also in the desire to consciously channel this impact so that respondents gain self-understanding and ultimately, self-determination through research participation (Lather, 1991, p. 68).

This impact of the research process on the participants is realised through the workings of the local network of teachers where co-imagining was done in collaboration with the participants.

Focusing on the way in which power relations in wider society are perpetuated in research practice, critical researchers take steps to ensure that research studies are democratically designed and that findings are democratically shared and produced. Catalytic validity embraces the paradigm of Critical Theory, and strives to ensure that research leads to action, because discussions of catalytic validity are substantive, and like Critical Theory, it suggests an agenda. Lather (1986; 1991), and Kincheloe and McLaren (1994) suggest that this agenda helps participants understand their worlds in order to transform them. The agenda is thus explicitly political because catalytic validity suggests the need to explore whose definition of the situation is operating in the situation.

Eisenhart and Howe (1992) draw from Roman (1989), and Roman and Apple (1990) when they describe valid research in this context as,

Using a methodology that resonates with the experiences of the participants; allows participants to understand and transform their experiences of subordination; reduces the separation between the researchers’ intellectual world and the participants’ descriptions and understandings of their experience; and allow the researcher’s prior theoretical and political commitments to be informed and transformed through participants’ experiences (Eisenhart and Howe, 1992, p. 652).

In the following section, I explore democratic validity (Anderson and Herr, 1999), which in turn was developed further by Vithal (2003) as democratic participatory validity.

6.10.2. Democratic validity and democratic participatory validity

In practitioner or insider research, such as the current study, democratic validity “refers to the extent to which research is done in collaboration with all the parties who have a stake in the problem under investigation. If not done collaboratively, how are the multiple perspectives and material interests taken into account in the study?” (Anderson and Herr, 1999, p. 16). “Democratisation of educational research is an important goal of critical education research” (Eisenhart and Howe, 1992, p. 653), and it is in this context that the participants cannot be ‘forced’ into research. In this case, the application of democratic participatory validity in research methodology enabled me as the researcher to place less emphasis on my own interpretations, and to give primacy and voice to others’ dissenting views and understanding (Vithal, 2003).

Democratic participatory validity “reveals the confidence with which the researcher is making particular claims, to show the extent to which they are shared and conflicting” (Vithal, 2003, p. 94). It is also used to declare the extent of involvement of the participants in the research process and the eventual claims made.

It further indicates whether “co-learning agreements” are being set up between the researcher and the participants rather than “data-extraction agreements” (Wagner, 1997), and in the case of the former, what is the nature and quality of those agreements. In keeping with democratic participation, this study was characterised by the following key features that afford participants an opportunity for participation, namely: openness, choice, negotiation, reciprocity, and flexibility. These key features are inherent in all the phases of participation outlined in the earlier sections of the research design, and are supported by the shared power relations between myself and the participants. The theoretical methodological tools discussed above provide us with a means to clarify and discuss the potentiality of teaching and learning situations. The focus of this study was on the existing actual situation. Such tools allow us to plan and describe an improved or future desired context for excellence in teaching, and subsequently, better learner achievement.

I mitigated against the problem of imposition in the actual situation by integrating a critical perspective through prioritising the following key concepts:

- Openness;
- Negotiation;

- Choice;
- Reciprocity;
- Flexibility; and
- Generativity.

These concepts were brought to bear in the study in the ways elaborated on below.

Openness: Openness is key for democratic participation and effective communication, particularly with regard to data production during each of the main phases of participation in the study (Chapter 4, Section 4.4). Interviews are the key research instruments that were used for data production in this study. This allowed the participants to express disagreements and concerns within the research, and hence enable richer data and opportunities for stronger analysis.

Choice: Choice is the key feature that allowed each of the participants to be recruited and to afford each a space for professional development in the enactment of democracy through the medium of research, as facilitated by a peer in the local PC-SA network.

Participants exercised their choice to participate and to develop themselves by a willingness to open up their largely private teaching and learning space and practice to, firstly, a fellow PC-SA member, and secondly, to a researcher who intended to disseminate the research findings to the world. Insight into these arguments were informed by the initial on-site school visits, which were welcomed by both the school principal and the participants. Choice in the research process affords the participants the freedom to withdraw or change the nature of their participation should their experience of the research process become exploitative in any way. Choice also becomes essential if participants are to maximise their own learning gains, and to reap the benefits of the effort and commitment that any successful research project requires (Vithal, 2003).

Negotiation: Negotiation is the keystone of effective democratic participation as negotiation between the research project partners holds the potential and possibility for change. This means, firstly, that the participants track their own progress in the process of enacting a practice that is underpinned by democratic principles. Secondly, this means that the researcher is able to understand and document the meanings given to that kind of teacher performance as enacted by the research participants. In this regard, and in Vithal's (2003) words,

The presence of negotiation allows an (actual) situation in which, whatever the idea or action that is put forward by the researcher and by the participants, it always has the status that it can be challenged, critiqued, discarded, reformed or transformed. This means that the quality of reasoning both in practice and in theory may be improved (Vithal, 2003, p. 97).

Participants were at all times valued as education professionals with unique knowledge base, skills, interests, intentions and values that differed from that of the researcher, even though they participated in a collaborative effort or as members of a local network.

Reciprocity. Reciprocity “ensures that the goals and outcomes of the research process will meet the needs and interests of both the researcher and the research participants” (Vithal, 2003, p. 97). This key feature of democratic participation serves as the active cohesive force between the researcher and the research participants, one that maintains the research and educational relationship between the two partners in a given project. This partnership was negotiated in the initial meetings of the research project, and was maintained through the workings of the local network meetings.

To reiterate, and as guided by James and van Laren (2009), for the research to be worthwhile to both the teachers and researcher, close co-operation was key at all stages of the project, which include, *inter alia*, the conception of the project, data production, and aspects of the data analysis.

Flexibility: Flexibility, alternatively, allows for greater ease of forward manoeuvrability within the context of rigid school time-tables and fixed lesson duration at school level, including the commitments made in each of the above key features. Schools can be viewed as prisoners of time in the sense that deep learning is constrained by the pressure of rigid time frames resulting from school structural issues, which include, *inter alia*, lesson duration segments, weekly controlled tests, end of term tests, formal performance tasks for assessment, and year end examinations. Thus the frenetic daily pursuit of work completion by teachers renders learning – which needs time – to be mediocre or of the “skill and drill” type for fear that learners will not score well in these tests. Hence, the issue of time is an important factor in the data production as it was often not adhered to at school level by both learners and teachers. Flexibility on the part of the research process was thus factored into the process. The key feature of negotiation was to ensure that all parties adhered to set time frames for school visits, as a delay could have imposed unintended challenges on the various phases of the research process.

Generativity: According to Angen (2000), research should also have a “generative promise” (p. 389), raise and open up new possibilities and questions, and stimulate new dialogue (Creswell, 2007). Generativity as a criterion for research is a concept in which studying a specific situation can give rise to new ways of perceiving the totality of the situation, or reveal aspects of the totality not seen before (Vithal, 2003, p. 101). It may also allow for situations where research enables the generation of new ideas for theory and practice. Research “must have transformative value leading to action and change. Our research should also provide non-dogmatic answers to the questions we pose” (Creswell, 2007, p. 206).

6.11. CONCLUSION AND SUMMARY OF THE CHAPTER

This Chapter presented a detailed account of the research design used in the study to bring into reality an unusual practice. This was done using a qualitative case study, and qualitative inquiry, and the use of Critical Theory as an overarching framework.

Data constitution, access negotiation with the teachers, and the research sample were briefly discussed. This was followed by a detailed discussion on taking the co-imagined ideals of the co-imagined situation into an arranged science classroom situation.

The various stages of the research were presented and discussed, and the chapter closed with a brief discussion on the researcher’s stance, limitations and challenges, ethical considerations, and the issue of validity. The next chapter deals with the data analysis.

In adopting a critical orientation, this study set out to improve the democratic living conditions of science teachers and their learners. The framing of the research design is, firstly, from a Critical Theory orientation, which focuses on the improvement of human life as an outcome. Secondly, the framing of the research design from a critical science orientation refers to the process that people engage in to obtain the desired outcome (McGregor, 2003). The critical science approach unites science for observation (evidence) and philosophy for analysis and criticism (reason) (Yoo, 1999). From a participatory research approach, according to Creswell (2007), the researcher ought to provide a voice for the participants, raising their consciousness and improving their (and their learners’) lives (p. 22). According to the author, the hallmarks of such a perspective is that the process must be recursive and dialectical, focusing on change in practice, and that it be practical and collaborative as inquiry ‘with’ others in the process of envisioning new possibilities (Creswell, 2007, p. 23). The two key aspects that are discussed in the next two chapters are: (a) understanding the science classroom as a

space for democratic living (Chapter 6), and (b) the enactment of the science classroom as a space for democratic living (Chapter 7).

CHAPTER 7

UNDERSTANDING THE SCIENCE CLASSROOM AS A SPACE FOR DEMOCRATIC LIVING

RQ 1: What is science teachers' understanding of the classroom as a space for democratic living, one that infuses critical science, and a notion of democracy?

The data generated through the use of the relevant qualitative research instruments discussed in Chapter 6, and the use of the data analysis procedures discussed in Chapter 5, was used to produce the results presented and discussed in this chapter.

In answering the above research question, the teachers' responses about an unusual classroom practice yielded the following understanding, which is listed below. The first response speaks to the issue of the learner, the second one speaks to the issue of space, which speaks to a unique kind of space that is referred to as a learner authentic space. The third type of response speaks to learning-centred practice. The fourth response speaks to the teacher as resourceful facilitation, and the fifth one speaks to participative mediation. The following five understandings were foregrounded, and speak to learner independence, learner practice, learning, teaching practice, and tools used:

- An independent *learner* – an independent learner who thinks and participates;
- An authentic *space*;
- A learning-centred *practice*;
- Resourceful *facilitation*; and
- Participative *mediation*.

The first of the listed teacher understanding is directed at the learner in terms of an independent learner, and in this way embraces *independence*. There are two variations of independence, one concerns *thinking*, and the other speaks to **participation**. The first sub-category, thinking, whether it be creative, critical, problem-based, independent, or being counted on, these are all variations in thinking. Thinking that is self-reliant affords learners the opportunity to find their own voice in learning, and addresses the need for reclaiming the learners' voice within the science classroom. The second variation of independence is participation, which refers to collaborative interaction that brings about collaborative decision-making. The category of independence points to the development of independent thinking. It

may also lead to collaborative decision-making. The idea of collaborative decision-making appears to leave little or no room for individual decision-making, which is very interesting because one would think that independence, or the concept independent, concerns the individual or person, but here the term independent is used in terms of a group. The very essence of collaboration is the construction of shared meaning (Roschelle, 1996).

The second category, namely, *authentic space*, speaks to learner practice and its four sub-categories, which allow for **contextualising learning**, **problem-based learning**, **transformative learning**, and **integrated learning**. The third teacher understanding refers to *teacher practice* and has seven variations, namely, **democratic practice**, **holistic practice**, **relevance**, **dialogic practice**, **differentiated practice**, **learner empowering practice**, and finally, practice in service of “**social justice and inclusivity**”, incorporating *the affective domain* and *moral regeneration*. The fourth understanding concerns the teacher’s role in *resourceful facilitation*, where this understanding has variation and has to do with individuals. A teacher as facilitator works with a group as an available resource to learners in order to help guide their learning process. The fifth and final teacher understanding speaks to *participative mediation*, which shows no variation, and has to do with the tool/s used during school classroom practice in order to enhance or enable learning. Below, I elaborate on each of the sub-categories of the above listed five teacher understandings.

7.1. INDEPENDENT LEARNER (CATEGORY 1)

In using the term ‘independent’ learner, we mean a learner who thinks and participates with others – I think, therefore I participate, and to be is also to participate. Independence may be characterised as the ability of a learner to reflect on their own thinking, participation and learning. Such a disposition fosters the ability to accommodate multiple perspectives in collaboration with others in order to come up with creative and valid explanations. Communocracy as a socio-political concept contains, *inter alia*, the desire to participate. Participation is universal to all human societies; without participation, human life within communal activities is meaningless (Diallo, 2006). For the individual to develop into an autonomous person, his/her sociocultural milieu must encourage such development (Brown, 1993; McGregor, 2003). The United Nations Convention on the Rights of the Child, Article 12, highlights the importance and role of learner participation in learning.

This teacher understanding concerns learner independence, that is, an independent learner who thinks and participates. It shows two variations, namely, *thinking* and *participation*. As can be seen from what the participants said (written in italics) with respect to independence, each participant spoke on this category, here I take an excerpt from one of them in order to illuminate this category. Teacher J said,

“Don’t always give them the answers. All the exposure they have already been through technology and books and through learner independence which is brought about by technology, through its use the world could be their oyster.”

This teacher shows us that her learners could be counted on at a level of teaching in expressing that,

“[They] go from what they know and extract what they already know. As a teacher you don’t know what they have already known, sometimes you actually duplicating or triplicating things that they already know, that it’s time-wasting.”

I discuss each of the above variations below under independence, beginning with thinking. Creative, critical, independent, problem-based or based on a person’s learning style, or for self-reliance to make a presentation, are all variations in thinking.

Category 1: Variation 1 (thinking – independent thinking)

With regard to independent thinking, Teacher J explained that, in order to develop learner thinking,

“Allow them to think for themselves, work with what they already know, it’s no use duplicating it.”

She further found that confident participation was a vital aspect of thinking and learning as she stated that,

“It allows them to gain the confidence that they need to go out there and participate in these topics.”

Category 1: Variation 1 (thinking – creative and problem-based thinking)

Teacher Z explained that creative and problem-based thinking required that learners verbalise their thoughts in front of others about the chosen local community problem. She supported this in saying,

“[The learners are] to be able to present what they think, for them to think more about the problem, how are they going to deal with the problem. [It] Allows them to say something, to do a thorough research.”

She further stated that she wanted them to be successful and creative problem-solving thinkers,

“I want them to achieve what they think, and to create more. To get something from them on what they think.”

Category 1: Variation 1 (thinking – critical thinking)

In terms of critical thinking, Teacher G explained that she wanted to, *“Bring about critical thinking”* and that she would like do this by using real-world problems that directly affected the learners by developing their self-analytical skills,

“A child that is not able to speak to start now to be critically thinking about issues around them. This will help inform the way they live their lives. For critical thinking to occur in classroom learning, there must be some self-analysis on the part of the child”

She wanted to build learners’ belief in their own capabilities and self-worth as she stated that it was, *“promoting the need for learners to believe in themselves.”* In terms of teaching that was based on the learners’ learning style, Teacher G explained that, *“with thinking, learning can take place using learners’ multiple intelligences.”* For her, this could be done by making connections with everyday life and the curriculum,

“Learning does not have to be formal all the time, messages here all relate to alcoholism and the way it relates to themselves as children and in their homes as well, addressing the alcohol problem has got to be multi-dimensional, multifaceted. Learning through the visual means is important because these kids’ learning style revolves around the visual and auditory, music for auditory, and lots of visual activities, and role-play. We use the ‘jig-saw’ because we don’t just focus and labour one method, we try now to look at various ways. We teaching the children that you don’t just look at a problem in one particular direction.”

With regard to thinking for the self-reliance to make a presentation, Teacher G said that, *“they would continue and stay comfortable and give that wonderful performance that they did in the classroom”* as they could use the information contained in the PBs as a guide, meaning, that *“they will stay on track with the information that is on the board, with their speeches & statements”* because they are adept at responding to questions posed. She further explained that,

“The questioning will not worry them because they can answer the questions like a lawyer, they may not be able to understand the questions as isiZulu being their home language, code-switching might be needed at that stage.”

Alternatively, thinking that is self-reliant affords learners the opportunity to find their own voice in learning. It also addresses the need to reclaim the learners’ voice within the science classroom. The second variation of independence is participation, which concerns collaborative interaction in order to bring about collaborative decision-making. The category of independence points to the development of independent thinking on the one hand, and on the other hand, it points to participation that leads to collaborative decision-making. The idea of collaborative decision-making appears to leave little or no room for individual decision-making, which is very interesting because one would think that independence, or the term independent, refers to the individual or the person, but here the term independent is used in terms of the group as a whole. The very essence of collaboration is the construction of shared meaning (Roschelle, 1996).

Category 1: Variation 2 (participation – through interaction, sharing ideas)

Interaction and contribution are forms in which participation, as a variation of independence, are spoken about by the participants.

Participation through interaction can be seen in incidents where each of the participants talk about this. In the sharing of ideas as a variation of interaction, Teacher G clarified that this included, *“learners sharing of own experiences, on a topic linked to learner’s everyday life.”* This occurred as a result of encouraging learner involvement in their learning as she wanted them to make a *“choice of topic for project work.”* The reason she gave for learners sharing ideas was to make learning relevant, *“They created the information and platform, and brought the issue forward and tried to persuade me as to what is more important to them.”* Within this category, Teacher Z discussed the sharing of ideas in, *“promoting learner communication, ensure that learners to work together.”* Where this could be done through dialogue and the exchanging of ideas, she clarified that learners had to, *“communicate with each other, to share some ideas with other people.”* Her reasoning in making education as a joint and collaborative decision-making exercise is *“to have teacher learner interaction, ensure that learners to work together so that they can make their decisions.”*

Teacher J, also talking about the sharing of ideas by learners, explained that, *“they must learn to share their ideas and not to hold back”* because she wanted to build their self-esteem. She also felt that *“each learner is to be confident in what they say, they must be sure on what they are contributing, it must be of benefit to everyone.”* Teacher M saw participation through interaction and information sharing, in the principle of Ubuntu, *“it (Ubuntu) is about democracy, it is about passing on information, it’s about caring for others.”* Her reason for this is that she viewed Ubuntu as all-encompassing in that *“it embraces almost all the goals that are there.”* Teacher M also discussed collaborative co-interaction based on learners responding to questions posed to them,

“With participation, they should understand that participation of all of them is relevant even if only two will present (at the showcase). Interaction, the learners have got to learn to always interact with the teacher, and the teacher must also interact with the learners.”

The reason given for this was purposeful interaction and accessing of task-related information, she explained that *“they are seeking information, because if they cannot they will not be able to get the information that they need. So, interaction so that the project moves forward.”*

Category 1: Variation 2 (participation – through contribution)

There were two participants who spoke about contribution as a variation in participation. Teacher M saw her goal for the task as learners’ contribution to the well-being of the classroom environment. She clarified that,

“The chosen task is not only one that benefits them, they are strong for taking up this task (problem of teenage pregnancy), and it is not only for now. [This is done for] them to see the finished product, be able to present their information, use the information for life, to pass it on to others learners. It is about sharing. Ubuntu, one of the principles is sharing and caring.”

She envisioned her learners taking a public stand regarding the problem, which can be seen when she says that, *“they are going to wear T-shirts with the slogan ‘true love waits’”*. She found learners’ action regarding the problem important as it *“can impact on the other learners not involved in the task; other youth’ mind-set will be changed.”*

Teacher J intimated that her goal for the lesson was for *“learners [to] give own contributions.”* She also maintained that learner contribution drives active involvement in the classroom in stating that,

“Learners go out to research, come back with all their findings, communicate it to the bigger group, sit and discuss it, see what they would like to see what happens, and the changes they would like to make on the topic, and to go beyond the guide given, and explore other problems found.”

Her reason for this way of learning was that it brings about effective problem solving through the learners taking initiative. She explicated, *“I want them to take initiative with that and explore that further, to identify which is going to work for them, and which is going to have more impact in solving the problem.”*

Category 1: Variation 2 (participation – through problem-solving)

Additionally, problem-solving, as a variation of independence, was discussed by Teacher Z, who envisioned exemplary task execution and accomplishment. She stated that she wanted, *“the task to be well done and well prepared”* as a goal directed at problem-solving. To achieve excellence, learners as citizens need to access specific and relevant information from the community, this is evident when she says that learners are *“to get the information from the other people and come back with the information so that we can solve the problem, and to see the evidence of doing the task.”* For her, it concerned problem-solving to address a local community issue, as she said that, *“it is important because we are solving other people’s problems in the community and within the school.”*

Category 1: Variation 2 (participation – through knowledge construction and application)

In terms of co-active knowledge construction and application, Teacher Z held that learners were to be supported in applying the knowledge gained in order to construct new knowledge. This was to be obtained in the process of constructing an artefact in the form of self-standing inter-linked PBs, which were used to carry out a presentation in front of an audience at an upcoming showcase. Her goal for the task was that the learners had to be active as she wanted *“them to construct the boards”* by sifting through the available data to decide on appropriate and relevant information, with the teacher as a resource available to learners when creating a project artefact. She maintained that,

“Learners [should] be able to recall information, obtain the correct and relevant information to construct the boards. Provide the criteria for constructing and evaluating the boards. That each board reflects the sub-topics on the problem, and that there is a link and supporting data and captions to the diagrams and pictures with data sources as well.”

Learners working on such a challenging and unusual task were given knowledge construction guidelines to assist them. The learners had to be able to interpret information, and keep the solution of the problem in mind while doing so. This can be seen as she explained that, the learners had to

“Ensure that there is a sequence to be followed in constructing the boards, and to know that there is a problem, and how they can deal with the problem. So, the learners will know and interpret scientific and environmental knowledge that affects their lives.”

7.2. AUTHENTIC SPACE (CATEGORY 2)

The term ‘authentic space’ refers to the existence or creation of appropriate teaching and learning environments in the current school situation. Such a space takes into account the diversity that exists amongst the school-going youth within the science classroom. Recognition of student differences, and the response to these, are seen as socially constructed phenomena. An authentic space is considered as an appropriate teaching practice to bridge the divide between school learning and learners’ real-life learning experiences from which they are usually sheltered from by current science classroom practices.

This teacher understanding shows that there are four variations in the teachers’ understanding of an authentic space, one that allows for contextualised learning, problem-based learning, integrated teaching, and integrated learning.

Category 2: Variation 1 (contextualised learning)

With regard to the first variation of an authentic space, namely, contextualised learning, three participants spoke about this type of learning. Teacher J held the opinion that learning is about putting yourself out there, and that learners should not be afraid of this process. This is evident when she said that, *“learners must learn and not be afraid to communicate”*, especially in learning encounters wherein she would engage the learners in solving problems that related to their daily lives. This was to be done through “talking” as she explained that learners must *“participate in problems which they see and which are around them, something that they must take up themselves, talking things out, and talking it through.”* In such contextualised learning, learners are given agency through talking about problems in their daily lives. She argues that communication develops confidence, which opens wider thinking spaces. She explained that, *“it is through communication that they learn and gain their confidence; in that way, you open up a much wider thinking.”*

Teacher Z, in her quest to get “*learners to be creative*” as a goal for the lesson, favoured guided learning in a problem that affected her learners, this is evidenced as she claimed that, “*we [herself and her peer educators] helped them, to guide the learners. The topic affect us [learners] and the local community.*” Alternatively, on promoting learner involvement, Teacher G maintained that through allowing learners to choose a topic for learning, she would like to see her learners exchanging information that they brought from home into the classroom. She listed that this was done, “*by show of hands, problems at home listed on the chalk board, sharing of own experiences on a topic linked to learners’ everyday life.*”

Teacher M, in her goals for the teaching and learning process, talked about PBL, which encourages learner involvement: “*project work learning process affects them.*” Her approach to enacting this in the science classroom involved providing the learners an opportunity to choose a topic that focused on recurring societal and environmental problems. She explained that, “*we are going to choose a topic which concerns social and environmental issues that they are going to discuss.*” Her argument for working in this way was to contextualise learning by creating a connection between school and society, “*because the school is part of wider society.*”

Category 2: Variation 2 (problem-based learning)

On the second variation of authentic space, namely, problem-based learning, Teacher J maintained that the problem solving of learners “concerns” and “experiences” of the problem promoted joint collaboration and decision-making through the use of multiple mediating devices to gain access to learner thinking and understanding on the topic that they chose. She clarified that,

“[It was for] them to consider how would they go about dealing with it? In a way where they could find some of the solutions around the concerns that they have, and the problems they are experiencing, through a task in the form of a spider diagram, which we would discuss and illicit key aspects of science which they can identify within that discussion. Team work is very important, and consultation and decision making must be done jointly.”

Her argument was that project work serves as a means for learner collaborative action, which can be seen when she says that, “*they need to use these whilst working on the project, in that I would try to instil in them that there must be team spirit, team work.*”

Teacher M, in her goal for the teaching and learning process – one that affords learners a chance to take initiative, talked about problem-based learning as a way to enact classroom practice that afforded learners the opportunity to learn and do problem-solving as assisted by her. She explicated that, “*they state the problem, they to solve the problem, they to go and collect information before they solve the problem. I as a teacher to ensure that they have enough information and that they collect enough and correct information.*” Her argument for doing it in this way was for the learners to access the required information, and for them to observe how problem-solving occurs. This can be seen when she says that, “*learners are to collect information in order to see how they solve the problem.*”

Teacher Z, in what she wants to show the learners about the task, talks about learner excellence in task execution related to dealing with a local community problem. This can be seen when she says, *the task to be well done and well prepared.* For her, teaching and learning for excellence would involve the improvement of learners’ decision-making and inquiry skills in order for them to collect specific and evidentiary information from the community. This is evidenced when she says that, “*learners get the information from the other people and come back with the information so that we can solve the problem, and to see the evidence of doing the task.*” Her argument is that learners learn best when linking school based learning to actual real life community issues brought to the science classroom by the learners who chose the topic. She views this as “*important because we are solving other people’s problems in the community and within the school.*”

Category 2: Variation 3 (transformative learning)

As a third variation of authentic space, namely, transformative learning, one participant provided two examples (authentic learning, and transformative learning) as variations found within this type of learning. Firstly, Teacher G discussed an authentic learning in expressing “*that this task is not just a simple academic task, the task is something that is related to life.*” Her understanding was that, as the task could have an impact on learners’ lives, they had a choice in matters that affected them, this is supported in her saying that, “*the task is something that will impact in the future of their own lives. It will impact in such a way that, by the time they get into high school, they will realise that they have a choice.*” Her argument was that learners would be empowered in terms of knowledge about the social ills in their community, “*they will be able to make an informed choice about taking that first drop of alcohol.*” Secondly, Teacher G talked about what she wanted to show the learners about the task,

maintaining that it was about transformative learning. This can be seen when she said that she wanted to, *“show that this task will be able to change them.”* She posited a classroom practice that challenged traditional teacher-learner roles and relations in the classroom from ‘power over’ to ‘power to’ in that she, *“change[d] their power relations first between myself and them, in that they will now teach and I will listen, and assess.”* She explained that it promoted learner autonomy and authentic practice, one that is inclusive of learners’ lived experiences. She further stated that,

“Like there were barriers in the class, and now we removed it, at home they will use the same strategy in trying to remove the barriers, by taking that kind of power and transferring it, and find ways to solving the problems they have at home. So basically conscientizing that – the power you have in the class, you will take it at home as well because here I gave you the opportunity to challenge my authority.”

Category 2: Variation 4 (integrated learning)

As a fourth variation of authentic space, namely, integrated learning as a teaching and learning goal, Teacher G detailed integrated learning as, *“total learner participation, self-reliance and initiative, an integrated way of working of these.”* This type of learning, for her, occurred through classroom practice that promotes learner autonomy, power sharing and empowerment. She clarified that,

“To transfer my power to the children and allow them to participate and to manage the lesson on their own, and focusing on their multiple intelligences, what will interest them, and group them accordingly. Learners take to responsibility for their own learning – self-reliance will come from their own initiative. Create that initiative, the challenge and the task must be stimulating enough, you find that the children become more self-reliant.”

Her argument was that this way of learning afforded an opportunity for learners to encounter learning through active participation, and it challenged dominant practices to make way for learner involvement. This was evident as she stated that, *“their previous under-performance is due to being taught in a traditional way, the teacher is in command and holds all the power in the classroom, participation comes initially if you give them the opportunity.”*

7.3. LEARNING-CENTRED PRACTICE (CATEGORY 3)

Learning-centred practice refers to a unique science practice that is the antithesis to the mind-set that sees the teacher as an expert and the student as an empty vessel. Through this type of classroom practice, all knowledge is viewed as a product of the individual's interaction with ideas, including learner co-action with the teacher and their own peers, as mediated via personal and social learning. The teacher, instead of using lesson plans, now designs learning plans wherein learners design their own relevant, meaningful learning experience so that they can learn concepts and appreciate contexts related to a recurring problem in their own community (Williams, 1999; McGregor, 2003).

Working in this way, education becomes a joint enterprise in which learning encounters concern constructing a concept rather than simply transmitting knowledge or facts. Learning plans, according to McGregor (2003), promote power sharing, foster a sense of ownership and commitment, and both teacher and learners are responsible for the learning outcome, or lack thereof. This type of teacher practice is centred on learning, and employs learners' idiosyncratic and multidimensional ways and capabilities of knowledge building.

With regard to this category of teacher understanding, there are four variations in their understanding of a learning-centred practice, which affords the following practices, namely, democratic practice, holistic practice, relevance, dialogic practice, differentiated practice, learner empowering practice, and practice that incorporates social justice and inclusivity, the affective domain, and moral regeneration.

Category 3: Variation 1 (democratic practice)

The first variation of learning-centred practice, namely, democratic practice, was spoken about by three participants, Teacher M (three times), and once by Teacher G, Teacher Z, and Teacher J.

Firstly, when asked about what she wanted to show the learners about herself, Teacher M required that the learners learn from her performance of democracy in the science classroom, so "*that they understand and practice democracy.*" Her view was that this could be done through the actual enactment of democracy in practice, "*if I say they must select their own topic, they must vote for the topic.*" Her reasoning was that learners should take ownership and be actively involved in the lesson as, "*they are the ones who are going to do the topic.*" As an additional goal, she maintained that the task afforded the opportunity for learners to perform

or enact the concept of democracy, this is evident when she says that, *“democracy is something which is practical even in a learning environment.”* She stated that the role of the teacher changes to one that guides learners, *“the teacher is really, really a facilitator.”* Her reasoning was that she wanted to break assumptions and place herself as the teacher in the role of democratic change agent. This is evident when she says that, *“because with the learners there is the assumption it’s the teacher who has got to sort of dictate the learning situation.”* In another lesson, Teacher M again wanted to show her learners her democratic teacher disposition as she wanted to *“show that I am a person who is very clear about democracy.”* She found that this could be enacted through learner empowerment and action underpinned by *“democratic principles”*, and policy making provision for learner involvement, and the teacher using democracy to promote moral autonomy. This is evident when she said,

“I am indirectly teaching them about democracy, empowering them so that they know that in whatever you do, you have got to apply the democratic principles. There is a law on the right to public participation.”

Her reason for this was that working in this way allowed learners the opportunity to conduct an investigation to solve their own chosen problem. This is evident when she says, *“as when the learners are doing their research, I don’t want to instil my own values on them. They came up with the topic, so they have got to be the ones who solve the problems.”*

Secondly, still in terms of democratic practice as a variation of learning-centred practice, Teacher J held that learners’ understanding of the concept democracy needed to be learnt within the context of a problem, and as the basis for problem-solving,

“[The] concept of democracy, words that come to mind when using the word democracy that they hear, what they read about and what they see, their understanding of the word democracy, their understanding of the word poor sanitation.”

She found that it promoted learners’ thinking, and it made use of learners’ prior knowledge to build new knowledge. She explained that she did this because,

“To ask them to think, they must put down some words on paper so that they could display so everyone can see it. To take the topic from what they know and their daily surroundings, on what they do on a daily basis, what is being done in the home? In that part the cleanliness and a lot of the hygiene is very evident. What is being used in the homes, to keep the cleanliness and the hygienic conditions? To start with some of what they knew in the home, the cleanliness, for

them to come up with suggestions, where I want them to give me examples of what they see in their homes, what is being used for sanitation and hygienic conditions in the home.”

Her argument for this approach to classroom practice was that the teachers’ role as a side guide during knowledge co-construction, and the learners seeing school learning running parallel with learning occurring at home was helpful in the learners taking control of their own learning. She further explained,

“I want them to get into the deeper meaning of it, taking them from the home, to the where the problem lies in the school. Hence from familiar surroundings to the school, to bring about an understanding of the concept of democracy. For sanitation – taking them from familiar surroundings at home to the school where the problem lies.”

Thirdly, Teacher Z discussed having learners use democracy as the basis for social organisation and as a means to promote their shared interests, as evidenced in her statement, *“learners to bring their ideas and promoting the democratic way in the classroom.”* She observed that this allowed learners an opportunity to exercise their own voice, and gave each learner the opportunity to act, *“it is not only the teachers but the learners who can express their views.”*

Fourthly, and lastly, Teacher G spoke about *democratic practice in the classroom*. Her way of doing this was through an educational relationship based on two-way respect, establishing an environment conducive to teaching and learning, and using a collaborative learning approach. She explained that,

“[To] work and learn along constitutional principles – respect each other, respect the teacher and the teacher must respect them. A classroom conducive to teaching and learning, they must accept each other in their classroom, must be able to rely on each other, respect each other at all times, collaboration and support for each other, develop, carry and sustain the spirit of Ubuntu [for] promoting collaboration and democratic classroom practice.”

Category 3: Variation 2 (holistic practice)

The second variation of learning-centred practice, namely, holistic practice was spoken about by Teacher G when referring to one of her teaching and learning goals for the lesson in referring to *“democratic practice in the classroom, holistically.”* This is consistent with the need to prepare the school-going youth for democratic participation, as their contact with science is mainly through the socio-scientific issues that they confront in their own communities (Kolsto, 2008). She found that this could be achieved through classroom practice

that must “*develop, carry and sustain the spirit of Ubuntu*. According to Diallo (2006), on the one hand, Ubuntu is a universal concept that embraces all humanity. Koka (2001), on the other hand, speaks about communocracy as a socio-political concept that is deeper than the Greek version of democracy, and posits that it contains the elements of universality and inclusiveness in its scope and operation.

Additionally, Teacher G discussed “*the multi-dimensionality of the task*” when asked about what she would like to show about a lesson task. Her reason for this was to promote holistic classroom practice in, “*promoting integrated approach to learning and teaching*.” The way in which this was to be done was by using classroom practice that was planned to incidentally develop learners’ skills, values, and in the lesson, to exploit ways to develop learners’ knowledge and attitudes as well. She explicated that she tried to,

“Bring out multiple dynamics in teaching and learning, bring out many skills, feelings and values that are unplanned, happening and observed incidentally. Whilst it is happening, capitalize on that and to focus on how teaching and learning can be improved, and can bring in the knowledge, skills, attitudes and values, all in one presentation.”

Category 3: Variation 3 (dialogic practice)

A third variation of learning-centred practice, namely, dialogic practice, was spoken about by Teacher G with regard to the teaching and learning process as she posited that the process focused on building learners’ self-confidence and problem-solving skills through dialogue. She claimed that, “*to focus on speaking, the learner will be able to communicate confidently and effectively in a spoken language in a wide range of solutions*.” She found that this could be done through an integrated and multi-disciplinary approach to classroom practice where learners actively and openly exchanged ideas and feelings, and there was room for disagreement. This is evident when she says, “*to integrate the arts and culture with English, the various solutions will be the various tasks. Each group will have a particular task, communicating ideas and feelings expressively with confidence*.” Her reasoning for this way of learning was the promotion of human rights through a classroom practice that created affordances for learners’ skill development,

“The key outcomes here are demonstrating basic interaction skills for participating actively in group discussions the key outcomes here are demonstrating basic interaction skills for participating actively in group discussions. All those skills come in on the task focusing on human rights issues.”

Additionally, in talking about what she wanted to show about herself to the learners, Teacher G wanted to have a two-way communication teacher-learner educational relationship. She explained, *“that barriers of teacher-learner relationships need to be broken.”* Her opinion was that this could be done, although it required a pedagogy of passion, and a teacher-learner relationship that is based on trust, *“you have to show some compassion if you teach with the heart, a teacher/learner relationship established on trust.”* She argued for the enactment of a classroom practice that establishes trust, respect and works in service of social justice. She expressed that, *“teaching and learning should actually work through trust, respect and trust, on behalf of both the learner and teacher. You handling children coming from homes with violence, and homes with various trauma.”*

Teacher M wanted to have learner participative interaction through communication as teaching and learning goals for a lesson, which is evident when she discussed the importance of, *“communication, participation, interaction and response to questions.”* She held that these goals could be achieved in the classroom through learner two-way collaborative interaction with the teacher,

“They must be able to communicate properly. Participation, they should understand that participation of all of them is relevant even if only two will present. Interaction the learners have got to learn to always interact with the teacher, and the teacher must also interact with the learners.”

She expressed that she wanted purposeful learner interaction, and easy access to task related information. This is evident when she says, *“if they are seeking information, because if they cannot they will not be able to get the information that they need. Interaction so that the project moves forward.”*

Teacher Z wanted to solicit learners’ responses to problem solving, *“the teacher must be able to take the answers from the learners and discuss the issue.”* She stated that she would use a mediation device to encourage debate and discussion in a democratic context, and that she would, *“create a debate between the learners and the teacher, to do enough research.”* She explained that debating would be used to establish the main argument and to solicit learners’ opinions as a requirement of democratic order. This is evident when she says, *“Debate so that they can get the argument, and get different opinions from the learners, since we are living in the world of democracy.”* Additionally, Teacher Z posited that two-way dialogic communication was useful for *“promoting learner communication”* as a goal for teaching and

learning, as this could help the learners to, “*communicate with each other, to share some ideas with other people, including other teachers.*” She argued that education is a joint enterprise in collaborative action towards a common outcome, “*to have teacher learner interaction, ensure that learners to work together so that they can make their decisions.*”

Category 3: Variation 4 (differentiated practice)

Teacher G’s goals for thinking during teaching and learning are aligned with practice that reflects the characteristics of learners’ learning styles, and can be seen when she says, “*I want to break assumptions with thinking, learning can take place using learners’ multiple intelligences.*” She found that this could be done by using a social learning approach using more informal classroom practice and by making connections between learners’ everyday life and the curriculum, including the use of multiple mediating devices. She explained that,

“[In] grouping them, learning can take place using multiple intelligences. Learning does not have to be formal all the time. Messages here all relate to alcoholism and the way it relates to themselves as children and in their homes as well. Addressing the alcohol problem has got to be multi-dimensional, multifaceted.”

She argued that practice needs to create affordances for multiple perspectives by taking into consideration learners’ different ways of learning, and that it should cater to both *auditory learners* and *visual learners* through the use of multiple mediating devices that promote learner involvement. This can be seen when she says,

“Learning through the visual means is important because these kids’ learning style revolves around the visual and auditory, music for auditory, and lots of visual activities, and role-play. We use the ‘jig-saw’ because we don’t just focus and labour one method, we try now to look at various ways. We teaching the children that you don’t just look at a problem in one particular direction.”

Teacher G also discussed *total learner participation* as a teaching and learning goal in the same learning encounter. She posited that this could be enacted in the learning encounter where classroom practice is driven by learners’ interest, and through a differentiated learning approach. She mentioned that, “*focusing on their multiple intelligences, what will interest them, and group them accordingly.*” Her reason for total learner participation was to challenge dominant practices to make way for learner involvement as learners’ “*previous under-performance is due to being taught in a traditional way, participation comes initially if you give them the opportunity.*”

Additionally, within the same learning encounter, Teacher G - whose goal for the teaching and learning process was to promote greater dialogue with the learners - posited that this could be done through the use of multiple tasks that afford the opportunity for differentiated learning so that every learner has opportunity to learn. She explained that,

“The various solutions will be the various tasks (on the problem of alcohol in the community), each group will have a particular task, they have various tasks such as cartoons, newspaper articles, through a rap song, and poetry writing; giving criticism, bridging the gap by asking questions, giving choices, showing sensitivity to the rights and feelings of others, and using emotive language.”

Her argument was for greater learner involvement in their own learning, which is evident in her statement, *“the key outcomes here are demonstrating basic interaction skills for participating actively.”*

Category 3: Variation 5 (practice based on relevance for the learner)

A fifth variation of learning-centred practice, namely, practice that ensures that what is taught or learnt is of interest or is relevant to the learner, was discussed by Teacher G. She argued for learners' relevant and meaningful learning within a space that is conducive to such learning. This can be seen when, in a lesson prior to my school visit, she stated that,

“The learners [were] asked to make a choice between the school subject language issue and alcohol problem at home, they created the information and platform, and brought the issue forward and tried to persuade me as to what is more important to them.”

In another learning encounter, Teacher G expressed how affording learners the opportunity to gain understanding, abilities and commitments enabled them to act on the things that were of interest to them, *“I don't pose that autocratic teacher in the front and controlling, and everything on my turf and on my terms. It is you taking control, and giving me feedback.”* She discovered in her practice that the learners did not have much parental supervision. This can be seen when she says, *“they come from where there's nothing, they go outside, spend time playing outside, they don't have a mentor.”* This type of classroom practice is centred on the learner, and is based on his or her interests and motivations in life.

In her goal related to thinking in classroom practice, Teacher M talked about learner relevant practice that promotes learner thinking, which requires sensitivity to others. She was of the opinion that this could be done through learners giving thought to the relevance of

information to themselves and others who were affected by the problem to be solved. She wanted learners to “*think and know that this picture is relevant, and these headlines are relevant, but the picture is not relevant, be sensitive when they present their information.*” Her argument was that they should engage in sifting to access relevant and appropriate information, and then think about the relevance and fitness for purpose of the accessed information. This can be seen when she says that,

“The learner first of all has got to learn to sift information so that he should know which information is right, which information can be utilized, and think quickly so that they know what fits where, which is relevant but do not fit. Sensitive because their information although they have to present the facts as they are, understand that other learners or teenagers who become pregnant because of the lack of knowledge, or some of them are victims of rape.”

Category 3: Variation 6 (learner-empowering practice)

The sixth variation of learning-centred practice, namely, learner empowering practice, was detailed by Teacher G with regard to what she wanted to show the learners about herself in a learning encounter. This included that she wanted to reconfigure teacher-learner power relations for learner empowerment and power sharing. This can be seen when she refers to the, “*transference of my power to the learners.*” In order to enact such a practice in the science classroom, she posited that it involves encouraging learners to talk and share ideas openly, and establishing an educational relationship built on trust, practice that is centred on the learner, and using the teacher as a resource on the side to support them when needed:

“By being open to discussion, to information, and to trust. To get these children to basically talk and teach, and do the things that they can, to inculcate teacher’s power in the learners. Provide a lot of guidance to assist them along.”

Her argument for working in this way was classroom practice with learner enablement in mind, and can be seen when she uses the term, “*learner empowerment.*”

On learner empowering practice, Teacher J’s other learning goal for learning encounters was to celebrate the learning gains made by the learners, which can be seen when she says that she would like to, “*give learners a sense of accomplishment.*” She found that this could be done through learners being empowered to work collaboratively with adults, and learners “*embarking on this kind of project, tackled with adults, and show adults that they also have power.*” She explained that learners would be breaking the “trend” of traditional practice, which is disconnected from the learners’ own real-life experiences:

“They bring an issue like this into their curriculum, it might not have been tackled if they did not do it as a project on their own. It’s been a trend that content has been pushed within the classroom, not making differences in the lives of these learners.”

Category 3: Variation 7 (practice that incorporates the affective domain, moral regeneration, social justice and inclusivity)

The seventh variation of learning-centred practice, namely, practice that incorporates the affective domain and moral regeneration, was discussed by Teacher G with regard to her goal of showing to the learners that she wanted to promote moral education. This can be seen when she says, *“to show these children (learners) a little about morality.”* She clarified that this could be done in the classroom by reconfiguring power relations, and through power sharing with the learners:

“I share my power, I don’t pose that autocratic teacher in the front and controlling, and everything on my turf and on my terms. It is you taking control, and giving me feedback. I’m giving and sending my power to them indirectly and incidentally which they don’t really know, but I’m empowering them in the process. I also want them to reflect, to understand. I want them to take that opportunity, what I’m giving them, and use these strategies, and look at their own lives as well. So whatever they learning in the classroom, these are skills that they will take with them. So I’m basically taking the power and transferring the power onto them. I have this power of looking at this picture, and saying this that and the other.”

Her reason for enacting teaching and learning in this way was that learners had no role models or people in good standing that they could look up to at home and in the community where they lived. This can be seen when she says, *“morality, because they are from homes where there’s nothing. Because they live in small homes, they go outside, they spend time playing outside. So they don’t have a mentor, somebody to give them morality.”*

Teacher G’s goal for teaching and learning, in another learning encounter, was *values in education*. She posited that what was required was learner self-awareness and consciousness of the effect and extent of the problem in their living and learning environments, and applying their minds to find the reasons behind any adverse effect of the problem on themselves at home and at school. This can be seen when she says,

“Learners to produce the evidence of their learning, evidence relating to alcoholism, learners to start thinking and reasoning about the things happening around them. The need for noticing and to start thinking and reasoning about the learning and living environment.”

Her argument was that learners should be made conscious of the problems that affect them, *“for awareness.”*

Talking about her other goal for the learning encounter, Teacher G discussed practice that incorporates teaching for *social justice and inclusivity*. She explained that this could be enacted in the science classroom through learner empowerment and power sharing:

“Social justice, in the class there are privileged learners and I want them to know what it is like to live on the other side. I’m hoping that, by transferring the power, from the wealthy, from the rich to the poor, they (the pupils from the community at [...an informal settlement]) will be able to now share their experiences, and this will allow the so-called rich to share their power of wealth as well. Here it’s about inclusivity, here it’s about social justice.”

In her opinion, this comprised education for human liberation, she explained that,

“I will talk about this because there are lots of children with language barriers that must be included in the lesson. And there are children with lots of learning disabilities that must be included in the lesson. That different children have different learning styles and abilities must be included in the lesson.”

Teacher Z’s goal for the teaching and learning process was developing learners’ skills and values needed to function in a free and just society. This can be seen when she says, *“citizenship and literacy promotion, as a learner you must have a value in life.”* Her stance in enacting this in the classroom was in teaching values in education through teacher/learner collaboration, and through introspection by reflecting on the value of things in relation to oneself:

“Value and knowledge transfer between the learners and the teachers. As a learner you must have a value in life – you must look at the things then think about the value, why are you doing this, why are you sharing some ideas with other people – in this way you are promoting interaction.”

Teacher M, talking about her other goal for the learning encounter, highlighted practice that incorporates moral regeneration, and teaching for *social justice and inclusivity*. Her goal was a practice that promotes *“Ubuntu.”* She further explained that, *“it (Ubuntu) is about*

democracy, it is about passing on information, and it's about caring for others." She found that it is all-embracing regarding school classroom practices, as she stated that, *"it embraces almost all the goals that are there."*

In her goals for the teaching and learning process, Teacher G emphasised a learning space that must make learners feel safe and unafraid, which allows, *"a non-threatening, stimulating and contextualised learning process."* Her idea regarding this was to have a learning-friendly classroom space that must have a relaxed and constructive feel, and which would require that learners' affective responses to the task be taken into consideration. This can be seen when she says, *"looking at teaching and learning process in a very informal way. Presentation of group projects, or group tasks. The process affords two things to happen: they are to release information, and they are to deal with their feelings."* Her argument for working in this way was, *"promoting both the cognitive and the affective"* aspects of learning.

7.4. RESOURCEFUL FACILITATION (CATEGORY 4)

The term 'resourceful facilitation' refers to the enabling or aiding of learners' exploration of ideas and problems, and participating in individuals' or groups' interaction with ideas in a way that the learner(s) require on a 'need to have' basis. This implies the need for a human resource, or someone serving as an available and accessible resource to learners, off whom they can bounce ideas during the processes of meaning-making in science learning encounters. Serving as an available resource to his or her collaborating learners places the teacher in a position to provide just-in-time needed information or guidance so that they, *"always act by means of their environment rather than simply in their environment [so that learner] achievement of agency will always result from the interplay of individual [and collaborative] efforts, available resources and contextual and structural factors as they come together in particular and, in a sense, always unique situations (Biesta and Tedder, 2007, p. 137). Working in this way, "teachers will increasingly be called upon to switch roles from soloist to accompanist, helping students find, organize and manage knowledge, guiding their minds rather than moulding them" (Bélisle, 1997. p 24).*

Within this category of teacher understanding, namely, resourceful facilitation, no variation showed up in the data generated. It spoke mostly about the teachers' role during the teaching and learning process. Teachers play a role in the school when they are required, for example, to guide learning through classroom interactions. They do this by creating optimal

classroom environments for learning to occur (Hattie, 2003). With regard to what she wanted to show the learners during the learning encounter, Teacher G mentioned being an available resource and guide on the side to the trainee learner performers, *“that they would perform according to the input that I made.”* In order to do this in the classroom, she posited that learners should speak with honesty and express their own lived experiences based on what they actually know and what they had rehearsed in class:

“They [should] be honest, able to say what is on their mind, and are able to speak off the cuff, able to be confident and go through the process and experience exactly what they did. Talk about the reason they did the topic and what is happening in their lives.”

Her argument for doing it in this manner was that they were afforded a platform to share their own lived experiences before an audience. This is evident when she says, *“it is that they get an opportunity to say what is affecting them the most.”*

Teacher Z also discussed what she wanted to show about herself to the learners during the learning encounter in being a form of support and a resource to the learners. This can be seen when she talked about her task, explaining that it was, *“to work out the link from the first to the fourth portfolio board (display boards).”* She maintained that it could be enacted in the science classroom through learners being involved in knowledge application. Her argument for working in this way was that it enabled learners to use their own knowledge and available physical resources for active involvement and, *“to know how to take action on the topic.”*

Teacher J mentioned understanding learners’ actions in showing the learners something about herself, in support of this, she said, *“as a teacher understand what they are doing.”* She was of the opinion that this could be enacted in the school classroom through the teacher’s role as a guide to enable learners’ understanding of science concepts. This can be seen when she says, *“for learners to understand the concept, and to facilitate the process, and come in and assist them where they need guidance.”*

As a goal for the learning encounter, Teacher M explicated that what she wanted to show about herself to the learners was that the teacher is not the custodian or dispenser of all knowledge. This can be seen when she says that it is for the learners, *“to understand that the teacher is not standing on a pedestal, being the one who is dishing out knowledge, the teacher is not the only source of knowledge.”* She posited that this could be enacted by ensuring that learners are active inquirers who are able to access relevant subject information from accessible

local expertise. She stated that learners should, “*understand they are the ones who have to be seekers of knowledge, other people out there who they need to give relevant information like when they visit a local clinic.*” Her argument was that the teacher does not know everything about the problem of teenage pregnancy, for example, and that learners need to seek knowledge their local hospital/clinic midwife. This is evident as she states, “*I am not an expert; the clinic sister who knows everything about teenage pregnancy, because they are midwives.*”

7.5. PARTICIPATIVE MEDIATION (CATEGORY 5)

By participative mediation, I refer to a way of acting where teachers (as agents) employ and/or model the use of *educational tools* in a manner that creates affordances for learning for all learners. A mediating device is another name for a tool, which is any object, tool, or technology that is use to enhance performance beyond what could be done without the object, tool, or technology (Gee, 2008a). The use of mediating devices promotes inter-subjectivity, and hence, the distribution of knowledge – some in their heads, some existing in social practices and the tools they are using, and some existing in the tools themselves (Gee, 2008a). Other people inside and out of school can also be seen as ‘tools’ for learners if and when the learners interact with them. School-going youth learn with others, and work with a variety of tools in ways that help them accomplish more than they could by themselves, and this knowledge is stored in the group and its practices (Gee, 2008a). Tools, according to Núñez (2009, p. 12), “include both material tools – those that aid in behaviour transformation (psychological or thinking tools [e.g. language, gestures, group work, strategies, learners’ science knowledge]) and those that aid in the change of the environment (material tools [e.g. computers, calculators, dictionary])”.

In this category, the participating teachers’ understanding of participative mediation showed no variation. What the teachers said in this category speaks to the notion of participative mediation for the purpose of promoting learner involvement, and for learners to be able to use and enjoy the learning encounter or the learning experience.

Teacher G, in her teaching and learning goal for the lesson, discussed the use of a mediating device (or tool) in order to access learners’ responses on the extent of the problem of alcohol in their lives. She described that they did this,

“By communicating the challenges they faced or come across at home, draw a mind map to solicit the responses of the learners on the ways this social problem affect them and other people

in the community, to actually physically get the mind-map on the board. To educate using information and materials which the children are familiar with. Will use the Soul Buddyz (a book), to have the information that reaches the children in their own contexts.”

Her argument was that the use of a mediating device afforded opportunities for learners to open up and talk about the adverse effects of a specific problem, establishing an educational relationship based on trust, and allowed her to offer comfort and educational therapy to affected learners. She substantiates this by saying,

“It is important to brainstorm how serious this problem is, to draw on all the ideas coming through from the learners, to establish a circle of trust with the learners, educate to lead to therapy of releasing what it is they are feeling at home.”

In her goal related to the teaching and learning process whereby learners shared knowledge on the problem of teenage pregnancy, Teacher M discussed the use of multiple mediating devices, which would afford learners the chance to openly talk about the problem:

“Brainstorming on the board, accessing then afterwards it will be discussion and debating that information, to know if they are looking for information, they don’t have to argue about it. Each one has to bring his or her own information, and then we have got to sit down and verify.”

She argued that learners should be in a position to verify the accessed information through debating to avoid misconceptions, if there are any. This is evident as she explained, *“they will be debating that information to verify whether it is right or wrong.”*

Teacher Z, in her goal for teaching and learning, wanted to promote active learner engagement for, *“learners to be creative.”* Her approach to enacting this in the learning encounter was the use of a peer-driven model for teaching and learning in order to involve a group of learners who agreed to participate in the project work. This can be seen when a peer educator (PE), in a conversation with the group, stated, *“without me [PE] telling them what to do, they were to write speeches about presentations about the two possible topics to choose from.”* The argument by the PEs for using this approach to learner involvement was that it provided guided and supported learning on a problem that affected the new group of learners. They could then discuss this with their more experienced peers, who had previously engaged in project work with Teacher Z. One of the PEs clarified that,

“We (PEs) help them, to guide the learners. The topics affect us (learners) and the local community (the topic chosen was the problem related to Traditional medicine – muti murders, and Western medicine – sale of body parts).”

With regard to any other goal for teaching and learning, particularly through the use of PBL, Teacher Z talked about the use of learning experience as a *tool* to enhance or mediate learning. In her opinion, learning was the primary task for the school-going youth, a task that ought to promote greater epistemological access to education for all learners, and in this way enable them to use and enjoy their learning experience. This is evidenced in her statement, *“in school the child to learn, and then teach the learner to have that opportunity to live life longer in the school and the community.”* In terms of how this way of teaching and learning could be enacted in the school classroom, she emphasised pedagogical practices that are based on presenting information and talking, which builds learner confidence, and is useful to those who aspire to become future leaders. Such practices, for her, also afforded learners the opportunity to use democracy as a basis for learner personal growth, and the opportunity for civil involvement with others. She described that, *“learners to do presentation, to talk to other people, learners gain the confidence, they become future leaders in Life Orientation, and the community of that school. Teach learners democracy, they to work with other people to gain any information.”* Her argument for working in this way was to promote learner agency in the quest to realise set goals, and the promotion of Ubuntu for personal interdependence, and the well-being of the community. She highlighted that,

“If they can speak well they can succeed, umuntu ngumuntu ngabantu, without other people you can’t gain anything, this is important because the people are doing wrong things – the witch doctors and western doctors.”

The above analysis and discussion reflects what has occurred at a global level. The global analysis tells us that there are five teacher understandings, which are: *independent learner, an authentic space, learning-centred practice, resourceful facilitation, and participative mediation.*

Below is a discussion on teacher practice at the level of individual cases of teachers’ understanding of teacher practice. At this level, each of the participating four teachers’ understandings are discussed in terms of the uniqueness of each case. Although the participants adopted a common PBL approach, as members of the local Network of teachers, each one may have adopted their own unique way of interpreting and enacting the common approach back in

their own schools with their learners. Table 1 below presents a summary of the participating teachers' understanding of their practice. The table reflects that there are four categories (column 1), with variations in some categories (column 2) in the teachers' understanding of teacher practice. Columns 3 to 6 reflect each participant, and the ticks show how each participant spoke (or not) about each of the listed categories, and the extent to which each teacher spoke (or not) within each of the variations shown.

Table 7.1 Four categories, and variations, in teachers' understanding of teacher practice

Teachers' understanding of practice										
Categories (teacher understandings) (5)	Variations	Teacher J	Teacher M	Teacher Z	Teacher G					
1. Independent learner	1.1 Independent learner who thinks and participates – Thinking.	√√	√	√	√√					
		√		√	√					
		√			√					
			√	5		1	2	√	5	
	1.2 Participation - collaborative interaction to bring about collaborative decision-making.	√	√	√	√√					
		√		√	√√					
√				√						
		3		1	2	√	6			
2. An authentic space	2.1 Contextualised learning.	√	1	√	1	√	1	√	1	
	2.2 Problem based learning.	√	1	√	1	√	1	√	1	
	2.3 Transformative learning.							√	1	
	2.4 Integrated learning.							√	1	
3. A learning-centred practice (which affords the following practices)	3.1 Democratic practice 6.	√		√√	√	√				
			1	√	3	1		1		
	3.2 Holistic practice 2.							√		
								√	2	
	3.3 Relevance 2.			√	1			√	1	
	3.4 Dialogic practice 3.					√		√		
							1	√	2	
3.5 Differentiated practice 3.							√√			
							√	3		
3.6 Learner empowering practice 2.	√						√			
			1					1		

Teachers' understanding of practice						
	3.7	In service of "social justice and inclusivity"	√	√	√√	
		Incorporating the affective domain & moral regeneration 6.		1	1	√ 4
	3.8	Humanistic practice.			√	1
4. Resourceful facilitation	4.1	(No variation) Teacher as a resource and learning guide.	√	√	√	√
			1	1	1	1
5. Participative mediation	5.1	(No variation) Participative mediation as tool to enable/enhance learning	√	√	√	
				1	2	1
Total: 68			13	11	12	32

Just by looking at the above table, it is clearly visible that category 4 and 5 do not show variation in the teachers' understanding of practice. It is also clear that teacher 1 (Teacher J), in column 3, as an individual case and out of 5 understandings of practice in this table, had no spoken understanding with respect to Category 5 (*participative mediation*). Within category 1 (*independent learner*), Teacher J marginally emphasised thinking (five times) more than participation (three times). With category 2 (*authentic space*), out of four variations in this category, she only talked about two of the variations (contextualised learning – once, and problem based learning – once). In category 3 (*learning-centred practice*), which shows seven variations of teacher understanding, Teacher J talked about only two (democratic practice and learner empowering practice), and for category 4 (*resourceful facilitation*) she did have an understanding of practice.

On the other extreme, in column 6, and with respect to category 1, as an individual case, Teacher G also placed equal emphasis on thinking (four times) and participation (four times). This participant had an understanding of practice for each of the four variations shown in teachers' understanding shown in category 2 (namely, contextualised learning, problem based learning, transformative learning, and integrated learning). Within category 3, which shows seven variations of teachers' understanding, Teacher G emphasised the seventh variation (four times) more than the fifth variation (three times). She then talked equally (twice) about the second and fourth variations, and once each for the first, third and sixth variations. The participant held an understanding of practice within each of the five categories, and within each of the variations shown on the table, with one each for categories 4 and 5. This participant

showed a wide range in the depth and width of her understanding when compared to the other three participants.

In the fourth column of the above table, Teacher 2 (Teacher M) gave equal emphasis to thinking (once) and participation (once) with respect to category 1. In category 2, out of four variations in this category, she only talked about two of the variations (contextualised learning – once, and problem based learning – once). In category 3, which shows seven variations of teacher understanding, this participant emphasised democratic practice (three times) more than two other variations, namely, relevance (once) and practice that is in service of “social justice and inclusivity” and incorporating the affective domain and moral regeneration (once). With the final two categories, categories 4 and 5, she emphasised category 5 (twice) more than category 4 (once).

Within the fifth column, teacher 3 (Teacher Z) gave equal emphasis to thinking (twice) and participation (twice) with respect to category 1. Again like Teacher J, with category 2, out of four variations in this category, she only talked about two of the variations (contextualised learning – once, and problem based learning – once). Within category 3, which shows seven variations of teacher understanding, Teacher Z talked once on democratic practice, once on dialogic practice, and once on practice that is in service of social justice and inclusivity, and incorporating the affective domain and moral regeneration. With the final two, categories 4 and 5, this participant talked once about each one.

The earlier global level of analysis, together with the above discussion about teacher practice at the level of teachers’ individual cases of understanding of teacher practice provide more insight into the topic under study. It is against this backdrop that we are able to see what is espoused by each participating teacher with regard to teacher practice. This enables us, and the reader, to know more about each particular case. This also responded to the first research question, in that, by the time each participant was observed in the actual classroom during the enactment of their espoused practice, I already had something to critique each case against, during actual classroom practice (to see whether what they each did was consistent with what they each said about their practice). This also was relevant in light of the second and third research question, which reads: *How do science teachers construct and enact the science classroom as a space for democratic living? And why?*

7.6. CHAPTER CONCLUSION AND SUMMARY

In answering the first research question, the research findings, as discussed in this chapter, yielded five qualitatively different teacher understandings, namely, independent learner, authentic space, learning-centred practice, resourceful facilitation, and participative mediation. These findings tell us what the participants thought regarding their unusual practice. Each category in turn was constituted by a variation of sub-categories, with some showing more variation than others. These results are of value in that they were used as data to account or adjudicate what these teachers actually did during the enactment of their own teacher practice with their science learners.

The next chapter deals with the enactment of a science classroom as a space for democratic living, one that infuses critical science and a notion of democracy.

CHAPTER 8

THE ENACTMENT OF A SCIENCE CLASSROOM AS A SPACE FOR DEMOCRATIC LIVING

RQ 2: How do science teachers construct and enact a science classroom as a space for democratic living? And, why?

Chapter 7 dealt with the participating teachers' understanding of an unusual practice, while this chapter deals with their enactment of this unusual practice. The research data presented and discussed here answers the second and third research questions. The data was generated through the use of the post-lesson semi-structured interviews, including the classroom observation schedule, and video-recordings of the lessons observed.

The participants in this study, from a more global perspective (see Table 8.1 below), enacted their science classroom as a space for democratic living by doing so in the following four ways:

- By looking at school science *learning* from a different angle, seeing it as response, or as responding to what is other or different, to what challenges, irritates, or disturbs us (a 'learning as response' metaphor, or, pedagogy of response);
- By seeing the discipline of school *science* as context-driven;
- By utilising *language* in classroom practice as a medium for bringing one's beginnings into the world, or as a medium that allows one to be; and
- By viewing *teaching* as conscious sustained co-action.

Each of the above four ways of enacting a science classroom space for democratic living encapsulates four key concepts that are directly related to the phenomenon explored in this study (teacher practice). These four ways comprise: *learning*, *science*, *language*, and *teaching*. Each of these four interwoven ways of enacting practice are illuminated and elaborated on further in the sections that follow.

8.1. LEARNING AS RESPONSE

The first category of teacher enactment, *learning as response*, is firstly based on the need for opportunity to be created for learner initiative taking Secondly, this is based on learners being given a real opportunity to make particular kinds of responses to the curriculum through the posing of challenging questions. This category is constituted by five sub-

categories, namely, learner participation, action learning, participative mediation, learning-centred practice, and differentiated learning.

With respect to *learning as response*, under *learner participation*, the evidence from the classroom observation shows that Teacher J's idea of enactment in this sub-category was based on learner democratic participation. *She used the chalk board as a tool for two-way rich dialogic communication between herself and the learners and animated 17 learners, who were the school leaders chosen from each of the Grade 7 classes, to participate. The project work groups were immersed into a way of learning science where they made decisions and chose a topic of own individual choice, and then agreed, through voting, on the topic that would be done collaboratively as a project* (LE1, observation data, criterion 1).

Her reason for working in this way was because her practice allowed each learner to freely “*think*” and “*express themselves*.” This can be seen when she says, “*they need to think and express themselves in way they wanted to, and say what they wanted to say, and not be afraid to talk, and say openly and freely. And that, what they had to say, would be accepted*” (Post-lesson interview data, LE1, Incident 4).

Teacher J, in another lesson, used the idea of learner collaborative participation. The classroom observation data shows that her practice afforded learners the chance to respond collaboratively to a challenging task in a supportive science learning space, one that enabled them to take initiative with guidance. This is evident in that the *Teacher creates two working groups of 5/6 learners each to analyse research findings. Group 1 working on interview findings, and group 2 on school audit findings. Each group was left to take own initiative on a task that is totally new to them* (LE3, observation data, criterion 1). Her reason for this was to give learners the opportunity to participate in challenging tasks to solve a problem affecting their daily lives:

“The amazing part here when the teacher had left them they continued to work because they wanted to do and they wanted to see that solved. They understood what was being said and there were differences and it needed to be taken into consideration here. You could see by their facial expression that they were getting a bit frustrated at the beginning, but they were very intense in what they were discussing and in the end they accepted both answers, and it was accepted that there was a difference between the two ablution blocks” (LE3, Post-lesson interview data, incident 4).

Teacher M's notion of learner participation was based on learner dialogic participation. Data from the classroom observation shows that her practice afforded learners the opportunity to choose a topic and to express their own voice. She did this by creating space for a two-way, open dialogue that afforded learners the opportunity to take the risk to willingly respond to questions and to contribute their own ideas. This can be seen as: *Chalk board used as a tool for collaborative and dialogic communication and participation by all learners on how project work promotes greater learner involvement through problem based learning, decision making and them choosing a topic for learning* (LE1, observation data, criterion 1). Her reason for enacting practice in this way concerned:

"...the concept of Ubuntu, because if something is being done, consensus needs to be reached. Because, for instance, the boy who wanted to do research on the wastage of water in the school. He was a very good researcher, and if he had said ok, because I wanted this one and it was not chosen, so I am pulling away from participation, but he came anyway and he gave his co-operation. But he didn't hold back and was not bitter because he understood how democracy works. That at times we have got to sacrifice for progress" (LE1, post-lesson interview, incident 1).

Teacher Z, like Teacher M, focused on learner dialogic participation. The data from the classroom observation indicates that her classroom practice afforded learners the opportunity to participate in dialogue-rich and conversational interactions based on their interest in and knowledge of the problem. Her teaching and learning environment promoted active participation by all learners, and encouraged them to take the risk in co-creating something new. This can be seen where her, *Teaching style created affordance for respectful and dialogic and conversational relations. Teacher and peer educators supported the groups' learning through prompting, modelling and giving useful scenarios on problem solving* (LE2, observation data, criterion 1). She believed in democratic practice as,

"It is not only the teacher can help the learners. I asked them to assist in order to see the progress so that I can help the group in the project. I am using the democratic way so it is not only the teacher who can help the learners. The learners must help themselves, and peer to peer. So when you return you will see the first boy imitating Siphso, and he will do his presentation same like Siphso did" (LE2, post-lesson interview, incident 2).

In terms of the second sub-category of **learning as response**, which is *action learning*, there are three variations: the notion of action learning within a democratic space, problem

based learning, and inquiry based learning. Action learning asks the question: what kind of school do we want so that learners can ‘act’? This calls for real opportunity for learners to take initiative, and to respond in their own unique ways to the learning opportunities provided to them. The question regarding action and democratic subjectivity concerns how much action is possible in schools through being with others, not only in the school environment, but action that extends to society at large, which becomes a life-long process.

The evidence from the classroom observations shows that Teacher G’s idea of enactment in this sub-category was based on the notion of action learning within a democratic space. Her classroom practice was underpinned by democratic principles, and the use of practice tools to promote action learning. My notes on this aspect were as follows: *Teacher uses newspaper clippings as visual and persuasive tools to invite learner participation in issues linked to learners’ lives, and issues that affect them. The teacher used this first session with 35 Black learners from the nearby informal settlement, and 5 Indian learners. This Grade 7 class in an Indian school were labelled as very poor performers who were “lazy, very noisy and don’t do their work” and “the teachers called us names, stupid children, you are failures, go back to Black schools”. Their human dignity was violated, the teacher wanted to restore that* (LE1, observation data, criterion 1). Teacher G stated that *“we want everyone to heal, for all the teachers to understand the children and vice versa, so that everyone can learn.”* In terms of democratic values, she emphasised that teacher should not humiliate a child who cannot do what is asked of them. This ideal comes in very strongly, especially in teaching and learning with children of different backgrounds with learning barriers, learning disabilities. These, too, should be treated with human dignity. This is extremely important because if they are not treated with human dignity and their mother tongue is not respected, this violates the South African constitution (LE1, post-lesson interview, incident 4).

In terms of problem-based learning, Teacher G viewed action learning as classroom practice that affords learners the opportunity to choose a project work topic. This promotes a classroom environment for dialogic relationships that enable learners to take the risk in constructing something new out of the problem at hand. My observation notes on this were as follows: *Learners afforded opportunity to choose a topic, and for each one to vote for his or her favourite one between two (alcoholism or language problem), they chose the first one as an issue that affected them in their daily real life experiences in the community and at school. Teaching style created affordances for respectful and dialogic and conversational*

relations (LE2, observation data, criterion 1). For her, this allowed her to handle any problem in society, or any problem that pertains to social justice. However, this has to be interactive and the information has to come from the children. The children need to experience it, reflect on it, and give feedback about what is going on (LE1, post-lesson interview, incident 1). In the interview, this participant revealed that her opinion was that if you give them (the learners) the opportunity to speak up in the front like this here, they take pride in their culture, their heritage and their self-esteem. So here it's not just about the lesson, it is about developing one's self-esteem, being proud of your culture, and being able to say what you want to say in your mother tongue (LE2, post-lesson interview, incident 4).

Regarding inquiry based learning, Teacher M viewed action learning as classroom practice in terms of the teacher affording a team/group of four members a chance to inquire about a problem at a local clinic or hospital. She made an appointment with a clinic/hospital midwife for learners to visit so as to access the relevant information on the problem. My notes on this lesson were as follows: *Teacher made arrangement with the local Clinic or Hospital, for 4 learners (4 girls and 2 boys) to meet with the midwife regarding the topic and problem they chose. This was done in response to suggestion made by a member of the group when asked to say how they would access data on the problem* (LE2, observation data, criterion 1).

Her reason for enacting practice in this way was that she envisioned a classroom practice that is based on trusting teaching and learning relations, thus enabling risk-taking by learners during the process of learning about the problem. She explained in detail that,

“Because it is a relationship it is sort of reciprocal. I give you respect and I get respect. I am honest with you and I get honesty, I trust you, you trust me. If they have got concerns it is easy for them to get to the point because they know that you will accept, you will not shut them down because they are raising points. You will explain to them about the issues, where you see they are not clear. There is a lot of risk but it is easy for them to ask if they are not sure about the information. Maybe, when you grew up, there were things that were said, like about teenage pregnancy: when can you get pregnant, when you do what must you do? And when you look at them now, they were all wrong. So even now, maybe they even get wrong information, but it is up to that teacher especially a democratic teacher to explain all those things. In classroom situation they will be able to voice all those things about the differing views and opinions that may even cause them to fall pregnant, and get the facts on the issue. So if they are able to open up to you then you can tell them. You tell them that if you don't trust me then there is sister so-and-so, you can go and they will also give them information, and who will confirm what you

are saying. At their level of development, human beings are social beings, at that level of development, as teenagers, they need to be in contact with people of the opposite gender, but what happens is that the parents are so evasive and they don't explain. They hide information like, don't go with boys. They think that if you go with a boy you will fall pregnant. They don't state clearly what causes pregnancy. The facts are not given to the youth as parents feel that it is too explicit, vulgar or open. It may be cultural or religion" (LE2, post-lesson interview).

The third sub-category of **learning as response**, *participative mediation*, showed no variation. Teacher M's enactment of this sub-category was carried out through the use of a practice tool (chalk board) to guide, prompt and solicit learner thinking and participation. Her calm and conversational dialogic relations gave learners time to think and contribute as unique individuals. Her classroom practice was not exclusively focused on subject content only. My observation notes on this are as follows: *This is evident when learners responded to the teachers' open dialogic approach that invited them to willingly participate. Teacher written prompts afforded learners time to adjust to a mixed class (Grade 8 and 9s), to think, decide, and commit to participate in a common problem solving task* (LE1, observation data, criterion 2). Her reason for doing this was that democracy enables learners' participation, which is to the benefit of all involved. Sometimes democracy is not about the self, it is about others. She further explained that, *"they understood in the case of democracy that it is about co-operation, it's not about myself, what I want. But it means that, if it is agreed upon in a democratic way, I cannot disassociate myself from the task because I do not favour it"* (LE1, post-lesson interview, incident 1).

In this same sub-category, Teacher Z enacted this by using classroom practice that was centred on the learners' own unique responses to challenging questions posed through the use of practice tools to mediate action learning. My critical notes are that: *This is evident when she built dialectical relations with the learners in order to provide them with the dispositions that would help them have meaningful and rewarding experiences in the classroom. Teacher made use of teaching and learning tools to afford opportunity for learners to act* (LE1, observation data, criterion 2). She emphasised that this was to enable learner self-expression in what they want to say, and for them to express their own views, and to express what they already know. The summary diagram on the board showed the topic first, followed by the abatwasa and next, the four types of traditional healers, which was not found in the Arts and Culture textbooks. It helped the learners to understand and explain the topic better when talking about the problem in the next step or lesson (LE1, post-lesson interview, incident 4).

Teacher G enacted participative mediation as a classroom practice through the use of a teaching and learning tool that promoted active and sustained learner participation. This tool used created affordances for learners to take risks and initiative so that they could act and create something new as they engaged in inquiry-based learning. My notes detail that: *Learner involvement enabled them to use investigation instruments to collect data from the local community on the problem. Teacher employed teaching and learning tools (mind-map, jig-saw) that promote active learning. The tools enable learners to act and listen in order to foster and maximise participation in a large class. The tool also creates affordances for learners to participate in small-scale processes that allow them to interact with each other in doing science* (LE3, observation data, criterion 2). She did this to promote learner interactive problem solving using their own information and real-life experiences as related to the problem. She supported this in explaining that,

“To handle any problem of society, or any problem that pertains to social justice – it has to be interactive. And the information has to come from the children. The children need to experience it, they need to reflect on it, and the need to give a feedback about what is going on” (LE1, post-lesson interview, incident 1).

She further clarified that,

“We can say in the lesson, that we are failing very badly in the science and technology part of it, and that is something we need to come up with. The describing, the analysing, the selecting – all those skills that we need to teach and inculcate. We need to talk about testing. At our school we find that these children are talking so well now fail miserably in their tests. One of the reasons they fail so miserably in their tests is that we don’t teach them to differentiate, to discuss, to analyse, to sort out, to classify, to present, to perform, to define. These are all skills that we should be teaching, and we don’t do that, because predict and what would happen. Whilst I was talking, all these things were coming up incidentally. But we are not focusing on that, we not giving the child a chance to learn by putting this to the child in the normal lesson. This kind of informal lesson I’m presenting can be done where you can inculcate all of these kinds of skills” (LE3, post-lesson interview, incident 1).

Teacher G again enacted participative mediation through the use of a teaching and learning tool. This promoted active and sustained learner participation through the affordances it created for learners to take the initiative to act and be creative. My notes further detail that, *The teacher uses a larger topic, learnt in previous lessons, to afford learners opportunity to apply their knowledge in the construction of four 1mX1,5m portfolio boards (PBs). Practice*

created affordances for learners to transform problematic situation that they face in real life, giving them the opportunity to work in each of 4 small-group tasks wherein they are to take initiative, make decisions, argue, make choices, apply different strengths and take risks in order to create a product (information board) according to given specifications and criteria. Each small-group task works with a given sub-title of the larger problem topic to construct their information board, which, when complete, will be joined together to form flexibly interlinked and free-standing boards to constitute a single unit on the project problem. That is, project based learning working from small group collaboration, to larger group collaboration (LE4, observation data, criterion 2). She did this so that the learners were able to use the available resources in collaborative groups to construct artefacts using co-operative learning:

“This is important because you must learn to agree eventually, for whatever the outcome is going to be, and learners must accept the outcome. The entire project has got to be done constitutionally. So, the group must go with the majority decision. The science topic, and in every aspect of life, there are values and philosophies, even within science. We are making decisions based on evidence and facts. We respect each other’s point of view, and think about what is important for the majority of the people in the country. Science falls down the line if you do not address the problem of democracy in the country, there will be no space for science. First you need to motivate the scientific issues, promote democracy, promote thinking, and addressing issues in a very rational way, and then your science can grow” (LE4, post-lesson interview, incident 2).

With respect to the fourth sub-category of **learning as response**, namely, *learning-centred practice*, the evidence from the classroom observation shows that Teacher G’s idea of enactment in this sub-category was based on classroom practice underpinned by democratic principles. She also believed that teacher-learner trusting relations would afford the learners the opportunity to take initiative, voice self-inflicted doubt, and to engage in teacher-learner reflection on the obstacles to the learners’ ability to act. The ability of a learner to act, or not to act, are both viewed as outcomes of the learning process. My notes on this are as follows, *Teacher practice affords learner opportunity to try out her presentation skills in the classroom before her peers. The learner, who is assigned by the teacher, and her small group of task peers do so in preparation for the upcoming showcase before an authentic audience. She previously had an opportunity to talk in the school assembly, worked on the problem sub-topic, and participated regularly with a group in the construction of the board depicting the problem with the information she was to present. Here, she took the initiative to stand in front of the class, started with trying-out to present, and then struggled, initially, to begin. The respectful and*

trusting teacher-learner relations freed her up to express her self-imposed internal constraints, and external constraint of the use of a hand-held paper as a guide and cue card, which she may use and read when needed, and then talk – seemingly came in the way of her doing a presentation (LE 5, observation data, criterion 1).

This teachers' practice acknowledged that learners are different or unique, and that they should be afforded the opportunity to find their own way of coming into presence in a public space populated by others. She supported this in expressing,

“I think with children that feel, you cannot put them in a structured environment and then ask them to learn and then read and to write. These kids do things, and you want to be able to allow them to do these things in any way they can do these kinds of things. There is a lot of learning going on in the process of these kinds of action research and when you looking at the various types of media as well. These children have never been given an opportunity to work in a group as a team. To use various sources, to speak in public because they are always told you are not good enough to do this, so just give the others a chance. These are the little gems that are sitting in your class, and I think it is important in that our future leaders are sitting in the classroom that we can't see, because we are looking for the perfect situation, and the perfect response and a perfect outcome, but it's not that way. These kids are perfect in their own way, all you have got to do is to know where they are coming from, and try to get it out. And I think that is what this project could show that these learners could not do much before, and now they could speak. So these children were given a chance” (LE5, post-lesson interview, incident 1).

Teacher Z's enactment of this sub-category was based on classroom practice that afforded learners the opportunity to choose a teaching and learning topic, and to express their own voice. The teacher created an environment for dialogic relationships that gave the learners a chance to take risks, willingly respond to questions, and to voice their own experience of the topic. My observational notes detail that, *Teacher created social learning encounters from which she and the learners both gained. She created opportunity for learners to form sustainable, dialectical and supportive relations with the peer educators, whose contagious enthusiasm as the previous year's winners helped the learners take own initiative and to voice own ideas (LE1, observation data, criterion 1).* She stated that,

“When it comes to democracy the learners have the right to choose what they want to say. Because you can't force them, you won't force the learners you must not say this one is final. So you must give the other people the opportunity to express their views. They have got the

freedom of expression, because when they have got the time to listen, this is done so that they can respond exactly what we do really” (LE 1, post-lesson interview, incident 1).

Teacher J’s enactment of this sub-category was based on practice underpinned by learners’ ideas. This is evident in the way that she created an opportunity for learner participation. This gave them a chance to think, initiate and act in order to bring their own sovereign ideas into a respectful public space. My observation of this is as follows: *Learners were encouraged to think, choose, respect one another’s opinions, and to act on their own, and in small groups, and to respond in writing to thought provoking questions, and to then discuss own meaning of the term ‘democracy’ (LE2, observation data, criterion 1).* Her reason for this was that democracy enables the creation of a classroom environment that is conducive to teaching and learning, and as a concept, principle or ideal, it must be lived out and enacted in classroom learning encounters. This can be seen in that she said,

“It is important for the expediency and efficiency of the lesson, and for maximum learning to take place. During that very lesson I came across, in one of the groups, there was a little bit of an altercation that came through, where one learner felt she was not eh...they were not listened to her, they were not taking note of her contribution at that particular time. So when it came to certain part of working together and team work, I actually stopped there and I used that as an example, to the entire group, as to where we need to listen to each other, and we need to respect. The word respect came up very strongly there, it was on one of the charts on the wall, the other was working together which meant team work and they needed to use it and apply what was written down on their display charts (LE2, post-lesson interview, incident 1).

With respect to the fifth sub-category of ***learning as response, differentiated learning***, the evidence from the classroom observation shows that Teacher G enacted this through small group tasks. These tasks gave learners the opportunity to participate in real small scale collaborative action in problem solving. Therefore, the learners had an opportunity to cross discipline boundaries to explore their creativity and to create meaning using their unique learning style or strength (English language, Arts and Culture, Natural Science, Life Orientation). The observation notes detail that, *Teacher used a tool to foster total learner participation (jig-saw). Larger topic/problem is broken down into “puzzle” shaped pieces with sub-topic inscribed on each. Method is use to scaffold learning process as small groups of 4 to 5 learners working on own sub-task by infusing science learning with English and Arts and Culture subjects. Eight sub-task groups were constituted, promoting differentiated learning: do a drama on alcohol related domestic violence; role play (facts about alcohol); cartoon*

analysis (alcohol abuse); critique newspaper advert on sale of alcohol; comment on media article on 'Name & shame' drunk drivers; do a rap-song on anything that troubles you about alcohol; tell and report on results of survey on problems in community caused by alcoholism (LE3, observation data, criterion 3). She evidenced this in her interview as she highlighted that,

“In order to place learners into groups, I have to know the ability of my learners. I have to put them into groups of their own abilities. And I have to set the work to suit the child to the learning style. And then they will produce the fruits of my labour. There is a lot of planning and a lot of common sense of the teacher. The teacher has to know the child. The material relevant to this topic has been identified by the learners in the newspaper” (LE2/3, post-lesson interview).

8.2. SCIENCE AS CONTEXT-DRIVEN

The second category of teacher enactment, *science as context-driven*, is constituted by two sub-categories, namely, being socially just, and multidisciplinary practice. Science as context-driven requires that school classroom practice, or the curriculum, be based on local contextual problems as the starting point for learners' critical reflection and action. Learners, in this category were provided the opportunity to co-design meaningful learning experiences that are connected to daily life, and to other subject disciplines. It was also aimed at empowering learners to think and act critically so that they could transform their life conditions. Science as a multi-disciplinary subject, alternatively, creates opportunities for the learner to see that learning is not compartmentalised or subject-specific. Learning encounters were used to enable learners to move across discipline borders in an unforced way.

Teacher J's enactment of practice in the first sub-category of *science as context-driven*, *socially just practice*, was based on the notion of service learning for civic action. According to McFadden (2006), socially responsive and responsible science education includes attention to science-related social issues and takes into consideration the social uses of science and technology as part of the science curriculum. This is evident when it was observed that, *Mostly service learning and civic oriented problem solving action were infused with science learning* (LE1, observation data, criterion 3). Her reason for enacting practice in this way was that it promoted learner civic-mindedness as learners have a right to a clean environment, and access to municipal services. She maintained that,

“They have a right to a clean environment and to clean water and access to basic services, which they are paying for. They are shocked to hear that we have an area-based management

where the municipality is brought right here, and knowing that these people are here to service the community, and we are not making use of them. Even if their parents sit back very complacently, it is these children who will take it back to give feedback at home (LE1, post-lesson interview, incident 3).

In terms of the second sub-category of *science as context-driven*, multi-disciplinary practice, Teacher J's enactment was underpinned by cross-curricular subjects. These included Human and Social Studies, Life orientation; Arts and Culture, and Natural Science. According to Down (2006), interdisciplinary practice is part of a set of values regarding how teachers might begin thinking and acting on a vision of critical teaching. This was evident when it was observed that, *Learners were afforded opportunity to cross disciplinary boundaries (LE2, observation data, criterion 3)*. She emphasised the use of teaching and learning tools to promote active learner involvement through problem solving. To this end, she said,

“At first they felt very afraid to approach the problem, and I am now there to help them through the process where they can do it in a democratic way, and at the end of it, if they go there and find proof through use of scientific methods, finding the proof of the problem they are researching, then definitely, someone is going to sit up and listen to them. Someone has to do it, because they are not only going to point out what them as children have to be exposed to, and put up with (LE2, incident 5, criterion 3). Elsewhere, they had to record negative influence on their health and their hygiene in the school (LE3, incident 1), and for them to work with statistics in class, and some of the children a spoilt by the use of calculators and here they had to come up with the stats mentally (LE3, incident 3).

Also in this sub-category, Teacher M, Teacher Z and Teacher G enacted this in different ways. Teacher M's enactment afforded the opportunity for science learners to cross discipline boundaries in order to utilise needed insights to boost their creativity, as her practice was not based solely on transmitting a set of content and skills to learners. This was evident when I observed that, *Life Orientation and Human and Social Studies were integrated with science learning. These subjects were used for the affordances they create to develop learners as active citizens who can influence and shape policy on socio-scientific issues affecting the community (LE1, observation data, criterion 3)*. Her reason for this was that classroom practice should be based on trusting teaching and learning relations. She further explained that this should enable learners to take risks during the process of learning about the problem that affected them and others in the school and community. She explained,

“There is a lot of risk but it is easy for them to ask if they are not sure about the information. In the classroom situation they will be able to voice all those things about the differing views and opinions that may even cause them to fall pregnant, and get the facts on the issue. So if they are able to open up to you then you can tell them” (LE1, incident 1, post-lesson interview).

In Teacher Z’s case, the enactment of a multi-disciplinary practice showed that her classroom practice afforded learners the opportunity to also explore indigenous knowledge, namely, traditional medicine, side by side with Western medicine as they had opportunity to inquire about the problems created by bad practices that affected them and the community. I observed that, *Her practice was based on knowledge co-construction led by learners’ authority on the subject* (LE1, observation data, criterion 3). This was evident when traditional African cultural knowledge located in traditional medicine practices was compared with Western science knowledge practiced in Western medicine. The teacher and learners then compared these to see how the two knowledge systems could come together for the benefit of the sick in the local community and for problem solving. Her reason for enacting practice in this way was that democracy is used as a way to promote collaboration between traditional healers and Western medicine. Democratic practice also promotes collaborative classroom practice for the mutual benefit of all people. This was evident in her statement: *“According to democracy, when the people came with their research and their opinions, they just came together and discuss and come with the solid answer, and it promote the culture of learning and teaching in the class”* (LE1, post-lesson interview, incident 2). Teacher Z also afforded learners the opportunity to cross discipline boundaries to create new meaning for creative problem solving purposes (LE2). This was evident in the observation that, *Life Orientation was promoted for community health medicinal use and needs, and in mathematics they worked with statistical data regarding the number of patrons for each type of healer that was needed, and the number of muti murders, which were discussed as supporting curricular areas for science* (observation data, incident 2).

Teacher G’s enactment of multi-disciplinary practice showed that her classroom practice enabled learners to cross discipline boundaries in their knowledge creation processes. This was evident in that they used their own unique learning strengths to translate written text into other forms to create new meaning through the use of, *inter alia*, diagrams, graphs and mind-maps. I observed that, *The project based learning approach afforded learners the chance to work across discipline boundaries: Arts and Culture, Design and technology, drawing graphs to represent mathematical information, writing summaries and reports* (LE4, observation data, criterion 3). Her reason for enacting practice in this way was for learners to

reach agreement through “*democratic decision-making*” so that “*learners must accept the outcome*”, and the problem “*has got to be done constitutionally*”. She further explained,

“This lesson started off with learners working in isolation, now we moving to camaraderie, a spirit of Ubuntu to protect people’s rights, everyone having a say to not just talking on alcoholism, but about life itself, to what one can do to assist others with learning. This is important because you must learn to agree eventually, for whatever the outcome is going to be, and learners must accept the outcome. The entire project has got to be done constitutionally” (LE 4, incident 2, post-lesson interview).

8.3. LANGUAGE USED AS A MEDIUM

The third category of teacher enactment, *language used as a medium for bringing one’s beginnings into the world*, is based on the use of language in order to be fully participative, and to be a subject in the context of plurality and difference. In this case, the language with which the learner responds, or speaks with, is the one that gives the learner his or her own unique and singular voice, and it is the language of responsivity and responsibility (Biesta, 2006). This category emphasises that every learners’ voice should be expressed, respected and heard. This category is constituted by five sub-categories, namely: performance democracy, promoting science literacy, promoting action learning, modelling communication to promote being, and promoting learners voice.

In enacting practice under the first sub-category of **language used as a medium**, Teacher J and Teacher G’s practice showed some variation in the way that they each enacted this classroom practice. Teacher J’s enactment of practice as performance democracy showed learner participation and enactment of their own idea of democracy through writing, drawing and action. This was done in order to show where each learner stands, and, what he or she thinks and believes in in order to express who they are, and in order to come into the world populated by others. This was evident when it was observed that, *Teacher afforded each learner opportunity to be creative by drawing a poster (total of 13) with words describing the ideal of democracy, what it means to each learner. The product was to be for public display on the wall, to reveal personal belief and standpoint which is to be enacted by the author, and as sovereign contribution to the class ‘rules of democracy’ to be enacted by all learners, or to be applied when ‘working together’, and to resolve conflict when it arises* (LE2, observation data, criterion 4). She maintained that democracy enables the creation of a classroom environment

that is conducive to teaching and learning. Democracy, as a concept, principle, and ideal must be lived out and enacted in classroom learning encounters. She supported this in stating,

“It is important for the expediency and efficiency of the lesson, and for maximum learning to take place. The word respect came up very strongly there, it was on one of the charts on the wall, the other was working together which meant team work and we need to ... eh they needed to use it and apply what was written down on their display charts” (LE2, post-lesson interview).

Teacher J’s enactment of practice as promoting science literacy as the second sub-category of **language used as a medium** showed that she used the English language genre interchangeably with the science language genre to promote science learning, and to advance science literacy and learner fluency. My observation of this was as follows: *Teaching tool is used to create learner interest in problem solving an issue affecting them daily. A spider diagram is drawn centrally – with the topic inscribed – on a flip chart paper stuck on the wall with 4 branches, each with a challenging question with sub-task questions: Sanitation, what is it? Sewage system, how it works. Sanitation problems. How humans are affected by poor sanitation. Science language genre: data analysis, research findings, conducting an audit, statistics* (LE3, observation data, criterion 4). She did this to involve the learners in conducting problem solving research, and for learner empowerment through conducting on-site research.

“It is important in that it does not necessarily mean what they had come up with, some of the others might have observed the same thing, and they could add, and you have given them the flexibility for them to do their own research, their own findings and audits. There would be no window dressing, it is based on what they have seen and what they have experienced. The questionnaire was basically a guide for them to follow, and the teacher is not there to influence them. It was up to them to record what was affecting them and having a negative influence on their health and their hygiene in the school. It (facts, as opposed to opinions) is important because it’s experimentation. It is also gives them the opportunity where they are seeing the problem, and seeing the fault. That they go and find out how they can fix the problem, how could they better it, how could they be a part of solving of that particular problem they are experiencing? The facts [are key] as they will have to separate what is merely an opinion and what is fact, and has been proven as obtained from the observations and interviews conducted. They [the audit and a questionnaire] are effective in that they had initially brainstormed the problem and analyse the causes of the problem affecting them. The questionnaire was centred on that” (LE3, post-lesson interview).

Teacher G's enactment of the third sub-category of **language used as a medium**, namely, modelling, showed that this practice afforded learners the opportunity to examine best practice, and task learning expectations were communicated to each group using a powerful, visual exemplar that fostered learner action. My observation notes were as follows: *The teacher modelled best practice in the construction of Portfolio Boards by learners. She used a finished product constructed by a previous group. Such a visual product captured, for the learners, the essence of what needs to be done by them, with her assistance and guidance as she regularly moves around the class from group to group. The model artefact displayed is able to communicate to learners, in a manner that the teachers' words or language alone may not achieve* (LE4, observation data, criterion 4). The reason for enacting practice this way was for learner empowerment through self-directed learning, learner self-discipline and adapting to circumstances, and for learners to speak and guide as leaders. She further states, "*We [learners] have to control our behaviour and adapt to circumstances as a leader, and allow others to lead, to speak, to guide. Here, it is not me begging them to work, they are empowered to work on their own*" (LE4, post-lesson interview).

Teacher G's enactment of the fourth sub-category, communication to promote being, also showed that her practice afforded each learner the chance as a unique individual to apply his or her learning strengths and communication style in collaborative learning tasks. Learning tasks and tools enabled learners to use their own voice to show where they stood, who they were as unique individuals, and to make their own contribution to the problem solving task in being responsible and caring humans. This was evident in my observation: *Classroom dialogic practice enabled learners to be empowered and use own voice to challenge child abuse. Such practice enabled them to reflect on their own, and to share their pain caused by irresponsible parents who let teenagers take care of the children while they are drinking at home or away, some were left unattended, and have had to go and look for food from their neighbour* (LE3, observation data, criterion 4). She did this because the problem of alcohol in the community contributed to school going youths' learning problems, and it impacted their expected levels of learning achievement. She described the situation in that, "*They explained points of view, they gave their opinions, asked questions and answered questions. They also showed sensitivity to their feelings*" (LE3 incident 1, post-lesson interview).

Teacher G put it differently in an earlier learning encounter in saying,

“I think it is not just the language, it’s the act of speaking, and the opportunity to stand in the front and do something in your own language, is what gives a child the confidence to learn. And with this confidence, more learning can take place. They take pride in their culture, their heritage and their self-esteem. It’s about developing one’s self-esteem, being proud of your culture, and being able to say what you want to say in your mother tongue, and being able to co-operate with others” (LE1, incident 4).

Teacher G’s enactment of the fifth sub-category of *language used as a medium*, namely, *promoting learners voice*, shows that her practice promoted the learners’ voice where learners could use a language of their choice in a room populated by others, and they could identify and state the nature of the problem chosen by them. This is evident in my notes as: *Teaching and learning space enabled a learner to communicate fluently in English as an English second language speaker. The learner is afforded space to try-out her presentation skills using English to exercise her own voice. Project Based Learning empowered her, and her peers, to excel in presenting a real-life problem before her peers and the teacher, and to come into the world as a unique individual (LE3, incident 1, criterion 4).* The reason for enacting practice in this way is that teacher practice needs to acknowledge that each learner is unique, having different learning strengths and emotions regarding their involvement in learning encounters. This is evident in her detailed explanation,

“I think with these children, with children that feel, you cannot put them in a structured environment and then ask them to learn and then read and to write. These kids do things, and you want to be able to allow them to do these things in any way they can do these kinds of things. There is a lot of learning going on in the process of these kinds of action. These children have never been given an opportunity to use various sources, to speak in public because they are always told you are not good enough to do this, so just give the others a chance. These kids are perfect in their own way, all you have got to do is to know where they are coming from, and try to get it out. And I think that is what this project could show that these learners could not do much before, and now they could speak. So these children were given a chance (LE5, post-lesson interview).

8.4. TEACHER PRACTICE AS CONSCIOUS SUSTAINED CO-ACTION

The fourth category of teacher enactment, teaching *practice as conscious sustained co-action*, is based on the idea that teacher practice is transformative to the extent that it is relevant to the learners, employs their prior knowledge, and sustains their active involvement in activities that are co-designed in order for them to encounter learning. This category affords

the teacher an opportunity to embrace learners' cultural capital through the use of unusual or innovative pedagogical practice. This category is constituted by eight sub-categories, namely: practice driven by learners' interest, knowledge, and authority; transformative practice; threaded discursive practice; power conceptualised in terms of energy; promoting assessment for learning; democratic practice; promotion of reflective practice; and practice as promoting learner subjectivity.

The first sub-category is teaching *practice as conscious sustained co-action*, namely, *practice driven by learners' interest, knowledge, and authority*. Teach J and Teacher Z enacted this practice in their own unique ways. Teacher J's enactment of practice utilised a mediating tool to acknowledge learners' ideas, contribution and interests driving the learning process. This is evident in my notes where, *Learners' ideas for problem solving were written on the chalk board for all to see the kinds of issues affecting them and the community. Their interests were acknowledged, and to be used to shape science learning. Learners given chance to list data sources to help solve the common problem they each were able to vote for (school sanitation issue)* (LE1, observation data, criterion 5). She enacted this practice because it enables learner autonomy. This can be seen when she says, "As we are not giving them the topics to deal with" (LE1, post-lesson interview, incident 1).

Teacher Z's enactment of practice under this sub-category showed that her practice was based on dialogue-rich co-action, and was done through the use of a meaning-making tool, namely a video viewing session on the problem in order to scaffold learning. The teaching and learning environment afforded the opportunity for learners to act and use accessible physical and human resources in order to solve a real-life problem based on their interests. This is evident in my observation that, *The teacher promoted open communication with the learners on a topic in which they had a lot vested due to direct and indirect experience with traditional medicine practices. She made relevant resources available so they could begin working on the Traditional Health Practitioners Bill; The trade in medicinal plants in the Eastern Cape Province, South Africa; she arranged for them to view a video on muti murders showing statistics and the extent of the problem locally (TV programme hosted by Debora Patta: Produced by: M Hlatshwayo (Date Recorded: 25/04/2011)* (LE1, observation data, criterion 5). Her reason for enacting practice in this way was for learner empowerment by affording them the opportunity to access relevant reading material, and to learn and participate in platforms created for democratic discussions. This can be seen in her discussion,

“I understand now that they understand the topic, they all want to talk. There is a relation here with democracy, because once you have got the information, what we understand, is that you need to share, you must not be selfish, but share the information. Give other people information and you must take other people’s information and use it or keep it for future use. Information empowers the person, like when the teacher in the lesson comes up with irrelevant information, then the children will say, according to the book I have just read, it is written like this, that what you are saying, it is wrong. They have got the right to say their views. And they cascade the information to other learners and to empower them as well” (LE1, incident 5, post-lesson interview).

In the second sub-category of teaching **practice as conscious sustained co-action**, namely, transformative practice, Teacher J’s enacted practice was underpinned by learning friendly values that are attuned to learners’ ideas in order to promote change. This is evident in notes as, *Teacher’s teaching and learning approach is inextricably tied up with values of caring, respect, reciprocity and eagerness to hear each learners’ ideas, as school leaders who have something to contribute to bring about change in the school* (LE1, observation data, criterion 6). She stated that, *“At this point they were really pushing me to get their responses written on the board in the way they stretched their arms. They are not sitting back and just taking in, they want to be part of the lesson”* (LE1, incident 2, post-lesson interview).

Also in the second sub-category of transformative practice, Teacher G’s enacted practice was underpinned by the use of past classroom practices and learners’ experiences to promote change in classroom practice in order to promote access to education for all learners. My critical notes of the lesson describe that, *Learners’ lived experiences shaped the learning situation. Teacher made use of learners’ previous experiences in which their human dignity was violated, at the school, in the previous Grade* (LE1, observation data, criterion 6). She did this to promote learner interactive problem solving using their own information and real-life experiences of the problem. This can be seen in her clarification:

“To handle any problem of society, or any problem that pertains to social justice, it has to be interactive and the information has to come from the children. The children need to experience it, they need to reflect on it, and the need to give a feedback about what is going on. And that cannot be done because, at the moment I am standing at the front. I’m doing a traditional lesson unfortunately, and what we want to do is take this further into the field. A lot of fieldwork and field research to be done. It (traditional lesson) had to have a little bit of structure, because we did not want to begin in a very loose structured way, because children need a little bit of

structure. And to come in with structure and trace the path from a structural way, and to break it down, would be meaningful to them, because children need a safe environment to learn, and children need a structured approach to feed into. And you've got to provide that skeleton and that is provided there" (LE1, post-lesson interview, incident 1).

With respect to the third sub-category of teaching **practice as conscious sustained co-action**, threaded discursive practice, the evidence from the classroom observation showed that Teacher J's enactment in this sub-category was based on learner responsiveness to challenging questions. Ideas expressed were further illuminated and elaborated on by the initiator through teacher prompting and probing in order to sustain learner elaborative and dialogic discussion on the point or idea initiated by him or her. This was done for the benefit of their peers who may have wanted to hear more as well. The critical notes evidence this: *Learners' individual responses and ideas were followed up on, through questioning, to confirm and take input from other learners on what they think, or on how they feel, about some of their peers' points raised* (LE1, observation data, criterion 7). Her reason for enacting practice in this way was that learners were afforded the opportunity to express their own point of view; which promoted the idea of individual thinking as the basis for collaborative thinking. She supported this in saying, *"Democracy, is that they were allowed to express themselves any which way, I did not ignore any of them, I allowed each, and every one of them, as an individual, to participate in thinking"* (LE1, incident 2, post-lesson interview).

The evidence from the classroom observation shows that Teacher G's idea of enactment in the fourth sub-category of teaching **practice as conscious sustained co-action**, namely, teachers' power conceptualised in terms of energy, was based on the notion of teacher caring and democratic practice. These foster learner participation through the teacher expending her own energy. This is based on infusing classroom practice with care and warmth to promote positivity and action on the part of the learners. According to Malcom (2008), in human relationships, notions such as generosity, vision, care, love, justice, democracy, and rationality are forms of energy. Malcolm (2008) further explicated that the use and management of energy serves whatever purposes chosen, and in any choice, there are moral dimensions; the energy of generosity, love and ideology are part of social interactions. He holds that "In the act of power, something is transferred. That something is energy" (Malcom, 2008, p 186). In Teacher G's classroom, we can see how care and generosity guided her interactions, and how her positive power was used to drive teaching and learning. This was evident in the notes as, *Teacher trusting dialogic relations with her learners affords her opportunity to know learners'*

capabilities intimately. When the learners hear the teacher talk about sharing that positivity, and her energy that flows into her learners, and then seeing her doing it daily, then to them, theory becomes practice. Learners are freed up to emulate the teacher, and learners who become positive are no longer negative about their own capabilities (LE5, observation data, criterion 5).

She viewed the teaching and learning space based on creating positive energy in the classroom, which allows for the teacher's "positive energy to flow into the lesson". This enables classroom practice that helps learners to "accept the teachers' positive energy" for improved learning (LE1, incident2). She responded that,

"Like my energy, it's your positivity, that fact that there is always a solution, that your problem becomes a solution, that every mistake becomes a challenge, and every challenge becomes an opportunity to learn. So the flow of energy is something that is very important. It must go into the classroom climate. (LE1, post-lesson interview, incident 2). Here you passing the power to the children. And you need to make it a democracy, you use your own power to empower children, and empower others as well" (LE2, incident 3).

Teacher G's enactment of the fifth sub-category of teaching **practice as conscious sustained co-action**, namely, promoting assessment for learning, shows that her classroom practice enabled learners to get immediate feedback on their learning or lack thereof. According to Roskos and Newman (2012, p. 3), who draw on the work of Sadler (1989), formative assessment involves making judgements about the quality of learner responses, and using those judgements immediately to guide and improve learners' understanding and skills. The authors argue that such an assessment is about forming judgements frequently in the flow of instructions for the purpose of taking an active role as this deliberately scaffolds learning from a lower level to a higher level of learner performance. In Teacher G's learning encounter, learners were afforded the opportunity to reflect on their failure to begin or act, and each learner was given a chance to try again under the teacher's guidance. Learner failure, and learners' successful action, are both viewed as outcomes of classroom practice.

The observational notes show that, *Teacher practice incorporated assessment for learning. She fostered this through the use of question and answer sessions of knowledge co-construction with each small-group task. She gave immediate positive feedback for successful work done, and corrective feedback when learner work or give responses or work showed little or no progress in learning gains (LE3, observation data, other).* Her reason for enacting

practice in this way was that classroom practice is enshrined in policy which “*spells out so clearly what we supposed to have in a lesson, we don’t do that [because] we are not giving the child the chance to learn*”. Her classroom practice was based on the criterion referenced assessment of learners in order to assess skills and content. Assessment practice is fair when learners are given a chance to see the assessment criteria, and the expected level of performance, and to use this to guide their learning. This can be seen in her statement,

“You see I have two sheets, one is the assessment sheet they have with them, relates to the arts and culture where you focusing on the skills, the skills of the cartoon. They bring out the skills they were supposed to. The other one is the English language skills in language communication. The learning outcome one, there the child is supposed to communicate the ideas with confidence and expression, which they did. They were supposed to bring out the facts and opinion, which they did. They supposed to give the sequences in oral discussion and logical arguments, which they did. It was added on to the mind-map as well. Their interactive skills, which they did. They were to take on different roles, which they did. They explained points of view, they gave their opinions, asked questions and answered questions. They also showed sensitivity to their feelings. Their oral presentation, their posture, their audibility, their body language, their confidence basically. So my sheet has all of these criteria. Each group has a copy for the learners, so basically in one lesson, you will be able to do all of this on one sheet. I will give you a copy of this. The facts would be the information that is coming across, it doesn’t only relate to the first group, the information in terms of the survey. What I will do, I will verify the data here. I would go through the information and I would see – did the children talk about what was in that particular information. So before the teacher does the assessment, I cannot do a valid piece of assessment until I go through the work first. That is why if a teacher wants to be fair, and wants it to be reliable assessment, you have to know the content before you give it to the children, and you have got to know what you gave to them. You have got to know what it is you expect of them. The children have to know what it is that is expected of them as well, so that is why we gave them these criteria sheets. So each group has the questions and suggestions, and leading assessment criteria as to what is expected of them. So in the presentation, they ought to have done that particular aspect” (LE3, post-lesson interview, incident 1).

In the sixth sub-category of teaching **practice as conscious sustained co-action**, namely, democratic practice, Teacher M, Teacher Z and Teacher G enacted practice in their own unique ways. Teacher M’s enactment of democratic practice utilised practice tools that afforded learners the opportunity to be free from external constraints placed on them. Learners were able to voice their own opinion regarding the problem and were motivated as to why it

was a problem. Their peers supported the listed contributions as each learner stated why the contribution was to be accepted. According to Oswald and Moriarty (2009, p. 11), context-relevant pedagogy that promotes active citizenship is consistent with a transformative education approach, which “is designed to open up democratic spaces for participatory construction of curricula and learning outcomes”. I noted that, *Three learners responded more often than the others, their responses were taken up by their peers, in order to initiate own additional discussion and input* (LE 1, observation data). This was done because democracy enables learners’ participation for the benefit of all involved. She evidenced this in her utterance,

“Sometimes democracy is not about self, it is about others. Democracy links with the concept of Ubuntu, because if something is being done, consensus needs to be reached. Because the boy who wanted to do research on the wastage of water in the school. He was a very good researcher, and if he had said ok, because I wanted this one and it was not chosen, so am pulling away from participation, but he came anyway and he gave his co-operation” (LE1, incident 1, post-lesson interview).

Teacher Z’s enactment of democratic practice as a sub-category also showed that her practice was underpinned by democratic principles that afforded the opportunity for each learner to use their own creativity and ability to act, and where one learner’s ability to act created affordances for his or her peers to also be creative and to be able to act as well. This is evident in my notes: *Learners were still new to project based learning, the few (3) who spoke were those prompted by the democratic space created, that allowed them to exchange ideas on the topic and problems as well* (LE1, observation data, criterion 7). Her reason for enacting practice in this way was that it promoted learner empowerment by allowing them to access the relevant reading material to learn and participate in platforms created for democratic discussions. She admitted that,

“It is challenging because when it comes to gender equity, the girls are more powerful than the boys, which means that we need to revisit the whole topic so that the boys must take part again. They must get the opportunity to read again, to embark and to get into the discussion, so that we can say that, yes, there is a democracy” (L1, post-lesson interview, incident 1).

Teacher G’s notion of democratic practice was also based on classroom practice underpinned by a mural placed up against half of the classroom wall, one that was teacher-

learner co-created depicting the principles of democracy as practically done and acted out in the classroom. I noted that, *The teacher had the word “DEMOCRACY” stuck on the wall using big cut-out letters, with learner drawn works of art showing kids holding hands, signs, pictures, and with words that signify the principles of democracy stuck around the main word, namely: trust, human dignity, human rights, respect, non-discrimination, non-sexism, non-judgemental, equality* (LE1, observation data). She proudly explained,

“You see in our classroom we already have democracy rules on the wall. And if you look at one of those walls it has the finger, and it says respect. The children use this as a sign. The sign that you always respect, so the respect is there all the time and they know that. No matter what you say, and they know that even if you slip and fall, you still show someone respect. So that respect, eh...the sign, I want you to capture the sign when you come to the class. This is the sign, it’s on the wall, that’s drawn in blue, one of the children drew it. You can see that the youth culture is coming in here as well. So you bringing in the youth culture to teach through it. So you bringing their own culture and symbols. You bringing the youth culture to teach what they know, you teach from the known” (LE1, post-lesson interview, incident 4).

On the seventh sub-category of teaching **practice as conscious sustained co-action**, namely, the promotion of reflective practice, Teacher G’s practice was based on the idea that a teaching and learning space should be democratic to allow learners to act, and where a learner’s action, or inaction, can be used as the basis for him or her to reflect thereupon, and to increase his or her chances for successful action or learning. In my notes, I captured that, *With reference to Mbuli, a learner who was able to act, the classroom practice, and democratic space created for her to act, enabled her to be a subject and to come into presence, in a disjunctive space* (LE5, observation data, incident 7). She gave her reason for this practice as,

“These kids are perfect in their own way, all you have got to do is to know where they are coming from, and try to get it out. And I think that is what this project could show that these learners could not do much before, and now they could speak. So these children were given a chance [to co-reflect with the teacher] (LE5, post-lesson interview).

On the eighth and final sub-category of teaching **practice as conscious sustained co-action**, namely, practice as promotion of learner subjectivity, Teacher J’s classroom practice afforded each unique individual the chance to publicly declare themselves, and to be the product of their own creation, which they would soon have no control over when it was taken up by others for their own purposeful and creative action. This is evident when, *Each learner was afforded the opportunity to hold up own created poster and read out the meaning written*

about democracy, and to paste it on the wall, and each learners' unique interpretation was equally accepted by others and acknowledged by the teacher (LE2, observation data, criterion 7). Her reason for enacting practice in this way was that democracy, as a concept, principle and ideal should be lived out and enacted in classroom learning encounters. She maintained that, *"It is important for the expediency and efficiency of the lesson, and for maximum learning to take place"* (LE2, post-lesson interview, incident 1).

Teacher Z's classroom practice afforded each unique individual the space to be a subject, a space that is underpinned by democratic principles. Learners were afforded the opportunity to be creative and to act using their own initiative where their ability to act provided others the chance to also take their own initiative to begin and act. This is evident in my notes as, *Four learners dominated discussions, shy ones spoke less and listened with sustained interest, hence a few interacted. Shy learners were prompted to give their own views, or to respond to questions posed* (LE2, observation data, criterion 7). She did this to enable learner collaborative practice based on joint effort and contribution, which should be acknowledged during public presentation by a selected team, instead of individual effort, in order to prevent *"violating the group's views if you say what you feel"*. On personalising the presentation, and solution, she began with the word I. She explained that,

"In the class this sometimes happens, but not in an open presentation. In the classroom where you use democracy, you have a right to say what you feel. In the group you are working you may be violating the groups' views if you say what you feel, but in a presentation, you present what the group did together. If asked a question after the presentation you can also respond and say what you feel or think, and need not involve other people. If there is a group, the learner come up with his or her own problem or initiative or solution, you just give that learner the space to express his or her feelings, and then get the mandate from the group and then if the group accepts that thing, then you must accommodate the space for that learner, so in this way the ideas of group, and of the individuals in the group, are accommodated" (LE2, post-lesson interview, incident 3).

Teacher G's classroom practice was permeated with two-way rich dialogic relations wherein one learner's ideas were 'thrown' to the class to invite comment and for others to add to, or to differ from the initial idea. This was evident in my notes when, *Teacher practice based on "democratic decision making" afforded opportunity for learner subjectivity, and for inter-subjectivity* (LE4, observation data, criterion 7). Her reason for doing this was based on the need for learners as a small task-team of four to five learners to reach agreement through

“democratic decision making”. The problem had to be carried out based on “*the group must go with the majority decision*”. Teacher-learner co-action in science is underpinned by joint decision-making, and based on evidence, facts, and respect for others and their views as a way to work scientifically in the classroom. She described that,

“This lesson started off with learners working in isolation, now we moving to camaraderie, a spirit of Ubuntu to protect people’s rights, everyone having a say to not just talking on alcoholism, but about life itself, to what one can do to assist others with learning. This is important because you must learn to agree eventually, for whatever the outcome is going to be, and learners must accept the outcome. The science topic, and in every aspect of life, there are values and philosophies, even within science. We are making decisions based on evidence and facts. We respect each other’s point of view. Science falls down the line if you do not address the problem of democracy in the country, there will be no space for science. First you need to motivate the scientific issues, promote democracy, promote thinking, and addressing issues in a very rational way, and then your science can grow” (LE4, post-lesson interview, incident 2).

Teacher M’s classroom practice created an opportunity for the reporting learners, who paid the local clinic a visit, to appear before their eagerly waiting peers, to take the initiative and to give feedback to the others in a way that would suit them best. In them taking initiative, they did so not know how their peers would react to what they presented. Their peers could have taken their information and initiative in ways that they had no control over. The information that the other learners received, if any at all, would have enabled them to act as well, and thereby bring their own beginnings into the world as well. I observed that, *The teacher wrote three headings on the board as a guide for their feedback: What is teenage pregnancy? What are the causes? How can it be prevented? The learner delegation of 4 each walked to the heading they chose to write about, and their attentive peers read with eagerness and responsiveness by speaking to the presenters. The teacher listened to their conversations standing on the side while the learners interacted with each other* (LE2, p observation data, criterion 7). She enacted this practice to foster trusted teaching and learning relations that would enable risk-taking by learners during the process of learning about the problem that affects them and others in the school and community. Teacher M stated,

“If the learners know, first of all, that you are a person who adheres to the principles of democracy, then they will trust you. Because it is a sort of a relationship that is sort of reciprocal. If they have got concerns it is easy for them to get to the point because they know that you will accept, you will not shut them down because they are raising points. There is a lot

of risk but it is easy for them to ask if they are not sure about the information. Maybe, when you grew up, there were things that were said, like about teenage pregnancy. So even now, maybe they even get wrong information, but it is up to the democratic teacher to explain all those things. In classroom situation they will be able to voice all those things about the differing views and opinions that may even cause them to fall pregnant, and get the facts on the issue. So if they are able to open up to you, then you can tell them. You tell them that if you don't trust me then there is sister so-and-so you can go and they will also give them information, and who will confirm what you are saying. At their level of development, what happens is that the parents are so evasive and they don't explain. They hide information. They don't state clearly what causes pregnancy. The facts are not given to the youth as parents feel that it is too explicit, vulgar or open. It may be cultural or religion" (LE2, post-lesson interview).

The above analysis and discussion reflects what occurred at a global level. The global analysis tells us that science teachers are in a position to construct and enact science classroom practice as a space for democratic living. They are able to do this in four distinctly unique ways, looking at science learning from a different angle: *learning as a response* to the curriculum (five sub-categories), seeing the discipline of *science as context-driven* (shows no variation), by *utilising language as a medium* for bringing one's (learners') beginnings into the world (five sub-categories), and by viewing *classroom practice as conscious sustained co-action* (eight sub-categories).

The global level analysis also informs us, in Table 8.1 below, that there was consistency in the teachers' enactment of practice with respect to criterion 1, as this practice was often observed. The same can be said about the four teachers in criterion 2, where three of them showed an improvement to a higher level of enactment (Teacher J, Teacher M, and Teacher G). Every teacher was recorded at the highest level of enactment in at least one learning encounter with respect to criterion 5. The remaining criteria show variation in the teachers' enactment of practice, with the widest variation observed with respect to criterion 8, as it displays all of the scales from 1 to 4.

Table 8.1 Classroom Observation Schedule Data: Global analysis

No.	Observation criteria	Applicable observation instrument Standard per participant (Teacher J –TJ; Teacher M – TM; Teacher Z – TZ; Teacher G – TG)											Comments		
		LE 1				LE 2				LE 3		L E 4		L E 5	
		T J	T M	T Z	T G	T J	T M	T Z	T G	T J	T G	T G		T G	
1	Teacher creates an educational (science teaching and learning) environment in which students have a real opportunity to begin, to take initiative.	2	2	2	2	2	2	2	2	2	2	2	2	2	Often observed across all participants – as data shows.
2	The educational (science teaching and learning) environment allows the students to respond in their own unique ways to the learning opportunities provided by the curriculum.	1	2	2	2	2	1	2	1	2	2	1	1	Often to always observed.	
3	Different curricular areas are explored and used for the particular opportunities they provide for science learners to bring their own unique beginnings into the world.	3	3	1	2	3	3	2	2	3	1	1	3	A wider variation occurred, it is interesting when it goes to individual level, shows most of the scales: 1-3.	
4	Language is approached/seen as a human practice in which learners can participate, and through which they can find new ways of expressing themselves, new ways of bringing themselves into the world.	2	3	1	2	3	3	2	2	3	2	2	2	TG and TM seldom observed, while TG and TZ often applied this criterion across all LEs.	
5	Educators show a real interest in the initiatives and beginnings of their learners during science learning.	1	1	1	1	2	2	1	2	1	2	2	2	TG, TM and TJ always or often observed in applying this criterion, and TZ always.	
6	Teachers spend time and effort on finding a delicate balance between the child and the curriculum so that there are indeed real chances for science learners to undertake something new,	2	2	1	1	2	3	2	3	2	2	2	2	The teachers often applied this criterion.	

No.	Observation criteria	Applicable observation instrument Standard per participant (Teacher J –TJ; Teacher M – TM; Teacher Z – TZ; Teacher G – TG)											Comments	
		LE 1				LE 2				LE 3		LE 4		LE 5
		TJ	TM	TZ	TG	TJ	TM	TZ	TG	TJ	TG	TG		TG
	“something unforeseen by us.”													
7	Teacher creates opportunities for learners to be a subject (or for inter-subjectivity).	1	2	3	1	1	2	2	2	1	2	1	3	TJ always applied this criterion in practice; and TM often, and TG ranged from always, often to seldom.
8	Opportunities created for respectful disagreement.	3	3	2	2	2	3	4	3	3	3	1	3	TJ, TM and TG seldom observed. A wider variation occurred as it shows all the scales: 1-4.
9	Opportunities created for difference.	2	3	3	2	2	3	3	2	2	2	2	2	TJ and TG largely often observed, with TM and TZ seldom observed.
10	Opportunities created for otherness.	2	3	3	3	2	2	3	2	3	3	3	3	TZ & TG seldom observed, while TM and TJ often to seldom observed.
11	Other?	Y	N	Y	Y	Y	N	N	N	N	Y	N	N	TM did not have any additional contribution to the data.

Key:

1 – always observed; 2 – often observed; 3 – seldom observed; 4 – not observed

Note: 1. Criterion 10, for ‘Other’ N=No; and Y=Yes, and

2. Teacher G (TG) for LE3 – second number is for follow-up lesson

The data presented in Table 8.1 reflects the findings pertaining to research question 2, as generated by the classroom observation schedule (Chapter 6, Figure 6.1, Phase 4; and Appendix G). The ‘observation criteria’ section in Table 8.1 is drawn from the literature (Biesta, 2006). These criteria were used as a basis to arrive at the different categories of teacher enactment of an alternative and unusual science classroom practice. The first two criteria speak about the environment, the third criterion discussed subject context, the fourth concerned language use, while the remaining criteria, namely, the fifth to the tenth, related to practice (with criteria 8, 9 and 10 – which linked to criterion 7, telling us about the nuanced way in which the enactment of subjectivity was observed).

Below is a discussion on teacher practice at the level of individual cases of teachers' enactment of teacher practice.

Just by looking at the above table, one is able to tell that Teacher G (with five learning encounters observed, including a follow-up learning encounter) was the only participating teacher who enacted her alternative and unusual practice as part of the normal school teaching program. She showed consistency in the upper level of enactment: levels 1-2 (as compared to the middle: levels 2-3; or the lower: levels 3-4), with respect to criteria 1, 4 and 9. Her enactment of practice showed variation in the upper levels of enactment for criteria 3 and 7, and variation in the middle level of enactment for criterion 2, while a wider variation was observed with regard to criteria 5, 6, 7 and 10.

Teacher J's (with three learning encounters observed) practice showed consistency in the upper levels of enactment (levels 1-2) with respect to criteria 1, 5, 6 and 9. However, her practice showed consistency in the middle level of enactment (levels 2-3) in criterion 3. Her practice also showed variation in the middle levels of enactment (levels 2-3) for criteria 4, 7 and 10.

Teacher M's practice (with two learning encounters observed) showed consistency in the upper levels of enactment (levels 1-2) with respect to criteria 1 and 6, and revealed consistency in the middle level of enactment (levels 2-3) in criteria 3, 4, 8 and 9. Her practice had variation in the upper levels of enactment (levels 1-2) in criteria 2 and 5, and in the middle levels of enactment (levels 2-3) in criteria 6 and 10.

Teacher Z's (with two learning encounters observed) practice comprised consistency in the upper levels of enactment (levels 1-2) with respect to criteria 1, 2, 5, 9 and 10. Her practice showed variation in the upper levels of enactment (levels 1-2) in criteria 3, 4 and 6, while it showed variation in the middle levels of enactment (levels 2-3) in criteria 7. Criterion 8 showed a wider variation.

Overall, when clustering the observation criteria, and taking into account the key criteria (criteria 1 to 7), Teacher G and Teacher Z's classroom practice was enacted at the upper levels of enactment (levels 1-2), whereas Teacher J and Teacher M did so at both the upper (levels 1-2) and middle (levels 2-3) levels of enactment, as represented in the table below.

Table 8.2 Teachers' overall observed levels of enactment of classroom practice

Teachers' overall observed levels of enactment of classroom practice				
	Environment created for learners to respond in own unique ways by taking initiative and to begin. (criteria 1 & 2)	Science as contextualised (criterion 3)	Use of language as a medium (criterion 4)	Classroom practice (criteria 5 to 10)
Teacher J	Upper levels (levels 1-2)	Middle levels (levels 2-3)	Middle levels (levels 2-3)	Upper levels (levels 1-2)
Teacher M	Upper levels (levels 1-2)	Middle levels (levels 2-3)	Middle levels (levels 2-3)	Upper levels (levels 1-2)
Teacher Z	Upper levels (levels 1-2)	Upper levels (levels 1-2)	Upper levels (levels 1-2)	Upper levels (levels 1-2)
Teacher G	Upper levels (levels 1-2)	Upper levels (levels 1-2)	Upper levels (levels 1-2)	Upper levels (levels 1-2)

Key:

1 – Always observed (level 1); 2 – Often observed (level 2); 3 – Seldom observed (level 3); 4 – Not observed (level 4)

Table 8.3 Summary of teachers' enactment of practice

Category 1 & sub-categories	Category 2	Category 3 & sub-categories	Category 4 & sub-categories
learning as a response (5 sub-categories)	science as context-driven (no variation)	utilising language as a medium (5 sub-categories)	classroom practice as conscious sustained co-action (8 sub-categories)
1	Learner participation	Performance democracy.	Practice driven by learners' interest, knowledge, authority.
2	Action learning	Promotion of scientific literacy.	Transformative practice.
3	Participative mediation	Modelling.	Threaded discursive practice.
4	Learning-centred practice	Communication to promote being.	Teachers' power conceptualised as energy.
5	Differentiated learning	Promoting learners' voice.	Promotion of assessment for learning.
6			Democratic practice.
7			Promotion of reflective practice.
8			Practice promoting learner subjectivity.

8.5. CHAPTER CONCLUSION AND SUMMARY

The findings that emerged from the analysed data show that science teachers are in a position to construct and enact practice in the science classroom as a space for democratic living in four distinctly unique ways, namely, *learning as response (5 sub-categories)*, *science as context-driven (shows no variation)*, *language used as a medium for bringing one's beginnings into the world (3 sub-categories)*, and *practice as conscious sustained co-action (8 sub-categories)*. The next chapter deals with Project Based Learning (PBL), with specific reference to Teacher G's story.

CHAPTER 9

PROJECT-BASED LEARNING AFFORDANCES: TEACHER G's STORY

In this chapter, I discuss the findings of teachers' enactment of an unusual practice by zooming in on Teacher G's conceptions and enactment in order to demonstrate how Project Based Learning (PBL) affords an opportunity for creating democratic spaces. Each of the four participants tried out, in the school situation, teaching their learners using an alternative teacher practice either with the whole class, or with a small group after school hours.

In line with the democratic underpinnings of the study, the participants had the power to choose the lessons that they wanted me to attend and observe, or to observe and record. They could thus base this choice on what they were ready to say and enact for the recording purposes of the study. This made it possible for the data generation process to be flexible, with the research participants having the power of control over what happened during the process of data generation inside their classrooms. In this chapter, I discuss one of the four cases of teacher enactment of an unusual teacher practice. I chose Teacher G for two reasons. Firstly, she was the only one who decided to enact her teacher practice within the constraints of day-to-day classroom practice – it was not an add-on after hours, as the other three teachers did this. Her practice was fully integrated as part of the day-to-day teaching of the mandated school curriculum. Secondly, out of the four categories of teacher enactment of practice that were identified in Chapter 7, Teacher G enacted all four categories, and within most of the variations found within each category.

Teacher G opened up her classroom practice for observation during five occasions, allowing for more data to be generated for research purposes. The findings of the first research question show that there is a wide range of depth in this teacher's understanding of an alternative teacher practice when compared with the other three participants (Chapter 7, Table 7.1).

I gave primacy to teacher G's story, as discussed above, and followed the insights provided by researchers Kovacs and Frost (2012). They made an attempt to implement a Biestian (2006) curriculum in a rural high school context wherein they teamed up with an English school teacher and her 15 9th Grade 'at risk' students. Their study was based on a quasi-experimental research design with two separate classroom groups of learners, namely, a

control group and an experimental group to measure the impact of the programme. The two groups of learners were subjected to a post-test at the end of the year through the mandatory school end of year STAR 9 test. The control group were taught the same way the teacher had taught them for the past seven years, while the experimental group of 15 ‘at risk’ learners were those involved in the research programme.

The authors acknowledged that the reliability and validity of the tests had been questioned by other researchers. However, Kovacs and Frost do give an account for why and how they risked the dangers of abiding by ‘the tests’ in order to infiltrate the hegemony of the tests in order to bring about change in practice in the way that Biesta (2006) had theorised. In their words, they could not wait but implement an alternative practice inside a public school because “to remain on the side-lines would allow unfettered growth of inherently anti-democratic practices such as now widely adopted Common Core Curricula” (p. 2). It is against this backdrop that Teacher G used her *energy* and her influence as part of the school leadership, as is evident when she says, “*because – you know I’m part of management and we have this every day – the teachers definitely cannot cope with these children, and have written them off.*” She preferred to integrate her unusual and alternative teacher practice within the school curriculum, rather than doing so as an add-on and having to meet with the learners after school hours, as the other participants did. She also had a class of largely ‘at risk’ learners. Teacher G worked from within the current school curriculum where she applied her new classroom practice, and wherein she positioned herself as a ‘critiquer’ of the usual and current testing system. She explained that,

“The describing, the analysing, the selecting – all those skills that we need, we need to talk about testing. At our school we find that these children are talking so well now but fail miserably in their tests. One of the reasons they fail so miserably in their tests is that we don’t teach them to differentiate, to discuss, to analyse, to sort out, to classify, to present, to perform, to define. These are all skills that we should be teaching, and we don’t do that.”

It is against this backdrop that Teacher G presented herself to her learners. She had a great deal of choice in how she wanted to teach them, and positioned herself as an advocate for change, and thus constructed the teacher as change agent storyline. She had the cooperation of the principal, who was open to new ideas on practice, and who had attended an annual showcase and had witnessed first-hand what previous learners from the school did. The decision taken by Teacher G to try out an unusual practice in the way that she did enabled her to place this alternative teacher practice squarely within the day-to-day time-table and curriculum

management and implementation of the school. She employed the resources that were made available at the school to bring this new practice into reality. Below, I turn to Teacher G's data with respect to her understanding of an unusual practice.

According to Creswell (2007), qualitative researchers first scan all of the data at hand in order to identify major organizing ideas, and this involves looking over field notes from observations using an observation schedule, interview data, and audio-visual images in order to observe what participants said and did. According to the author, this is done, "in stepping back and forming larger meanings of what is going on in the situations or sites" (Creswell, 2007, p. 154). Firstly, I summarize the participant's unusual practice, as outlined below, and as gleaned from the available data (as guided by Creswell (2007)).

I represent in visual and diagrammatic form the ideas distilled from the actions and utterances of the participants (with a focus on Teacher G), and the effects these had on the responses that were made by their learners within the learning encounters. The participants' learning plans and goals, as discussed earlier, and their focus group interview data, was also factored in to develop the organising framing for the data analysis.

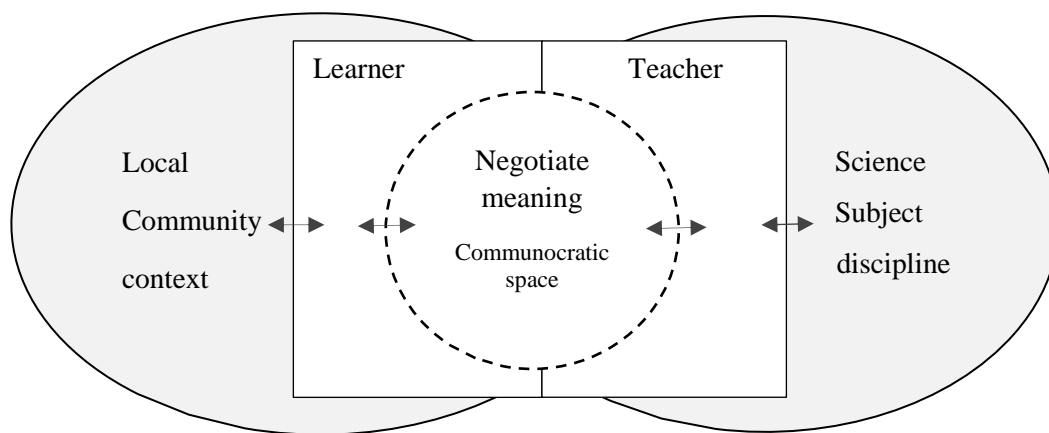


Figure 9.1 Organising framing depicting unusual teacher practice

In the above representation (Figure 9.1) of the participants' unusual practice, the science content is located within the local community problem brought into the school science classroom by the science learners. The organising framing for writing the narrative of the participating teachers is based on the concept of 'crucial description', as discussed in an earlier chapter (Chapter 5, Section 5.1). However, based on the outcome of the discussion and outcome of the data analysis on what each teacher said with respect to their unusual practice, an alternative organising framing for writing the participants' narrative is outlined below.

Following from the five categories that emerged from what the participants said about their unusual practice, the way in which the narrative is written for Teacher G is presented. The participants' views on what own practice was deemed to be informed the organising framing for Teacher G's narrative on what she actually did in the classroom with the learners when enacting an unusual practice. The following categories of teacher practice understanding were identified:

- Independent learner who thinks and participates;
- Authentic space;
- Learning-centred teacher practice;
- Resourceful facilitation; and
- Participative mediation.

These resultant categories of teacher practice were used in order to enable me to stay close to the teachers' espoused practice, if not in complete alignment therewith, when observing what she actually did. The purpose of this study was not to seek an alignment between what the teachers said and what they actually did in terms of an unusual practice. What the teachers said they did and what they actually did may be the same, or may not be the same. The teacher was in control over what was to be focused on within these incidents that were selected for discussion, and what was recorded, transcribed and reported on here. Each one of the incidents listed and discussed below were selected on the basis that each reflects elements of one, or a combination of the above listed five themes or categories of teacher practice. Those dimensions of teacher practice that stood out were those that were linked to the same in the literature. Teacher G's narrative follows below, and is based on each of the five categories of teacher practice, each reflecting the variations found, and what constituted each one.

Firstly, I discuss Teacher G's first learning encounter with her whole class group of 35 learners, and what she did when compared with the other three participants. This learning encounter was not amongst those chosen by her as an incident, like she did with the rest of the learning encounters that are reported on. This learning encounter shows how she deviated from the norm followed by the other three participants in enacting her co-imagined and unusual practice. Teacher G's enactment of an unusual practice, as observed, video-recorded and discussed in the post-lesson interviews conducted by myself, is narrated, interpreted and represented in the crucial description below. The narrative segments begin with the post-lesson

interview transcribed data, and are accompanied by data from the transcribed video-taped data that is based on the particular incident chosen by the participant (Teacher G).

A narrative of what Teacher G actually did and the reasons that she gave for doing so are now presented. Her narrative was used as a basis for explaining what she did, and other participants' actions were pulled in, where appropriate, to add richness or variation in what Teacher G did.

The narrative provided in this section is presented in a sequential manner. It begins with what the participant did in each of the five learning encounters, beginning with learning encounter 1 and ending with learning encounter 5. The first learning encounter was used by teacher G to give each learner an opportunity to “*take a stand*”. It is referred to as 1: learners’ taking a stand in Teacher G’s directive pedagogy as entry point. This is followed by a set of learning encounters, namely, learning encounters 2 to 5. The second one was to enable “*learners to make a choice*”, and the third one was to engage in “*co-action*” and “*taking initiative*” in responding to the curriculum, and a fourth one intended to afford learners the opportunity to construct Portfolio Boards (PBs), and the fifth and last one was intended to allow them the opportunity to “*stand up and deliver (present), as practicing*” – collectively these are referred to as 2: learners being afforded a project-based science learning opportunity to ‘act’ and share power in the service of social justice.

9.1. LEARNERS’ TAKING A STAND IN TEACHER G’S *DIRECTIVE PEDAGOGY* AS ENTRY POINT

From the outset, in Learning encounter 1, activity 1, Teacher G invited her learners to participate in a learning encounter that was based on trust, non-judgment, non-discrimination and respect for human dignity when she stated that “*we will learn and have open communication based on trust and in a non-judgmental way, and you will also learn about violation against one’s rights, discrimination, non-sexism and human dignity, and violation of one’s dignity.*” For her, these sets of key requirements or foundations for learner participation were to be given meaning by learners “*giving examples of each in daily or school life.*”

For Teacher G, the learners’ involvement would be achieved “*through the use of pictures or cartoons from newspaper,*” where learners would be participating in debate on sharing their own meaning of the key requirements or foundations for learner participation. They did this using their own newspaper articles or pictures. She invited and challenged the

learners to think, take a stand, and openly share their own learning resource material brought to school:

“You had pictures over here, give me a picture that shows you the violation of human dignity. Who thinks they have a picture that talks about the violation of human dignity? Come to the front and tell us why it is on the violation of human dignity.”

The learners responded to the teacher’s invitation, and did not hesitate to participate in this way by making their voices heard as solicited by the teacher, and by first thinking and then selecting the relevant visual text in their possession. This is linked to the first theme in teachers’ understanding of practice, namely, an ***independent learner who thinks and participates***. In this theme, the teacher draws on the learners’ ability to reflect on their own thinking, participation and learning, which fosters their ability to accommodate multiple perspectives in collaboration with others so that they can come up with creative and valid explanations.

On critical thinking, Teacher G explained that she wanted to, *“Bring about critical thinking,”* and that she would like do this by using real-world problems that directly affect the learners by developing their self-analytical skills.

“A child that is not able to speak to start now to be critically thinking about issues around them. This will help inform the way they live their lives. For critical thinking to occur in classroom learning, there must be some self-analysis on the part of the child”

She wanted to build the learners’ belief in their own capabilities and self-worth in, *“promoting the need for learners to believe in themselves.”* In terms of teaching that is based on the learners’ learning style, Teacher G responded, *“with thinking, learning can take place using learners’ multiple intelligences.”* For her, this could be done by making connections with everyday life and the curriculum, and can be seen in her response,

“Learning does not have to be formal all the time, messages here all relate to alcoholism and the way it relates to themselves as children and in their homes as well, addressing the alcohol problem has got to be multi-dimensional, multifaceted. This is so because, learning through the visual means is important because these kids’ learning style revolves around the visual and auditory, music for auditory, and lots of visual activities.”

For example, a learner volunteered by firstly holding her hand up, and then she walked to the front of the classroom, and held up her group’s picture, which the teacher read out: *Child porn horror*, with written text and four pictures embedded in the text showing people and places involved (see picture below). By using the pronoun “you”, Teacher G positioned the

learners and their role of learning, and used the pronoun “we” to position the learners and herself as part of a learning community. In this way, she created a commune or community storyline.

Additionally, the “*use of pictures or cartoons from newspaper*”, where learners participated in a debate on sharing their own meanings of the key requirements or foundations for learner participation using their own newspaper articles or pictures, is consistent with the theme ***Participative mediation***. This teacher understanding refers to a way of acting where teachers act as agents to employ and/or model the use of educational tools in a manner that creates affordances for learning for all learners. Her use of a mediating device provided a chance for the learners to open up and talk about the adverse effects of the problem. It also allowed her to establish an educational relationship based on trust, and to offer comfort and educational therapy to affected learners. This can be seen when she says,

“It is important to brainstorm how serious this problem is, to draw on all the ideas coming through from the learners, to establish a circle of trust with the learners, educate to lead to therapy of releasing what it is they are feeling at home [as a result of the problem of alcohol at home and the community].”



Figure 9.2 Visual, colour-enhanced print media used to allow learners to answer challenging questions to reveal who they are, and where they stand on an issue

For the learner, porn is, “*Taking children and making them do rude or loose stuff*”, and to a peer in the class, “*loose stuff*” meant “*naked*”. As stated, the teacher related this to an incident that occurred in real-life as the basis for open communication, and to encourage learners to express their own point of view: “*Has anyone heard about the rape case reported in the local media involving a school girl, where a girl said she was raped on the school grounds, and then there was an investigation, at what age was she, who can remember her*

age?” The incident was known to many learners, and their responses varied because the learning encounter afforded them the chance to participate based on “*trust, dignity, and respect,*” and a process that is “*non-judgmental and allowing open communication.*” The learners participated freely, stating - learner 1 (L1): “*She was about 15,*” L2: “*It was the man’s fault,*” and L3: “*She was part to blame as she did not scream, she did not cry for help.*” And to the teacher’s question, “*where is your human dignity?*” L3 responded: “*She was not forced, she wanted to take part so she gave consent.*” In the classroom practice, the teacher provided **resourceful facilitation** (as a theme of teachers’ understanding).

Through this teacher understanding, we mean the enabling or aiding of learners’ exploration of ideas, and problems, and participating in individual or group interaction with ideas relevant to the meaning making co-action and democratic spaces. The teacher, as an available resource to his or her collaborating learners, placed herself to provide just-in-time needed information and guidance to the learners in order for them to “always act by means of their environment rather than simply in their environment (so that learner) achievement of agency will always result from the interplay of individual (and collaborative) efforts, available resources and contextual and structural factors as they come together in particular and, in a sense, always unique situations (Biesta and Tedder, 2007, p. 137). Working in this way, “teachers will increasingly be called upon to switch roles from soloist to accompanist, helping students find, organize and manage knowledge, guiding their minds rather than moulding them” (Bélisle, 1997. p 24). Teacher G talked about being an available resource and guide on the side in, “*that they would perform according to the input that I made.*” In order to do this in the classroom, she posited that learners should always speak with honesty to express their own lived experiences based on what they actually know and what they have rehearsed in class. This can be seen when she says that, “*they be honest, able to say what is on their mind, and are able to speak off the cuff, able to be confident and go through the process and experience exactly what they did. Talk about the reason they did the topic and what is happening in their lives.*” Her argument for doing it in this manner was that they were thus afforded a platform to share their own lived experiences before an audience: “*it is that they get an opportunity to say what is affecting them the most.*”

The teacher related the incident to the learners’ own lives by stating,

“If you are under 15 it means you cannot have a boyfriend, and you cannot engage in sexual activity with your boyfriend because that will be against the law. If an older person want to or

engages in sexual activity with anyone of you in this class, what does that mean? What will they be charged with? Learners: Rape. Teacher: So, even your cell phone, if you take a picture of yourself and you post it on the net, you are telling everybody this is who I am, this is my body, you want everybody to see it, this is a violation of your human dignity.”

The teacher, moving the discussion and debate forward, stated that she wanted to get a bit more personal with the learners in posing a challenging question to them regarding the violation of their human dignity. *“How many of you believe that your human rights have been violated in some way at this school? Take any one of the rights or listed principles of democracy listed on the wall. I want you to raise your hand.”*

The teacher posed challenging questions requiring learners to make particular kinds of responses, and through this, it allowed each one to show who they were, where each learner stood on a particular matter that affected him or her. On seeing that only one learner had raised her hand, the teacher used another approach to solicit a renewed and greater response and instead physically drew a line on the floor with a piece of chalk. She then asked all the learners to stand up, and go to the front of the class, and to stand on one side of the line drawn. The teacher then asked, *“If you are willing to share how your rights have been violated, then you are free to step over the line.”*

Teacher G’s goal for teaching and learning was based on *learning-centred practice* as a teacher understanding theme. The sub-theme was: practice that incorporates the affective domain, moral regeneration, social justice and inclusivity as *values in education*. In terms of how this could be done in the science classroom, she posited using learner self-awareness and consciousness on the effect and extent of the problem on their living and learning environments, and applying their minds to find reasons behind any adverse effect of the problem on themselves at home and at school. She wanted, *“learners to produce the evidence of their learning, learners to start thinking and reasoning about the things happening around them. The need for noticing and to start thinking and reasoning about the learning and living environment.”* Her argument was that learners should become conscious of the problems that affect them, and this can be seen where she indicates, *“for awareness.”*

Teacher G, talking about her other goal for the learning encounter, mentioned practice that incorporates teaching for *social justice and inclusivity*. She explained that this could be enacted in the science classroom through learner empowerment and power sharing, that is,

“Social justice, in the class there are privileged learners and I want them to know what it is like to live on the other side. I’m hoping that, by transferring the power, from the wealthy, from the rich to the poor, they (the pupils from the community at Birmingham, an informal settlement) will be able to now share their experiences, and this will allow the so-called rich to share their power of wealth as well. Here it’s about inclusivity, here it’s about social justice ... I will talk about this because there are lots of children with language barriers that must be included in the lesson. And there are children with lots of learning disabilities that must be included in the lesson. That different children have different learning styles and abilities must be included in the lesson.”

One learner again stepped forward. She then asked the learners to show some honesty, and asked, *“How many of you know that you are not honest about what I am asking you to do, but you are scared to say what you are supposed to say, take three steps forward and stand on this side of the line.”* More than half of the class responded and stepped forward. The teacher again checked with the learners, *“So this side of the line (learners) have issues, have violation of their rights”*, and in assisting them to communicate openly and to confront the truth and not to be scared in voicing the violation of their rights in the classroom, the teacher asked them to reflect on the activity, and said, *“Reflect on the reason for being scared the first time you were asked to indicate that you had issues, yet in the other (first) activity you demonstrated and admitted that you were scared that you had issues.”*

At this stage of the learning encounter, the learners gained confidence in their own ability to communicate with this particular teacher at the school in the way that she involved them in real issues that affected them. They were better able to express their own voices as evidenced by these comments - L1: *“I was scared to tell the truth because others were going to laugh, the other learners in the class were going to judge me,”* and why they were not scared of the teacher - L2: *“Because you will not tell other teachers about what we saying. Because, ma’am, you said in this class we must trust each other.”* The teacher’s understanding of practice, namely **authentic space**, required the creation of the appropriate teaching and learning environments that recognise the diversity that exists amongst learners in the classroom. Such a space is also intended to bridge the divide between school learning, and learners’ real-life learning experiences. Teacher G’s practice, with respect to transformative learning as a sub-theme of authentic space, talked about an authentic learning task: *“that this task is not just a simple academic task, the task is something that is related to life.”* Her understanding was that the task was to have an impact on the learners’ lives as they have a choice in matters that affect

them, that is, *“the task is something that will impact in the future of their own lives. It will impact in such a way that, by the time they get into high school, they will realise that they have a choice.”*

Her argument was that learners would be empowered in their knowledge of the social ills in their community. This can be seen in her explanation, *“they will be able to make an informed choice about taking that first drop of alcohol (and problems that affect them at school).”* Secondly, Teacher G argued that the task concerned transformative learning, *“to show that this task will be able to change them.”* She postulated a classroom practice that challenges traditional teacher-learner roles and relations in the classroom from ‘power to’ rather than ‘power over’, that is, *“change their power relations first between myself and them, in that they will now teach and I will listen, and assess.”* Her argument was that this would promote learner autonomy and authentic practice, one that is inclusive of learners’ lived experiences,

“Like there were barriers in the class, and now we removed it, at home they will use the same strategy in trying to remove the barriers, by taking that kind of power and transferring it, and find ways to solving the problems they have at home. So basically conscientizing that – the power you have in the class, you will take it at home as well because here I gave you the opportunity to challenge my authority.”

Teacher G acknowledged difference, even amongst teachers, *“As teachers we are different, there are things that I like that others do not like.”* She also enquired from the learners how they were affected by this: *“What is it that you do because of lack of trust?”* Three learners did not hesitate to respond. L3 – *“Because after school, when there is a problem in the school, everyone start laughing and they blaming this class,”* and L4 – *“Because last year we had a bad name because most of the learners didn’t want to listen to the teacher, so the teacher told the principal and he announced in assembly, and the other children know that there is too much noise from this class and that the learners don’t do their work,”* and L5 – *“Because last year we had a bad name because most of the learners didn’t want to listen to the teacher, so the teacher told the principal and he announced in assembly, and the other children know that there is too much noise from this class and that the learners don’t do their work.”* The learners’ responses to the challenging questions positioned them as ‘critiquers’ of their own learning conditions, and they used the pronoun “we” to maintain the learning community storyline, and maintain the teacher (with learners) as change agent of the storyline.

The teacher spoke in a softer, measured and reassuring tone of voice with her class of 35 learners in stating the following,

“So, we spoke about human rights, which rights of yours were violated, and do not use names of people involved or teachers’ names. We want to address the problem in general, so you are not doing it for me because I am a good teacher. We said this year we want to focus on this problem this year, and whatever we do for our class we are doing it for the other class as well. So you could be creating something that will last forever. When you leave the school at the end of the year and you go to high school, whatever you leave behind, the others are being pushed. So we want everyone to heal, and for everyone to understand each other, for all the teachers to understand the children and for the children to understand the teachers so that everyone can learn. We do not want to write people off. So, what issues of democracy do you think are being violated? (Pointing to where the concept democracy is pasted on the wall, see picture below).

Teacher G’s repeated use of the pronoun ‘we’ positioned the learners and herself as a learning community that has the potential to create something that is good for the class, as well as others in the school. Teacher G’s use of verbs in the above measured and reassuring tone of voice, verbs whose associated processes are largely material and verbal processes, signals action and talking being entered into by members of the learning community. This time, the teacher directed her question to a specific learner, calling her by name.



Figure 9.3 Visual, colour enhanced, on the wall depiction of the concept of democracy and its associated principles and values (non-racism, respect, non-discrimination, equality, freedom of speech, Ubuntu, non-judgemental, sharing ideas, open communication, human dignity).

The learner responded - L1: *“Everyone starts labelling this class.* L2 – *“We had a bad name last year”* and L3 – *“The class did not do all their work.”* L4 – *“The problem is the children were not behaving.”* The learners were not the only ones who were behaving badly, as indicated by L6 in speaking about teachers: *“They called the children bad names, like black sausage.”* Other learners added to this comment in mentioning other hurtful comments, which

included words such as “*moron, stupid children, black people don’t have names, you stay in a zoo, go back to the Black schools, you are failures, you were born in the bushes, and teachers having favourites.*”

A learner elaborated on the term “*favourites*” by stating, L5 – “*The teacher named the children that she thought were nice, and ignored those who she did not like, the teacher worked with Indian children and attention was given to them because the teacher could not handle all of us and the behavioural problems, and the rest of us she called us to class during break to explain the work to us.*” For the teacher, the principles of democracy were to ensure that all learners learn, as “*all can learn. You are capable of learning just like everybody else,*” she also felt that it was the role of the school to ensure that this happened to help “*the learners to understand each other and the other teachers to understand the learners.*” The teacher viewed the situation described above as a problem, and concluded the learning encounter, which intended to involve the learners from the beginning, by intimating,

“What we said this year is that we don’t want to take this out of the class [...] and we are going to do something about this problem. So we will start out and find out what these problems are whether these problems are in your class or whether these problems are in the other class. So, not to create any hatred, so it means whatever we spoke about, there is lots of trust, let’s keep it here and work on it together. Let’s not take it out of the class and cause further hatred, anger, and animosity as it will get you nowhere, and then you are going to have a problem. So you are going to be responsible for all the information that we have, we are going to sit together, we are going to work with that, and that information you are going to see it coming up in the photographs and the cartoons.”

It appears that this teacher’s strategy in this learning encounter was to integrate language learning as a basis for science learning and vice versa, and that a solid foundation in language was seen as the building blocks for science and further learning, which “*every learner is capable of [doing]*”. In light of the above actions and comments, particularly by Teacher G, a unique kind of solidarity and bonding was established and consolidated between her and the learners, one that is embedded in, according to her, “*trust, confidentiality, human dignity, non-sexism, non-discrimination and open communication.*”

Gleaning information from what Teacher G did with her learners, it appears that she virtually immersed their co-established learning community into an alternative form of teacher practice, one requiring each learner to encounter learning as action, particularly within the

learning encounters that were to follow the initial one. The other three participants chose the usual approach in which the network members introduce themselves and allow the learners to choose the topic, identify possible sources of information on the chosen topic, and to prepare ways to access relevant information. It could be that Teacher G was not simply just enacting her unusual practice as an ‘arranged situation’, but she did what she wanted to do as part of building a close working and educational relationship with her learners when she stated, “*We said this year we want to focus on this problem this year, and whatever we do for our class we are doing it for the other class as well. So you could be creating something that will last forever.*”

9.2. LEARNERS AFFORDED A PROJECT-BASED SCIENCE LEARNING OPPORTUNITY TO ‘ACT’ AND SHARE POWER IN THE SERVICE OF SOCIAL JUSTICE

In this section, I return to what Teacher G, and the other participants, actually did with their learners, how they enacted an unusual practice, and the reasons they gave for doing what they actually did. The data from the post-lesson interviews, and data from the focus group interviews were used to write the narrative. This data is based on those incidents which the teachers each identified and selected to explain what they did when enacting an unusual science practice.

The teacher (Teacher G’s enactment as the focus of this section) was free to select a number of incidents from each learning encounter, and because of this freedom to select, one or more incidents were then selected for the narrative written below. This selection was based on the relevant data to help me in answering research question 2 of the study, as articulated at the beginning of this section. Strauss and Corbin (1998) posit that “conditions are a conceptual way of grouping answers to the questions why, where, how come, and when” (p. 128). These authors find that there are three such conditions, namely, causal, intervening and contextual, arguing that the importance of these conditions lies in “the interweaving of events (or conditions) leading up to the problem, an issue, or a happening to which persons are responding through some form of action/interaction, with some sort of consequences” (p. 132). I reduced the teachers’ data below in terms of the *What*, *How*, and *Why*. I then began the exercise of reading each incident that the participants selected in the post-lesson interviews with the intention of identifying concepts, phrases or segments that were consistent with each of the four dimension of teacher practice. Units were formed where the concepts or phrases identified

were to be related to the *What* aspect of teacher practice. Teachers' responses to the *How* and *Why* had a bearing on the *What*, and if viewed in isolation, would not keep the coherence of the teacher's response. The units, formed in this way, were used to form two sub-units in order to label the participants' responses as either traditional or unusual practice.

9.2.1. Results: Narrative on Teacher G's responses to RQ 2

The purpose of this section was to unite, categorise and establish categories in order to interpret the responses made by Teacher G with regard to what she actually did. The purpose was also to do this for the reasons that she gave for what she did in enacting an unusual practice in her science classroom. As discussed in Chapter 7 (Table 7.1), there are four categories that were identified in the teachers' enactment of their practice. The respective number of category variations that exist under each of the four categories listed below are firstly individually defined, and then individually presented and interpreted. The data contained in each of the respective categories identified are driven by the participants' responses.

Category 1: Looking at science learning as response (pedagogy of response)

The essence of this category requires that the school, its leaders, and classroom practitioners take responsibility for two educational requirements. It requires, firstly, an educational environment where learners have a real opportunity to 'begin', and to take initiative. Secondly, it requires an educational environment that is not exclusively focused on the reproduction of subject matter in the curriculum, but rather one that allows learners to respond in their own and unique ways to the learning opportunities provided by the school curriculum. This requires that the work of the science teacher creates a *democratic space* that affords an opportunity for each learner to make particular kinds of responses to the curriculum offered by the school and the teacher. This category is constituted by five variations, namely, learner participation, action learning, participative mediation, learning centred practice, and differentiated learning.

Variation 1: Learner participation

In this variation, there are three variations, namely, the notion of action learning within three key contexts, viz. a democratic space, problem based learning, and inquiry based learning. Action learning asks the question, what kind of school do we want so that learners can 'act'? This calls for real opportunity for learners to take initiative, and to respond in their own unique ways to the learning opportunities provided to them. The question on action and democratic

subjectivity concerns how much learner action is possible in schools through learners being with others - action that is not only afforded to the learners in the school, but action that extends to society at large and becomes a life-long process.

Teacher G's idea of enactment in this sub-category was based on the notion of action learning within a space that is underpinned by democratic principles, and by using practice mediating tools used to promote action learning. My notes detail that, *Teaching practice is based on "respect, being non-judgemental, non-discrimination, non-sexism and respect for human dignity". Teacher uses newspaper clippings as visual and persuasive tools to invite learner participation in issues linked to learners' lives, and issues that affect them. The teacher used this first session with 35 Black learners from the nearby informal settlement, and 5 Indian learners. This Grade 7 class, which was in an Indian school, was labelled as very poor performers who were "lazy, very noisy and don't do their work" and "the teachers called us names, stupid children, you are failures, go back to Black schools". Their human dignity was violated, the teacher wanted to restore that – "we want everyone to heel, for all the teachers to understand the children and vice versa, so that everyone can learn"* (LE1, observation data, criterion 1). Her reason for this was,

"In terms of democratic values, you do not humiliate the child who cannot do what you asked them to do. That comes in very strongly, especially in teaching and learning [with] children of different backgrounds, with learning barriers, with learning disabilities, treat them with human dignity. It is very, very important, because if you do not treat them with human dignity and do not respect their mother tongue, that is a violation of our constitution (LE1, post-lesson interview, incident 4).

Teacher G, in terms of problem-based learning, viewed action learning as classroom practice that affords learners the opportunity to choose a project work topic, which promotes a classroom environment for dialogic relationships that enable learners to take the risk in constructing something new out of the problem at hand. This can be seen in my observational notes where, *Learners were afforded opportunity to choose a topic, and for each one to vote for his or her favourite one between two (alcoholism or language problem), they chose the first one, as an issue that affected them in their daily real life experiences in the community and at school. Teaching style created affordances for respectful and dialogic and conversational relations* (LE2, observation data, criterion 1). For her, the reason for working in this way was,

"To handle any problem of society, or any problem that pertains to social justice – it has to be interactive. And the information has to come from the children. The children need to experience

it, they need to reflect on it, and the need to give a feedback about what is going on (LE1, post-lesson interview, incident 1). If you give them the opportunity to speak up in the front like this here, they take pride in their culture, their heritage and their self-esteem. So here it's not just about the lesson, it's about developing one's self-esteem, being proud of your culture, and being able to say what you want to say in your mother tongue (LE2, post-lesson interview, incident 4).

Learning environments must be conducive to teaching and learning, and must ensure that learners feel safe before any learning can occur (Howard, 1994; Jensen, 1998).

Variation 2: Participative mediation

Teacher G enacted participative mediation as a classroom practice through the use of a teaching and learning tool that promoted active and sustained learner participation. The tool used created affordances for learners to take risks and initiative so that they could act and create something new as they engaged in inquiry-based learning. This is evident in my observation as, *Learner involvement enabled them to use investigation instruments to collect data from the local community on the problem. Teacher employed teaching and learning tools (mind-map, jig-saw) that promote active learning. The tools enable learners to act and listen in order to foster and maximise participation in a large class. The tool also creates affordances for learners to participate in small-scale processes that allow them to interact with each other in doing science (LE3, observation data, criterion 2).* Her reason for doing so was for learners to interactively engage in problem solving using their own information and real-life experiences of the problem. This is evident as she explained,

“To handle any problem of society, or any problem that pertains to social justice – it has to be interactive and the information has to come from the children. The children need to experience it, they need to reflect on it, and they need to give a feedback about what is going. We can say in the lesson that we are failing very badly in the science and technology part of it, and that is something we need to come up with. The describing, the analysing, the selecting – all those skills that we need to teach and inculcate. We need to talk about testing. At our school we find that these children are talking so well now fail miserably in their tests. One of the reasons they fail so miserably in their tests is that we don't teach them to differentiate, to discuss, to analyse, to sort out, to classify, to present, to perform, to define. These are all skills that we should be teaching, and we don't do that, because predict and what would happen. Whilst I was talking, all these things were coming up incidentally. But we are not focusing on that, we not giving the child a chance to learn by putting this to the child in the normal lesson. This kind of informal

lesson I'm presenting can be done where you can inculcate all of these kinds of skills (LE3, post-lesson interview, incident 1).

Teacher G again enacted participative mediation through the use of a teaching and learning tool wherein it promoted active and sustained learner participation through enabling learners to take the initiative to act and be creative. This is evident in my notes that, *The teacher uses a larger topic, learnt in previous lessons, to afford learners the opportunity to apply their knowledge in the construction of four 1m x 1.5m portfolio boards (PBs). Practice created affordances for learners to transform problematic situation that they faced in real life, giving them the opportunity to work in 4 small-group tasks wherein they were supposed to take initiative, make decisions, argue, make choices, apply different strengths and take risks in order to create a product (information board) according to the given specifications and criteria. Each small-group task worked with a given sub-title of the larger problem topic to construct their information board, which, when complete, would be joined together to form flexibly interlinked and free-standing boards to constitute a single unit on the project problem. That is, project based learning working from small group collaboration, to larger group collaboration (LE4, observation data, criterion 2). She did this to teach learners to use available resources in collaborative groups to construct artefacts using co-operative learning. This can be seen in her detailed explanation,*

“This is important because you must learn to agree eventually, for whatever the outcome is going to be, and learners must accept the outcome. The entire project has got to be done constitutionally. So, the group must go with the majority decision. The science topic, and in every aspect of life, there are values and philosophies, even within science. We are making decisions based on evidence and facts. We respect each other's point of view, and think about what is important for the majority of the people in the country. Science falls down the line if you do not address the problem of democracy in the country, there will be no space for science. First, you need to motivate the scientific issues, promote democracy, promote thinking, and addressing issues in a very rational way, and then your science can grow” (LE4, post-lesson interview, incident 2).

Teacher G employed multiple mediating devices: learners' voice, choice, and agency in order to create affordances for learners' active involvement. Formative assessment tools and colour-enhanced drawings and pictures were used to promote creative and critical thinking.

A mediating device is another name for a tool, which is any object, tool, or technology that is use to enhance performance beyond what could be done without the object, tool, or

technology (Gee, 2008a). The use of mediating devices in teacher practice promotes intersubjectivity, and hence the distribution of knowledge. The use of a mediating device was a strategic move made by the teacher to create affordance(s) for learners to ‘act’ or take initiative and in this way, bring their own unique beginnings into the world (Biesta, 2006). The mediating device affords the small-group members the chance to collaborate with others, and to negotiate meaning with others in the group. Small-group activity works well when the teacher deploys certain learners to a particular group based on their individual strengths and resourcefulness, and by assigning a particular kind of mediating device to be used by the small group to mediate meaning. The teacher called each learner by name when placing them in their respective small groups, and frequently visited each group to guide, question, prompt, probe, and scaffold their meaning-making processes within the small-group work on a particular sub-topic within the larger topic.

Teacher G made use of small-group tasks by assigning certain learners to work as a group. “Deep knowledge of one’s students as individual learners, enables educators to integrate lived experiences into the daily learning of the classroom. Drawing on students’ experiences provides teachers with the opportunity to represent their knowledge in the curriculum so it is meaningful and students see themselves reflected in the learning that takes place in the classroom” (Villegas and Lucas, 2002a). Nuangchalem (2010) argues that the “socio-scientific issues offer a way to explore the nature of science, bridge student and scientific literacy, interdependence of science and the society movement, and democratizing science in society” (p. 36).

Variation 3: Learning centred practice

Teacher G’s idea of enactment in this variation was based on classroom practice underpinned by democratic principles and teacher-learner trust relations that afforded the learners a chance to take initiative, voice self-inflicted doubt, and to engage in teacher-learner reflection on obstacles to their ability to act. The ability of a learner to act, or not to act, is viewed as the outcomes of the learning process.

This is evident in the observation as, *Teacher practice affords the learners the opportunity to try out her presentation skills in the classroom before her peers. The learner, who is assigned by the teacher, and her small-group task peers do so in preparation for the upcoming showcase before an authentic audience. She previously had an opportunity to talk in the school assembly, worked on the problem sub-topic, and participated regularly with a*

group in the construction of the board depicting the problem with information she was to present. Here, she took the initiative to stand in front of the class, started with trying to present, and then struggled initially to begin. The respectful and trusting teacher-learner relation freed her to express her self-imposed internal constraints, and external constraint of the use of a hand-held paper as a guide and cue card, which she may use and read when needed, and then talk – which seemingly came in the way of her doing a presentation (LE 5, observation data, criterion 1). Teacher G understood that that teacher practice acknowledges that learners are different or unique, and that they be afforded opportunity to find their own way of coming into presence in a public space populated by others, as well as into the possibility of difference. This can be seen when she said

“I think with children that feel, you cannot put them in a structured environment and then ask them to learn and then read and to write. These kids do things, and you want to be able to allow them to do these things in any way they can do these kinds of things. There is a lot of learning going on in the process of these kinds of action research and when you looking at the various types of media as well. These children have never been given an opportunity to work in a group as a team. To use various sources, to speak in public because they are always told you are not good enough to do this, so just give the others a chance. These are the little gems that are sitting in your class, and I think it is important in that our future leaders are sitting in the classroom that we can’t see, because we are looking for the perfect situation, and the perfect response and a perfect outcome, but it’s not that way. These kids are perfect in their own way, all you have got to do is to know where they are coming from, and try to get it out. And I think that is what this project could show that these learners could not do much before, and now they could speak. So these children were given a chance” (LE5, post-lesson interview, incident 1).

With respect to literacy in science that is linked to social justice and learners’ interests, according to Kyle (2010), “Learners must be engaged in meaningful ways to facilitate their ability to conceptualise and apply constructed knowledge to new situations, contexts or decisions that as citizens they may require to make in the future, and, through a holistic learning process, learners are able to envision meaningful connections between life world experiences and the culture of science” (p. 8). In Gilbert’s (2006) words, discussions and interactions play an essential role in classroom pedagogy, which provides important avenues for student input. This is promotes students being vested in the class content, as opposed to alienating them from it. The teacher’s co-constructing and co-learner role is key when we consider how this notion of equality can lessen students’ sense of marginalisation, which can positively impact their identity formation and subsequent success in school science (Brickhouse and Potter, 2001).

This levelling was essential in creating a safe place for learners to share power, and a space in which to discuss difficult issues (Gilbert, 2006; McGregor, 2003). In the above segment, the teacher did not contribute much, and constructed a stance of “not-knowing”, which privileges the learners’ knowledge, and in this way achieves the goal of *extracting the information* from the learners’ experiences of the problem (on alcoholism in this case) (Béres, 2008).

Variation 4: Differentiated learning

Teacher G’s idea of enactment in this variation was based on small-group tasks, which required the learners to participate in real small scale collaborative action in problem solving. In so doing, the learners had the opportunity to cross discipline boundaries to explore their creativity and to create meaning using their unique learning styles or strengths (English language, Arts and Culture, Natural Science, Life Orientation). My notes detail that, *The teacher used a tool to foster total learner participation (jig-saw). Larger topic/problem is broken down into “puzzle” shaped pieces with sub-topic inscribed on each. Method was used to scaffold learning process as small groups of 4 to 5 learners were working on their own sub-task by infusing science learning with English, and Arts and Culture subjects. Eight sub-task groups were constituted, and promoted differentiated learning: do a drama on alcohol related domestic violence; role play (facts about alcohol); cartoon analysis (alcohol abuse); critique newspaper advert on sale of alcohol; comment on media article on ‘Name & shame’ drunk drivers; do a rap-song on anything that troubles you about alcohol; tell and report on results of the survey on problems in the community caused by alcoholism (LE3, observation data, criterion 3).*

She explained that,

“In order to place learners into groups I have to know the ability of my learners. I have to put them into groups of their own abilities. And I have to set the work to suit the child to the learning style. And then they will produce the fruits of my labour. There is a lot of planning and a lot of common sense of the teacher. The teacher has to know the child. The material relevant to this topic has been identified by the learners in the newspaper” (LE2/3, post-lesson interview).

Teacher G used her knowledge of each learners’ abilities and unique learning strengths to translate written text into other forms of textual or diagrammatic form to create new meaning through their recognition of the affordances presented or created by them using each available tool (Gee, 2008a).

Category 2: Seeing the science discipline as context-driven

Science as context-driven practice requires that school classroom practice, or the curriculum, be based on local contextual problems as the starting point for learner critical reflection and action. Learners, in this category, were given the opportunity to co-design meaningful learning experiences that are connected to daily life, and to other subject disciplines. It was also aimed at empowering the learners to think and act critically so that they could transform their living conditions. Science as multi-disciplinary, alternatively, creates opportunities for the learner to see learning as more than just being compartmentalised or subject-specific. Learning encounters should enable learners to move across discipline borders in an unforced way.

This theme was constituted by two variations, namely, socially just practice, and multi-disciplinary practice.

Variation 1: Socially just practice

The teacher acted as a ‘critiquer’ of the role and responsibility of the learners’ parents regarding their general health, safety and academic performance with respect to the problem of alcoholism in the community, and parents’ apparent lack of understanding of the problem of foetal alcohol syndrome as a condition affecting learner academic performance. Some parents in the community had been positioned by the learners as negligent in giving their children alcohol. The teacher was also concerned that other teachers had written these children off as useless. She understood that these were the educational matters that needed to be addressed for improved learner involvement, and improved learning gains for her learners.

With Teacher G, her enactment in this variation, namely, multi-disciplinary practice, showed that her classroom practice enabled learners to cross discipline boundaries in their knowledge creation processes as they used own unique learning strengths to translate written texts into other forms to create new meaning through the use of, *inter alia*, diagrams, graphs and mind-maps. I noted that, *The project based learning approach afforded learners to work across discipline boundaries: Arts and Culture, Design and Technology, drawing graphs to represent mathematical information, writing summaries and reports* (LE4, observation data, criterion 3). Her reason for enacting practice in this way was for learners to reach an agreement through “*democratic decision making*” so that “*learners must accept the outcome*”, and the problem “*has got to be done constitutionally*”. She further stated,

“This lesson started off with learners working in isolation, now we moving to camaraderie, a spirit of Ubuntu to protect people’s rights, everyone having a say to not just talking on alcoholism, but about life itself, to what one can do to assist others with learning. This is important because you must learn to agree eventually, for whatever the outcome is going to be, and learners must accept the outcome. The entire project has got to be done constitutionally” (LE 4, incident 2, post-lesson interview).

In another teacher observed learning encounter, Teacher G’s socially just practice was intended to remove barriers and create conditions for learning. Teacher G used her unusual practice, including her reflective positioning as a socially just and knowledgeable teacher, to deal with an aspect of a local community problem as chosen by the learners, namely, *foetal alcohol syndrome affecting practice*. She acted as a ‘critiquer’ of the ineffective laws and regulations pertaining to the sale and use of alcohol in order to provide appropriate and authentic learning and classroom experiences. The purpose of working in this way was so that she could deal with the challenge whereby learners, as “*unable or poor English language speakers,*” were afforded the opportunity to regain their own voice with a view to addressing this issue through greater learner agency. The students critically questioned traditional science knowledge towards a new understanding of science as a subjective, and as a collaborative and reflective process involving multiple ways of knowing (Fusco and Calabrese-Barton, 2001). Culturally responsive educators are committed to being agents of social change, ultimately working to remove barriers and creating conditions for learning that are beneficial to all learners (Ontario Ministry of Education, 2009).

From a critical science approach, teacher practice is aimed at ensuring that learners gain, firstly, personal freedom from internal constraints such as biases or lack of a skill or point of view, and secondly, that learners gain social freedom from external constraints such as oppression, exclusion, abuse of power relations and marginalisation (McGregor, 2003, p. 2). The author states that removing these limitations to freedom and daily life involves the processes of emancipation, liberation, empowerment, and transformation (McGregor, 2003).

Socially just teaching also includes the transformation of any educational structure or policy that diminishes the learners’ learning opportunities (Chubbuck, 2010).

Category 2: Multi-disciplinary practice

In this category, learners should be afforded the opportunity to co-design meaningful learning experiences that are connected to daily life, and to other subject disciplines. It is also

aimed at empowering learners to think and act critically so that they can transform their living conditions. Science as a multi-disciplinary subject shows learners that learning is not compartmentalised or subject-specific.

With Teacher G, her enactment of multi-disciplinary practice shows that her classroom practice enabled learners to cross discipline boundaries in their knowledge creation processes, as they used own unique learning strengths to translate written text into other forms to create new meaning through the use of diagrams, graphs and mind-maps: *The project based learning approach afforded learners to work across discipline boundaries: Arts and Culture, Design and technology, drawing graphs to represent mathematical information, writing summaries and reports* (LE4, observation data, criterion 3). She wanted learners to reach agreement through “*democratic decision making [that] has got to be done constitutionally.*” In her words,

“This lesson started off with learners working in isolation, now we moving to camaraderie, a spirit of Ubuntu to protect people’s rights, everyone having a say to not just talking on alcoholism, but about life itself, to what one can do to assist others with learning. This is important because you must learn to agree eventually, for whatever the outcome is going to be, and learners must accept the outcome.” (LE 4, incident 2, post-lesson interview).

According to Marks and Eilks, (2009), learners perceive school chemistry as being relevant to them because it is connected to their everyday lives, as well as to other school subjects and disciplines. Critical teaching is based on the infusion of science and democracy, and requires that learners conduct research on a problem so that they become “co-researchers with the teacher in studying their community and conditions, and their own culture”, and in this way learning becomes “interdisciplinary” (Down, 2006, p. 47). A critical science-based approach does not maintain clear subject matter boundaries (Montgomery, 2008).

Category 3: Language used as a medium to allow one to be, to bring one’s beginnings into the world

Teacher enactment of practice under this category is based on the use of language in order for science learners to “be” fully participative, to be a subject in the context of plurality and difference. In this case, the language with which the learner responds, or speaks is the one that gives the learner his or her own unique and singular voice, and is the language of responsivity and responsibility (Biesta, 2006). This category allows the learners’ voice to be expressed, respected and heard. This category is constituted by five sub-categories, namely: as

performance democracy, promoting science literacy, promoting action learning, modelling, communication to promote being, and promoting learners' voice.

Variation 1: Practice modelling

Teachers' enactment of practice under this variation of practice is such that learners are afforded the opportunity to examine best practice, and task learning expectations are communicated to each group through the use of a powerful, visual exemplar of expected performance. This is provided to foster change for improved learning gains through learner-guided co-action. Teacher G's enactment of this variation of practice was enacted where, *The teacher modelled best practice in the construction of Portfolio Boards by learners. She used a finished product constructed by a previous group. Such a visual product captured, for the learners, the essence of what needs to be done by them with the assistance and guidance of the teacher as she regularly moves around the class from group to group. The model artefact displayed is able to communicate to learners in a manner that the teachers' words or language alone may achieve* (LE4, observation data, criterion 4). She did this with the aim of learner empowerment through self-directed learning, learner self-discipline and adapting to circumstances, and for learners to speak and guide as leaders,

"We (learners) have to control our behaviour and adapt to circumstances as a leader, and allow others to lead, to speak, to guide. Here, it is not me begging them to work, they are empowered to work on their own (LE4, post-lesson interview).

From improved learning gains, one can conclude that it was the teacher's pedagogy and content of the science classroom, rather than more vague notions of 'voice' and 'community' which fostered the continuing process of transformation of the learners and the teacher in the class (Gilbert, 2006).

Variation 2: Communication to promote being

Teacher enactment in this variation of practice requires that teacher practice creates opportunities for each learner as a unique individual to apply his or her learning strength and communication style in collaborative learning tasks. Learning tasks and tools enable learners to use their own voice to show where they stand, who they are as unique individuals, and to make their own contribution to the problem-solving task in being responsible and caring humans.

I noted that, *Classroom dialogic practice enabled learners to be empowered and use their own voice to challenge child abuse. Such practice enabled them to reflect on their own situations, and to share their pain caused by irresponsible parents who allowed their teenagers to take care of the younger children while they were drinking at home or away, some were left unattended, and had to go and look for food from their neighbours* (LE3, observation data, criterion 4). Her reason for enacting practice in this way was that the problem of alcohol in the community contributed to school going youths' learning problems, and impacted on their expected levels of learning achievement. This was evident when she said, *"They explained points of view, they gave their opinions, asked questions and answered questions. They also showed sensitivity to their feelings"* (LE3 incident 1, post-lesson interview). Teacher G put it differently in an earlier learning encounter by stating,

"I think it is not just the language, it's the act of speaking, and the opportunity to stand in the front and do something in your own language, is what gives a child the confidence to learn. And with this confidence, more learning can take place. They take pride in their culture, their heritage and their self-esteem. It's about developing one's self-esteem, being proud of your culture, and being able to say what you want to say in your mother tongue, and being able to co-operate with others (LE1, incident 4).

According to Basu, Barton and Clairmont (2008), the idea of agency is an integral part of learning, and learner agency is key for learner involvement in science learning. Concurring with Holland (1998), they argue that one can recognise learner agency when an individual, or group, acts on, modifies, and gives significance to the world in powerful ways with the aim of creating and/or transforming themselves and/or their living condition. From a socially-situated perspective on learning, according to the above authors, "learning science becomes 'a process of coming to be, of forging identities in activity' (Basu, Barton and Clairmont, 2008, p. 16). Based on this view of identity, agency, for them, takes on a new meaning, "we take the stance that the process of coming to be, is rich with agentic possibility." Based on own imagined practice, and self-agency, individuals "set particular goals towards which they want to direct their action". They also seek to put in motion a process that involves risk-taking because, although one might expend energy, one may not actually achieve what one had set out to do.

In terms of Gilbert's (2006) findings, the learners in this study took ownership of their science learning as a direct result of the teacher's practice. He is of the view that, "it was the teacher's pedagogy and content of the science classroom, rather than more vague notions of

‘voice’ and ‘community’ which fostered the continuing process of transformation of the learners in the class”. For him, “this happened because of particular activities the teacher had the students engage in – that enabled them to transform – once students had learned to express their opinions they then began to exercise ownership over their opinions”. He further asserts that, in his own research, learners “began to understand why they believed what they believed. This critical reflection on their own belief systems was a dramatic change for students who had never before been asked to confront what they valued and why” (p. 4).

Variation 3: Promoting learners’ voice

This variation of practice is based on the idea that teacher practice ought to promote the learners’ voice, where learners can use a language of their choice in a room populated by others, and can identify and state the nature of the problem as chosen by them.

In Teacher G’s case, *The teaching and learning space enabled a learner to communicate fluently in English as an English second language speaker. The learner was afforded space to try out her presentation skills using English to exercise her own voice. Project based learning empowered her, and her peers, to excel in presenting a real-life problem before her peers and the teacher, and to come into the world as a unique individual* (LE3, incident 1, criterion 4). Teacher G understood that teacher practice needs to acknowledge that each learner is unique, having different learning strengths and emotions regarding their involvement in learning encounters.

“I think with these children, with children that feel, you cannot put them in a structured environment and then ask them to learn and then read and to write. These kids do things, and you want to be able to allow them to do these things in any way they can do these kinds of things. There is a lot of learning going on in the process of these kinds of action. These children have never been given an opportunity to use various sources, to speak in public because they are always told you are not good enough to do this, so just give the others a chance. These kids are perfect in their own way, all you have got to do is to know where they are coming from, and try to get it out. And I think that is what this project could show that these learners could not do much before, and now they could speak. So these children were given a chance” (LE5, post-lesson interview).

From a critical science point of view, it provides freedom for alternative viewpoints to be respected and valued (Gilbert, 2006). In order for learners to begin to adopt more critical stances in the learning encounters, they first had to develop their critical ‘voice’ (Giroux, 1998)

by way of the affordances created by the teacher, who repeatedly connected the subject content to the learners' lives. The United Nations *Convention on the Rights of the Child*, Article 12, posits that a child who is capable of forming his or her own views has the right to express those views freely in all matters affecting the child.

Category 4: Viewing teaching as conscious sustained co-action

This category of teacher practice is based on the idea that teacher practice is transformative to the extent that it is relevant to the learners, employs their prior knowledge, and sustains their active involvement in activities that are co-designed in order for them to encounter learning. This category affords the teacher an opportunity to embrace learners' cultural capital through the use of unusual or innovative pedagogical practice.

This category is constituted by eight variations of practice, namely, practice driven by learners' interests, knowledge and authority; transformative practice; threaded discursive practice; teachers' power conceptualised as energy; promotion of assessment for learning; democratic practice; reflective practice; and practice promoting learner subjectivity.

Variation 1: Transformative practice

This type of practice requires that teachers' practice creates affordances for science learners to be in a position to use the knowledge gained, and for it to be applied to new situations, and in this way, promote change. The accumulation of facts or isolated bits of information or concepts during science learning encounters no longer serve as meaningful learning to learners who are to acquire a large body of science facts in their heads. Learners are required to co-construct concepts, rather than accumulate predetermined facts.

Teach G's enacted practice was underpinned by the use of past classroom practices and learners' experiences to promote change in classroom practice. This was done in order to promote access to education for all learners. This is evident when, *Learners' lived experiences shaped the learning situation. Teacher made use of learners' previous experiences in which their human dignity was violated at the school in the previous Grade* (LE1, observation data, criterion 6). She reasoned that this would boost learner interactive problem solving using their own information and real-life experiences as related to the problem. This can be seen when she says, *"To handle any problem of society, or any problem that pertains to social justice, it has to be interactive. And the information has to come from the children. The children need to experience it, they need to reflect on it, and the need to give a feedback about what is going*

on.” In terms of sustained learner action, learners’ interest is said to arise from a topic that evokes curiosity and passion. Through the use of such topics, learners tend to invest more time and energy to learn about them (Cikszentmihalyi, 1990). PBL teachers have the responsibility of explicitly soliciting learners’ interest, such as giving them the opportunity to choose a topic, to bring their own print media excerpts or cuttings, or their own drawings that are based on the subject content. When soliciting the learners’ interest in this way, they tend to participate in the learning encounter much longer (Wolfe, 2001, Sousa, 2001).

“And that cannot be done because, at the moment I am standing at the front. I’m doing a traditional lesson unfortunately, and what we want to do is take this further into the field. A lot of fieldwork and field research to be done. It (traditional lesson) had to have a little bit of structure, because we did not want to begin in a very loose structured way, because children need a little bit of structure. And to come in with structure and trace the path from a structural way, and to break it down, would be meaningful to them, because children need a safe environment to learn, and children need a structured approach to feed into. And you’ve got to provide that skeleton and that is provided there” (LE1, post-lesson interview, incident 1).

The acquisition of disconnected facts is viewed as having little or no benefit to the learner (Fedje, 1999). The focus has changed from the acquisition of isolated facts, to learners being required to make particular kinds of responses to the curriculum offered by the school. Learning is about being “able to tie one concept into the next, and trying to build on it” (Fedje, 1999, p. 13).

Variation 2: Teachers’ power conceptualised in terms of energy

Teacher practice under this variation of practice is based on the notion of teachers’ caring and democratic practice, which that fosters learner participation through the teacher expending his or her own energy. It is based on infusing classroom practice with care and ‘warmth’ to promote positivity and action on the part of the learners. Teacher enactment, or performance, of a notion of democracy enables them to use their own energy and animated positivity to project this onto their learners with the intention of empowering and animating them to act on their own so that they can take initiative to ‘act’ as well.

In this category, the participant responded in various ways on how she enacted an unusual practice. Firstly, she stated,

“Like my energy, it’s your positivity, that fact that there is always a solution, that your problem becomes a solution, that every mistake becomes a challenge, and every challenge becomes an

opportunity to learn. These are the things that you supposed to be teaching the child ... it happens in the class, so the hope you creating, and the positive energy that you creating in the class is something that they will take to their home eventually. And what happens is that at home they don't have that, what they have is just negativity. When you walk into the class, you come and accept my positive energy, and you try to keep that with you. And the more you have it, your achievement and success increases. But the less you have it in your class, right, that is when the children start failing, they don't want to try, they don't improve the expectations of their learning, they don't want to do as much as they can, because you make them feel as if they can't do it ... the flow of energy is something that is very important. It must go into the classroom climate. You must spend the whole week doing that. Now that is what you call interactive learning."

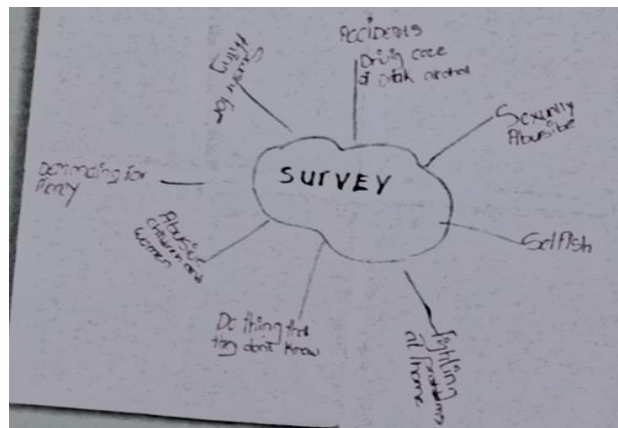


Figure 9.4 A mind map reflecting the main topic and sub-topics: swear for nothing; demanding for money; abusive – children, women; do things that they don't know; fighting at home; selfish; sexually abusive; accidents in driving because of drinking alcohol

The contents reflected in Figure 9.4 refers to what Teacher G stated, “*That is interactive learning,*” which was used for learner-learner collaboration at small-group level, and, the members of the small group used their group work to interact with the whole class. Teacher G’s notion of “*energy*” in those instances where teacher co-action with learners through project based learning drives science learning, is consistent with the notion that a project focuses your attention on a specific challenge, and concentrates your energy (Malcolm, 1992).

Teacher G’s idea of enactment under this variation of practice demonstrated how care and generosity guides interactions, and how her positive power was used to drive teaching and learning. My observation notes on this are as follows: *Teacher trusting dialogic relations with her learners affords her the opportunity to know learners’ capabilities intimately. When the*

learners hear the teacher talk about sharing that positivity, and her energy flows into her learners, and then seeing her doing it daily, then to them, theory becomes practice. Learners are freed to emulate the teacher, and learners who become positive are no longer negative about their own capabilities (LE5, observation data, criterion 5). Her reason for enacting practice in this way was that the teaching and learning space should be based on creating positive energy in the classroom that allows for the teachers' "*positive energy to flow into the lesson.*" Classroom practice that enables the learner to "*accept the teachers' positive energy*" also improves learning. (LE1, incident2):

"Like my energy, it's your positivity, that fact that there is always a solution, that your problem becomes a solution, that every mistake becomes a challenge, and every challenge becomes an opportunity to learn. So the flow of energy is something that is very important. It must go into the classroom climate. (LE1, post-lesson interview, incident 2). Here you passing the power to the children. And you need to make it a democracy, you use your own power to empower children, and empower others as well (LE2, incident 3).

According to Malcom (2008), in human relationships, notions such as generosity, vision, care, love, justice, democracy, rationality are forms of energy. The use and management of energy serves whatever purposes chosen, and in any choice has moral dimensions as the energy of generosity, love and ideology are part of social interactions (Malcom, 2008). The author holds that "In the act of power [sharing with learners], *something* is transferred. That something is energy" (p 186).

Variation 3: Promoting assessment for learning

Under this variation of practice, teacher classroom practice enables learners to get immediate feedback on their learning, or lack thereof. Formative assessment involves making judgements about the quality of learners' responses, and using those judgements immediately to guide and improve learners' understandings and skills (Roskos and Newman, 2012, p. 3, who draws from Sadler, 1989). The author argues that such an assessment concerns forming judgements frequently in the flow of instructions for the purpose of taking an active role to deliberately scaffold learning from a lower level to a higher level of learner performance.

Teacher G's enactment of such practice enabled learners to get immediate feedback on their learning, or lack thereof. In Teacher G's learning encounter, learners were afforded the opportunity to reflect on failure to begin or act, and each learner was given the opportunity to

try again under the teacher's guidance. Learner failure, and learners' successful action, are both viewed as outcomes of classroom practice. My observational notes indicate that, *Teacher practice incorporated assessment for learning. She fostered this through the use of question and answer sessions of knowledge co-construction with each small-group task. She gave immediate positive feedback for successful work done, and corrective feedback when learner work or responses or work showed little or no progress in learning gains* (LE3, observation data, other). Her reason for enacting practice in this way was that classroom practice is enshrined in policy which "*spells out so clearly what we supposed to have in a lesson*", and "*we don't do that*" because "*we are not giving the child the chance to learn*". Classroom practice should be based on the criterion referenced assessment of learners in order to assess skills and content. Assessment practice is fair when learners are given the chance to see the assessment criteria, and the expected level of performance, and to use that to guide their learning,

"You see, I have two sheets, one is the assessment sheet they have with them, relates to the arts and culture where you focusing on the skills, the skills of the cartoon. They bring out the skills they were supposed to. The other one is the English language skills in language communication. The learning outcome one, there the child is supposed to communicate the ideas with confidence and expression, which they did. They were supposed to bring out the facts and opinion, which they did. They supposed to give the sequences in oral discussion and logical arguments, which they did. It was added on to the mind-map as well. Their interactive skills, which they did. They were to take on different roles, which they did. They explained points of view, they gave their opinions, asked questions and answered questions. They also showed sensitivity to their feelings. Their oral presentation, their posture, their audibility, their body language, their confidence basically. So my sheet has all of these criteria. Each group has a copy for the learners, so basically, in one lesson, you will be able to do all of this on one sheet. I will give you a copy of this. The facts would be the information that is coming across, it doesn't only relate to the first group, the information in terms of the survey. What I will do, I will verify the data here. I would go through the information and I would see – did the children talk about what was in that particular information. So before the teacher does the assessment, I cannot do a valid piece of assessment until I go through the work first. That is why if a teacher wants to be fair, and wants it to be reliable assessment, you have to know the content before you give it to the children, and you have got to know what you gave to them. You have got to know what it is you expect of them. The children have to know what it is that is expected of them as well, so that is why we gave them these criteria sheets. So each group has the questions and suggestions, and leading assessment criteria as to what is expected of them. So, in the

presentation, they ought to have done that particular aspect (LE3, post-lesson interview, incident 1).

Criterion referenced assessment for learning is very unusual and progressivist practice (Tanner and Tanner, 1995). Such formative type of assessment provides the learner with expected standards or levels of learner performance. Such standards in science education and teaching provide on-going and real time guidance on a particular skill or cognitive demand placed on the individual learner working with small social group learning tasks. According to Marks and Eilks, (2009), learners perceive school chemistry as being relevant to them because it is connected to their everyday lives, as well as to other school subjects and disciplines.

Stobart (2009) suggests that the spirit of assessment of learning sees learning intentions and success criteria as a process of negotiation with the learners. In this way, the learners and teachers are both active in understanding what is needed. Alternatively, science education must include learner-centred pedagogy, reality-based content, and come from a holistic perspective (Gilbert, 2006). From a democratic perspective, it is best to share the assessment criteria with the learners prior to the assessment. A critical science-based approach does not maintain clear subject matter boundaries (Gilbert, 2006).

Variation 4: Democratic practice

Democratic practice utilises practice tools that afford learners an opportunity to be free from the external constraints placed on them. Learners are enabled to voice their own opinions regarding the problem, and they are to motivate why it is a problem. In this case study, the learners' peers supported the listed contributions as each learner was given a chance to state why the contribution was to be accepted.

Teacher G's notion of democratic practice was also based on classroom practice underpinned by a mural placed up against half the classroom wall. This mural was teacher-learner co-created and depicted the principles of democracy as practically done and acted out in the classroom. This is evident when, *The teacher had the word "DEMOCRACY" stuck on the wall using big cut-out letters, with learner-drawn works of art showing kids holding hands, signs, pictures, and with words that signify the principles of democracy stuck around the main word, namely: trust, human dignity, human rights, respect, non-discrimination, non-sexism, non-judgemental, equality* (LE1, observation data). She explained that,

“You see in our classroom, we already have democracy rules on the wall. And if you look at one of those walls it has the finger, and it says respect. The children use this as a sign. The sign that you always respect, so the respect is there all the time and they know that. No matter what you say, and they know that even if you slip and fall, you still show someone respect. So that respect, eh...the sign, I want you to capture the sign when you come to the class. This is the sign, it’s on the wall, that’s drawn in blue, one of the children drew it. You can see that the youth culture is coming in here as well. So you bringing in the youth culture to teach through it. So you bringing their own culture and symbols. You bringing the youth culture to teach what they know, you teach from the known. (LE1, post-lesson interview, incident 4).

According to Oswald and Moriarty (2009, p. 11), “context-relevant pedagogy that promotes active citizenship is consistent with transformative education approach, which is designed to open up democratic spaces for participatory construction of curricula and learning outcomes”. Teacher G encouraged the learners to link in their own experiences, and thus she created a “*safe democratic space*,” which honoured their knowledge (Bères, 2008). Democratic practice that is enacted in a science classroom that is intentionally built as a public space for learners ‘action’ includes the teacher’s way of inviting learners to participate in debates that foster purposeful science teaching and learning conversations.

Variation 5: Promotion of reflective practice

Teacher practice, in this instance, was based on the idea that a teaching and learning space that is democratic affords the opportunity for the learner to act. The learners’ action, or inaction, was used as the basis for him or her to reflect thereupon, and on the basis of the resultant outcome, this created affordances for both the teachers and the learners to increase their own chances for successful action and/or learning.

Teacher G believed that the teaching and learning space should be created to afford her to enact or use her performance democracy to enable each learner to act and be a subject in the presence of others. *With reference to Mbuli, a learner who was able to act, the classroom practice, and democratic space created for her to act, enabled her to be a subject, and to come into presence, in a disjunctive space* (LE5, observation data, incident 7). Teacher G expressed that,

“These kids are perfect in their own way, all you have got to do is to know where they are coming from, and try to get it out. And I think that is what this project could show that these

learners could not do much before, and now they could speak. So these children were given a chance (to co-reflect with the teacher) (LE5, post-lesson interview).

Formative assessment practice complements the assessment of learning, and is not in competition with it as it enables learning, while the other measures learning (Clarke, 2005). Clarke posits that there are four elements of assessment of learning, namely, sharing learning goals, strategic questioning, effective feedback, and self-assessment and peer-assessment. Immediate feedback requires that the learner who is given just-in-time feedback is afforded the opportunity to be a subject through the teachers' prompting and probing dialogic questioning. This allows the learners to engage in self-reflection in the co-construction of learning practice. Such teacher-learner co-reflection is intended for the learner to perform at an improved or higher level. The learning that takes place from the learners' inability to 'act' is likely to be far more important than his or her successful 'action'. It becomes necessary for learners to be afforded the opportunity to 'act' and for them to make mistakes, which enables them to learn more.

In a related learning encounter, Teacher G stated that teachers, including herself, should reflect on their practice in order to, firstly, assist learners to reflect on their learning, and secondly, for the teacher to self-regulate and conduct on-going self-development within each learning and teaching encounter. This would improve the learning gains of each learner through the process of self-critiquing. She supported this by saying,

“Whatever we do, I think we need to reflect back – why is it important to your life? Why is it that we are teaching you this particular thing? And, what impact is it to have in your own life? – bring that about. It is because the information is not contextual to them and relevant to their lives. I think our teachers need to do that all the time, to keep on reminding of the relevance of the education they are learning. Then we won't have children turning away from schooling.”

Teachers have the responsibility of explicitly soliciting learners' interest, such as giving them the opportunity to choose a topic, to bring their own print media excerpts or cuttings, or own drawings that are based on the subject content. This teacher had unique way to brighten up her “*democratic space (from the focus group interview data),*” when she responded,

“The colour in your class – have areas where you know that certain things will happen. Have space, that is your learning space – I feel your energy must flow in and flow out of the lesson. So have that space, and have a flexible environment, where, today you in this group, tomorrow you in that group. Keep on changing it because we do not want people getting bored, and sitting

in one place all the time. You know, different groups, paired work, three or four in a group, sometimes individually, sometimes.

Her reason for this innovation was, “you can’t always have them sitting in one place all the time, that will kill your lesson. So you keep on changing. As soon as they get tired, getting bored – change, use another strategy to teach. And if you do this all the time, that is how you sustain the interest of the children in your classroom.” Teacher G positioned herself as a constructor of learners’-interest teaching experiences, and maintained that the teachers’ energy should be infused in practice storyline. For her, colour had a role to play in learning, “colour is energy, colour makes learners create and think, and her reason is that, “the cartoon, let’s look at the cartoon. Now this is what I was saying about colour, this colour is energy, this is the colour that makes them create, that makes them think.” Teacher G reinforced the affordance created by the use of mediating devices that were colour-enhanced, which maintained the mediating device storyline. Such interest-generating and colourful mediating devices have the power to draw in even very quiet learners who have a learning inhibition,

“This learner (viewing the cartoon on the overhead projector in front of the classroom, doing a role-play involving 3 learners) is very quiet, with the learning disability, but he is talking and is confident here, and he can’t even see that there. He is leaning forward and he is talking ... So the jig-saw is not about the lesson, the jig-saw is about the lessons, it’s about people, it’s about your right to learn. And it’s about the inter-relationship with everything. With democracy, with principles applied in the classroom, how they are going to talk about it, how they going to challenge, how they going to criticize. If you look at the policy document it’s all in there.”

The teachers’ response that, “*they are engaged, they would rather have her and listen from a peer, than listen from the teacher,*” is an indication of the value and power of change, and reinforces an earlier point made in line with maintaining interest. She stated, “*So you keep on changing. As soon as they get tired, getting bored – change, use another strategy to teach.*” Having their ideas shared by their peers in a school classroom encourages others to also have such ideas, particularly if those ideas are attended to and valued intently by the teacher. Peer-guided instruction is beneficial for the peer ‘educators’ as it helps them to consolidate their knowledge and skills, and it is also good for their peers because peer teaching is able to improve learners’ conceptual learning and problem solving abilities (Slavitch and Zimbardo, 2012).

Variation 6: Practice as promotion of learner subjectivity

Teacher enactment of practice under this variation of practice comprises a teaching and learning space that is democratic and affords the opportunity for each learner to act. The learners' action, or inaction, is viewed symmetrically as outcomes of teaching and learning that flows out of teacher-learner co-action during the knowledge mediation process. Both successful action, as well as not being able to act, are used as the basis for the teacher and/or learner to reflect thereupon, and to ensure that the learners' chances for successful action or learning are maximised.

Such an approach to education gives the school a double educational responsibility, one that requires teachers to create real opportunities or learning encounters for learners. These opportunities, firstly, provide for difference – at the level of educational responsibility for each individual learner, and, secondly plurality – at the educational level of responsibility for “the world”. This requires educational practice that afford learners the chance to reach beyond their self-interest and take responsibility for what happens in the space between themselves and others, that is, a public space.

Teacher G's classroom practice was permeated with two-way rich dialogic relations wherein one learner's ideas were ‘thrown’ to the class to invite comment and for others to add to, or to differ with, that is, *Teacher practice based on “democratic decision making” afforded opportunity for learner subjectivity, and for inter-subjectivity* (LE4, observation data, criterion 7). Her reason for enacting practice in this way was the need for learners as a small-task team of 4 to 5 learners to reach agreement through “*democratic decision making.*” The problem had to be carried out based on “*the group must go with the majority decision.*” Teacher-learner co-action in science is underpinned by joint decision-making, and is based on evidence, facts, and respect for others and their views as a way to work scientifically in the classroom,

“This lesson started off with learners working in isolation, now we moving to camaraderie, a spirit of Ubuntu to protect people's rights, everyone having a say to not just talking on alcoholism, but about life itself, to what one can do to assist others with learning. This is important because you must learn to agree eventually, for whatever the outcome is going to be, and learners must accept the outcome. The science topic, and in every aspect of life, there are values and philosophies, even within science. We are making decisions based on evidence and facts. We respect each other's point of view. Science falls down the line if you do not address the problem of democracy in the country, there will be no space for science. First you need to

motivate the scientific issues, promote democracy, promote thinking, and addressing issues in a very rational way, and then your science can grow (LE4, post-lesson interview, incident 2).

The essence of this theme requires that the school, its leaders, and classroom practitioners take responsibility for two educational requirements. Firstly, it concerns an educational environment where learners have a real opportunity to ‘begin’ to take initiative. Secondly, it requires an educational environment that is not exclusively focused on the reproduction of subject matter in the curriculum, but rather one that allows learners to respond in their own unique ways to the learning opportunities provided by the school curriculum. This implies that the work of the science teacher is to create a *democratic space* that affords an opportunity for each learner to make particular kinds of responses to the curriculum offered by the school and the teacher.

Such responses are made to answer challenging questions that reveal who the learner is, where he or she stands in relation to ‘others’ on a particular topic, and not as self-expression. The teacher recounted, regarding a three person presentation after the group work, that the practice in this theme was based on, *“I focus on a language issue here. The child right at the end (Siyanda), I want her to speak in isiZulu. I want you to focus on her expression when she is talking, her face, for the first time she had a smile on her face.”*

The teacher illuminated how this occurred,

“Phumzile is talking at the moment and she is telling her the English – what it is she sees in this here, and later she passes it on to Zamani who is also quite confident in English as well. I want to focus on a language issue here. Obviously they have prepared Siyanda, they must have assisted herto present the same information in isiZulu, and I think they wrote it on a piece of paper because she was reading in isiZulu. Now this is a child that does not speak at all in the classroom. She does not make an attempt because she just came in (to a school that was previously meant for learners of Indian origin). It’s two months that she’s here now. She is coming from a different school.”

The teacher positioned Zamani and Phumzile as proficient in English and as contributors to their peers’ learning. Siyanda was positioned as lacking in English, let alone the language of science. Zamani and Phumzile were constructed as peer ‘teachers’ for Siyanda. They were also positioned as initiative taking learners in assisting Siyanda, *“I think they wrote it on a piece of paper because she was reading in isiZulu.”* She explained that she did it because,

“Now, why I say that this kind of lesson (or practice) is important especially for people like her because you have visual information. And if you notice in the first one I drew that information. I drew the body and I drew the key words there. That is for people like Siyanda. For those who can’t read and write, visual information assists them in understanding (see Figure 9.5 below).

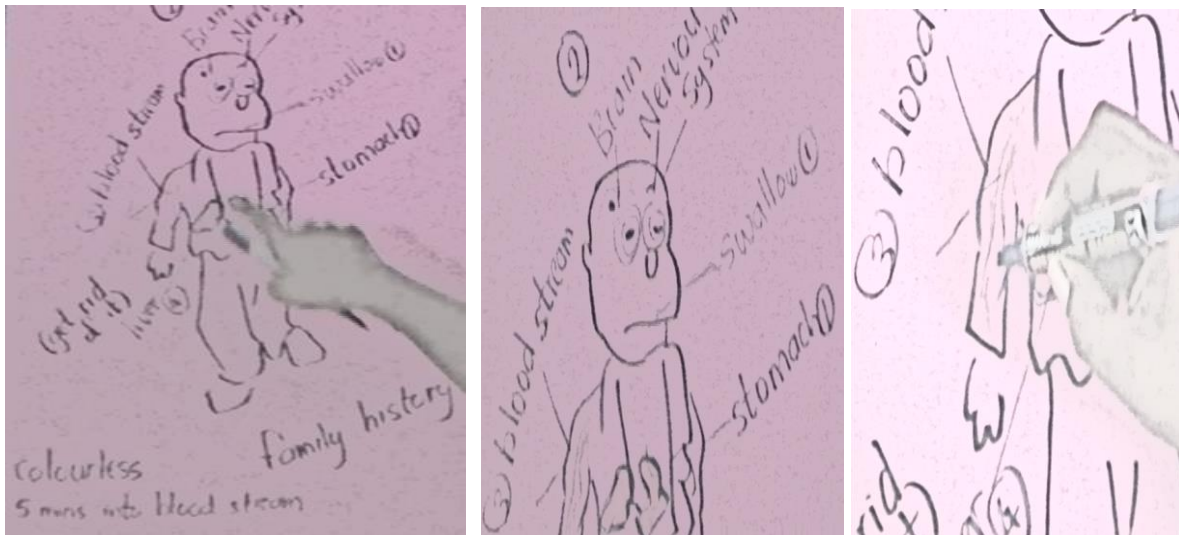


Figure 9.5 Teacher co-constructed visual and colour enhanced drawings using her own and learners’ ideas regarding the effects of alcohol on the body, and the organs and systems involved

Teacher G used the co-constructed drawing, and stated,

“So the cartoon is to help assist people like Siyanda. Here she is talking now, listen to how fluent, she is absolutely fluent in isiZulu, and confident. At first she was very afraid, but if you listen to her now, the conversation was flowing. That comes in very strongly, especially in teaching and learning [with] children of different backgrounds, with learning barriers, with learning disabilities, eh...treat them with human dignity. It is very, very important, because if you do not treat them with human dignity and do not respect their mother tongue, that is a violation of our constitution. And I think, at all times, afford them the opportunity to speak in the mother tongue. And even if it does not make sense to me, it will make sense to all the other Blacks or African children, the Zulu children in the class. They understand what’s going on with her.”

In this data segment, Teacher G positioned herself as having a ‘responsibility without knowing’, when she stated that, “even if it (isiZulu) does not make sense to me,” and she appeared to have a measure of comfort in believing that, “it will make sense to all the other

Blacks or Zulu children in the class.” Learners from whom she could get a translation on what was said and presented by Siyanda in isiZulu.

This was possible because of the *trust* that she had established with the learners on day one (Section 6.3). Under the current theme, *trust* would be ‘trust without ground’ (Biesta, 2006). In Biestian terms, and within an educational relationship, learning always begins when the learner is willing to take risks, which is not possible without ungrounded trust, otherwise there would be no need for trust. The teachers’ unusual practice, within this theme, enabled Siyanda to “appear” and to “come into the world,” as well as to “act”. She could act in the presence of ‘others’ who were different, but who *cooperated* with her, and took up her idea(s) or initiative(s) in order to also have the ability to act in their own unique way and to be a subject. This was the case when she made her presentation in a language that she was familiar with, as a unique persona (Biesta, 2006). The teacher, via the repeated use of the pronouns *she* and *her* at the start of the above extended data segment positioned Siyanda as part of the community of science learners *at this school*, and thus maintained the ‘community of science learners’ storyline.

The teacher reflected on this particular learner, and her changed participation through the affordances that her practice created for the learner to ‘act’. She proudly explained,

“Her smile, generally she is a quiet child that never says a word. And she is always looking down like this here, (indicating with her head). Now she is talking in her own language, she is upright, she is looking up and she has got a smile on her face while she is talking. I noticed that, but you will never see that and normally it’s an embarrassment for her – I can’t talk, I can’t talk. It’s the first time she’s coming to the front. She came before to read, but she could barely manage, and I told her to go and sit. In terms of democratic values, you do not humiliate the child who cannot do what you asked them to do.”

To understand what it means to be a subject, within this theme, also involves learning from those situations in which one has not been able to ‘come into the world’, in which one has experienced, for oneself, what it means to not be able to ‘act’. Such an experience of frustration could, after all, be far more significant and have a much deeper impact on the learner than the experience of successful action (Biesta, 2006). It concerns not being able to bring one’s beginnings into the social fabric of the community of science learning, or to be a subject. Teacher G emphasised,

“She (Phumzile) has got the patience to allow her to say that, but the last part she (Siyanda) could not say that, so she translated that into English. How: You see this is a kind of Ubuntu. It’s happening already with the children in this particular class. The children are relating to the other children. And notice that they are not laughing. Now whereas she thought she would come out to the front and they would start laughing. They are co-operating. You see in our classroom we already have democracy rules on the wall (see Figure 11). And if you look at one of those walls it has the finger, and it says respect. The children use this as a sign. The sign that you always respect, so the respect is there all the time and they know that. No matter what you say, and they know that even if you slip and fall, you still show someone respect.”

As soon as Siyanda gained freedom from internal constraints, *“I can’t talk, I can’t talk,”* and freedom from external constraints, *“she thought she would come out to the front and they would start laughing,”* the teacher pointed out that she *“is talking in her own language, she is upright, she is looking up and she has got a smile on her face while she is talking,”* and her peers, *“they are co-operating.”* As soon as Siyanda reclaimed her authentic voice, through the affordances created by the teacher’s *democratic space*, and her *performance democracy*, she was able to ‘appear’ and ‘act’. In this sense, ‘action’ is anything but self-expression, it is about entering the social fabric, and is therefore thoroughly relational. It is about responding to, and therefore being responsible for what and who ‘other’ (Biesta, 2006) is.

In Biestian terms, an educational relationship requires ‘responsibility without knowledge’ in that the teachers’ responsibility is less about the quality of teaching or successfully meeting needs. It is more about a responsibility, through her practice, for the subjectivity of each learner, for that which allows him or her to be a unique, singular being. This happens without knowledge because we cannot know the unique being we take responsibility for. In this data segment, Siyanda was able to ‘act’ and be a subject precisely at that moment – neither before nor thereafter, but when the other learners *“are co-operating,”* she then became a subject. Human subjectivity, and democracy, is not defined by the attributes of an individual, rather, it is based on collaborative action with others, with difference, and with disagreement. (Biesta, 2006; Kovacs and Frost, 2012). The notion of democracy infused by the teacher into her science classroom practice is based on a Biestian (2006) notion of democracy, one that is based on his conception of subjectivity, which is understood as a quality of human interaction, *“a kind of Ubuntu, children are relating to the other children, they are not laughing (at Siyanda), they are co-operating, the respect is there all the time, and the patience to allow.”*

In another incident using role-play in front of the class, the teachers' educational practice under this theme enabled another form of action,

“It’s Zamani, she did not speak much, she is looking, she is using her eyes, showing to Pauline telling her it’s her turn. So she turns her head and looks at her. (How): She (Zamani) is a very dominant child. She is very fluent in English. She is very respectful. She’s got lots of rules and regulations that she follows through. I think now she is becoming a teen and she just wants to get out of her shell. She is a very bright child, with Zamani she is a dominant child and I did not want her and Pauline to lead, she can be very boastful, can be very domineering, because whenever Pauline dominates – and Pauline needs to learn about social justice issues as well, because Pauline believes it’s her pre-ordained task to always lead.”

In this data segment, Zamani was constructed, through the teachers' choice of verbs (*looking, using, showing, telling, turns, looks, fluent, follows*) as the learner who had agency to act, and at the same time was constructed by her teacher as being patient (*did not speak, looking, turns her head and looks*) towards her “*very domineering*” peer. To respond is therefore as much about activity (about *looking, using, showing, telling, turns, looks, fluent, follows*), as it is about passivity (listening, waiting, being attentive, creating space and *looking, she is using her eyes, showing to Pauline telling her it’s her turn*). This conception of learning, namely, learning as response, is educationally more significant (Biesta, 2006).

In Biestian (2006) terms, ‘difference’ and ‘plurality’ are key concepts related to the notion of subjectivity. The teachers' educational practice enabled the learners to do the following,

“So can you see here, and this is very important, for in this class you have five Indians (learners) and the rest are African children. And here, although the children, academically they don’t perform, they are leaders in their own right. Zamani is so capable in doing what she is doing, but Pauline is dominating in this particular presentation, and I wanted Zamani to take on the role from Pauline ... because what’s happening with the African child, we notice that in all schools, even in this country, the Indian child is dominating a lot, and the reason they are progressing is they are afforded the opportunity to lead at all times. When it comes to affirmative action you will also find that they have a good command of the language and they are leading all the time, so they are progressing.”

In the above data segment, the teacher points out the two cultural groupings in her classroom learning together on a common topic and activity, highlighting some of the differences with respect to the advantages the one had over the other. On the one hand, when

positioning Pauline, the teacher ascribed this to proficiency in language, and thus associated her role with a verbal process. On the other hand, she positioned Zamani as “*capable*” and “*doing what she is doing*,” material processes that thus constructed her as having agency, and having the ability to “act” and come into the world populated by ‘others’ and ‘difference’ (Biesta, 2006). This enabled her to be a subject. Pauline, alternatively, was not assigned any material processes, and thus positioned as lacking in agency.

“What they need to do now in this country, they need to pass that role and responsibility to the child that is not empowered. To share that energy that they have, with the others ... to show that they basically need to show, again your Ubuntu spirit coming in, passing on your skills to the next person. And giving her the confidence to say, look you are capable, you can do this, now take the responsibility and do it.”

The teacher acknowledged the cultural differences that existed in her classroom, and she believed in empowering learners by sharing her power with the ‘other’, who is less empowered, through the principle of Ubuntu, which is a local value and belief system that makes sharing possible.

The teacher concluded,

“That comes in very strongly, especially in teaching and learning, children of different backgrounds, with learning barriers, with learning disabilities, eh...treat them with human dignity. It is very, very important, because if you do not treat them with human dignity and do not respect their mother tongue, that is a violation of our constitution. And I think, at all times afford them the opportunity to speak in the mother tongue. And even if it does not make sense to me, it will make sense to all the other Blacks or African children, the Zulu children in the class. They understand what’s going on with her.”

In this data segment, Teacher G positioned herself as having a ‘responsibility without knowing’. The teachers’ role in this case is understood in terms of a responsibility for the coming into the world of unique, singular beings, and a responsibility for them in this world of plurality and difference (Biesta, 2006; Kovacs and Frost, 2012).

9.3. CHAPTER CONCLUSION AND SUMMARY

This chapter dealt with two things. The first part dealt firstly with learners taking a stand in Teacher G’s directive pedagogy as an entry point. Secondly, learners were afforded a project-based science learning opportunity to ‘act’ and share power in the service of social

justice. The findings of the first research question show that there is a wide range in the depth and variation of her understanding of an alternative teacher practice. The results also reveal that her enactment of this unusual classroom practice was fully integrated into the heart of the school curriculum, which is administered by each school teacher following a set school timetable, assessment procedures, and teaching timetable. It can be concluded that Project Based Learning (PBL) creates affordances for learners to ‘act’ and to be a subject. This implies that learner involvement in their own learning requires that appropriate space be created in school learning encounters wherein learners are, *inter alia*, able to share power with others. In the next chapter (the Epilogue), I deal with the notion of exploring possibilities of an alternative practice through looking at three key dimensions, namely, reform practice, socially just practice, and communes of practice.

CHAPTER 10

EPILOGUE - EXPLORING POSSIBILITIES OF AN ALTERNATIVE PRACTICE

The purpose of this study was to explore the infusion of both critical science and a notion of democracy within school science teaching and learning, which could afford learners the opportunity for greater involvement in their own learning. Improved and sustained levels of learner involvement were aimed at countering the stranglehold of dominant teacher practice that has the effect of anaesthetising the learner, and sheltering them from their cultural and real-life, authentic learning experiences. The underlying assumption was that, through the critical theory underpinnings of the study, which focuses on the outcome, the infusion of critical science would make the process of getting to the desired outcome practical. It was also assumed that a notion of democracy would have the effect of promoting human subjectivity as a quality of human interaction.

The desired outcome was to counter the stranglehold of the market and dominant teacher practice, firstly on the learning gains of school science learners, and secondly, and particularly, on the external and internal constraints placed on the science teacher in his or her pedagogical practice. A critical science approach requires that teachers rethink and change their pedagogical practices rather than maintaining the status quo. A notion of democracy, as adopted in this study, was used to improve the human, social and pedagogical day-to-day living of the teacher and the learners in the school science classroom. These matters are important to me, as a practicing teacher, and for the members of the local network of teachers as the learner is the most important part of our work. Schools and teachers are required by education policy to create cultures and teacher practice that ensure the involvement of all learners (epistemological access) in the curriculum offered by the school (RNCS, Grades R-9, Schools; DBE, CAPS, 2011). The underlying assumption was that an alternative and appropriate teacher practice, one that is underpinned by the infusion of critical science and a notion of democracy, would serve as an effective method for uncovering the socially constructed nature of an unusual teacher practice from the participants' perspective.

In this study, I explored four teachers' unusual science practice through which they worked against the grain of dominant school practice, which largely sheltered them from their own cultural practices, as discussed in this study. I used a critical events narrative approach, including Positioning Theory, to address the research questions and identify the storylines,

positions, and speech acts evident in participants’ stories of their unusual practice. This took place within the context of a series of enacted learning encounters that were planned by the teachers with learner involvement in mind. The type of learner involvement discussed here serves to challenge the stranglehold of the dominant practice, which had the effect of anesthetising science learners in schools into passivity and obedience. When I stood back and examined the layers of research data with regard to my hypotheses on teacher practice, I was able to construct three broad storylines of teacher practice that were produced through the analysed data, as captured in the table below (Table 10.1). I used the table drawn below to show the link between the four categories of enacted teacher practice. This is done using the teachers’ understanding of practice and the variations of each from RQ 1 as a guide. The three characterisations of teacher practice, namely, reform teacher practice, communes of teacher practice, and socially-just teacher practice were used as the three pillars that characterised Teacher G’s practice.

Table 10.1 New categories formed from the combined results of the study

Research question 1 categories (as taken into consideration)	Research question 2 categories (used as a basis to explore broad storylines)	Clustered teacher practice storylines		Storylines
		Reflective positioning (positioning self).	Interactive positioning (positioning others: learners; teachers; parents)	
Independent learner	Pedagogy of response			
Independent learner who thinks	Learner participation			Reform practice storyline.
Independent learner who participates collaboratively	Action learning		Learner as part of community of science learners.	Reform practice storyline/ Communes of practice storyline
	Participative mediation	Teacher as member of general teaching community.		Reform practice storyline.
An authentic space	Learning-centred practice		Learner as part of community of science learners.	Reform practice storyline.

Research question 1 categories (as taken into consideration)	Research question 2 categories (used as a basis to explore broad storylines)	Clustered teacher practice storylines		Storylines
Contextualised learning	Differentiated learning	Teacher as member of the classroom as learning community.	Other teachers as ignoring curriculum policy.	Reform practice storyline.
Problem based learning			Learner as part of community of science learners.	
Transformative learning	Science as context-driven			
Integrated learning	Socially just practice	Teacher as member of general teaching community; Inclusive practice.	Teachers writing the learners off as useless.	Social justice storyline.
A learning-centred practice	Multi-disciplinary practice			Reform practice storyline.
Democratic practice	Utilising language as a medium	Inclusive practice		Communes of practice storyline.
Holistic practice	Performance democracy	Inclusive practice	Learner as part of community of science learners.	Communes of practice storyline.
Relevance	Promotion of scientific literacy			
Dialogic practice	Modelling			
Differentiated practice	Communication to promote 'being'.	Teacher as member of the classroom as learning community.		
Learner empowering practice	Promoting learners' voice		Learner as part of community of science learners.	
In service of "social justice and inclusivity". Incorporating the affective domain and moral regeneration	Classroom practice as conscious sustained co-action	Teacher as member of general teaching community. Inclusive practice.	Learner as part of community of science learners; parents as neglecting their children.	Social justice storyline.
Humanistic practice	Practice driven by learners' interest, knowledge, authority.	Teacher as member of general teaching community.		Communes of practice storyline.
Resourceful facilitation	Transformative practice			
Teacher as a resource and learning guide/role	Threaded discursive practice.	Teacher as member of local network of teachers.		
Participative mediation	Teachers' power conceptualised as energy.	Knowledge co-creator		

Research question 1 categories (as taken into consideration)	Research question 2 categories (used as a basis to explore broad storylines)	Clustered teacher practice storylines	Storylines
Participative mediation as a tool to enable/enhance learning	Promotion of assessment for learning.	Teacher as member of general teaching community.	
	Democratic practice	Teacher as member of local network of teachers.	Communes of practice storyline.
	Promotion of reflective practice.		
	Practice promoting learner subjectivity.	Teacher as member of local network of teachers.	

The research findings from Teacher G’s enactment of an unusual practice provided me with data through the way that she both reflectively and interactively positioned herself. I utilised the post-lesson interview data that was analysed. The four categories of teacher practice found in Chapter 8, together with the variations found in each, were used to find a set of appropriate or matching teacher enacted practice storylines. This allowed me to arrive at the three broad storylines, namely *reformed practice* (through the clustering of storylines such as: practice based on learner subjectivity and plurality – teachers’ use of a mediating device for creative and critical thinking; reformed classroom practice; curriculum compliant practice; teacher not only source of knowledge; teacher having responsibility for the learner ‘without knowing’), *communes of practice* (clustered storylines such as the teacher as member of general teaching community; ‘critiquer’ of peers not implementing curriculum policy; teacher as member of the school teaching community; learners as members of classroom learning community), and lastly, *socially just practice* (practice based on storylines like, *inter alia*, teaching for social justice; practice based on the spirit of Ubuntu; inclusive practice; parents not understanding problem of foetal alcohol syndrome) (See Table 10.1). This was done because I was theorising about teacher practice, as I had indicated that this was the phenomenon that was placed under the spotlight in this study. The data that became available to me was obtained from the analysed post-lesson interviews that were conducted. This was done by clustering the available types of teacher practice storylines. What happens, then, when a person decides to incorporate this alternative and unusual practice fully in the day-to-day mandated school curriculum, rather than trying it out as on the side or as add-on after school (like the other three participants did in this study)?

Below, I draw the readers' attention to the three key concerns of the study, namely, *ensuring the democratisation of pedagogy and pedagogical spaces, how to create affordances for learners to improve or change their own living conditions through their learning of science* (linking this to learner authority), and *how to build democratic dialogue* (link threaded dialogic discussion with exploring possibilities). Each of the three concerns, which were first raised in the Prologue of the study, are dealt with in the sections that follow. I begin by discussing the first concern listed above, and thereafter discuss the other two separately as well.

10.1. CONCERN 1 OF THE STUDY: DEMOCRATIZATION OF PEDAGOGY AND PEDAGOGICAL SPACES

In an earlier part of this study (the Prologue), my foregrounding of the democratisation of teachers' pedagogy and pedagogical spaces was characterised by the three pillars in a manner that is intended to encourage greater dialogue and 'action'. It is characterised by *reform practice, socially just practice, and as communes of practice*. Below, I discuss each of these three characterisations of teacher practice as enacted by Teacher G.

10.1.1. Pillar 1: Democratisation of pedagogy and pedagogical spaces characterised as 'reform practice'

This pillar of practice was constituted by seven categories, namely, reformed practice as connectedness; inter-disciplinary; promoting learner involvement and ownership; power-sharing through energy flow; using mediating devices as a springboard for negotiated action; culturally responsive practice as an asset; and ongoing teacher growth and development.

Category 1: Reformed practice as connectedness.

This aspect of teacher reform practice was highlighted in Teacher G's assertion that,

"We failed as a team [referring to herself and the teachers who taught using the traditional classroom practice] when we did not do what we supposed to do in other learning areas [referring to integration across other subjects]. We are teaching in vacuums, and our children cannot relate to what they are learning. Our children in this particular group, Asmila (pseudonym) is a very bright and intelligent learner, because she has not been taught to look at things broadly. For example, if you looking at alcoholism, she's just focusing on one or two things, just facts, by the way information, because this is the way we teach our children, they try to live with the knowledge."

Teachers' practice requires that the knowledge gained by science learners needs to be useful to them in new situations. The accumulation of facts or isolated bits of information or concepts is viewed as having little or no benefit to the learner (Fedje, 1999). The author asserts that learners accumulating bits of unrelated subject facts that are divorced from their own lives is no longer appropriate for today's learners, families and society (Fedje, 1999). Learning is about "being able to tie one concept into the next, and trying to build on it" (p. 13). For the teacher, the use of a real-life topic, as chosen by learners, involves extending learning beyond the classroom and the school. In her words, "In a more critical approach to education, learning to use and process information," which, according to Fedje (1999), will always be more valuable than the acquisition of mere facts. Furthermore, when a person is confronted with these ideas about facts and application, "connections begin to form between the notions of learning facts and applying facts" (p. 13). She holds that: "an error in understanding can occur if the subject decides the facts have to come before the application. In reality, as learners work with examples and apply information in collaboration with others through multiple perspective taking, they learn facts through the process of application" (p. 14).

The use of the Project Based Learning (PBL) approach afforded learners multiple exposure to the topic content. Their active involvement through discussion and interaction with the teacher and their peers enabled them to acquire their own voice, and to look introspectively at their own lives. This enables them to create empowering moments that will help them make better sense of the social world around them through the lens of science content (Gilbert, 2006).

The author asserts that this exciting potential exists within science contexts where learners and teachers co-construct a middle ground where knowledge is contested, meaning is fluid, and the learners are encouraged to delve deeply into science issues in relation to their own lives and belief systems (p. 8). Nuangchalem (2010) argues that a teaching approach based on the use of socio-scientific issues, "can make a connection between the goal of science education and student needs and fulfil them [to gain skills in] higher order thinking, discussion skills, scientific argumentation, inquiry-based learning, and understanding the nature of science" (p. 36).

Category 2: Reform practice as inter-disciplinary.

The PBL approach afforded learners the opportunity to draw relevant information from other subject disciplines, as Teacher G indicated that she integrated content across subject disciplines (practice based on integrated subjects). According to Marks and Eilks (2009),

learners perceive school chemistry as being relevant to them because it is connected to their everyday lives, as well as to other school subjects and disciplines. According to Gilbert (2006), science or health education must include four key themes: democratic classroom approaches, learner-centred pedagogy, reality-based content, and it must come from a holistic perspective (p.1).

With respect to literacy in science that is linked to social justice, according to Kyle (2010), “Learners must be engaged in meaningful ways to facilitate their ability to conceptualise and apply constructed knowledge to new situations, contexts or decisions that as citizens they may require to make in the future, and, through a holistic learning process, learners are able to envision meaningful connections between life world experiences and the culture of science” (p. 8).

Category 3: Reform practice as promoting learner involvement and ownership

Teacher G listed the critical aspects that are pertinent under this theme as learner agency, active learner involvement, the use of criterion-referenced formative assessment sheet, serves to guide learners to learn and act within the learner as part of community of science learners.

According to Basu, Barton and Clairmont (2008), the idea of agency is an integral part of learning, and learner agency is key for learner involvement in science learning. In concurring with Holland (1998), they argue that one can recognise learner agency when an individual, or group, acts upon, modifies, and gives significance to the world in powerful ways, with the aim of creating and/or transforming themselves and/or their living conditions. From a socially-situated perspective on learning, according to the above authors, “learning science becomes ‘a process of coming to be, of forging identities in activity’” (Basu, Barton and Clairmont, 2008, p. 16). Based on this view of identity, for them, agency takes on a new meaning, namely, “we take the stance that the process of coming to be, is rich with agentic possibility”, and, based on own imagined situations and self-agency, individuals “set particular goals towards which they want to direct their action.” Learners thus begin a process that involves risk-taking because, although one might expend energy, one may not actually achieve what one has set out to do.

In Gilbert’s (2006) study, the learners took ownership of their science learning as a direct result of the teachers’ practice; he holds that, “it was the teacher’s pedagogy and content

of the science classroom, rather than more vague notions of ‘voice’ and ‘community’ which fostered the continuing process of transformation of the learners in the class” (p.4).

Category 4: Reform practice as power-sharing through energy flow

Teacher G stated that teaching and learning is *interactive*, involving knowledge *co-construction* within a learning encounter where there are *knowledgeable learners* and a knowledgeable teacher. This is done through the use of both *formative* and summative assessment that uses criterion-referenced assessment instruments, including the involvement of learners as peer ‘educators’.

In this context, she positioned her learners as learners actively translating for peers in isiZulu in small-group tasks as “*one way of handling the problem of multilingualism in the classroom.*” In this sense, the teacher learnt from her own learners. As teachers, according to Brooks and Brooks (1992, p. 2), and in our role as external agents for student learning, “we have greater control over what we teach, but far less control over what (and how) students learn”. The school teacher has a greater measure of control over what he or she thinks and does with regard to classroom practice.

It is against the above backdrop that I argue for a teacher stance that is similar to that of Béres, who, in her university teaching, argues that in adopting a ‘not knowing’ stance when working with students, it privileges their knowledge and encourages dialogical interaction (Béres *et al.*, 2008). In her words, ‘not knowing’ “has also suggested tentativeness, openness to multiple truths and recognition of the fluidity of identity [...] This has resulted in honouring and useful interactions for [...] participants” (p. 1). Her reason for adopting such a stance is, *inter alia*, to counter the structure of the classroom, which suggests a hierarchical relationship between the expert teacher and passive receiving students. In countering this structure, it would encourage students to link learning to their own experiences, “*to create a better learning environment which allows for learners and teachers to practice, teach and learn in their own ways, and to make it clear to learners that the teacher was also involved in ongoing learning with learners*”. Critical teaching that is based on the infusion of science and democracy, allows learners to become “co-researchers with the teacher in studying their community and conditions, and their own culture”, and learning therefore becomes “inter-disciplinary” (Down, 2006, p. 47).

Category 5: Reform practice as using a mediating device as a springboard for negotiated action

Teacher G employed multiple mediating devices, learners' voice, choice, and agency in order to create affordances for learners' active involvement. Formative assessment tools and colour-enhanced drawings and pictures were used to promote learners' creative and critical thinking.

A mediating device is any object, tool, or technology that a learner or teacher can use to enhance performance beyond what could be done without the object, tool, or technology (Gee, 2008a). The use of mediating devices in teaching practice promotes inter-subjectivity, and hence the distribution of knowledge. The use of a mediating device is a strategic move made by the teacher to create affordance(s) for learners to 'act' or take initiative, and in this way, bring their own unique beginnings into the world (Biesta, 2006). The mediating device affords the small-group members a chance to collaborate with others, and to negotiate meaning with others in the group. Small-group activity works well when the teacher deploys certain learners to a particular group based on their individual strengths and resourcefulness, and, by assigning a particular kind of mediating device to be used by the small-group to mediate meaning. The teacher called each learner by name when placing them in their respective small-groups, and frequently visited each group to guide, question, prompt, probe, and scaffold their meaning-making processes within the small-group work on a particular sub-topic within a larger topic.

Teacher G made use of small-group tasks by assigning certain learners to work as a group. The idea is that learners and teachers are in position to learn new practices when participating with others and working with various tools and technology "in ways that help them accomplish more than they could by themselves, and that knowledge is stored in the group and its practices" (Gee, 2008a, p. 92). Such tools enable teachers to draw on learners' experiences so that this represents learners' real life experiences in the learning encounter and in this way, see themselves reflected in the learning that takes place in the classroom (Villegas and Lucas, 2002a). Nuangchalerm (2010) finds that "socio-scientific issues offer a way to explore the nature of science, bridge student and scientific literacy, interdependence of science and the society movement, and democratizing science in society" (p. 36).

Category 6: Reform through culturally responsive practice as an asset

Teacher practice should recognise that *all learners learn in different ways*, and that the learner is a critical part of teacher practice. In this way, learners are positioned as having *an active role*, and as being *the most important person* in an educational relationship. The teacher acknowledged the ‘cultural uniqueness’ of each learner, and used this in the learning encounters to create affordances for learners to ‘act’ and to learn (Brown-Jeffy and Cooper, 2011).

According to Villegas and Lucas (2002a), culturally responsive educators, “use what they know about their students to give them access to their learning” (p. 27). The teacher used her learners’ cultural uniqueness as an asset to promote learning. “The knowledge children bring to school, derived from personal and cultural experiences, is central to their learning. To overlook this resource is to deny children access to the knowledge construction process” (Villegas and Lucas, 2002a, p. 25). They further explicate that “Culturally responsive teachers have a high degree of sociocultural consciousness, hold affirming views of students of diverse backgrounds, see themselves as agents of change, understand and embrace constructivist views of learning and teaching, and know the students in their classes” (Villegas and Lucas, 2002b, p. 27). These authors posit that the main task of culturally responsive educators is to “create a classroom environment in which all students are encouraged to make sense of new ideas - that is, to construct knowledge that helps them better understand the world - rather than merely to memorize pre-digested information. One way teachers can support students’ construction of knowledge is by involving them in inquiry projects that have personal meaning to them” (p. 27).

Category 7: Reform practice as ongoing teacher growth and development

The teacher has acknowledged the need for her to learn from her own learners, “*I have found out through the children,*” including the fact that she was knowledgeable and had ways to be so, “*I have read material about this (foetal alcohol syndrome).*” Teacher G reciprocated the trust that her learners had in her, trust that was established in an earlier learning encounter (Section 7.3) when she showed trust ‘without having grounds’ to do so, when she allowed her learners to present science content in isiZulu without knowing what the learners actually said.

She also relied on those learners who could speak English to interpret what the learners said in isiZulu, again relying on her learners to give the correct version of such translations. She also afforded her English second language speaking learners to use their mother tongue to

discuss content matter in their small-group tasks. The element of risk for her was not knowing if the content being presented was actually correct as it was presented by one learner to the class of largely isiZulu speaking learners (30), and with no immediate translation into English for the few non-isiZulu speaking learners (5) in the class. This was an example of a teacher taking responsibility for the learner(s) ‘without knowing’, with respect to the educational relationship between her and the learners, an educational relationship that is acknowledged in a socio-political conception of democracy (Biesta, 2006).

This presents the teacher with another opportunity for ongoing professional development with respect to her learning of the basics of the isiZulu language from her learners. As discussed earlier (Section 9.2), Teacher G saw the need for the teacher to self-regulate and conduct ongoing self-development within each learning and teaching encounter solely for improved learning gains for each learner. This was done through the process of self-critiquing, which she supported by stating, “*whatever we do, I think we need to reflect back – why is it important to your life? Why is it that we are teaching you this particular thing? And, what impact is it to have in your own life? – bring that about.*” As professionals, teachers are expected to act as researchers and problem-solvers, reflecting on their own practice and assuming greater responsibility for their own professional development (OECD, 2004, p. 89). Environmental education, as critical education, refers to openness and uncertainty with respect to both the content and the process of learning (Kyburz-Graber (1999).

10.1.2. Pillar 2: Democratisation of pedagogy and pedagogical spaces characterised as ‘socially just practice’

This category is constituted by five categories, namely, socially just practice as making a better space for everyone; as one that is based on the spirit of Ubuntu and democracy; as science learning for social transformation; as learners sharing their energy; and as removing barriers and creating conditions for learning.

Category 1: Socially just practice as making a better space for everyone

Teacher G, merely through “*just doing it,*” seemed capable of developing knowledge and positive attitudes to inclusion or “*inclusive education.*” Inclusion is not bringing people into what already exists, it is making a new space, a better space for everyone (Dei *et al.*, 2000). This teacher made use of multiple teaching strategies to get every learner involved in authentic learning activities that were directly related to the local community problem, as identified by

the learners through the use of the jig-saw method described and employed by Teacher G. Ryan and Rottmann (2012) posit that social justice involves all aspects of education. They state that it is important to integrate social justice practices into all facets of education, including learning. On classroom learning, they assert that inclusion begins when teachers honour different ways of knowing and sources of knowledge, allow students to write and speak in their own vernacular, and employ culturally compatible communication styles. The teacher assumed an advocacy or activist role that challenges those societal-level issues by requiring policy makers at governmental level “*to intervene in terms of addressing the consumption, sale and abuse of alcohol by parents*” of school-going youth. Working in this way, the teacher’s practice embraced all key and relevant role players linked to the local community problem chosen by her learners. The teacher used and appreciated learners’ and their families’ and the community’s available ‘funds of knowledge’ (Moll, 1994) to offer each of them individual access to the science knowledge and skills needed to improve, and influence their own and their family’s real-life situation. Socially just teaching also includes the transformation of any educational structures or policies that diminish learners’ learning opportunities (Chubbuck, 2010).

Category 2: Socially just practice as based on Ubuntu and democracy

The teacher in this category positioned herself, and her unusual practice, one that was non-judgemental and compassionate, and through this, her constructor position enabled her to create a science classroom that simulated a home family unit. In such a situation, the teacher becomes *in loco parentis*, seemingly to empower her learners to counter the parents as ‘*negligent in caring for them*’. The concept of Ubuntu describes the essence of being human through other human beings, “It is a universal concept that embraces all humanity within the circle of the human race. It is a philosophy that transcends ethnic and racial boundaries, religious affiliations, ideological and political limits” (Koka, 2001, p. 11). According to Diallo (2006), the human need for social belonging, individual autonomy, and the desire to participate is universal to all human societies. Of the three aspects listed here, participation is particularly significant as without it, human life is meaningless (Diallo, 2006).

Communocracy is a socio-political concept that is, in essence and application, deeper than the Greek version of democracy, and is a concept of today and tomorrow’s global village. It contains the elements of universality and inclusiveness in its scope and operation (Koka, 2001, p. 11). The concept of African communocracy, according to Diallo (2006), makes it

possible for the characteristic of unity in life to co-exist with that of diversity in culture, beliefs and practices. Unity in life is inclusive of the diversity in human cultures, languages, habitat, socio-political, economic and production systems. Where diversity is acknowledged and accepted, inter-dependent relations were deemed necessary (Diallo, 2006). With respect to teachers becoming inclusive practitioners, according to D'Amant (2009), this requires that school pedagogical practices be grounded in politics of ethics, difference and democracy, as intended in this study. The author suggests “the recognition and acknowledgement of diversity, a respect for difference, and the right to experience a sense of belonging, and participate actively in all aspects of society without having to give up or deny one’s unique identity” (p. 22). In her view, “if an education system aligns itself with a politics of ethics, difference and democracy, education for social justice and true inclusion, schools’ policies and practices should address how schools can learn to support and respect diversity rather than suppressing and denying it” (p. 22).

Category 3: Socially just practice as science learning for social transformation

This includes the teacher as ‘critiquer’ of the learners’ parents and their roles and responsibilities, namely, that “*parents are not understanding problem of foetal alcohol syndrome as a condition affecting learner academic performance,*” and “*parents as negligent in giving children alcohol,*” including the critique that “*other teachers have written these children off.*” These are educational matters that need to be addressed for improved learner involvement and improved learning gains for her learners. Classroom practice that is attentive to learner growth is steeped in a critical and transformative philosophy, one that requires thinking-centred constructivist approaches, multiple ways for expressing content literacy and understanding, learning as a life-long process, and intellectual growth that is best nurtured in democratic contexts that value multiple perspectives (Gilbert, 2006; Henderson and Hawthorne, 2000).

These authors argue that teachers’ work must go beyond teaching learners to act and think critically, to use that critical knowledge for social transformation (Gilbert, 2006). Goals of equity and work are thus created to counteract the oppressive structures that have continually worked to marginalise diverse students in science contexts (Rodriguez, 1998). The critical science approach is about letting the learner decide what they need to know, do, and think based on what they already know (McGregor, 2003, p. 3). *School classroom practice* that is based on the infusion of science and democracy empowers learners to take on “activist” roles that enable

them “to effect change in society from the knowledge they gained” (Down, 2006, p. 47). Education and classroom practice must ensure, “that it is oriented toward the purpose of fostering critical and participatory democracy, that it enables students to change, transform, and reinvent the world they are inheriting, and that it fosters our youth’s ability to work collectively toward a better society” (Kyle, 2010, p. 12).

Category 4: Socially just practice as learners sharing their energy

The teacher positioned the learners in a new role, namely, as “*learners sharing their energy*” in the way that she shared hers with them – from one who is “*empowered to those who are not*” yet empowered. This positioning was also intended for power shifting from empowered learners “*in order to give those learners,*” who are not yet ‘unempowered’, a *chance* to ‘act’ and to ‘come into presence’ (Biesta, 2006). An outcome of the peer tutoring exercise is that it helps learners recognise the relevance of their education, and realise their own role in improving the quality of life in their communities or schools. The tutoring, and knowledgeable learners would be more effective and caring ‘teachers’ if they respected the challenges faced by their peers. Moreover, the role of the teacher would be to ensure that everyone involved understood the goals and organisation of the activities. In such a context, the teacher is required to ensure that, for mutual appreciation, peer tutors are provided with affordances to practice appropriate communication skills such as listening, probing for clarification or additional data, and encouraging others as modelled by him or her (Sparks-Langer *et al.*, 2004).

Learners sharing their knowledge in the way discussed here occurred within the “actual small-scale classroom processes and approaches” that the teacher created “to allow for students to participate in ‘doing’ critical science” (Gilbert, 2006, Abstract). In order to enact critical science, teachers and learners must be able to connect science to larger societal issues, particularly local problems, which they chose because they were affected by it in their own community, as explored in this study. Students’ thoughts, beliefs and questions serve as the starting point for scientific investigation where an underlying goal is for students to utilise this scientific knowledge to empower their own, and others’ lives (Gilbert, 2006).

Learners sharing their own knowledge with peers both promotes and enhances their own ideas for agency and identity. This is argued from a socially-situated perspective on

learning, where “learning science becomes ‘a process of coming to be, of forging identities in activity’ or ‘identities-in-practice’ (Basu, Barton and Clairmont, 2008, p. 16).

Category 5: Socially just practice as removing barriers and creating conditions for learning

Teacher G used her unusual practice, which included her reflective positioning as a socially just and knowledgeable teacher on an aspect of the local community problem chosen by the learners, namely, *foetal alcohol syndrome affecting teaching and learning*. This also positioned her as a ‘critiquer’ of *ineffective laws and regulations pertaining to the sale and use of alcohol* affecting practice. This allowed her to provide appropriate and authentic learning and classroom practices. The purpose of this teacher’s task was to deal with a particular challenge whereby learners, as *unable or poor English language speakers*, were afforded the opportunity to regain their own voice with a view to addressing this issue through greater learner agency. Students critically question traditional science knowledge in gaining a new understanding of science as a subjective, collaborative and reflective process involving multiple ways of knowing (Fusco and Calabrese-Barton, 2001). Culturally responsive educators are committed to being agents of social change, ultimately working to remove barriers and creating conditions for learning, which are beneficial for all students (Ontario Ministry of Education, 2009). From a critical science approach, teacher practice is aimed at ensuring that learners firstly, gain personal freedom from internal constraints such as biases, lack of a skill, or point of view, and secondly, that learners gain social freedom from external constraints such as oppression, exclusion, abuse of power relations and marginalisation (McGregor, 2003, p. 2). The author states that removing these limitations to freedom and daily life involves the processes of emancipation, liberation, empowerment, and transformation (McGregor, 2003).

10.1.3. Pillar 3: Democratisation of pedagogy and pedagogical spaces characterised as ‘communes of practice’

The participating teachers were all members of the local network of teachers, which may be considered as a professional learning community (DBE, Strategic Planning Framework for Teacher Education and Development in South Africa, 2011-2025). Membership to this network, as an ongoing professional teacher development structure and platform since 2003, was the basis for their recruitment as participants in this study. This local network of teachers is an example of a ‘commune’ of practice, as articulated by O’Sullivan and Rusch (2005).

Notwithstanding her membership to the local network of teachers, Teacher G positioned herself as a member of the following communes of practice: being a member of the general and school community; and being a member of the classroom as a learning community, as discussed below.

Category 1: Communes of practice as being a member of the general and school community

Teacher G positioned her reformed practice as part of two different and interlinked communes of practice. Firstly, she was a member of a general and school teaching community, in which case she positioned herself as a ‘critiquer’ of her peers, who “*are not entirely implementing curriculum policy.*” At her own school, her peers were positioned discursively as ‘other’ teachers, whose practice was not transformed. Teaching from a critical approach calls for “more equitable science teaching that challenges outdated notions of objectivity within science, and to move toward a science that critiques the larger societal structures that sustain power and dominance” (Gilbert, 2006, p. 1).

Down (2006) formulated general guidelines and practices to assist in the task of “reimagining teachers’ work in more socially-just, democratic and sustainable ways” by asserting that teachers’ work needs “to emphasize critiquing current realities and participate in the recreation of our worlds” (p. 43).

Category 2: Communes of practice as being a member of the classroom as learning community

Secondly, this teacher positioned herself as a member of ‘the classroom as a learning community’ wherein the learner is positioned as a peer *teacher*, and in other instances, the learner is positioned as capable of *learning from his or her peers*. This includes the aspect of the teacher ‘learning from her learners’. The teacher, in her ‘*we*’ relations with the science learners encouraged discussion, interaction and open communication in order to co-construct meaning with them. Discussions and interactions play an essential role in classroom practice, which provides important avenues for learners’ sustained input as this gives them a vested interest in the class content, as opposed to alienating them from it (Gilbert, 2006). According to the author, the teacher’s co-constructing and co-learner role is critical when we consider how this notion of equality can reduce learners’ sense of marginalisation. This levelling was essential in creating a *safe* place for learners in which to discuss difficult issues that were of interest to them, and that affected them in their own community. According to Gilbert (2006), teachers’ practice can create a challenging and supportive classroom environment which is seen

as a space for students to take on critical stances and question their own internalised assumptions of their real life situation. If learning is conceptualised as participation, then what is learned comprises the norms and practices of a community (Sfard, 1999). According to Diallo (2006), the human need for social belonging, individual autonomy, and the desire to participate is universal to all human societies, and participation is particularly significant as without it, human life is meaningless. To view learning as participation requires us to recognise the importance of members' social relationships in the community, which are also critical to their identity formation (Lave and Wenger, 1991). In addition, when we begin to examine the dynamics of participation in classrooms, we need to keep the teacher's long-term and short-term instructional goals in mind, as well as the students' goals.

In the examples provided in Lave and Wenger's work, we see that many individuals, beginners working with a knowledgeable person, may hold a long-term goal of becoming an expert in their field. However, in terms of the working relations between beginners and their knowledgeable master craftsmen, others (Contu and Willmott, 2003) argue that "... by mainly focusing on the relations between Community of Practice (COP) members, Lave and Wenger (1991) give too little attention to the wider institutional context" (p. 292). In this regard, Mørk *et al.* (2010) concur with Contu and Willmott (2003) in arguing that "Lave and Wenger (1991) underscore the importance of looking at the social structure of practice and its embedded power relations, but to date the contribution between continuity and displacement for newcomers and old-timers has not been a central concern in the literature (p. 575). The researchers are concerned about the historical record of COP of the treatment of 'newcomers' or novices. These researchers posit that "'Old-timers' and 'newcomers' may have conflicting stakes when it comes to access and control (of knowledge and other resources)" (p. 577). The educational relations between the teacher ('old-timer') and the learner ('newcomer') in the current dominant classroom practice, which alienates learners from their own learning, is a concern in this study as a result of unequal power relations. Therefore, the utilisation of the notion of a '*commune of practice*' is viewed as educationally more appropriate (as discussed in Chapter 2, Section 2.2.2). Below, I draw the readers' attention to the second concern of the study.

10.2. CONCERN 2 OF THE STUDY: CREATING AFFORDANCES FOR LEARNERS TO IMPROVE OR CHANGE THEIR OWN LIVING CONDITIONS

Below, I draw the readers' attention to the second concern listed earlier in this chapter, namely: *How do we create affordances for learners to improve or change their own living conditions?* Already, through the 3 pillars discussed earlier (section 1 of Epilogue), we see learners going beyond improving their living conditions, not just their own, but also the living conditions of the 'other'. Teacher G's enactment of classroom practice, as discussed in Chapter 8 (Category 4, variation 1 of practice, and variation 6 of practice), tells us that in variation 1 of practice, her **transformative practice** afforded science learners the opportunity to change their living conditions where they were able to use the knowledge gained, and apply it to new situations, and in this way, promote change. In variation 6, her **practice as promotion of learner subjectivity** was one that afforded learners the opportunities to reach beyond their self-interest and take responsibility for what happens in the space between themselves and others.

Teacher G's learners, a group of seven Grade 7 girls, took the initiative to do the 'unthinkable' in an "action" where *they showed empathy, compassion and I think, very important, is redress* to the 'other'. Teacher G argued (in the focus group meeting held for the participating teachers) that,

"In my context, remember the two classes of communities in the classroom. The school I am from, we have the two classes, the informal settlement, and the other, the affluent community. Now it's a mammoth task to get the children to understand that you need to share, because you've got a privileged school with affluent kids. There is no sharing. It's private property, but in the end, it's capitalism all the way. Sharing of information in lessons but that is as far as co-operative work goes. But that spirit of Ubuntu, of giving from yourself, you will find that with some schools, children take their lunch and throw it away in the bin when there are other children who are starving. Where teachers themselves will eat in the staff room and they bring a whole picnic basket while there will be hands waiting outside the window of children waiting for lunches to go around. So that humanistic approaches of teaching, and of serving is not everywhere. We are trying to instil in the children, the haves must try to assist the have-nots.

Teacher G related an incident in her school where learners in her class, and in the project, took it upon themselves to begin a feeding scheme on their own in order to feed lower Grade learners, Grade 1 to 3 learners from the nearby informal settlement, who did not have a

morning meal at home before coming to school. They provided these learners with porridge before the start of school in the mornings. This learner initiative was the result of the teachers' *performance democracy*. The affluent children in the school from the local community attended with the teacher the funeral of one of their class mates from the local informal settlement who had passed on. The privileged children visited an informal settlement for the first time and experienced the problems their peers had, and on return wanted to assist the hungry learners in the school by offering them a meal before the start of the first lesson of the school day. The local school community children were immersed in a totally different culture and saw first-hand how the 'other', who is different to them, lived. About seven girls in the Grade 7 class got together, and raised funds to buy the ingredients to prepare the porridge, which was boiled with milk on a low flame burner. They were assisted by a school caretaker, and made the string of hungry learners line up with their mug in hand to get their portion of porridge from the breakfast club. Teacher G explained that "*the 7 girls showed empathy for the hungry children,*" and that *the 7 girls, [were] both of African and Indian groups mixed.*"

Teacher G stated,

"We always talk about redress, affirmative action and of levelling the playing fields. Now these kids understand why. Generally these kids say this is nonsense why is the government not doing something about this. But now the learners realise that they are to be given the opportunity. So in the classroom, I said although you know and you can speak better, you have to give them a chance to act, because they never had it before. So now it means that you have to relinquish your power, and give it to somebody else. So that is something the children need to learn."

In responding to the focus group interview question: It comes back to the issue I raised earlier, that of teaching the learners to be, not only to know content, would you say this is so in this instance? Teacher G responded, "*Yes, a part of learning must transform the child, to be caring and being considerate. It is understandable in the higher schools, but like here in the primary school, to see these children transforming so early is quite commendable. These are the kinds of children that will not succumb to peer pressure, that will say no to drugs or alcohol. That will say no to sex.*"

The essence of subjectivity and "action" requires that the school, its leaders, and classroom practitioners take responsibility for two educational requirements. It requires, firstly, an educational environment where learners have real opportunity to 'begin', and to take initiative. Secondly, it requires an educational environment that is not exclusively focused on

the reproduction of subject matter in the curriculum, but rather one that allows learners to respond on their own and in their unique ways to the learning, and other fruitful opportunities provided by the school and school curriculum. This implies that the work of the science teacher is to create a *democratic space* that affords an opportunity for each learner to make particular kinds of responses to the curriculum offered by the school, and the teacher. Such responses are made to answer challenging questions that reveal who the learner is, where he or she stands in relation to the ‘other’ on a particular topic, and not as self-expression.

In Biestian terms, and within an educational relationship, learning always begins when the learner is willing to take risks, which is not possible without ungrounded trust, otherwise there would be no need for trust. The teachers’ unusual practice enabled the team of seven learners in her class to “appear”, to “come into the world” and to “act”, neither before, nor after, but only in the presence of ‘others’ who were different. This occurred when each of the seven learners *showed empathy, compassion for the other*, as a group of unique individual personas (Biesta, 2006).

Understanding what it means to be a subject involves learning from those situations in which one has not been able to ‘come into the world’, in which one has experienced, for oneself, what it means not to be able to ‘act’. Such an experience of frustration could, after all, be far more significant and have a much deeper impact on the learner than the experience of successful action (Biesta, 2006). It is about not being able to bring one’s beginnings into the social fabric of the school community, or the community of science learning, or to be a subject.

Teacher G reflected on her own learning and encounters with the ‘other’,

“I think that not coming from the community itself and living in my own comfort zone, I learnt a hell of a lot about the community, and that is not something all teachers are able to have the privilege to. And I think that as long as we are teachers, and we do not know how the other side lives, we cannot possibly teach them in the context of where they are coming from, we’ll never have the compassion and empathy, and we will teach out of context and no learning will take place in that respect.”

In Biestian terms, an educational relationship requires ‘responsibility without knowledge’ in that the teacher’s responsibility is less about the quality of teaching or successfully meeting needs. It is more about a responsibility, through her practice, for the subjectivity of each learner, for that which allows him or her to be a unique, singular being,

and it is without knowledge because we cannot know the unique being we take responsibility for.

In the case of the group of seven learners, they were able to ‘act’ and be a subject precisely at that moment, not before nor thereafter, when the other learners were *co-operating*, which allowed each one of them to become a subject. Human subjectivity, and democracy, is not defined by the attributes of an individual, rather, it is based on collaborative action with others, where difference disagreement exists (Biesta, 2006; Kovacs and Frost, 2012). The notion of democracy infused by the teacher into her science classroom practice is based on a Biestian (2006) notion of democracy, which is based on his conception of subjectivity, and which is understood as a quality of human interaction. In the next section, I address the third and last of the three concerns raised at the beginning of the Prologue, namely, *how does one build democratic dialogue?*

10.3. CONCERN 3 OF THE STUDY: BUILDING DEMOCRATIC DIALOGUE

The notion of building democratic dialogue has to do with the notion of authority. In the Prologue, Elsworth (1989) talks about the issue of authority within teaching and learning processes in the classroom. In an article entitled, *Why Doesn't this Feel Empowering? Working through the Repressive Myths of Critical Pedagogy*, Elsworth (1989) illuminates the extent to which we, as teachers, because of our ascribed status and authority, foist our beliefs, values, and pre-occupations onto our learners. This teacher practice stance goes against the current education policy, as articulated in the local Curriculum and Policy Statement (CAPS, 2011), which advances active learner involvement and critical thinking on the part of the learner. Elsworth proposes a limited role for the teacher, one consistent with the purpose of this study, namely, the building of a coalition or alliance with important others within school classroom pedagogical processes, such as, building a teacher-learner coalition.

In this study, such a ‘coalition’ was based on the building of democratic dialogue, fostering sharing through the creation of a space where disagreement, difference and otherness are promoted, and where learners as unique individuals were involved in their own learning by talking from their own perspective or voice. I also asked, how do you build democratic dialogue that removes both internal and external constraints that may prevent the science learner from reclaiming their own voice in science learning encounters that a teacher planned with learner involvement in mind?

In this study, I utilised the notions of ‘coalition’ and threaded discursive practice, or threaded discussion, within the science classroom practice. The notion of threaded discussion is linked to Becks’ (1994) insight, which informs us that a degree of authority is inevitable. Beck posits that, “much of the solution (in the teacher-student relationship) lies not in doing away with the teacher authority but in focussing on student authority as well: we need to think in terms of reciprocal authority” (p. 2). This author advances the idea of “increasingly egalitarian relations between teachers and (learners of school science) so that as far as possible the exercise of authority is reciprocal and matches the respective insights of the participants” (p. 7).

It is against the above backdrop that I link the teachers’ science classroom to the notion of possibilities wherein I argue that both teacher authority and learner authority be acknowledged and respected, and that authority be reciprocal, particularly in the presence of difference and plurality. Based on this argument, the respected and reciprocal authority is used to drive and achieve sustained threaded discussion, which is driven by learners’ interest, and the relevance of the topic to them. This argument is linked to the notion of possibilities because it is sustained by the learners themselves, and in this context, I refer to possibilities, things that were not planned, things that happened on their own when one looks at the ideas of interest and relevance because they have shown, in this study, to create possibilities.

10.4. EXPLORING THE POSSIBILITIES OF AN ALTERNATIVE PRACTICE

Exploring the possibilities of an alternative teacher practice requires imagined teaching and learning spaces that are underpinned by collaborative teacher-learner co-action. This is where power and authority are shared on a chosen topic that everyone has an interest in. Skovsmose (2011) finds that, “A feature of critical practice and research is to address not only the given situation, but (co-)imagined situations as well”, and that, “it is important to consider what could be done differently, acknowledging the constraints that condition the particular teaching-learning processes” (p. 23). The author proposes the use of an ‘imagined dialogue’ (one that did not take place) between two people, presumably a teacher and a learner, in order to explore “what could be”, using ‘explorative reasoning’ to analyse data. In this study, rather than analysing the data based on an imagined dialogue between two people, I delved into ‘imagined’ data that was a product of what occurred in the realm of the ideal or co-imagined situation. I did this while reflecting on the problems that existed in the ‘actual’ or ‘current situation’, so as to present what ‘could be’. Below, I re-employ the organising frame for

depicting an unusual teacher practice’, which was presented as a product of what the four participating teachers said about their unusual practice.

It is appropriate to elaborate on this framing at this juncture because I now have actual data on what was actually done by one of the participating teachers in the study. In this way, I could develop a fictional account of ‘what could be’, rather than ‘what is’, using an alternative and complementary visual and diagrammatic representation.

Here, I draw on Chubbuch’s (2010) metaphor of a window (p. 16) to posit the notion of a window of possibility in order to develop the above fictional account in exploring the possibilities of an alternative or unusual teacher practice. This refers to teacher practice that is an alternative to the current dominant teacher practice in schools. Where this window of possibility holds true, it “can offer/engage (the teacher) in the exploration of own agency as the teacher learns to see that history is not inevitable, that there are spaces where it can bend, change, and become (transformed), and [...] as a window will help (the teacher) see that he or she is capable of coming to be, and that as window, [it] will lead [teacher/s] to problem-pose the ordinary, taken-for-granted [dominant practice], and to envision [and enact, an alternative teacher practice]” (Chubbuch, 2010, p. 18). It is in light of this window of possibility, including the diagrammatic framing of classroom practice that is connected to real life, that the following fictional account was developed. As ‘a window’, the process of ‘coming to be’ “is rich with agentic possibility” (Basu *et al.*, 2008, p. 16).

In Figure 10.1, I present a framing of classroom practice that is connected to real life in the form of a graphical organiser.

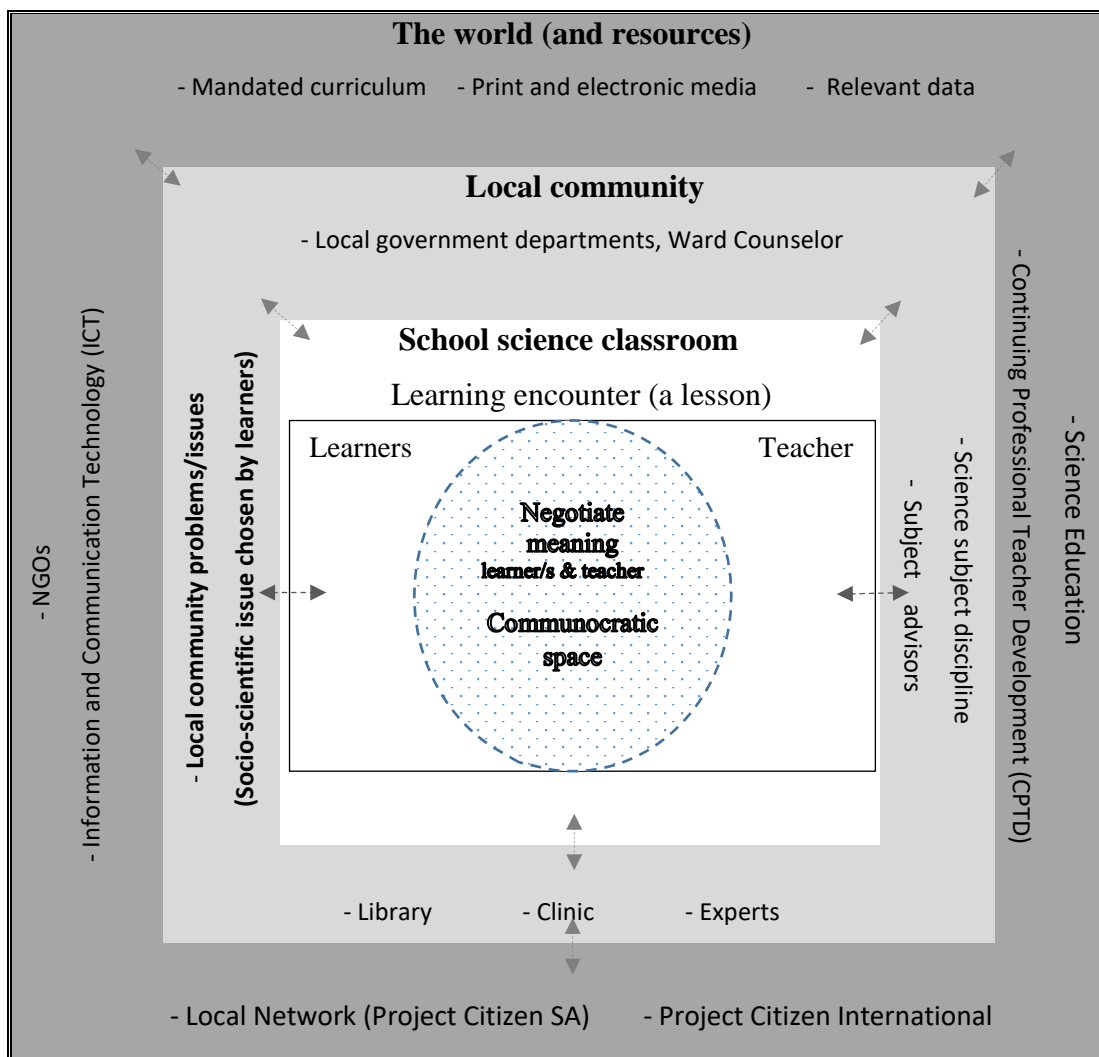


Figure 10.1 A framing of classroom practice that is connected to real life.

In the above representation (Figure 10.1) of the participants' unusual practice, the science content is located within the local community problem, which was brought into the science classroom by the learners. This content is taken from the local community context where the learners lived and where they, and the local community, were affected by the content, or learner chosen topic regarding a recurring problem or a socio-scientific issue. Members of the local network of teachers used the PBL approach, which requires that the learners in the science classroom identify, and bring to the science classroom, a local community problem that will be used as a basis for teaching and learning.

All of the problems identified by the learners in the classroom were listed on the board because each learner was free to name a community related problem, and then through deliberation, a prioritised list was drawn up. After this, the learners voted, or agreed by

consensus on one topic that would be used for PBL. The teacher's performance democracy – a notion of each performing, living, or enacting democracy during classroom practice as they had agreed to during the focus group meeting – drove the voting or the process of deliberation that took place in arriving at a single topic. The socio-scientific problem brought into the school classroom, one that was commonly known by them to exist, required that they go back to the community to establish information through interviewing local community members. They had to do this to establish that it was indeed a community problem.

The learners also gained additional knowledge on the problem and how it affected the different people who they interviewed, and in this way, they extended their knowledge of the problem. On their return to the science classroom, the learners sat and collated the community responses from the interviews conducted and the recorded responses. Learners were afforded the opportunity to analyse the completed and returned interview sheets, and to report on the findings, which proved that the problem existed. What is of importance to this study is that each learner's knowledge of the problem or topic increased greatly as a result of the data collation process in the classroom. Having access to that amount of knowledge, and living with the problem in their day-to-day experiences gave these learners the power to negotiate. Power is one of the key ingredients that is required to enter into negotiation with someone else.

With reference to the above visual and diagrammatic representation, Figure 10.1, the lightly shaded part represents the school science classroom, with the learning encounter inside it represented by the circle with a dotted line. It was in this circle that knowledge co-construction occurred through the process of negotiation between the learner(s) and the teacher. It is a democratic space created by the teacher's performance democracy, and is referred to as a Communocratic space, as discussed in Chapter 3 (Section 3.2.2).

The left-hand side of Figure 10.1 indicates the real-life context where the learner draws on his or her knowledge of the topic and content. This is also the place from which the learner draws his or her power to negotiate, take initiative, and make particular kinds of responses to the curriculum when answering challenging questions posed by the teacher on the topic. The infusion of a notion of democracy into science teaching and learning requires that learners take initiative, bring their own beginnings into presence, and be a subject. The infusion of critical science into science teaching and learning requires knowledge co-construction, and power-sharing between the learner and the teacher.

The right-hand side of Figure 10.1 above, and within the lightly shaded part, indicates the teacher and his or her power, which is, *inter alia*, by virtue of his or her knowledge of the curriculum, pedagogical content knowledge, and his or her knowledge and experience of science as a subject and discipline. The above discussion has enabled us to identify the first of two ingredients in negotiating meaning: the power to negotiate, which assisted me to answer the question: *What gives the learner the power to negotiate meaning?* This is so because, to negotiate, one has to have the power to be able to negotiate. It refers to the learners' **knowledge** of the local context, and knowledge of the recurring community problem. The second ingredient for negotiating meaning in a manner that is sustainable over a longer period of time lies in finding the answer to the question: *What drives the process of negotiating meaning between the learner and the teacher?* In other words, what keeps the process of negotiation on track, especially on the part of teacher G's class of 35 learners? It is the learners' **interest** that drives the process of negotiating meaning, and it is also a question of **relevance** of the topic. Two key concepts were identified by Teacher G. A key aspect of a critical orientation to research is the outcome, and with respect to the process of meaning making, **threaded discursive practice** or discussion is the desired outcome, and is also the answer to the question: *What sustains the meaning negotiations?*

The knowledgeable science learners may not each be an expert to the same extent of the teacher, but that they are each an authority on this particular topic, which affects them in their own real-life context. Below is a diagrammatic representation of an educational relationship that drives learning as it occurred in Teacher G's classroom (Figure 10.2). Learners' learning was driven by an educational relationship based on shared and respected, reciprocal *authority*, which empowered learner-teacher *action* which gives rise to sustained threaded discussion.

Learners' learning driven by **an educational relationship** based on shared and respected reciprocal **authority**, which empowers learner-teacher **action**. This gives rise to sustained threaded discussion.

Diagrammatically:

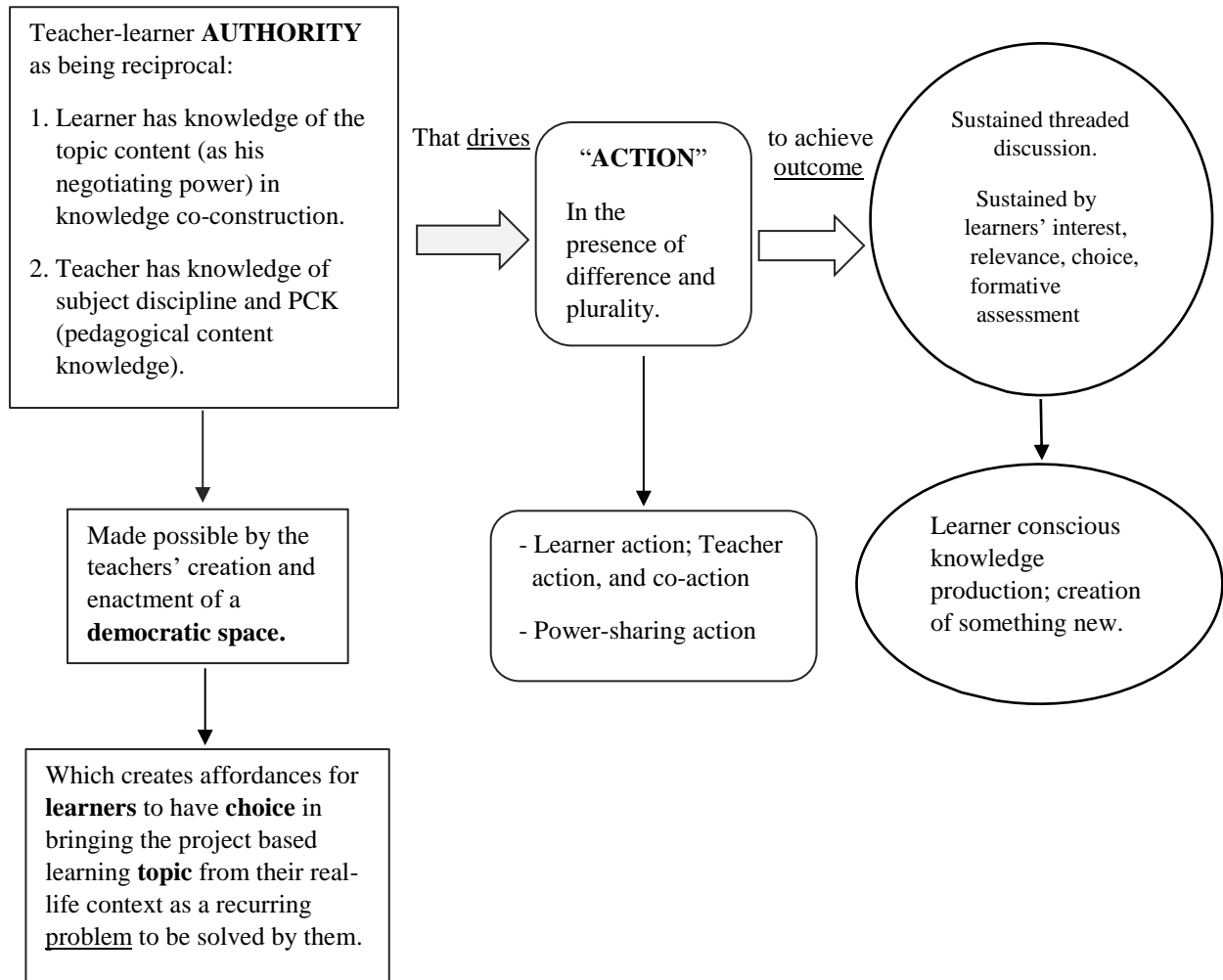


Figure 10.2 Diagrammatic representation of an educational relationship that drives learners' learning

It is against this backdrop that one can say that the negotiation process in the science classroom is on track to such an extent that even the teacher can learn something from the learners on the topic in which the learners have a vested interest. The teacher has an interest in the topic as well, as he or she has to make provision for the topic to be brought into the classroom in this particular way, and through their performance democracy. Teachers' use of the Project Based Learning (PBL) approach creates affordances for active learner involvement in their own learning. He or she also has considerable knowledge on how the school science curriculum is organised, and implemented, and how best to use the learners' chosen topic to ensure sustained involvement of all of the learners.

In light of the above discussion, the closing question in concluding this thesis is: *Is this account fictional?* That is, does it afford you, the reader, to see a ‘window of possibility’ for an alternative teacher practice?

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APPENDIX A

LETTER OF INVITATION TO THE LOCAL NETWORK MEMBERS

Invitation & Information Letter to PC-SA members to participate in a Research Study.

Student: Mr T Jafta

Institution: UKZN

Student No. : 200201889

Research Title: *The democratisation of the teaching and learning space: A South African case study*

RE: Access negotiation meeting: First of two (28 January 2011). Proposed 2nd meeting 09 Feb.2011

Dear Participant:

Thank you for accepting the invitation to participate in the above research project. Pursuant to a previous meeting (held in April 2010) in which you were invited to participate in the above research project (see attached document), you are hereby invited to participate in an access negotiation meeting and discussion with me the research project leader.

Access Negotiation for the study (The meeting will take approximately 0,5 - 1hours)

This aspect is intended to explain what your involvement in the research entails. It is also meant to discuss the limiting conditions for participation, and to recruit a cohort of PC-SA teachers. I am interested in what teachers are currently saying and doing about science classroom practice that is underpinned by democratic principles and values. The topic, section, theme, etc. to be taught by the teacher, one deemed to be a social issue as defined by PC-SA (and which is not necessarily driven by the need to do a display or a showcase). The duration of the classroom observation sessions (which the teacher deems to be necessary or sufficient to depict this kind of practice, and that may depend on the science topic chosen by the teacher). The class group (or sub-group) that will participate in the teacher's practice that is to be observed. The teacher is to prepare a lesson plan for the topic, section, theme, etc. Working in consultation with the PC-SA teachers who are willing to participate in the research study, I plan to begin with the classroom observations in February 2011 and complete these by March 2011, and hold the focus group interview meeting on 1st of April 2011.

At the end of the above meeting, each teacher present shall be given a consent form to indicate his/her acceptance to participate in the research, by appending own signature and date. Those teachers who are willing to participate are invited to the next meeting at a suitable date, place and time. If you choose to participate in this study, your involvement would entail the following critical aspects of the research:

- Pre-classroom observation meeting: Teachers who agree to participate in the study. This meeting is held in order to illicit information of a logistical nature, *inter alia*, date, topic, class group, and learning plan. The school visits for lesson observation will begin once access to the school and classroom is negotiated to minimise invasive nature of research, and a timeline is determined at the meeting.
- On site classroom observation: Observation of classroom teaching practice. Here I intend to spend more time with each PC-SA member at his/her school:

1. To listen to what the teacher says about democracy in the classroom (prior to the lesson);
 2. To observe what the teacher does in a teaching and learning situation that is underpinned by democratic principles on a chosen topic (Teacher determines which lesson);
 3. To listen to what the teacher says, after the lesson, based on a video-playback in which the teacher identifies and discusses incident/s that depict practice informed by democratic principles and values (i.e., incidents of performance democracy).
- Off site focus group **Interview** meeting with the team of teachers, after all the on-site observations have been conducted, to obtain/discuss the nuances that were not easily obtained during the individual classroom observations. The interview is based on information picked up from the previous classroom observations and interviews.

Approximately five (5) classroom observations (as a minimum) will be conducted per teacher on the above 3 aspects based on one observation a day/lesson. The interviews and observations would be video-taped and/or audio taped. The interview session that follows the classroom observation would involve video tape play-back upon which teachers comment on incidents identified and considered as critical incidents of ‘democratic living’ during the science lesson(s).

Participation in the study is voluntary and all data (including audio tapes) that is collected will remain confidential in a locked cabinet, and will be destroyed after the study is completed. Educators will be reimbursed for financial expenses (such as travel for pre-determined meetings and teaching resources) incurred for participation in the study. A pseudonym will be used to protect your identity. In the event that you no longer wish to participate in the study, you are free to withdraw at any time you desire. Please indicate your willingness to participate in the study. See the following page titled “Letter of Consent”, and then sign and return the “Letter of Consent”. If you have any questions or concerns, please feel free to contact the following persons:

Yours Sincerely: Mr T Jafta.

Contact details:

Tel: 031-2059940 (work)

Cell: 072 1841 403

E-mail: dantom@webmail.co.za

Further inquiries regarding the above research may be addressed to either:

1.

Name: Dr B Alant
 Division: School of Mathematics, Science and Technology, UKZN
 (Phone): 031- 260 8242

2.

Name: Prof R Vithal
 Division: DVC – Teaching & Learning UKZN
 (Phone): 031-2608231

APPENDIX B

INVITATION TO THE LOCAL NETWORK MEMBERS (SECOND MEETING)

Invitation & Information Letter to PC-SA members to participate in a Research Study.

Student: Mr T Jafta

Institution: UKZN Student No. : 200201889

Research Title: *The democratisation of the teaching and learning space: A South African case study*

RE: Access negotiation meeting Second of two (09 February 2011).

Dear Participant:

Thank you for accepting the invitation to participate in the above research project. Pursuant to a previous meeting (held in April 2010) in which you were invited to participate in the above research project (see attached document), you are hereby invited to participate in an access negotiation meeting and discussion with me the research project leader.

Access Negotiation for the study (The meeting will take approximately 0,5 - 1hours)

This aspect is intended to explain what your involvement in the research entails. It is also meant to discuss the limiting conditions for participation, and to recruit a cohort of PC-SA teachers. I am interested in what teachers are currently saying and doing about science classroom practice that is underpinned by democratic principles and values. The topic, section, theme, etc. to be taught by the teacher, one deemed to be a social issue as defined by PC-SA (and which is not necessarily driven by the need to do a display or a showcase). The duration of the classroom observation sessions (which the teacher deems to be necessary or sufficient to depict this kind of practice, and that may depend on the science topic chosen by the teacher). The class group (or sub-group) that will participate in the teacher's practice that is to be observed. The teacher is to prepare a lesson plan for the topic, section, theme, etc. Working in consultation with the PC-SA teachers who are willing to participate in the research study, I plan to begin with the research in July 2010 and/or August 2010.

At the end of the above meeting, each teacher present shall be given a consent form to indicate his/her acceptance to participate in the research, by appending own signature and date. Those teachers who are willing to participate are invited to the next meeting at a suitable date, place and time. If you choose to participate in this study, your involvement would entail the following critical aspects of the research:

- Pre-classroom observation meeting: Teachers who agree to participate in the study. This meeting is held in order to illicit information of a logistical nature, *inter alia*, date, topic, class group, and learning plan. The school visits for lesson observation will begin once a timeline is determined at the meeting.
- On site classroom observation: Observation of classroom teaching practice. Here I intend to spend more time with each PC-SA member at his/her school:
 1. To listen to what the teacher says about democracy in the classroom (pre-observation semi-structured **Interview**, 3 questions);
 2. To observe what the teacher does in a teaching and learning situation on a chosen topic (**Observation** of lessons - Teacher determines which lesson);
 3. To listen to what the teacher says in a post-observation **Interview** (using 3 semi-structured interview questions) based on video-playback in which the teacher identifies

and discusses incidents/moments that depict practice informed by democratic principles and values (or, incidents of performance democracy);

- **Off-site focus group Interview meeting with the teachers, after all the on-site observations** have been conducted. The interview is based on information picked up from the previous classroom observations and interviews. The topics are devised from the responses gained from earlier interviews and observations, and the group works from this data. Semi-structured interview questions 3 or 4, or Unstructured questions, one leading question and teachers talk about it.

Approximately five (5) classroom observations (as a minimum) will be conducted per teacher on both (1) and (3) above, and one observation a day. The interviews and observations would be video-taped and/or audio taped. The interview session that follows the classroom observation would involve video tape play-back upon which teachers comment on incidents identified and considered as critical incidents of democratic living during the science lesson(s).

Participation in the study is voluntary and all data (including audio tapes) that is collected will remain confidential in a locked cabinet, and will be destroyed after the study is completed. Educators will be reimbursed for financial expenses (such as travel for pre-determined meetings and teaching resources) incurred for participation in the study. A pseudonym will be used to protect your identity. In the event that you no longer wish to participate in the study, you are free to withdraw at any time you desire. Please indicate your willingness to participate in the study. See the following page titled “Letter of Consent”, and then sign and return the “Letter of Consent”. If you have any questions or concerns, please feel free to contact the following persons:

Yours Sincerely: Mr T Jafta.

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(Phone): 031-2608231

APPENDIX C

STRUCTURED ONE-ON-ONE INTERVIEW SCHEDULE (PRIOR TO THE SCHOOLS VISITS)

Interview Schedule		Name:	Date:
The following interview schedule will be used to conduct a one-on-one semi-structured interview.			
Question	Responses	Comments	
1. Who is your role model as a democratic persona, and why?			
2. Explain briefly what you consider to be the opposite of democracy?			
3. What is your key interest in the notion of democracy / democratic pedagogy in the classroom situation?			
4. Do think this is important for education / classroom teaching practice today? Explain your response briefly.			
5. What does such teaching and learning practice look like, sound like, feel like – one that is informed by democratic principles and values?			
6. Is there a comparison between what you were like prior to joining PC-SA and now? Explain if there is any regarding your teaching practice/philosophy.			

Model or Frame of teacher response to Professional development

1. Focus on own interest
2. Focus on what motivated you to join the PC-SA network
3. What you love about working with the youth to-day in the new South Africa
4. Other

APPENDIX D

PRE-LESSON ONE-ON-ONE INTERVIEW SCHEDULE

An initial short interview with the teacher prior to the learning encounter with the teacher (3 structured questions), to solicit the following:

Teacher's Goals for democracy (or democratic living) in the classroom

Structured Questions	Teacher responses	Comments
1. What are your teaching/learning goals for the lesson in terms of : How you facilitate action in terms of: (a) communication, (b) choice (c) values, (d) participation, (e) self-reliance, (f) interaction (teacher/learner; learner/learner) (g) response to key questions (h) voice (i) initiative Select one or more and say Why this (or each) is important?		
2. What are your goals about teaching/learning process ? Why is it important to you?		
3. What are your goals about thinking in teaching/learning? Why is it important to you?		
4. (a)What would ' I like to show about myself ' as a teacher? Why is it important to you?		
(b)What would ' I like to show about my learners '? Why is it important to you?		
(c)What would ' I like to show about the task '? Why is it important to you?		
5. What other goals are there, if any?		

Interview Prompts (for teacher input prior to the lesson observation)

1. My idea is
2. My reasons are that
3. I believe my reasons because
4. Ideas against my idea are
5. I would convince someone who doesn't believe me by

APPENDIX E

POST-LESSON ONE-ON-ONE INTERVIEW SCHEDULE

A short interview again with the teacher at the end of the lesson based on what the teacher did (2 semi-structured questions). Video tape play-back upon which teachers comment on incidents identified and considered as critical incidents of democratic living.

Semi-structured Questions	Teacher responses	Comments
(The teacher views the play-back of the video-recording, and is asked to choose incident(s) he/she regards as reflecting ' democratic space ' in classroom practice, and explains what is seen on the video pictures – and is prompted for discussion or clarification by the interviewer)		
1. Select a time(s) on the video play-back – or select a moment or incident you regard as one underpinned by democratic principle/s, and give reason for the choice		
2. Explain why you consider the selected incident or actions in the lesson as being underpinned by democratic principles.		

Material/Evidence selection

The teacher chooses a video-clip(s) that he/she considers as an incidence of democratic living/pedagogy from the video-playback of the lesson he/she had just done. He/she explains the reason(s) for (a) his/her selection, and (b) for the incidence as being democratic. (Note: For each incidence the teacher chooses the time(s) of the video-clips, and the explanation and reason(s) for each selection. The interview is to be video- or tape-recorded).

Semi-structured questions (prompts)

1. Why do you think that?
2. What is your reason for that?
3. Can you think of another argument for your view?
4. Can you think of an argument against your view?
5. How do you know?
6. What is your evidence?
7. Is there another argument for what you believe?
8. What can you draw from the videos about the teacher's perceived changes in their teaching?
9. What can you draw from the videos about the teacher's perceived changes in themselves as teachers?

APPENDIX F
FOCUS-GROUP INTERVIEW SCHEDULE

Interview Schedule: Name: Date:		
<p>The following interview schedule will be used to conduct a focus group semi-structured interview. A focus group interview would be conducted depending on the presence or existence of diverging views on the phenomenon under the spotlight in the study, as articulated by the different participants involved in the study.</p> <p>The focus group interview is indeed to bring a measure of agreement on what a ‘democratic space’ is conceived to be - on the part of the participants. Wording of the focus group question/s will depend on the data produced by the above research instruments.</p>		
Question	Responses	Comments
1. ...		
2.		
3. What does such teaching and learning practice one that is informed by democratic principles and values?		

Frame of teacher response to Professional development

1. Focus on own interest
2. Peer collaboration and feedback
3. Distributed expertise

APPENDIX G

CLASSROOM OBSERVATION SCHEDULE

Classroom observation schedule		Lesson No.				Teacher:	
Data Generation Instrument: Classroom Observation Sheet (No.)		Topic:				School:	
		Date:					
No.		Standards (See key below)				Comments	
		1	2	3	4		
1	Teacher creates an educational (science teaching & learning) environment in which students have a real opportunity to begin, to take initiative.						
2	The educational (science teaching & learning) environment allows the students to respond in their own unique ways to the learning opportunities provided by the curriculum.						
3	Different curricular areas are explored and used for the particular opportunities they provide for science learners to bring their own unique beginnings into the world.						
4	Language is approached/seen as a human practice in which learners can participate, and through which they can find, new ways of expressing themselves, new ways of bringing themselves into the world.						
5	Educators show a real interest in the initiatives and beginnings of their learners during science learning.						
6	Teachers spend time and effort on finding a delicate balance between the child and the curriculum so that there are indeed real chances for science learners to undertake something new, "something unforeseen by us"						
7	Teacher creates opportunities learners to a subject (or for inter-subjectivity)						
8	Opportunities created for disagreement						
9	Opportunities created for difference						
10	Opportunities created for otherness						
11	Other?						
		Key: 1 – always observed; 2 – often observed; 3 – seldom observed; 4 – not observed					

APPENDIX H
TURN-IT-IN CERTIFICATE

APPENDIX I
EDITORS CERTIFICATE