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TRANSFORMATIVE PRACTICES IN SECONDARY SCHOOL SCIENCE CLASSROOMS: LIFE HISTORIES OF BLACK SOUTH AFRICAN TEACHERS

By

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ABSTRACT

TRANSFORMATIVE PRACTICES IN SECONDARY SCHOOL SCIENCE CLASSROOMS: LIFE HISTORIES OF BLACK SOUTH AFRICAN TEACHERS

By

Loyiso C. Jita

This study investigated the construction of teaching practices that are aimed at including all students in learning the key ideas of science and helping them to develop a voice for participating in the discourses in and outside of the science classroom. Such practices define what in this study is referred to as transformative practice.

The study tells the stories of three Black secondary school teachers in South Africa who have worked to construct a transformative practice in their biology and physical science classrooms.

Using a life history perspective, the study explored the relationships between teachers' identities and the changes in their classroom practices. Data were collected mainly through periodic interviews with the teachers and observations of their teaching practices over a period of 18 months.

An important finding of the study was that the classroom practices of all three teachers were defined by three similar themes of:

- "covering the content" and preparing their students to succeed in the national examinations,
- developing deep conceptual understandings of the subject matter, and

- including **all** students in their teaching by constructing what other researchers have called a "culturally-relevant" pedagogy.

This finding was consistent despite the observed variations of context and personal histories.

A major finding of this study on the question of the relationship between identity and teaching practice was that despite the importance of context, subject matter, material and social resources, another category of resources - - the "resources of biography" - - proved to be crucial for each of the teachers in crafting a transformative pedagogy. These "resources of biography" included such things as the teachers' own experiences of marginalization, the experiences of growing up or living in a particular culture, and the experiences of participating in certain kinds of social, political, religious or professional activities.

The study suggests that it is not only the experiences that provide a person with the resources for crafting a transformative practice, but a conscious reflection on and willingness to learn from these experiences that makes them available as resources for crafting such a practice. Further research is needed to better understand what the rubric of "resources of biography" includes and to explore the interactions between these kinds of resources and the material, human, and social resources that teachers need to reform their classroom practices.

DEDICATION

To my mother
for teaching me the value of hard work and service.

Fumana mama nokuba ibhityile.

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Pursuing a doctoral education and writing a dissertation in a university that is oceans away from home can be a long and challenging experience. I wish to thank all those colleagues and friends who made the experience worthwhile and whose support and encouragement sustained me throughout the program.

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A special word of appreciation goes to the many teachers who have made it their business to help Black students develop the skills to participate in the processes of social transformation in South Africa. Special thanks goes to "Mrs. Hlophe," "Mr. Tshabalala" and "Mr. Sithole" (not their real names) for allowing me to use their stories to puzzle over the issues of social justice and participation in the field of science education.

Finally, I owe this whole undertaking to my family: My wife Thuthukile, who has lived through it all and still retains her sense of humor and generosity. Her faith in my abilities to "complete the dissertation" has sustained me throughout the writing process. My mother and father who gave me a name, "Loyiso", to follow. And my lovely daughters, Hlengekile and Bulelwa, who gave me wonderful moments of laughter and joy, even when at times I seemed a little, cut off from them.

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CHAPTER ONE

INTRODUCTION

This study is about the lives and work experiences of Black science teachers in South Africa. It tells a story of three secondary school teachers, two men working in schools in the Gauteng Province and one woman who teaches at a school in KwaZulu-Natal.[1] Theirs is a story about how life experiences and "identity politics" provide the frameworks for en-visioning and enacting a classroom practice that has the potential to provide **all** students with much deeper skills and understandings to participate in the processes of social transformation and reconstruction in South Africa. Such a practice is in this study referred to as transformative practice.

The study grew out of my experiences, first as a student and then as an educator, in the Black schools of South Africa during the times when apartheid was the law. I was at school during the most repressive period of apartheid, in 1976 when scores of protesting students were brutally murdered by the regime.[2] I was also part of the community leadership, as a young university student, during the optimistic and creative times of the development of counter-hegemonic discourses of "people's education for people's power" in the mid-1980s.[3] In the twelve years of my grade schooling, I was

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[1] Gauteng and KwaZulu-Natal are two of the nine provinces that make up the geographical demarcations of the (new) South Africa. Two very different provinces, with the former often referred to as the financial capital of South Africa that includes the country's administrative capital in Pretoria and the "financial capital" in Johannesburg, while the latter is a predominantly rural coastal province with Durban as its nerve center. The choice of teachers in these two provinces will be discussed later, in the section on methodology.

[2] Aspects of the history of South African education are discussed at various points throughout the dissertation. I have chosen to locate such an historical discussion within the context of telling the stories of the three science teachers in order to bring out its pertinence and consequences on people's lives.

[3] "People's education for people's power" was formulated by the National Education Crisis Committee, NECC (later called the National Education Co-ordinating Committee) in December of 1985, as an approach to deal with the inadequacies and crisis in education, especially the education of the Black majority in the

taught by groups of hard-working and dedicated Black teachers, few of whom had any advanced degrees or any university education at all. With the exception of one or two, I loved and respected most of these teachers for their commitment to "preparing (us) for the rough world out there," as they often remarked. For many years, as a youngster, I heard this theme of "preparing for the rough world out there" many times over, at church, at school and at home. It became part of the discourse around which aspects of my identity as a Black child, student, teacher, activist and researcher were to be constructed. The emphasis was on acquiring such skills as would enable our cohort to participate in (re)shaping a world that was experienced by most of the adults around (parents, teachers, church ministers etc.) as oppressive and hostile to Black people. Most of these teachers tried with varying degrees of success to enact a kind of pedagogy they perceived to be adequate to the challenge of providing the skills for meaningful social participation and (re)construction.

CONCEPTUALIZING A TRANSFORMATIVE SCIENCE EDUCATION

When I began teaching, about eleven years ago now, I had a clear image of the kind of teacher I wanted to be. I wanted to be like Mr. Juluka[4], my 12th grade biology teacher, whose classroom practice came close to what I envisioned as the meaning of preparing students for participation in social practices designed to build democracy and justice for all. Like many of my grade school teachers, Juluka lived within the community, knew my folks very well, and in fact outside of class I called him uncle - -

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country. In one sense, people's education was a response to the education crisis, and in another, it offered a scenario for education in a future post-apartheid South Africa (Kruss, 1988). This is more so now that the leaders of that movement occupy senior positions within the new Ministry of Education.

following the example of his nephews (playmates of mine) who often came to visit the neighborhood on weekends and during school holidays. Juluka could be very tough and uncompromising, another feature he shared not only with my folks but with many of my other grade school teachers as well. He could also be funny and jolly in class, exceptionally accommodating but still focused and demanding of his students. Most of all, though, Mr. Juluka could be very engaging in his approaches to the subject matter of biology. He was not shy about asking "too many questions" of one student, probing his/her thinking on every response given. As students we sometimes dreaded the opportunity to ask or respond to questions, as we knew many more probes would follow. He would not be deterred, for he pounced on a student even when his/her hand was not up (to indicate a desire to take a turn in the verbal participation in class).

I still have vivid memories of that one lesson Mr. Juluka presented on the structure and functioning of the human circulatory system. It was almost sixteen years ago, in a matriculation (grade-12) class, at Lwazi secondary school. Lwazi secondary, our school, was a regular township school with all the challenges that have come to be associated with these kinds of schools in Black townships - - especially the inadequate provision of facilities and resources for learning.[5] As the deputy principal of the school, Mr. Juluka had also earned himself a reputation as a no-nonsense man. He was very tough and strict on school discipline. Despite this reputation, his biology lessons were always something to look forward to.

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[4] The names of people, and schools at which they work(ed), have been changed to protect them from easy identification.

[5] In Chapter three I describe one such school where Mr. Sithole, one of the participants in the study, worked. Appendix C provides a typology of the different kinds of schools in South Africa.

For that lesson, Juluka took advantage of an experience most of us (students) were familiar with in our daily lives, the concept of a four- roomed house. Four roomed "town-houses" are a common feature in Black townships of South Africa, and are often referred to as the "match-boxes" because of their shape and small size. Mr. Juluka used the concept of a four-roomed house to build an image of the human heart with its four chambers, the two atria and the two ventricles. Elaborating on his metaphor, he described how the heart, like the house, was central to our very existence. Knowing that most of us would be less familiar with the anatomical details of the human heart, he methodically introduced the concepts and the terminology, pausing at strategic points to contrast the details with the match-box houses he had described. The houses had four small rooms, which he compared to the chambers of the heart, and connecting passages, which he compared to the valves, the tricuspid and bicuspid valves of the heart. Juluka had started the lesson in a rather strange manner: "I have a four roomed house, you all know that, don't you".... Now what you do not know is that I have reconstructed it inside, in such a way that you can move from the back rooms to the front ones through a set of passages connecting each back room to the front one adjacent to it. The passages have names, and I have chosen to call them the tricuspid valve and the bicuspid valve." He then went on to construct a simple sketch that would illustrate the details he had described, and proceeded with more. It was in the midst of our amazement and laughter that we finally realized that he was actually describing the structure of a human heart.

Reflecting back on the experience, I am often struck by the kind of learning context Mr. Juluka was able to create through the use of his metaphors. In this particular case, we were all amazed and confused as to what he was up to this time. At the same

time, we were also curious and anxious to know what he was driving at. We understood the biological concepts as he described and explained them, but the context of a four-roomed house seemed misplaced. It took a bit of thinking and passing around of little notes among several students in the class for us to figure out that he was actually describing the human heart. Only when we had figured it out did he confirm that he was indeed discussing the human heart. By precipitating some confusion, amazement, anticipation, intense intellectual engagement, and challenge in trying to figure out the next twist in his lesson puzzle, Juluka had managed to create a discourse community of science learners in his classroom. Little notes were passed from desk to desk, commenting and puzzling over some aspect of the lesson. We were all careful not to be disruptive of the lesson, or to appear disrespectful of Mr. Juluka in any way as we engaged in the "public" deliberation on the subject matter. For a stranger not familiar with these discourse patterns in that classroom, it would be easy to conclude, as many white researchers in South Africa have, that Black students sit quietly and are not engaged when the teacher presents the lesson. And that the students engage in rich discussions only when invited by the teachers, who are not apt to issue such invitations for fear of exposing their inadequacies.[6]

What made the four-roomed house/heart metaphor stick was not only its connections to the familiar life experiences Juluka had drawn on or its novelty, but also how he later used it to critique both the physical and the social reality of these four-roomed houses. Using a commercial model of the human heart, Juluka then invited the students to contrast the metaphor with the real object it represented. From this

[6] In the next chapter, I will review some of research findings emanating from many such classroom studies conducted in South African schools (most of which are done in Black schools).

comparison, broader issues on housing and the environment were discussed. The biology lesson acquired a relevance of a different kind to our social existence. Through this metaphor, the teacher had found a way to bring together the everyday, the scientific, the cultural, and the political. It is the interaction of these different facets of human experience both inwardly and outwardly that made this experience indelible. That is, Juluka had managed to provide us with the discourse frameworks with which to interpret and make sense of our life experiences. Such new interpretations help students construct new sets of personal identities that give rise to committed actions for social change (Bromley, 1989; Martin and Mohanty, 1986; Pratt, 1984).

Mr. Juluka could have just plunged in and given a lecture on the anatomical details of the human heart as required by the matriculation syllabus or maybe he could have just brought in the commercial model of the human heart and then attached labels to everything that we saw on the model. Instead he chose to tell a story - - a story which brought out the cultural, the economic, the political, the scientific, and committed our deep inner feelings into the lesson. Most good science teachers would applaud Mr. Juluka's intentions to connect his lesson on the blood circulatory system with the life experiences of his students but would question the wisdom of a veteran matriculation teacher who allows a lesson on the circulatory system to engender a discussion on housing policies and the environment - - interesting topics, yes, but not interesting enough to feature in the biology national examination content. Such observers would probably subscribe to a view of good teaching that emphasizes clear objectives and goals of exploring the scientific canon, hence, meeting well-stated objectives being central for evaluating teaching. On the other hand, however, supporters of Mr. Juluka would

advance a view of good teaching that puts a higher premium on the teachers' ability to pay attention to and respond to students' ideas and insights and the reality around them. This is the kind of teaching that builds on the prescribed subject matter content to provide frameworks for (re)constructions of identity. In this view, a teacher who is seen as too sincere or wedded to the objective would be criticized for not paying enough attention to his/her students' ideas and life experiences.

A few years later, as the local community rose up against the government on the very issues of housing policy and arbitrary rent hikes, little did Mr. Juluka know that the stuff of his biology class would become a part of our various contributions to these community struggles of the day. By the late-1980s, many of my former classmates at Lwazi had become seasoned activists against the institutional injustices of apartheid. It is difficult to imagine how Juluka would know of the deeper contribution his biology-plus lessons made in helping to shape some of his students' social and political identities. For the system he works for discourages such innovation in teaching practice through its:

- tight prescription of the biology curriculum "to be covered" at all schools by a particular time frame,
- policing of the implementation of this curriculum by way of regular inspections and centrally controlled processes of textbook adoption,
- assessment programs that center around the high stakes, end-of-year assessment of teaching and learning,
- reward structures for teachers, that are based on performance indicators of curriculum implementation, and

- teacher education programs and in-service program that are themselves traditional in conception and implementation.

In Chapter two, I will revisit this discussion of the policy tools and discourses that act to constrain innovation in South African classrooms.

As I began my own journey into teaching, the vision of wanting to be like Mr. Juluka proved difficult to sustain and realize. I had entered the profession through a "back door," without a teaching qualification after completing an undergraduate degree in biochemistry and microbiology and taking up a position as a laboratory assistant in one of the country's major brewing companies. After a brutal crash of the "self" at the brewery, under the powerfully constraining and oppressive discourses of racial exclusion and sexism[7], I was happy to work in the township among the people whose experiences of marginalization and exclusion I shared. The teaching job provided me with an opportunity to reconstruct my wounded self. Among the multiple identities I could be associated with, I reconstructed myself as Black male teacher, and a political activist committed to issues of social justice and national liberation. In my new position, I felt valued and needed, especially because of the perceived skills and qualification in science I brought to the system. In the light of my negative experiences with racism and sexism in particular, I became committed to a "pedagogy of the oppressed" (Freire, 1970). Constructing such a pedagogical practice, however, proved to be too much of a challenge. From a practical standpoint, I wondered about what it would take to teach differently within the system that seemed to discourage "a pedagogy of difference." More

[7] When I was recruited to the quality control laboratory at the brewery, I was the only one with a university qualification (obtained at an historically white institution), save for the boss. I was also one of two Black males employed at a level higher than a cleaner or sample collector, and the only one who had been

specifically, I wondered about what would motivate or compel a teacher to construct transformative practices in his/her classroom. And whether these practices would all look like Juluka's in scope, content, and consequences? And what it would take to encourage and/or sustain them?

Later, as a teacher educator at a historically Black university in KwaZulu-Natal, I continued to ponder these questions in search of defensible explanations for my own failures and successes in crafting a transformative practice. My association with teachers, both as a teacher and as a teacher educator, privileged me to the narratives of their daily struggles with classroom practice and their skirmishes with senior education officers who were often policing the implementation of the official curriculum.

This study comes out of those narratives of teachers' attempts to change practice and their concerns with improving the quality of education for students from formerly disenfranchised and poor communities in South Africa. This study explores the life histories of three science teachers who engage in resistance and change in their pedagogy. By privileging these teachers' voices, I hope to add insights into the personal, political, cultural and social factors that have shaped their lives and practices. Such insights generated from the "wisdom of practice" can be used to inform our attempts to improve both the education of new teachers and the in-service education of practicing teachers.

If we take Gramsci's position seriously that "hegemony is never complete,"[8] then the development of different pedagogies alongside the dominant traditional apartheid pedagogy should not at all be surprising. Teachers, motivated by the "desire to do good",

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recruited while a student and funded by the company as part of their management development program for Black people. All the white employees in the division were women.

[8]. I use the term "hegemony" in the Gramscian sense of the potential and opportunity of the dominant group to shape the consciousness of subordinate groups by its prescription of dominant discourses and practices

struggle to make their classroom practice more relevant to their students. They use various teaching methods to get students "involved" in the learning process, and they seek to affirm their students' life experiences by drawing examples from the "life world" of these students. This is what I have termed an "alternative pedagogy/practice." Alternative practices, though genuine in their attempts to address the marginalization of students who have traditionally been under-served by the system, fail to incorporate a "social critique and a revolutionary agenda" (McLaren, 1998: 442). Transformative practice, however, goes a step further; it seeks to address issues of power both in schools and society. Its major goals seek to provide students with the critical learning and understandings that can be used to effect personal, social, political, and economic transformation in a democratic South Africa. Its major assumptions rest on the notion that "critical understanding leads to critical action" (Freire, 1970). In this study, transformative pedagogy is conceived of as a form of practice that seeks to engage learners in a reconceptualization of both the epistemological and pedagogical frames in the classroom. Juluka's work of broadening the "what" of biology, how it is learned, how we know what we know, is illustrative in this regard.

Although most evidence of such a practice in South Africa remains anecdotal, few studies of transformative practice have found their way into academic journals and periodicals.[9] For example, the close examination of "the racial nature of scientific authority" in the context of South Africa by Jansen (1990) led him to engage his students in a critical discussion about scientific knowledge and its construction or "discovery."

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and suppression of counter-discourses. Like Gramsci, I believe that hegemony is never successfully imposed and complete. It is always being re-imposed and resisted.

[9] This is not to diminish the value of the "spoken word", nor to minimize the importance of the local experiments at transformative practices, that for one reason or the other have not found their way into the

Jansen began this discussion from examining the most widely used biology text in South Africa, the Senior Biology for Standard 9 & 10 (Du toit *et al*, 1985) He engaged the question of scientific authority by discussing the authority of the text, and its eight authors (all white and Afrikaners). This exemplifies one possibility of reconceptualization at an epistemological level. On the pedagogical front, it is the changes in the tasks assigned, the classroom discourse and the classroom environment to allow students an increased role in their learning that are of interest (NCTM, 1991). For example, Julie (1991/92) writes of an interesting case of how he challenged students who were preparing to march on the educational authorities over the issue of overcrowded classrooms. He challenged his students to use their mathematical knowledge to construct a definition of an "overcrowded classroom" using the concept of volume that he had explored with them in a math lesson. This is one example where the classroom tasks were recast in order to promote learner involvement and relevance to their experiences.

In summary, transformative practice can, therefore, be thought of as posing a challenge to traditional practice on a number of fronts:

(i) Classroom relationships between teachers and students and among the students are redefined. The classroom discourse shifts away from the teacher to all members of the classroom community. Such a shift in discourse patterns communicates powerful values about knowledge and authority. Whose knowledge and ways of thinking are valued, who can/can't contribute, and what is an acceptable contribution?

(ii) Alternative conceptions of the subject matter or the discipline in general are presented and explored. This may involve a reconceptualization of the nature of subject

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formal academic (mostly western) vehicles of affirmation. In the next chapter, I will consider some of the alternative and/or transformative discourses that have become dominant in western science education.

matter knowledge, for example exploring the 'tentative nature of science' or the 'socially determined conventions' that underlie most concepts and operations in mathematics.

(iii) An emphasis is placed on the relationship between knowledge/power and social existence. Julie's example above demonstrates one attempt to weave mathematical knowledge into the students' struggles to reconstruct their social experiences.

Although we are clearer about the goals of transformative practice and the challenges it poses to traditional practices, we are less clear about what range of possibilities exist within this broad theme of transformative practices, how they take shape in the different classrooms and what accounts for them. In this regard, this study provides exemplars of three classrooms where versions of this form of practice were observed. More importantly, I explore the lives and experiences of the three science teachers involved in crafting such a practice, in order to learn more about what it takes to engage in such fundamental change in classroom practice.

THE SOCIAL AND CULTURAL CONTEXT OF SCIENCE EDUCATION IN SOUTH AFRICA

The hierarchy of apartheid

South Africa is a pluralist society with a diversity of "racial" and ethnic groups. Until recently, officially since the adoption of the new constitution in 1996, this diversity of its peoples has been used to define political and socioeconomic rights and privileges. According to the recent census data of 1996, the total population of South Africa is about 40.5 million, of which 11% are Whites, 9% percent are Coloreds, 3% are Indian/Asians

and 77% are Africans (Orkin, *et al*, 1999). The White population is comprised mainly of two groups - - the Afrikaans-speaking or Afrikaner group who are mostly descendants of Dutch settlers who first came to South Africa in 1652; and the English speaking group which is mainly of British origin. Other White ethnic groups, for example of Jewish decent, Greek decent, and Portuguese decent occupy powerful minority strata within the dominant White communities. The Colored people are a product of miscegenation between Whites, Malay slaves and the indigenous African population. The Asian, mainly Indians, came to South Africa in the second half of the 19th century as indentured servants to work in the sugar plantations of KwaZulu-Natal. The last group, the Africans, is the indigenous inhabitants of the country (together with the Khoi-San peoples[10] who were precariously classified as Colored or African). The Africans have been called by many names, including Kaffirs, Aborigines, Natives, Non-Whites, and Bantu, none of which has been acceptable to the Africans. In the late 1970s, the term Black was used to replace the other terms. As in the White groups, Coloreds, Indians and Africans are not monolithic; they are constituted by a number of ethnic, religious, political and other groupings.

The four officially demarcated groups, Whites, Indians, Coloreds and Africans enjoyed different socioeconomic rights and privileges in this "hierarchical order of the races" (Kallaway, 1984; Switzer, 1993). In politics, economics, and education, Whites always got a better deal than all the other groups, with Africans getting the worst. South African education today still suffers from the legacy of both Dutch and British colonialism and apartheid distortions of the past. Of note is the immediate history of exclusion by "race" and ethnicity, which has resulted in different racialized patterns of

[10] The Khoi-San peoples are pejoratively known as the Bushmen.

participation and success within the education system. For example, the success rate by Africans at the Matriculation examination level (grade-12) has not been any better since the first African matriculated as a private candidate in 1880. As Horrell (1963) reports, the success rates at the turn of the century were disproportionate: between 1901 and 1910, only five Africans had matriculated; and this number had risen to only 22 by the end of the decade that followed. These numbers have not been impressive over the years, as the national average pass rate for the 1990s hovers below 60% (Arnott *et al*, 1997; SAIRR, 1997).

Black participation in science education

The poor participation and success rates of Black people have been more pronounced in those subjects with a higher premium in society - - particularly mathematics and the sciences. According to the Bantu education scheme, mathematics and science were the particular subjects from which Black peoples were to be excluded (Kallaway, 1984).[11] For example, between 1985 and 1993, the national average pass rate in matriculation physical science for Black learners was 47% (Shindler, 1997; Sidiropoulos, 1997). During that eight-year period, the percentage pass in physical science had never reached beyond 50% nationally.[12] Participation rates have also been relatively low. For example, in 1994 (the last year in which South African learners wrote matriculation examinations under racially segregated examination systems) only 16% of the 250, 000 matriculating female learners enrolled for physical science compared with

[11] Bantu education, as the name indicates, was a kind of education scheme that was specifically designed for Black people in South Africa. It was to be inferior to the education of other "races" by design (Rose and Tunmer, 1975). Science and mathematics were considered irrelevant to the native lives and were discouraged or excluded from the curriculum.

21% of the 188, 000 matriculating male learners.[13] Against this background, therefore, Sidiropoulos' (1997) observation that in the years between 1985 and 1993 Africans accounted for only 2.6% of the total number of students graduating in engineering and technology should not be surprising.

These statistics would not be so alarming were it not for the fact that they give us a clue into the distribution of rights and privileges within the South African society. For instance, the participation and success rates of Africans in higher education, especially in the sciences, has been dismal with ten percent more whites graduating with science degrees than Blacks (Foundation for Research Development, FRD 1993). This is an embarrassing statistic for a country where more than three quarters of the population is African, and it has implications for the kinds of jobs and careers that become available to African peoples. Secondly, it is not surprising that there are fewer qualified Black science teachers within the education system. According to a recent survey of seven (of the nine) provinces, only 42% of science teachers nationally were qualified to teach science with percentages even lower for schools serving Black learners (Arnott, *et al*, 1997). Recently, policy-makers have been concerned over the fact that South Africa lags behind most countries in scientific and technological literacy (Department of Arts, Culture, Science and Technology,DACST, 1998). In comparison with 19 other countries, for example, South Africa ranked 18 out of 20 on natural and environmental sciences literacy, only fairing better than Russia and Poland (Department of Arts, Culture, Science and Technology, DACST, 1998). South Africa s ratio of scientists and engineers per

[12] From about 1995 when all the separate apartheid departments had been unified, national average pass rates were slightly higher. This is because of the higher averages in the other former "racial" departments.
[13] Biology, another of science subjects, is an exception to this enrollment pattern (with 86% of females enrolling and 85% of the males). The success rates in biology are not radically different however.

1000 of the population is 3.3 - - making it one of the lowest among both developing and developed countries (compared to Brazil's 11.2; or the United State of America's (USA/US) 21.6 (Sidiropoulos, 1997).

Although some of the government programs initiated after 1994 have made an impact on the situation, many Black peoples still remain vulnerable and live the lives of the oppressed primarily because of their social and economic conditions. The inequalities continue to be supported by a number of discourse structures and systems in society such as the economic system, the political system, the curriculum structure, the pedagogical practices and the dominant cultural discourses. The racialized capitalist production system of South Africa has relied heavily on availability of cheap and unskilled Black labor, while social privilege is still structured by a discourse of racial discrimination and exclusion. In schools, much of the curriculum remains exclusive and irrelevant (Christie, 1985; Jansen, 1990b; 1989; Nkomo, 1990). And pedagogical practices derived from the colonial and apartheid past remain in place in most classrooms. Consequently, a culture of negativity about the future of Black schooling pervades society, such that those who can, bail out of Black schools. These discursive systems are, however, not automatic in their effects of defining Black learners and teachers to social relations of inferiority. For each one of them is not monolithic. Each is a product of history and struggle and contains within itself multiple and contradictory elements. It is a known fact, for example, that no two analysts can explain the content and meaning of the apartheid political system in the same way (evidence of this abounds at present within the processes of "truth" searching by the Truth and Reconciliation

Commission, TRC, of South Africa).[14] Also, if we take Foucault's (1982) notion that such multiple and contradictory discourse systems are material and constitutive of our subjectivities, then our histories will also be multiply-stranded and contradictory with many different kinds of opportunities and possibilities.

THINKING ABOUT ALTERNATIVE IDENTITIES AND DISCOURSES

The processes by which transformative discourses are constructed and adopted by teachers are of interest in this study. That is, how do Black teachers construct new identities that enable them to charter new forms of practice in their classrooms? This involves investigating the construction and meaning assigned to new forms of identities and practices by transformative teachers.

As Bromley (1989) argues, personal history by itself "lacks the power to bring about change, until it is embedded in social relations linked to wider processes by a political discourse." On the other hand, he further argues, an "analysis of social relations by itself, is also ineffective until given emotional reality through being instantiated on an individual level by grounding it in one's own personal history" (p. 211-212). Bromley's analysis allows for a construction of closer links between social analysis and self (re)construction, with personal histories used to "evoke both interest in and capacity for individual change" and political discourses provide the context for the personal histories and enable transformation of social relations (p.212). Bromley, therefore, posits a model where teachers actively choose to engage in transformative practice. That is, it is not enough for Black teachers to have lived their lives under conditions of oppression for

[14] The TRC is a constitutional body established in 1996 to sort out the history of South Africa in terms of victims/perpetrators of gross human rights violations from 1960 to 1994. Although it had an initial life

them to want to commit to a transformative practice, but a discourse of resistance and transformation is needed for action. To disrupt the cycle of exclusion and inequality in education, attention needs to be paid to both the personal histories of teachers and the alternative discourses that shape those histories.

In its attempts to intervene in the patterns of exclusion and inequality in educating all children in South Africa, the new government has tried to reconstruct the social and political discourse on a number of fronts: First, through its adoption of the new constitution and the crafting of appropriate legislation, many of the political privileges and rights have been restored to the African majority of South Africa. Second, government has already declared science and technology as the two key areas of focus for transformation (Department of Education, DoE, 1995). To further give visibility to the idea of reconstruction of science and technology, the year 1998 was declared the "year of science and technology" (DACST, 1998). Third, new curriculum initiatives have just been launched in the primary school grades, to be implemented progressively through the grade levels. The new curriculum, based on Outcomes Based Education (OBE) models, is called the curriculum 2005 initiative. In science, the new curriculum contains elements that provide an alternative discourse pattern to the traditional curriculum. Fourth, the cultural terms and conditions of schooling are also being reshaped through the government's campaign of restoring "the culture of teaching and learning," especially in African schools (Department of Education, DoE, 1997). The campaign attempts to disrupt some of the hegemonic practices of "teachers and learners" in schools.

Despite the strides made in reconstructing the discourse systems in South Africa, most classrooms do not seem to have been affected by this change (Jansen, 1998; Jita,

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span of two years, this has been extended to give enough time for the process "to be completed."

1998; Mohammed, Interview August 1998). Most teachers have still to embrace the new discourses and construct their identities around them. We are not clear, however, about what it takes for teachers to embrace new discourses and teach differently. This study presents narratives of three science teachers who have attempted to craft a transformative practice. Their practice is constructed within the context of their histories as Black people who grew up and were educated under apartheid, and who now teach Black learners under a new set of emerging conditions created both by the legacy of apartheid and the interventions of the new government.

DEFINITION OF TERMS

Black/African

In this study I use the term "Black" interchangeably with the term "African." In South Africa, the name Black has its roots in the Black consciousness Movement (BCM) of the 1960s. It was used as an inclusive term to refer to all those who were marginalized and oppressed under the terms of apartheid. That is, it was used to refer collectively to Africans, Coloreds and Indians. However, by 1979 the name had been appropriated by the apartheid government and used to refer to Africans only (since sections of the White people wanted to refer to themselves as Afrikaners to emphasize their connection to Africa as well). Although most of the time I use the terms, Black and African interchangeably, there are times when I use Black to define the collective (experiences of the oppressed). My use of the term Black is also motivated by the fact that most African people often refer to themselves as Black. Politically, African has become a fashionable

statement in the new South Africa. There is now a rush by all political leaders, Black and White, to stake their claims to being African.

Discourse

I use "discourse" to mean statements used at disciplinary, political and cultural levels to convey meaning and to restrict and regulate what can be said, known and experienced. In this way, discourses are constitutive of our subjectivity, and thereby link knowledge and power (Foucault, 1980; Weedon, 1987). Discursive practices refers to the "rules and institutional arrangements through which discourse statements are produced and communicated (Foucault, 1980).

Township

I use the term "township" to refer to the formerly exclusively Black residential areas. These areas are often easy to distinguish from the White residential areas (often called suburbs) by the differences in infrastructure. While white residential areas are well provided for with services such as adequate electricity, tarred roads, street lighting and regular garbage collection, the townships enjoy very little of such services. Schools in these two areas of residence are also marked by these sharp disparities. The provision of educational facilities in South Africa followed a pattern of social stratification, with White schools being well provided, while African schools received the least - - Indian and Colored schools straddling in between the two extremes in that order.

Identity

By "identity" I refer to the people's sense of self, as socially constructed within social settings.

ORGANIZATION OF THE DISSERTATION

The first chapter has attempted to locate the genesis of this dissertation both within my personal realities of growing up and struggling to teach science in South Africa. It also located the dissertation within the broader theoretical/practical concerns of working for change in schools and classrooms, especially those that serve disproportionate numbers of Black students.

The second chapter samples a range of literature to locate the theoretical framework of the study. Literature in such varied traditions as science education and social theory is employed in this dissertation.

The third chapter describes the methodology used in the research. The study has two interwoven components: the ethnographic component of classroom observations, and the life story component of the teachers' discussion of the place and meaning of their lives. There is an uneasy tension of emphasis between these two components (at least in the mind of the researcher as the dissertation is being constructed). The presentation is meant to be interactive between life stories and ethnographic inquiry, with a view to understanding why the teachers constructed the kind of practices I observed during the visits to their classrooms.

The fourth, fifth, and six chapters present cases of life stories and classroom experiences of the three science teachers. The construction of particular forms of identities and practices by these three teachers is presented.

Chapter seven is the conclusion. It recaptures some of the important themes and lessons from the stories of the three teachers and explores some of the implications for policy, research and teaching.

An Epilogue pulls together aspects of the researcher's story and ponders the questions raised by the research in regard to my own identity as a Black researcher, teacher, and teacher educator.

CHAPTER TWO

THEORETICAL FRAMEWORK

This study is located at the intersection of three areas of concerns, viz. concerns with teachers who resist dominant patterns of modal practice, in science education, within the context of the South African education system. Accordingly, I have chosen to review three different sets of literature, beginning with the literature on critical theory which provides the basis for thinking about a kind of pedagogical change that has consequences beyond the classroom. I examine the concerns with pedagogical change and its potential for social change within the context of South Africa. Given the particular focus of this research on science teaching, I also review literature on some of the recent attempts to promote change in the teaching and learning of science in schools. As a result of my emphasis on changing practices, I have chosen to de-emphasize modal practice except only to acknowledge its existence in the context of the changes observed in the practices of the three case teachers in this study and the reform literature reviewed here.

This study is grounded principally in the tradition of critical theory. There are many versions of this theory, and consequently many different forms of critical pedagogy emanating from them (Giroux, 1995; Gur-Ze'ev, 1998; McLaren, 1998). All versions, however, rest on the assumptions that the existing society is both exploitative and oppressive, but also that it is within our capacity to change it and make it equitable (Anyon, 1981; Carr & Kemmis, 1986; Weiler, 1988). This common denominator is what GurZe'ev refers to as the notion of a "positive utopia." (GurZe'ev, 1998), also captured in Giroux's notion of the "language of possibility" (Giroux, and McLaren, 1987). Scholars in the critical theory tradition, especially those influenced by the "Frankfurt

school," tend to view education as either an instrument of oppression or of transformation. One line of scholarship within this tradition has focused on the processes through which the existing power relations in society are produced, maintained and reproduced (Anyon, 1981; Bernstein, 1977; Bourdieu, 1977; Bowles & Gintis, 1976; Giroux, 1983). The idea of "cultural capital," and the notion that schools and school knowledge serve to reproduce the dominant classes were often posited as explanations and causes of the inequalities in school and society.

Another line, however, focuses more on the day-to-day experiences of people or groups of people (especially the oppressed), and their struggles and resistance to the instruments of oppression and exploitation (Freire, 1970; Giroux, 1988; 1985; Shor and Freire, 1987; Willis, 1977). It is the latter strand that has the most appeal to critical scholars in developing countries, because of its usefulness in analyzing their experiences of racial and sexual oppression, in sponsoring the voices of oppressed men and women in education, and on its emphasis on conceptualizing possibilities for change. The story of this research on science teachers who teach differently is located within the latter strand of critical theory of education. In its later articulation, influenced by the various discourses of postmodernism and post-colonialism, this strand now presents schooling

> less in a language of reproduction and resistance and more in terms of different ways of articulating one's identity from the perspective of social class, gender, race, and sexual preference (sic), and in terms of developing a language of meaning as teachers and students address together the issues and struggles of critique and possibility (Oldenski, 1997, p.82).

Issues of power, discourse and identity construction within the context of larger material and discursive conflicts, therefore, become paramount in telling the stories of the three science teachers. This is a radical departure from the earlier analyses by critical theorists

science teachers. This is a radical departure from the earlier analyses by critical theorists that subsumed all individual actions and experiences under singular regulatory schemes of race, class, gender, or structure.

Paulo Freire is one critical scholar of the latter strand, whose work has probably had the most impact in many developing countries. His work has been used in countries such as Angola, Mozambique, Guinea-Bissau, Chile, Brazil, and many others. Freire attacked the very basis of traditional pedagogy: its emphasis on the transmission and transference of knowledge. He was critical of what he terms the "banking" system of education where:

> Education (thus) becomes an act of depositing in which the students are the depositories and the teacher is the depositor. Instead of communication the teacher issues communiqués and makes deposits which the students patiently receive, memorize and repeat. This is the 'banking' concept of education, in which the scope of action allowed to the student extends only as far as receiving, filing, and storing the deposits...(Freire, 1970, p.58).

This form of traditional pedagogy imposes a number of limitations on its recipients. The most obvious, both from radical and conservative perspectives, is that it does not adequately prepare students for critical, proactive participation within the society. Even in education systems where such a pedagogy was maintained by design to fulfill other social objectives (e.g., within Black education in apartheid South Africa, or communist education in the former Soviet Union), it can be argued that its successes were modest at best, as more and more people continued to fashion social actions and programs designed to undermine the social objectives of such uncritical and hegemonic pedagogy.

In education, Freire's ideas and those of other critical theorists have found application in diverse programs designed to get students involved or included in the learning processes, and empowered in ways that seek to affirm their life experiences.

From a critical theory standpoint, **inclusion, voice**, and **empowerment** are the central themes of any pedagogy of transformation (Freire, 1970; Giroux, 1988; 1985; Gore, 1992; hooks, 1996; Shor and Freire, 1991). However, as Jennifer Gore (1992) and Elizabeth Ellsworth (1989) demonstrate with their critique of the notions of empowerment, voice and dialogue in critical and feminist theories, the meanings of these concepts are not pre-determined. The specific material contexts and discourses within which they are articulated shape their meanings. In the classrooms, teachers are thus not always at the center of the consciousness raising activities, and students, especially those for whom the empowering practices are constructed, are not always ready to have their voices heard by others in a dialogical relationship. A complex array of power dynamics inside and outside of the classroom determine whether or not and how students and teachers participate in the classroom experiences.

Inclusion, voice and empowerment are important concepts for thinking about transformative practice in South Africa. Without a representation of their experiences in the design and processes of schooling, Black peoples in South Africa often felt 'excluded' by the system and resisted its implementation (Christie, 1985; Kallaway, 1984; Walker, 1996). **Inclusion**, as used in this study, therefore, denotes not only the attempts to bring in more Black students into the science classrooms (access), but to bring them in as active subjects whose experiences shape their learning and understandings of the content of science. Inclusion is used to refer to the deliberate efforts by teachers to draw on the day-to-day realities and differing experiences of the students to present the subject matter, to craft tasks and projects for students, and to assess their understandings of important concepts in science. The notion of inclusion

seeks to capture the teachers' overall approach to science teaching by examining three categories of the teacher's classroom practice that constitutes the bulk of what organizes classrooms in most schools in South Africa and elsewhere:

- Presentation of the content
- Assignment of Tasks and Questions (in the class-work, homework, projects, and other assignments)
- Assessment of students' understandings

With respect to each of these categories, three questions are asked of the practices of each teacher in this study: To what extent do they draw on the day to day experiences of the students? In what ways do the teachers weave these experiences into the three aspects of practice identified above? How do they make choices about what experiences to bring in, when and how?

Voice, on the other hand, refers to the articulation and representation of the multiple meanings and understandings constructed by the students within the classroom and school discourse. It is about extending the limits of what can be said about science in the classroom, who is allowed to participate in the discourse, and what meanings are given to the things that are said by the various participants in the science classroom discourse. I ask four questions to bring out aspects of voice that are important for critical pedagogues:

- What is talked about in the science classroom, in terms of the specific subject matter of science, stories of lived experiences of both teachers and students, and other social issues of relevance to the community of science learners in the particular classrooms?

- Who talks about what and to whom? Who supports or listens and who does not?
- What meanings are assigned to what is said?
- What language(s) and concepts are used?
- How are choices about meanings and language made?

Critical education theorists argue that it is in the context of a pedagogy that privileges voice and inclusion, that students become positioned to develop the capacity and the willingness to exercise power ('empowerment') in ways that may have transformative consequences. The third component of this study, after voice and inclusion, examines the consequences of transformative practice. This includes concerns with such issues as :

- what kinds of conceptions of science students get from the teaching?
- how the concepts and conceptions of science help to shape different understandings of their experiences?
- how new constructions and identities help to shape social change?

The concept of a **transformative practice**, which forms a key component of this study, defines such pedagogy of voice and inclusion.

TEACHERS AS TRANSFORMATIVE PRACTITIONERS

The idea of looking at the work of teachers as transformative (and intellectual) derives from two separate influences on my own thinking and practice. First, Henry Giroux's (1985; 1988) notion of looking at teachers as "transformative intellectuals." Second, it comes from the definition of the South African struggles as being about more than just reforming the apartheid structures of the past but aimed at creating conditions

for a radical change (or transformation) from apartheid. That is, creating conditions for transforming the power relations in society.

Giroux's (1985, p.378; 1988, p.125-126) concept of "transformative intellectuals" is useful in this study for examining a number of issues about non-traditional practices in South Africa. First, it provides a "basis for examining teachers' work as a form of intellectual labor," as opposed to defining it in instrumental or technical terms (Giroux, 1988, p.125). Teacher thinking and actions, and the meanings assigned to them can therefore be studied more productively within this framework. Second, it clarifies the kinds of "ideological and practical conditions necessary for teachers to function as intellectuals" (Giroux, 1985, p.125). The social, economic, historical, cultural and political contexts within which teachers work also become a legitimate component of study. For instance, what conditions enable teachers to construct a pedagogy of difference in their science classrooms is a concern that can be pursued legitimately within this framework. Thirdly, it helps to make clear the role of teachers' work within the various discursive and material interests. That is, what organizations of power do their classroom strategies and approaches support, deliberately or inadvertently? Teachers, as transformative intellectuals, therefore, have an important role in "legitimating the [students'] voices in an effort to empower them as critical and active citizens." (Giroux, 1988, p.165).

CONCEPTUALIZING TRANSFORMATIVE PRACTICE IN SOUTH AFRICA

The notion of transformative classroom practice from the point of view of the South African discourses has its origins in the "people's education for people's power"

movement of the mid-80s. This was a movement to redefine both the content and context of education in South Africa (Kruss, 1988). As a result, classroom changes had to be located within this overall movement for social change and empowerment for them to be regarded as truly transformative (Unterhalter and Wolpe, 1989):

> Although the partial 'reforms' which could be implanted in Bantu education would be of value in themselves the fundamental point is that they were intended to be the outcome of a political process, in particular the assertion of people's power in the sphere of education. It is precisely this which would have given the achievement of changes in Bantu education their specificity as expressions of people's power and not merely as reforms (p.15).

The notion of reform is therefore not adequate to express the kinds of changes that were being advocated by the enthusiasts of "people's' education" in South Africa. Transformation and transformative practice became popular themes to express the demand for fundamental change in the apartheid educational discourse and practice of the 1980s and early 1990s. Teachers began to be regarded as important actors in this struggle for social and educational change (Davidoff, 1993; Enslin, 1988; National Education Policy Investigation, NEPI, 1992; Walker, 1989;), only if they could be convinced to have the right politics. As Enslin (1988) put it,

> those who recognize the role which teachers can play in the struggle to liberate South Africa from the present order, the brand of theoretical discourse available to teachers should be of some interest. (p. 73).

Although framed in this very orthodox (Marxist) manner of granting the privilege of transformative social action only to a select group of teachers with the right theoretical discourses, the vanguard so to speak, the focus on teachers as agents of transformation was an important step forward - - from the view of teachers as state agents who implemented Bantu education (Hartshorne, 1992; Kallaway, 1984).

The view of teachers as potential transformative agents legitimated alternative paradigms of practice in schools for many teachers and provided voice to new lines of research on teaching and teachers in South Africa. The important paradigm shift, precipitated by the people's education ideas, was that concerns with how well teachers were implementing the traditional curriculum and practices began to give way to new concerns about how teachers were constrained in doing their work of educating society (Nduna-Watson, 1995; Chisholm, 1992; Morrell, 1988; Walters, 1981). Later, these concerns about constraints further shifted to how well teachers could be 'helped' to adapt to and find ways of undercutting the constraining contexts to do the potentially transformative work. Most of the latter strand of work was carried out by university researchers, working mostly with elementary school teachers, and by non-governmental organizations working in the area of educational development (see for example, Breen and Coombe, 1992; Education Support Project (ESP), 1995; Flanagan, 1991; Potter, 1997; Walker, 1991; 1994; 1996; Wickham, 1997). While these projects are beginning to contribute worthwhile insights about transformational discourses and practices in Black schools and classrooms, the form they take as quasi-evaluation studies that look at the impact of the specific interventions by the university researchers in schools limits their scope. With the exception of Wickham's (1997) project which focuses on the classroom practices of a group of white teachers in KwaZulu-Natal province; and Porter's (1997) discussion of his own experience as a White university lecturer teaching in a formerly "Whites only" elementary school; and Walker's (1996) re-interpretation of her earlier dissertation research (i.e. Walker 1992), the studies stop short of entertaining richer accounts on the limits and possibilities for educational change in schools that serve Black

children, outside of the strategies framed by their own staff development projects. In a later publication of her earlier research in Black schools, Walker enriches our understanding of the possibilities, limits and dynamics of change as experienced by the Black elementary school teachers she worked with in the townships of Cape Town. Her analysis draws on the "feminist poststructuralist" approaches to look at the external factors that constrain the work of Black primary teachers. Secondary school teachers in Black schools experience many of the same kinds of constraints that she identified for the primary school teachers. Five of the discourses she identified in her study frame the context of work of the secondary school teachers studied here, viz. the discourse of authoritarian surveillance, the discourse of fundamental pedagogics, the teacher qualification discourse, the school-based control discourse, and the resource constraint discourse.

The discourse of authoritarian surveillance

This is the discourse that shapes the hierarchical relations and interactions between the teachers and their employer. This discourse captures the very unequal relations between teachers and the department, characterized by the absence of any "concept of teachers' rights" (Walker, 1996, p.82). Given the centralized structuring and organization of the education system, teachers' work and lives in school and classroom were often pre-determined from central office.

The discourse of fundamental pedagogics

Fundamental pedagogics is an ideology that was developed by the Afrikaner academics to uphold the vision of a Christian National Education (CNE) introduced by the Nationalist Party after its rise to power in 1948. Its central tenets are segregation or development of the separate "races"/"nationalities" and White superiority (Enslin, 1984; Kallaway, 1994; Nkomo, 1991; Unterhalter and Wolpe, 1989). A course in "fundamental pedagogics," or "theory of education" as it was sometimes called, was compulsory at all teacher education colleges and universities in South Africa. The content of the course was roughly similar at all institutions, except for the White English speaking universities that openly resisted and challenged its view of education. Fundamental pedagogics emphasized obedience for both teachers and students and presented an unquestioned doctrine of inequality between the different racial and ethnic groups in the country. Because of the apartheid laws that required Black students to get government approval to attend the Historical White Universities (HWU), very few Black teachers graduated from the White English speaking universities.[15] The classroom practices of many Black teachers are thus also constrained by their experiences of fundamental pedagogics.

The teacher qualification discourse

Changes in the state requirements for teaching often disempowered many of the teachers who were considered "under-qualified." Many of the older teachers in elementary and secondary schools began their careers in the 1950s and 1960s when the

[15] Although the requirement for Government approval was relaxed in 1994, the fee structure and the stringent admission requirements at these institutions limited the numbers of Black students that could attend. In addition, government provided incentives in the form of full scholarships for student teachers in

requirement for teaching was a grade eight plus two years of teacher preparation. With the new requirement of a matriculation (grade-12) certificate and three years of teacher preparation, most teachers who have served the system so diligently in the past find themselves with labels of "under-qualified" or "unqualified." Rural teachers, and/or Black teachers, are often affected in higher numbers because of lack of resources and institutions for upgrading nearer their places of work. Although the number of under-qualified teachers has dropped sharply in the last five years, thanks to a new government policy to encourage teacher upgrading, for those who still bear this label, the consequences are even harsher than years past. Such teachers are often the first to go when government implements its rationalization programs.

The school-based control discourse

This category describes the regulatory mechanisms of each school where the teachers work. The conditions at school level mirrored the national relations of oppression and surveillance, especially through the use of random inspections of curriculum implementation by the Educational Inspectors (EIs).

The resource constraint discourse

This category describes the manner in which teachers experience their impoverished environments, lack of facilities, texts and other resources necessary to do a decent job of educating in their subject areas.

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the Historically Black Universities (HBUs). For colleges of education (the equivalent of normal colleges in the USA), these incentives meant that literally all the students in a college would be fully funded.

A combination of these discourses function to regulate and constrain the classroom practices of many science teachers in South Africa. Collectively, they produce a set of modal practices that alienate both the Black learners and teachers alike.

It is important to note, however, that the influence of the regulatory discourses on teachers is not automatic. That is, it is still possible to find Black teachers whose practices depart from the normalized view of teaching (Mcleod, 1995; NEPI, 1992). This is where Walker's (1996) work breaks new ground on research about teachers and teaching in South Africa, in that she was able to simultaneously analyze the "spaces" and opportunities for freedom in the work and personal lives of the teachers in her study. Her discussion of the "spaces of freedom" (a concept she borrowed from Gore, 1993, see Walker p.161) includes an analysis of potentially counter-hegemonic discourses and interpretations of power that the teachers could appeal to in making sense of their attempts at classroom transformation. Walker, however, laments the fact that many of the teachers in her study did not have "access" to the counter-hegemonic discourses and therefore had trouble embracing many of the changes her professional development course wanted to promote. Walker's (1996) is the only study of Black South African teachers I have come across that explores the material and discursive realities of teaching in South African classroom from a personal meaning-making and human agency approach.[16] The present study differs from Walker's in that it focuses on secondary teachers who set out to change the way science and science classrooms are experienced by many Black students in South Africa and elsewhere - - as alienating, irrelevant and

[16] The only other similar study of 'transforming pedagogy' by Macleod (1995) explores the work of subject advisors (a layer of district level subject matter co-ordinators and facilitators) while Wickham (1997) explores similar issues with a group of white teachers.

perpetuating the inequalities of school and society. In addition, I seek to contribute insights about how the transformative teachers used the "internal" resources (of identity) to construct an alternative practice of science in their classrooms in spite of the external factors that conspire against change.

REFORMING SCIENCE EDUCATION GLOBALLY

As a graduate student in North America, with the concerns about voice and inclusion in science education, I have been drawn to some of the literature on reform in science education (for example, AAAS, 1989; 1995; NRC, 1996; NSTA, 1988). There have been several attempts at reforming science teaching and learning in North America and Europe in particular, targeting the issues of voice and inclusion, that provide interesting case material for thinking about transformative practice in South Africa. Many of these reforms have come under different names with slightly different ways of expressing their concerns based on the history, and each with its own problems and limitations. In the next section, I provide a snapshot of some of these science reform frameworks, with particular focus on their major tenets around the issues of inclusion and voice. My review of these ideas focuses less on the specific history of their development than on the major propositions they make for classroom change.

Scientific literacy for all

This is the most recent and prominent of the efforts at changing the practice of science education in schools. In the USA, its origins are often traced to Project 2061 vision statements of the American Association for the Advancement of Science (AAAS,

1989; 1993). Its major concerns revolve around two issues: first, the specific science concepts and skills and 'habits of mind' that students should have the opportunity to learn and develop in the science classroom, and second the fact that **all** learners should have access to these concepts and habits. In terms of the content of science education, the documents produced by AAAS, the National Research Council (NRC) and other reform documents develop the notion that science education needs to focus on a few key concepts, principles, and theories that weave together the different subject matter of science (AAAS, 1989; NRC, 1996). For example, the notion of "homeostasis and change" in science which cuts across different sub-disciplines of science and could be used to explore a broad range of phenomenon in the subject; or the notion of a "system," or the idea of a "model" and many more.

Teaching for conceptual understanding is based on the recently articulated constructivist theories of learning that highlight the notion that learners actively construct meanings of scientific phenomena within the context of their social and personal experiences (Anderson *et al*, 1987; Cobern, 1993; Matthews, 1994; Roth, 1994; Tobin, 1993; van Glasersfeld, 1989). In this view of learning, teachers are expected to teach in ways that engage the student's understandings and constructions deeply and meaningfully. For example, in the articulation of one of its standards for the teaching of science, the NRC (1996) proposes that teachers focus on "guiding and facilitating learning" by focusing and supporting inquiries, orchestrating discourse among students about scientific ideas, challenging students to share responsibility for learning and to recognize and respond to student diversity (p.32). These ideas about the need for students to be active in constructing their own understandings of the science concepts and

principles, and about the role of teachers in creating an environment that supports and encourages such exploration from the students individually and collaboratively, have given rise to a plethora of ideas and research agendas designed to realize some of the reform ideas. Palinscar, *et al* (1993); Roth (1995) and Hobden (1998), for instance, explore problem-solving within a context of collaborative group work in science classrooms as a way of getting students to attain deeper understandings of the subject (what Palinscar *et al* refer to as 'scientific literacy'). Studies of conceptual change among science learners define another major line of research in science education designed to realize deeper conceptual understandings in science learners (Driver, *et al*, 1994; Hewson *et al*, 1998; Hewson, 1981; Smith, *et al*, 1993, Smith, 1987). Yet another major area of research relating to the reform ideas involves issues of language and discourse in science teaching and learning (Lemke, 1990; Malecki, 1990; Rosebery *et al*, 1992; Saul *et al*, 1993; Vellom *et al*, 1995). A major goal of all these research programs is to contribute insights about how to develop conceptual understanding for **all** science learners.

The second concern of the reforms is the notion that **all** students need to learn and develop the conceptual understandings and habits of mind proposed. Unlike the first reform goal which has generated a lot of research interest, the second goal of teaching science to **all** students has not had the same attention from researchers and reformers in science education. Beginning with the major reform documents themselves, the AAAS (1989) and the NRC (1996) do not provide much to guide the efforts of educators who are interested in issues of inclusion for all students. These documents make reference to the rhetoric of **all** students without "addressing directly the ethnic, socioeconomic, gender

and theoretical issues that influence the teaching and learning of science in (our) schools" (Rodriguez, 1998, p.592). That is, teachers are left with very little to go by in making the changes to include **all** students in science education (Spillane *et al*, 1996). The research agenda on teaching for understanding, despite its success in providing insights on how to realize the reform visions in the classrooms, has come up short on the goals of inclusion of the different social, cultural, economic and gender groups. Several critiques of both traditional practice and the 'teaching for understanding' framework have led to several alternative proposals for transforming classroom practices of science teachers.

Feminist alternatives

One of the most sustained critiques of both traditional practice and 'teaching for understanding' comes from the feminist scholars and teachers (Barton, 1998a; b; Brickhouse, 1994; Harding, 1986; Longino, 1989; Osborne and Barton, 1998; Rosser, 1986; 1990). These scholars are critical of the notion that science learners, and particularly those who had been excluded from science, need only be provided with deeper conceptual understandings of the concepts in science to make it back into the science fold. They argue that the problem of exclusion is deeper that that: it demands a critique of the very scientific knowledge that other reformers take for granted. That is, the very content, culture, and discursive practices in the science classroom need to be opened up for critique (Barton, 1995). Instead of trying to assimilate all students into an unexamined discourse of science by using the "construct of difference" (Barton, 1995, p.33) to legitimate the dominant ideas in society, science education should be a forum for critiques that have the potential to transform the lives of students. These critiques of the

practice of science, and science education, and the knowledge it has created are premised on the fact that science is enacted by people and thus cannot remain free from personal, political and social bias (Richmond *et al*, 1998). Personal, political and social concerns therefore, need to be an integral part of science teaching and learning. In this framework, reform ideas become valuable only as far as they have something to say about science as it relates to the personal, political and social lives of those who are excluded from science education. In terms of their potential for addressing the concerns of inclusion and relevance for the marginalized as identified in this study, the feminist frameworks provide a ray of hope.

One of the major hassles for this framework is having to contest for space within the dominant frameworks of science education, and sometimes its exclusionary focus on women's experiences limit the scope of its influence within science education. Several promising projects in this framework are beginning to generate interest within the field of science education. For instance, Rosser's seminal works on "teaching science and health from a feminist perspective" (1986) and "female-friendly science" (1990) have been used by many in science education as a template for constructing curricula and practices that are responsive to the needs and experiences of women. Howes (1998) provides another example where the application of "difference feminism" (p. 877) to teach a high school unit on prenatal testing by appealing to the interests and experiences of the girls in her classroom. Barton (1995) also documented her teaching of a community college chemistry class from perspectives that include feminism.

Multicultural frameworks

Other reformers more concerned with broader issues of diversity in science education have advanced the idea of a multicultural science education (Atwater, 1994; 1995; 1996a; 1996b; Hodson, 1993; Rodriguez, 1998). Several constructions of multiculturalism in science education have been discussed in the literature recently. For example, one view holds that teaching for diversity in science education involves "learning to implement more culturally inclusive and socially relevant pedagogical strategies" in the science classroom (Rodriguez, 1998, p.590). Another view by Hodson (1993) moves a step beyond the focus on "overcoming linguistic differences, establishing culturally appropriate behaviors, and accommodating to differences in classroom expectations" (p. 689) by drawing up a scheme of three possible approaches to a multicultural science education:

In the fist approach, which he calls "Science Education in a Multicultural Setting," the use of both written and spoken language is adapted to avoid disadvantage to those with language difficulties, especially those for whom English is a second language Hodson, 1993). Attention is also paid to the 'language of science education', and more opportunities are provided for students to explore and develop understanding. Subject matter that recognizes and utilizes the culturally determined knowledge and experiences of students is used with culturally appropriate learning experiences.

In the second approach, which Hodson (1993) calls the "Anti-racist Science Education," textbooks, worksheets, and other curriculum materials are reviewed for purposes of removing all offensive and racially stereotyped content. More democratic school organizational procedures and learner-driven teaching/learning methods are

established while drawing attention to ways in which science and scientific ways of presenting information are sometimes misused to underpin racist attitudes and legitimate discrimination against minorities.

The third approach, the "Multicultural Perspectives for Science Education," draws in exemplars from a variety of cultures and countries and privileges the contribution of non-Western scientists to present science (Hodson, 1993). Furthermore, emphasis is placed on the culturally specific nature of scientific practice and to issues of justice, equality and freedom in the discussion of scientific and technological practices.

These three approaches to a multicultural science education derive from and mirror the compendium of classroom approaches identified by scholars in the broader field of multicultural education (see Melnick, 1999; Raptis and Fleming, 1998; Sleeter, 1989; Sleeter and Grant, 1987). All three approaches, however, stop short of embracing the more radical approaches that call for a total reconstruction of the science content to promote social action for transformation. For example, Cornbleth and Waugh's (1995) idea of a "transformative" practice and what Sleeter and Grant (1987) called the "multicultural and Social Reconstructionist" strands do not seem to find a place within the agenda of multiculturalism in science education. In the latter two approaches, science concepts, themes and problems would have to be written and taught from different perspectives of race, class, gender, and ethnicity with a view to promoting social action for change in schools and outside. This, as Melnick (1999) argues, is a very difficult challenge which accounts for the absence of comprehensive models to demonstrate "that curricular and instructional transformation are indeed possible" (p.13). In addition to the curricular and instructional difficulties involved in constructing such a practice, the

dominant frameworks and politics of knowledge upon which the whole enterprise of science and science education is premised are not compatible with such a "multiple perspectives" approach. The influence of the alternative discourses to science education will, therefore, also depend on their ability to master the resources to occupy the socio-political space in the field of discursive practices and ideas.

Cultural frameworks to science education

One response to the failure of the multicultural science frameworks to move beyond the prescriptions of the dominant culture in science education has been the development of the cultural approach to science teaching and learning (Aikenhead, 1996; 1997; Jegede, 1995; Pomeroy, 1994; Swift, 1992). Based on the premise that science is part of a wider cultural matrix of society or a "subculture" (Aikenhead, 1996; 1997), it has a distinct set of norms, values, and views on nature, knowledge and life itself. In this view of science, teaching and learning involve cultural transmission (Hawkins and Urevbu, 1987). To distinguish themselves from the traditional approach to cultural transmission, that of assimilation, advocates of the cultural perspective to science education propose the idea of 'border crossing' (Giroux, 1992). The concept of "border crossing" is used to explain how students move between their various cultural locations, e.g., home culture, youth subculture, school culture, and the science education culture. In this framework, all students - - western and non-western alike - - experience science as a foreign culture with borders that they need cross to be part of science education. Research work in this framework has focused on the extent to which the science subculture is congruent or discordant with the other dominant cultures within which the

students are embedded (Baker and Taylor, 1995; Cobern, 1994; Costa, 1995 as discussed in Aikenhead, 1996; Jegede, 1995). The more different the students' subcultures, the more difficult the processes of "border crossing." The strength of the cultural frameworks lies in their recognition of the traditional approaches to science education as a form of Western cultural transmission. The extent to which science educators take seriously this view of science as a subculture and adopt methods that promote "border crossing" as opposed to assimilation of students, provides better opportunities for promoting the inclusion of the marginalized students. This strength, however, also happens to be the very weakness of this framework. That is, by theorizing science as a subculture of Western culture, it negates the possibilities for reconceptualization of the discipline and distorts the history of science as an accumulation of contributions and perspectives from a diverse group of peoples and geographical locations.

Science-Technology-Society (STS) framework

Another set of proposals aimed at relevance in science education involve the attempts to combine the content of science and technology in discussing themes that have social relevance, like acid rain, pollution, and nuclear energy. The influence of this framework as an approach to injecting relevance into science education is diminished by the contradictory and contesting approaches that are often adopted by its advocates. For example, although the AAAS (1989) proposals seemed to support an STS approach, its elaboration of content and standards (AAAS, 1993) are less embracing of the STS approach. A clearer statement on STS comes from the National Science Teachers Association (NSTA) in the USA, when it advocates a view of STS as "the teaching and

learning of science in the context of human experience" and asserts that it "represents an appropriate science education context for all learners" (NSTA, 1990 as cited in Layton, 1994, p. 37). The NSTA view is, however, a minority view as most advocates and teachers consider STS to be just a chapter, a unit or a course within a school's science education program, and not a framework on whose basis science education can be reconceptualized (Bybee, 1993; Solomon, 1994; Yager and Tamir, 1993; Ziman, 1994). Aikenhead's (1994) review of various STS curricula in Canada, Europe and the USA illustrate the dominance of the tag-on approaches (where STS is somehow attached to the traditional science curriculum). The lack of clarity about the place of STS in science education (whether it is science education or just STS attached to science education) and its lack of attention to the issues of diversity, power and privilege in science education, make it less ideal to guide transformative practices in science teaching and learning.

Eclectic frameworks

The discussion of the alternative frameworks, separate from each other, in the preceding section may be misleading in suggesting tight borders separating the frameworks. In practice, teachers and researchers often appeal to several frameworks at once to make sense of classroom reality. In fact, the most promising alternatives in terms of equity and social justice for the marginalized science learners tend to combine two or more of these frameworks to understand and change classroom practice. As Rivera and Poplin (cited in Atwater, 1996a) pointed out, "neither constructivism, critical theory, feminism, nor multicultural education have developed an adequate way of responding to many of the meanings learners construct" (p. 831). Accordingly, Atwater (1996a)

explores a possibility for combining social constructivism and multiculturalism, while Taylor and Cobern (1998) advocate for something of an eclectic model that combines concerns from social constructivism, critical theory, feminist perspectives and cultural frameworks in science education. A few examples of actual research studies that hold promise for providing deeper insights about efforts to reconceptualize and reconstruct science teaching and learning in schools will be examined.

In his study of strategies for addressing the resistance to ideological change required to confront racism and oppressive social norms in the classroom (as opposed to pedagogical change) of pre-service science teachers, Rodriguez (1998) uses a framework that combines multiculturalism and social constructivism. His framework, which he calls "sociotransformative constructivism (STC)" (p. 589), links the concerns of teaching for diversity with those of teaching for understanding. Rodriguez (1998) is concerned with not only helping pre-service teachers affirm the abilities of **all** students to construct knowledge in the context of the learning communities in their classrooms, but also with helping them to deconstruct the "structures of power from which established cultural, historical, and institutional contexts spring" (p. 599). The pre-service science teachers are encouraged to think about the power structures that facilitate or undermine learning for the marginalized students. Analysis of classroom practice using the STC model focuses on four elements:

- **The dialogic conversation**: derived from Bakhtin's notion of "dialogicality," this involves paying close attention to who is doing the talking? Whose voices (insight, values, and beliefs) are being (re)presented by the speaker/listeners?

- **Authentic activity**: based on Dewey's notion of "educative experience," students are urged to go beyond the hands-on, minds-on activities, but to also reflect on how the subject under study is socio-culturally relevant and tied to everyday life.
- **Metacognition**: a major theme of the individual constructivists and Freire model of practice, students are instructed to develop a sense of consciousness and agency about their own ways of learning.
- **Reflexivity**: which focuses on students becoming aware of their social locations (ethnic, cultural, class etc.), academic locations, and how these influence their learning. That is, the "culture of power" is examined and transformed. (Rodriguez, 1998, p. 599-601).

In another synthesis of the different alternative frameworks, Osborne and Barton use a combination of critical theory and feminist perspectives to study issues that arise out of their own efforts to create a "liberatory pedagogy in science" (Barton, 1998a; 1998b; Osborne and Barton, 1998). This synthesis allows them to raise questions about how science is represented in schools and classrooms (and who has the power to sponsor these images), and how the identities of those who are included (and those who are excluded) are constructed by the various discourses of science (Barton, 1998a; Osborne and Barton, 1998). These are questions that have important consequences for who becomes **included** in science and science education, and whose **voices** get represented in the scientific discourse in the classrooms.

It is these questions of identity construction that are central to this study, more especially as they relate to science teachers. Very little is said, in the science literature

reviewed here, about how science teachers come to embrace one or more of the frameworks identified as guides for changing classroom practices. The question of how particular alternatives get adopted, partially or wholly, becomes more important in the context of the struggles for influence among the various discourses, especially those constructed on the margins. In studying how a group of South African teachers used their "lived experiences" (van Maanen, 1990) to craft classroom practices that are potentially transformative, I seek to contribute to this emerging body of work on the subject of identity and science teaching (Helms, 1998; Volkman and Anderson, 1998). Unlike the two recent studies in science education, one by Helms (1998) and the other by Volkman and Anderson (1998), this study makes no assumptions about the role (or potential role) of the subject matter in the construction of an identity of a science teacher. In fact, the initial conceptualization of the study assumed a much larger role for the political and ideological influences in shaping the professional identities of teachers who teach differently, in transformative ways. As it turned out, other factors including religion, culture, experiences as students, pre-service education and early professional experiences, eclipsed the role of politics in accounting for the changing practices of the South African teachers I studied.

I began my review of literature with an excursion into critical theory, which framed my definition of a transformative pedagogy. Using Giroux's concept of teachers as "transformative intellectuals," I explored the external factors that act to discourage South African teachers from embracing the role of a transformative intellectual. The review concluded with an exploration of some of the current proposals to reform science education internationally. Although many of these proposals hold promise, especially the

eclectic forms of the proposals, their impact and scope of influence in developing countries has thus far been limited. As I quickly found out from the interviews with the science teachers in South Africa, the reform ideas most of which are embraced in the new education policies have yet to reach the teachers in the classrooms. The teachers' changing practice could not, therefore, be explained adequately by looking at policy. Similarly, the teachers' politics could not provide an adequate explanation either.[17] In an attempt to seek alternative explanations for my observations, it became necessary to look beyond the literature reviewed earlier. The review extended to literature on "identity politics."

In the next chapter, I discuss the research design and methodologies used in the study. I also explore the shifts in the conceptualizations of the research and how "identity politics" came to be the privileged framework for making sense of the teacher's accounts of why they were engaged in the kind of practices I saw in their classrooms. In the context of explaining the shifts to identity politics, some of the literature on identity, outside of science education, will also be reviewed briefly.

[17] From my own experiences and interviews with teachers in the USA (during my pilot study), I had come to expect transformative teachers to be influenced by some radical politics that embrace equity and social justice. Data from the South African teachers suggest that although politics was indeed one of the factors, it was by no means the dominant and all embracing factor shaping non-traditional practice.

CHAPTER THREE

RESEARCH METHODOLOGY

In this section I trace the unfolding of the research study, its strategies, and the instruments used to collect and analyze data. I present both the "theory and analysis" of how the research was supposed to proceed, and how it actually proceeded in the field (Harding, 1987: 3). In discussing the origins and evolution of the research questions, the theoretical frameworks, and strategies for data collection and analysis -- in the context of my own life, as a South African teacher/researcher and doctoral student at Michigan State University-- I seek to engage in a kind of self-reflection about my own socialization into the research enterprise generally (Ballenger, 1992).

Even before I had clarified my questions into a "researchable problem," I knew I was interested in a research approach that would allow for the "voices" of the research participants to come out. I had read too much research on Black teachers, especially in South Africa, where I found myself "talking back" (hooks, 1989) to the researcher(s) because I could not hear the teachers' voices in their presentations. In this sense, the choice of a research approach was, for me, as much a political choice as it was a "rational" choice of tools to investigate a particular set of questions about the construction of specific forms of empowering practices by teachers. Cresswell (1998) observes that the **personal** concerns of the researcher often predispose him/her toward a particular research perspective and theoretical framework. In my case, lifting the marginalized "voices" of the Black science teachers was the more important concern.

The purpose of this study is to understand the lives and experiences of a group of Black science teachers who teach differently -- against the grain as it were (Cochran-Smith, 1991; Simon, 1992). These are teachers who teach in ways that seek to empower the learners with skills and knowledge to participate in the social processes of change in South Africa. I seek to understand how these teachers define and construct meaning in their lives (Bogdan and Biklen, 1992; Denzin, 1989a,b); how they make sense of their personal and work experiences (Bruner, 1990; Denzin, 1989a; van Maanen, 1990); and ultimately how they construct their identities in ways which help them to justify and explain the development of alternative constructions of classroom experience for themselves and their learners (Bromley, 1989; Bullough *et al*, 1991; Davidoff and van den Berg, 1991).

Although the study of personal experience, through life history approaches, has always been part of this research study, understanding the processes by which alternative identities are constructed by these science teachers has not always been the central theme of the dissertation. Its ascent can be traced through the various stages of the research process. The theme of "teachers' identities" unfolded as I tried to make sense of the research experience during the on-going initial analysis in the data collection stages and during the more detailed analysis during the writing up of the dissertation. It began to take root in the context of constant prodding by my dissertation director about "what is/are the story(ies) of this dissertation?" This dissertation is about the struggles of three science teacher to construct different, counter-hegemonic identities in their lives and work places. It is also an examination of some of the consequences of these constructed

identities, in terms of their potential for providing a basis for developing classroom practices that are themselves empowering to both teachers and learners.

I began this research with a larger focus on the "results" of the constructed identities, that is, the reformed classroom practices of the teachers. The three major questions of the research (as described in the original proposal) were:

- What do some examples of transformative practices in South African classrooms look like?
- What are the personal, social, cultural, professional, historical and political factors that help shape classroom practices of the teachers who engage in transformative practice at various points in history in South Africa?
- What does this suggest about what form(s) of transformative practices should be fostered and how it/they might be fostered?

Although I was dissatisfied with much of the mainstream research on reformed practice for its major focus on external factors that shape teaching and its silencing of the teachers in the process, the language of my initial focus did not highlight the issues I was most interested in strongly enough; viz. the teachers' lives and meanings assigned to them and how these meanings are deployed to justify, explain and make sense of actions to transform classroom practice (MacLure, 1993). The language of "identity politics" enabled me to find the voice through which to articulate these research interests (Bromley, 1989; Casey, 1993; Osler, 1997a; b; Somers and Gibson, 1994).

In the sections that follow, I chronicle the "life story" of this research, and to some extent that of the researcher, with its evolving focus on the identities of Black science teachers who teach differently.

RESEARCH DESIGN

After several unsuccessful attempts to secure a research grant to enable conduct of fieldwork for this research in South Africa, I took up a full time position as a researcher at an Education Policy Unit (EPU) at the University of Natal, Durban (UND) in South Africa. The Education Policy Unit is a Non-Governmental Research Organization (NGO) founded on a collaborative agreement between what used to be the anti-apartheid community organizations (under the auspices of the National Education Crisis Committee, NECC) and the University of Natal. Under the agreement, the university was to provide 50% of the funding for the EPU, while the remainder was to be generated from fund-raising activities. In real terms, however, the university never lived up to its side of the bargain except to provide for space, both physical and intellectual, for the unit to carry out its policy-oriented research and outreach activities. As a consequence of this design, the EPU became accountable more to its community constituencies than to the university structures. Although it has received wide acclaim nationally, including being commissioned by the national education ministry and several other provincial ones to draft their policy frameworks and white papers, the unit has, until recently, remained peripheral to the activities of the School of Education at UND. Administratively, the unit reports directly to the office of the Vice President for Research, thereby further removing it from the day-to-day interactions with the School of Education. In addition to its income generating (commissioned) research programs within the country, the unit has received much of its core funding from the Swedish and Danish International Development Agencies (SIDA & DANIDA).

At the time of my recruitment, the EPU had seven permanent staff members, four researchers and three support staff, plus two visiting senior scholars, one from an academic department at UND and the other a professor from England. Only two members of the research team were Black (as defined broadly to include all people with a collective experience of racial oppression in South Africa), one African and the other Indian. The senior researcher, who later became the acting director, and the visiting professor from England were the only two female researchers within the unit. Although the unit was small and dynamic, and progressive in its politics, it had not escaped criticism with regards to its recruitment and/or retention of Black researchers. The criticisms of the recruitment and retention of Black scholars by academic and research organizations were part of much larger debate about participation and equity in the various discourse communities shaping the knowledge/power relations in the South African society. What made the EPU special in these debates on participation and equity was is its founding commitment (and major fundraising theme) to the development of Black researchers, especially African women. With only two Black men, both in junior positions, the image obviously didn't fit the commitments. Although these debates on the representation of the Black voices within the research communities especially, and more particularly within the EPUs, were not new to me, it is how they played out in the context of developing my own research and doing fieldwork that they acquired more significance.[18]

[18] In 1987, I had the privilege of participating in some of the community discussions that gave birth to the idea of developing the Education Policy Units, as the "intellectual" arms of the mass organisations that were fighting against apartheid. The EPUs, three of them were established at the time, were conceived as training grounds for a new breed researchers, especially Black researchers, whose work was to be intricately linked to the community struggles to redefine education in South Africa. In the first set of EPUs formed in the late 1980s, two were located at Historically White Universities (HWU), and one at an Historically Black University (HBU). Mainly white "progressive" researchers staffed all of them. The

My dissertation project was negotiated with the management structures of the unit at the time of my recruitment. Although my senior colleagues were hesitant about a number of things in the project I proposed, they were willing, however, to sponsor a revised version of it as part of the EPU application for funding to either SIDA or DANIDA. Some of the issues of concern to them were in fact similar to the questions I had discussed with my dissertation committee and/or reviewers for some of the funding agencies in the USA who had expressed some interest in the project. Chief among the issues of concern was the conceptualization of transformative practice, what its content and methods were, and how it was different from traditional practice. My colleagues at the EPU were not positive about the possibility of finding teachers who embrace a pedagogy of empowerment in the Black schools, especially the schools in KwaZulu-Natal. Their argument was two-fold: First, on the basis of the matriculation results teaching in Black schools could not be expected to be any good; otherwise the results would not be as disproportionately bad as they are. Second, politically KwaZulu-Natal was fairly conservative and in fact repressive of any counter-hegemonic practices such that it would be unfair to expect Black teachers to embrace anything but the official discourse on classroom practice which was mainly traditional. Other reviews by funding agencies raised issues around research approaches, sample size, and the theoretical frameworks guiding the project. The following section provides some responses to the commonly asked questions about the project and thereby engages a discussion on the research design.

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number of these units has since expanded to six, all located at universities with the exception of one. The UND EPU was one of the first to be established in 1987.

THEORETICAL FRAMEWORK

In the original proposal, I located the study within the tradition of critical theoretical frameworks to educational critique and practice. Like other researchers working within these frameworks, I saw the study as another attempt to grapple with the issues of structure and agency in education (for example, Apple, 1990; 1995; Cochran-Smith, 1991; Giroux, 1983; McLaren, 1987; Simon, 1992; and many others). That is, issues about how the structuring of schools and society functioned to produce and sustain relations of oppression and inequality for the different racial, gender, class, and other oppressed groups in society were central to my investigation. Also central were issues about how various social actors in schools, especially the teachers, constructed different practices with positive outcomes for social change within these very constraining contexts. I saw my study as an elaboration of and a critique of Henry Giroux's (1988) notion of "teachers as transformative intellectuals." I was curious to find out what made Giroux's intellectuals transformative and how their lives were constructed to make sense of the goals of social transformation in particular contexts, especially in contexts that works against the attainment of that goal.

This framing of the question, as a social project of critique of schooling in South Africa, was not a problem for my South African defense, as much as it was for the US ones. In fact, in South Africa it emerged as a particular strength of the project. This was in part because of the historical failure by the dominant educational research discourse to problematize schooling and its processes of teaching and learning in the context of the apartheid ideology and structural and economic constraints prevailing in South Africa. The few studies in the vein of critical theory were considered by some as significant,

especially in the context of the new government's programs of social and economic transformations (examples of this kind of work in South Africa include projects by Jansen, 1989, 1990a, 1990b; Julie, 1991/92; Kallaway, 1994; Mncwabe, 1992; Nkomo, 1990; and a few others).

In the USA, however, where the critical theory discourse on social transformation is considered by some as marginal and unlikely to rise above certain levels of 'noise' to seriously challenge the power and privilege of the racial and ethnic majorities, the theoretical framing was viewed as a disadvantage. In the view of some of the funding reviewers, a study located on the margins, theoretically, was unlikely to raise issues that are relevant for the center. For me, however, the strength of the theory lies in its ability to provide the 'space' to examine the center from perspectives developed on the margins. That is, by studying the perspectives and practices of teachers on the margins (in terms of their non-traditional approaches, and being Black), we are likely to be even more reflective about the dominant practices and their outcomes.

TRANSFORMATIVE PRACTICE

Although I was less clear about what a transformative practice would look like in different classrooms and contexts, and what specific science content it includes or excludes, I knew enough conceptually from the "people's education for people's power" projects of the mid-1980s and practically from sitting and learning in classrooms constructed by Black teachers like Mr. Juluka to wonder about what it would take for these alternative practices to take root in the South African system. These images of teachers who teach differently posed a serious challenge to some of the gloomy images of

classroom teaching in Black schools, as presented in mainstream research in South Africa and elsewhere. The major goal of this pedagogy of difference was empowerment for social participation. I could not claim that all Black teachers teach to these goals, but I knew some who endeavored to, at least at certain historical times and places. From my reading of the literature, no one had ever attempted to study the lives of these teachers in South Africa, and only recently have such projects found favor in the economically developed nations as well. I was thus curious to find explanations of the teachers' constructions of difference.

Finding teachers who teach differently is never easy anywhere, for one has to first construct the differences one is looking for. In a situation where the differences are themselves the subject of the investigation, the task becomes compounded. Beginning with a review of literature in science education, I found pointers on ways in which difference in classroom practices can be constructed. For example, teaching for inclusion as in "science for all" is one way of constructing difference in classroom practice (AAAS, 1989; NRTS, 1996; Richmond, 1998). Another example is that of "cultural relevance" in the content and pedagogy of science and math education (Aikenhead, 1996a; Banks and Banks, 1995; Heath, 1994; Ladson-Billings, 1995; Sutherland, 1999). Similarly, an investigation where difference is constructed around 'teaching for social transformation' seems legitimate, especially in the context where such a transformation is the major item on the national agenda. The study strives to construct explanations of why some Black teachers choose to engage in this kind of practice.

DATA COLLECTION METHODS

Interviews

The main data collection procedures I used were interviews/conversations and participant-observation methods. I used three different kinds of conversation formats to learn about the teachers' visions of a transformative practice and how they connect to the stories of their lives. First, we talked in formal interviews that were focussed (Whyte, 1984). These were based largely on the interview protocol I had prepared and given to the teachers at least a day before the interview.[19] Much of the initial data on the teachers' life stories was generated from these kinds of conversations. These conversations tended to be longer, lasting anything between an hour-and-half and three hours. I had at least one such conversation with every teacher in the study. Second, we talked in formal interviews that were open-ended (Spradley, 1979). For most of these interviews, I prepared a list of possible prompts to areas of questioning that I wanted to pursue. I used these conversations, mostly, to generate data on the teachers' interpretation of particular events in the classroom and their point of view and elaboration on aspects of their stories I found interesting or confusing. Most of the focused interviews were tape recorded, except for those conducted with one of the female teachers who was not comfortable with any audio recording of the conversations. In all cases, I took detailed notes, which I filed and organized under each participant. The open-ended interviews varied a great deal but were shorter, lasting anything from 15 minutes to an hour. These kinds of conversations occurred more regularly during the study, especially during the observation periods.

[19] Copies of all the interview protocols and the questionnaire used for the survey are included in appendix A.

The third type of conversation I had with the teachers was the informal conversations. These are the types of conversations we had outside of the formal context of interviewing. These conversations often took place outside of school, in the corridors, in staff rooms when there were more people, and generally in settings where it was impossible and sometimes undesirable to record the conversations. For example, on occasion Mr. Sithole and I went out for drinks and used these sessions to talk about all sorts of issues including topics that were of interest to the research. Similarly with Mr. Tshabalala, we arranged to meet almost every time I went to Johannesburg on business trips unrelated to the study. We talked as friends and did things together during those times, and often we engaged on issues pertinent to the research. I made notes of these informal conversations where issues that had the potential to inform the study had been discussed, within a few days after the conversations. Although initially I tried to make these notes in the evenings of the same day of the conversations, the pressures of my other research commitments at Education Policy Unit often made this impossible. I set myself a target of making notes of relevant informal conversations within three days of the discussions and where it was possible, I began the next formal conversations with some kind of a restatement of the important issues raised during the informal discussions. For example, when Mr. Tshabalala had told me a lot of the history of the boarding school he went to for secondary education at a soccer game, I began our next formal conversation a few months later by telling that I had not been aware of X and Y about the school. This way of introducing the discussion often got us back to the issues we had talked about informally before proceeding to another set of issues. In this way, I was able to check on my notes, and also get as much as it was possible on tape during the formal

conversations. Soon after getting to know the other teachers in the study, I would meet and talk with them outside of school in some very unplanned conversations. For example, I had similar encounters with Mrs. Hlophe, one of the three focus teachers in this study, at a science teachers' workshop in Durban. I also had informal discussions with both of the other female teachers whose practices I studied, at an out-of-school cultural day celebration event. Our conversations in the staff room were also informal and got a lot of other teachers, who were not part of the study, involved in the issues of discussion. My goal was to allow the teachers to talk as freely, as was practical, about the various issues important to them, using their own common sense notions and concepts.

As part of my other work at the EPU, I was able to interview several policy-makers and government officials about a number of policy issues that help to define the context within which the identities of the sample teachers were formed. Most of these were formal conversations where I sought to understand the policy-makers understanding of what it means to teach differently and the policy context within which such a practice could occur. I also had access to a number of important policy documents from which the dominant constructions of the identities of Black teachers and their teaching could be read. Constructions of these issues on teachers' identities in the newer policy documents of the Government of National Unity (GNU) and utterances by policy-makers provided interesting reference material for telling the stories of the three science teachers in this study.

Almost all the formal interviews were conducted in English except for the set of interviews with one of the female teachers, who saw "no reason" why we had to conduct

our conversations in a language that was foreign to both of us. This was an interesting point because indeed at times the sample teachers struggled to articulate the deeper meanings of their utterances in English. To break the tension, on such occasions, I sometimes provided the English word I thought the teachers were trying to find or gave the expression in an African language. Teachers often did not find it easy to code switch once the conversation had been started in English. Part of the reason for the reluctance to code switch may be found in the ways language is taught in Black schools, that discourages such a practice and perceives it as a form of incompetence. In that context, I was never certain whether the words or expressions I had provided were the appropriate ones for articulating the teachers' own stories. The dilemma for me as a researcher in the project arose from the fact that my research was now located within the broader research of the Education Policy Unit and had to be shared with colleagues who did not speak the African languages. The infrastructure for the project did not support a wide scale use of an African language as the major language of the research. I used two strategies to try to reduce the constraints of language on the ability of the teachers to tell their stories in their own words and ways. First, I often restated what I thought the teachers were saying or gave another example and then asked for their comment. This technique worked better with the two men with whom I was most familiar, Mr. Tshabalala and Mr. Sithole, who had little problem disagreeing with anything I said that was out of context. My conversations with the women in the study were more "polite and polished" and disagreements were not likely to be brought out distinctly. The conversations were governed by many social and cultural conventions in our society that prescribe what can be said and how between men and women in the society. Also, the fact that the women

in the study, except for one, were much older than I was further constrained the nature of the conversations. A positive consequence of these constraints, however, is that the women controlled their stories a little more than the men did. I allowed them to organize and tell their stories in their own ways more than I did with the men. For example, without them raising issues about their husbands and partners, I could not ask them about the role they play in their lives as teachers.

The second strategy I used to reduce the negative effects of language was to conduct all the informal conversations in an African language, mostly IsiZulu but sometimes in IsiXhosa and SeTswana. Although I include this as a research strategy for addressing the impact of conducting our conversations in a foreign language, the situation could hardly have been otherwise. That is, outside of the formal conversation settings it was automatic to revert back to the African languages, and code switching in that context was spontaneous for some of the teachers. The formal interviews were transcribed, and in the case of the one teacher whom I interviewed in IsiZulu translations to English were made, by a number of research assistants assigned to me by the Education Policy Unit. All the research assistants, mainly undergraduate students, were trained briefly on how to do the transcriptions and "debriefed" after the transcription to preserve the integrity and confidentiality of the data. The quality of the transcriptions did vary among the research assistants, creating a need for some cleaning up by the researcher.

Collectively, the three types of conversations I had with the teachers provided a lot of data on the teachers' lives and work experiences, which I filed under each teacher. I read notes and the transcriptions of individual teacher interviews and created categories around which to be build stories of their lives. In the first level of analysis, I created

about 23 categories (or "bins") to organize the data. The categories included such organizers as schooling (primary and secondary), family, perspectives on 'good teaching', teaching experiences, university/college experiences, lesson expectations, descriptions of a typical lesson, and further education. I asked more questions on each category over the 18-month period of study and filled the "bins" accordingly. As I re-read the texts over and over again, I reduced them into larger chunks from which I could tell the stories of the lives of the sample teachers. For example, I collapsed such categories as lesson expectation, typical lesson, lesson preparation, previous years' approach to the lesson, students' understanding of the lesson under one category on "classroom practice and visions." I did this reduction for all the teachers in the study. The reconstructed categories allowed me to tell a unifying story of each case.

Observation method

I used this method to observe teachers in schools and classrooms over an 18-month period from February 1997 to August 1998.[20] For Mr. Sithole and Mr. Tshabalala, I was able to negotiate one-week breaks from my commitments at the EPU to travel to Gauteng for the fieldwork. I took three such breaks during 1997 specifically for this data collection, and also used other days when my EPU research commitments took me to Gauteng. For example, part of June and the whole of July 1997 I was contracted to do research work in Gauteng for the national Department of Education (DoE). In February of 1998, closer to my wedding which took place in Gauteng, I was again able to take time off and visit both Mr. Sithole and Mr. Tshabalala's classrooms. I was able to visit them

[20] The school year in South Africa begins in January and ends in Early December.

again for a week in July-August of 1998. I was able to visit Mrs. Hlophe' school from June 1997, when I first distributed the questionnaire to the schools. The observations with her were slightly difficult to schedule given her busy schedule during and after school hours. She was involved in the provincial curriculum reform initiatives, which required her to attend a number of meetings, which were sometimes scheduled within short notice. I visited her several times during 1997 and 1998, often for two successive days at a time. Initially I planned for four such visits during the second half of 1997, as per request I had made in the questionnaire for no more than 6 hours of observation per year. As we got to know each other, and with a couple of sessions when I would show up and find her tied up in one unscheduled meeting or another, it became easier to extend the period of observation into 1998. We reached a new agreement that I could just show up anytime, and, if she was not in a meeting we could talk or I could observe her teach. Despite this agreement, I made a point to call the day before though, just to be sure and to get information about the day's lesson.

The observations provided a context for understanding the visions of transformative practice and stories of their experiences that the teachers brought up during the conversations. I used the conversations and the observations to feed off each other and help me understand the local meanings of concepts and interpretations. For the observations, I used an observation protocol that I helped to design in the Michigan Statewide Systemic Initiative (MSSI) policy and program review study at Michigan State University (see Appendix A). I paid attention to the nature of the tasks assigned, the teachers' presentation strategies, their assessment tools and strategies, classroom discourse (who said what, to whom and in what language), and probed teachers on their

perspectives on aspects of my observations. I wrote notes of classroom observations with my comments and questions along the margins. Over the 18-month of observation, I varied my focus of observation sometimes paying attention to only one or two aspects of the categories noted above. To see teachers engage in classroom teaching, talk to students and colleagues, and grapple with the exigencies of the moment, gave me a deeper insight into their lives and workplace experiences. I wrote brief notes of about a half a page each on what I thought were the salient features of the lesson and/or the day's observation.

In writing up the case studies of the three teachers, I selected lessons and aspects of lessons that were typical of the observations and help me articulate the complex stories of each teacher's visions and practice.

LIFE HISTORY/LIFE STORY/NARRATIVE RESEARCH[21]

My interest in studying the subjective meanings of the teachers' experiences with constructing a different classroom practice, set the limits on the kinds of approaches that would allow for a decent exploration of the issues. Qualitative methods of research seemed appropriate for this study. For, according to Denzin and Lincoln (1994), they involve "the studied use and collection of a variety of empirical materials -- case study, personal experience, introspective, life story, interview, observational, historical, interactional, and visual texts -- that describe routine and problematic moments and meaning in individual's lives" (p.2). The particular focus of the research is the life story

[21] Like Maggie MacLure and many others, I use the terms such as Life history, Narrative and Life story with the "semantic fuzziness that is tolerated (and indeed unavoidable) in everyday language" (MacLure, 1993). The term is used to encompass a variety of research practices that focus on the articulation and ordering of human experience in order to construct meanings about the subjective reality of social actors

narratives of Black science teachers that places the "study of teaching and sponsorship of teachers' voice at the center of the research action" (Goodson, 1996, p.6).

In my choice of life history research, I was influenced by other scholars whose work explores similar issues about teachers who have dedicated their lives to empowering students to engage the power relations that give rise to inequality and oppression (Butt *et al*, 1992; Casey, 1993; Goodson, 1984; 1992; Knowles, 1992; Middleton, 1989; 1993; Nelson, 1992; Nias, 1989; Osler, 1997a, 1997b; Weiler, 1988). From these studies we are beginning to learn more about Goodson's argument that the actions of teachers cannot be separated from their personal socio-historical past (1984). Consider, for example, Lortie's (1975) notion of the power of the schooling experience in providing what he termed the "apprenticeship of observation" which many new teachers "activate" in their own classrooms. Collectively, these studies suggest a number of dimensions of people's lives that have an impact on their practice. The teachers' previous careers, even as students, and life experiences shape their view of teaching and the way they set about it (Casey, 1993; Goodson, 1984; Knowles, 1992; Middleton, 1993). Their 'life outside school' together with their latent identities and cultures shape their practice (Goodson, 1984, 1992; Casey, 1993; Middleton, 1993; Nelson, 1992; Osler, 1997a & 1997b). Teachers' career cycles, whether they are beginning teachers, veteran teachers, or even student teachers, play a significant role in decisions to change classroom practices (Goodson, 1984; Huberman, 1993; Knowles, 1992; Osler, 1997a & 1997b). Casey (1993), Middleton (1993), and Weiler (1988), who studied different groups of feminist teachers, have also drawn our attention to the role of political and

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(Bruner, 1990; Connelly and Clandinin, 1990; Riessman, 1993; Weiland, 1995). For a comprehensive review of research in this domain see Casey, 1995/96.

epistemological frameworks in crafting classroom practice. Goodson (1996) and Ginsburg *et al* (1992) also elaborate a view of the work of teachers as a "political and social construction" by active social agents (p.4-5).

Although we are now better informed about what aspects of life histories may play a role in the crafting of teaching practice, we still do not understand how these factors get translated into practice. Middleton (1989; 1993), Bromley (1989), and Casey (1993), for instance, propose the mediation role played by access to radical social theories in helping feminist teachers translate their own experiences of marginalization (past or present) into meaningful and empowering practice for their students. Knowles (1992) uses Crow's (1987) concept of "teacher role identity" to explain this connection between biography and classroom practice. Knowles' argument is that teachers' childhood experience, their early teacher role models, their previous teaching experiences, and other critical incidents in their lives, all come together to shape their "image of self as a teacher," which is significant in their development of practice in the classroom[22]. Despite the increasing number of life history studies of teachers, most of them are still largely descriptive with little theoretical framing to allow a broader test of the emerging understandings. And as Osler (1997b) observes, very little of such work has been done in the low-income countries. South Africa is no exception to this trend. Fewer studies have explored the question of teacher identities and the ways in which these impact on their work (see Macleod, 1995; Walker, 1996). The present study is located within these efforts to understand the identities of teachers who are engaged in

[22] What is significant about most of these studies is their finding on the marginal influence of teacher education on practice, thereby suggesting the need for us think differently about current programs designed to prepare teachers or those designed to help practicing teachers (staff development & in-service education).

one form of an empowering practice and the impact of these identities on their classroom practices.

This study of three science teachers is an exploratory research of a set of issues on what it means to teach differently under conditions of practice in South Africa. It is not intended to provide generalizable claims that would characterize the entire spectrum of science teachers and science teaching in South Africa. The strength of the study, however, lies in its ability to weave in many complex aspects of each teachers' life and context of practice which would otherwise not be possible using the conventional studies (Weiland, 1995). I chose three teachers who were different on a number of attributes commonly associated with variations in teaching practices such as the type of school they worked in, their own educational background, geographical location of the school, and gender, in order to develop understandings about how these contextual variables play out with different teachers. The experiences of the three teachers were also sufficiently common to their cohort of science teachers in South Africa. In this way, their stories can be read by many who confront the challenges of changing practice and constructing counter-hegemonic identities in South Africa and elsewhere. The study of three teachers provided sufficient breath and allowed me to dig deeper into the issues of each case without being overwhelming in the context of limited resources of time and human capacity especially.

FRAMEWORK FOR ANALYSIS OF TEACHER NARRATIVES

The most significant shifts made in the process of carrying out and writing up this research project is to be found in the frameworks used to make sense of the data. My

approach to the data analysis moved from a pre-occupation with finding the general themes and patterns by which the teachers' lives and actions could be explained. I was interested in understanding the deeper meanings they assigned to the particular social categories, e.g. age, race, ethnicity, poverty, church and religion, and others through which they chose to tell their stories. How these meanings are constructed, and used to justify, explain and make sense of their actions in the classroom became significant. The object of the study, therefore, shifted in some important ways. First, within a few months of beginning the project, it became clear to me that there were no consistent and pervasive science reform ideas similar to those advanced by many organizations in the USA that would explain the shifts in the teachers' practices. The new discourses of curriculum 2005 were still being formed and represented a privileged discourse of policymakers at that time. Second, the grand narratives of people's education and the broader anti-apartheid politics were not enough to explain the shifts in the teaching practices of these teachers, in part because the people's education agenda had by now lost its momentum and/or had been appropriated into other discourses of foreign origin - - more particularly the Outcomes Based Education (OBE) approach which South Africans believe they imported from Australia, New Zealand, the United Kingdom and Canada in that order. Why, then, were the participants in my study pressing ahead with their transformative agenda?

The stories of their lives provided some of the answers. Their upbringing in a complex web of relationships, and cultural, religious and economic circumstances provided interesting lines of inquiry for my study. I found it important, therefore, to listen and pay attention to the teachers' context and time-bound definitions of

transformative practice, some of which may/may not have similar consequences as the science reforms advocated in the United States and elsewhere globally. Gloria Ladson-Billings' (1995) work on the practices of exemplary teachers of African American students, which others would characterize as "just good teaching," came in handy as I sought to disengage my stranglehold on the definition of a transformative practice under these conditions. It was also important for me to understand the ways in which the lives of the participant teachers had provided the context for their transformative agendas. Identities and solidarities forged on the basis of these identities promised a better model for explaining the actions of these transformative practitioners. As Somers and Gibson (1994) argue about social actors in general, they "act because of who they are" and not because of interests and a set of learned values (p.53). Identity theories suggested more powerful ways of explaining difference among social actors in ways that took account of time, place and relationality (Bromley, 1989; Somers and Gibson, 1994).

Data analysis

The data from the life stories were analyzed for content features that brought out the teachers' struggles to overcome the normative identities and practices that attempted to define their lives and work experiences. Appealing to the poststructuralist notions that words and texts do not have a fixed and intrinsic meaning, my analysis sought to discover how meanings were constituted through the contexts in which they occurred and the social processes that defined them (Weedon, 1986). The meanings of the teachers' lives and identities are therefore constructed within contexts that are both material and discursive. My analysis thus presents life history narratives in their relatedness to the

material social practices and power relations that construct them. By presenting teachers who are different, the analysis seeks to reveal other meanings that may be present within the "regimes of truth," (Gore, 1992) and examines how they can operate differently in specific contexts. Unitary notions of teaching in Black schools or being a Black teacher are replaced by complex constructions of social identity -- where race becomes a social construction like class, ethnicity, gender, and socioeconomic status. How these identities and meanings are constructed, from what resources, and how they are used are all-important organizing questions for the analysis.

More concretely, my analysis borrows from Dollard's (1935) seven themes for judging life history, as modified and restated by Polkinghorne (1995) as guides in generating storied history or case study from gathered data in what he calls a narrative analysis: I have taken the liberty to adapt and restate them in a way that makes them useful to the analysis in this particular study.

- First, the descriptions of the cultural context in which the storied case study are constructed. This part of the analysis seeks to present the contextual features that give specific meanings to events so that their contribution to the plot can be understood. This is what Somers and Gibson (1994, p.61-63) refer to as the "public narratives" which focus on the cultural and institutional formations larger than the individual (e.g. family, church, government, and workplace organizations).
- Second, an analysis of life stories based on what van Maanen (1990, p.172) calls the four "existential themes" of corporeality (lived body), temporality (lived time), spatiality (lived space), and sociality (lived relationships with

others) is done. Somers and Gibson (1994) refer to this second stage as the construction of the "ontological narratives" of who we are.

- Third, an analysis of the meanings and understandings constructed of each situation or significant event using both the conceptual vocabulary generated by researchers and the "meta-narratives" (such as systems of production like capitalism and nationalism) is done. Somers and Gibson (1994) separate this stage into two distinct phases that involve the constructions of the conceptual and the meta-narratives/master-narratives. It is this particular analysis that allows for understanding of the influence of the "regimes of truth" (Gore, 1992) on the experiences and meanings assigned to the teachers' lives.

NEGOTIATION AND ACCOMODATION OF RESEARCH INTEREST WITHIN THE EPU RESEARCH PROGRAMS

After several in-house EPU seminars, negotiating both my own research interests and those of the institution, I developed a modified proposal that allowed for my dissertation research to be pursued in the context of a much broader study of science teaching practice in schools in KwaZulu-Natal. The proposal for the new study included both Black and White science teachers and located their practices within a set of reported practices and perspectives in a small survey of teachers in more than a dozen schools. The new study was constructed as having a number of phases: Phase I was to be a kind of a pilot for the larger study. In real terms though, phase I was the stuff of my dissertation: it involved in-depth observation and interviews with two teachers who lived and worked

in the Gauteng province, Morapeli Tshabalala and Movement Sithole[23]. These two teachers were selected first on the basis of my familiarity with their practices and their willingness to participate in the research study and second on my colleagues' insistence that we include teachers from Gauteng as an "insurance" against the uncertain prospects in KwaZulu-Natal. In a very complex way, phase I was a response to at least two pressing imperatives: first, the need to begin data collection soon enough into the new year (1997) to enable sufficient analysis for presentation at a conference in the latter part of the first quarter of the 1997; and second, to conceive of and try out research procedures and analytical tools to warrant continuation with the larger project which had since been funded to the tune of R187, 000 by DANIDA.[24]

Phase II, the KwaZulu-Natal component of the study, involved a survey of 87 teachers from whom a sub-sample of seven teachers were selected for in-depth observation and interview. It is from this sub-sample of seven teachers that Nozibele Hlophe, the third focus teacher of this study, was identified and approached on the basis of both the responses she provided to some of the questionnaire probes and by nomination from both the educational authorities in her region and her principal. The three focus teachers of this study were thus selected in very different but complementary ways.

[23] The names of persons and schools where teachers work are all pseudonyms chosen to protect them from easy identification.
[24] The South African currency is Rand, R. The dollar equivalence, $1 = R6.25 (as of 05/28/1999).

DESCRIPTION OF THE FIELD

KwaZulu-Natal (KZN) Province

The study was conducted in two geographical provinces of South Africa, KwaZulu-Natal and Gauteng provinces. KwaZulu-Natal province has the largest education department in the whole country. It serves a population of about 2.7 million students. It is one of the poorest provinces in the country and is the hardest hit by the political violence and disruptions that engulfed the country towards the elections of the new government of national unity. For purposes of addressing issues of educational access and quality, it presents an array of challenges to policy-makers.

Despite being one of the poorest regions in South Africa with high rates of unemployment and illiteracy, KZN has some of the best schools in the country and has consistently produced students within the top ten in the country. However, it has also produced schools within the bottom ten in the whole country. The disparities between the rich and the poor are more conspicuous in this region because of its large rural communities. It has a mix of urban township schools, suburban schools, farm schools, and schools serving 'squatter'/informal settlements, formerly whites only schools, formerly Indians only schools, formerly coloreds only school and a preponderance of rural schools formerly administered by the KwaZulu-Natal homeland..

Although KZN provides a potentially rich environment from which to explore the themes of this study, its choice was judicious and practical based largely on the considerations of my employment situation. In terms of my focus on Black teachers who teach differently, I do not feel compromised by this choice of the research site. The

choice was still as contingent and based on some principles of nomination, including self-nomination, as it was for the other two teachers from Gauteng (and would have been had the study been conducted only in Gauteng).

Gauteng Province

The Gauteng region encompasses the Johannesburg-Soweto area, which has often been referred to as the nerve center of South Africa. For purposes of addressing issues of educational access and quality, it also presents an array of challenges to policy-makers. For, despite its being the richest region in South Africa, it has a high number of unemployed persons in the country. The disparities between the rich and the poor are more glaring in their effects on the rupturing of the social fabric in many communities in this province. Like KZN, Gauteng also has a mix of rural schools, urban township schools, suburban schools, farm schools, and schools serving 'squatter'/informal settlements. My choice of studying teachers in this province was shaped largely by my familiarity with the area, having taught in two different schools in the area and lived most of my youth there. My familiarity with the socio-political setting in the region proved to be an asset in probing the stories of the teachers.

TYPES OF SCHOOLS[25]

As noted earlier, the context of science teaching was very different for the three science teachers who participated in this study. Mr. Sithole is employed in a "regular" township school in Evaton. His school had over a thousand students with just over 10%

[25] In appendix B, I present a very brief typology of the universe of schools found in South Africa.

of them in grade-12. The school is located in a very old township of Evaton with houses more than 30 years old. In the immediate vicinity of the school a lot of new four-roomed houses have been built in the last 10 years in what used to be a vacant piece of land. The school itself is 20 years old this year, and Mr. Sithole chairs a committee that is charged with organizing activities to celebrate 20 years of the school's existence. Most of the students at school are from the neighborhood with low socioeconomic backgrounds. Some, however, come from as far as Soweto, which is 30km away. With two other high schools within a radius of 1 km, it is surprising that all three of them have to turn students away at the beginning of every year. This is because of the large numbers of students and the skewed provision of facilities such that school buildings are sometimes erected next to each other while students in other townships have no facilities at all. Under the new South African School's Act (SASA) of 1996, students can attend any school of their choice but schools have to give preference to children from the neighborhood first.

Mr. Tshabalala teaches in a Finishing school, which is a type of school that was created for students who wished to repeat Grade-12. Finishing schools are special types of schools that exist only in places with very high failure rates and high demands for readmission to sit for the Grade–12 examination. They are very few in number per province and are allocated space in existing schools. They draw teachers from existing schools with surplus teachers, and in Gauteng groups of teachers who could not be employed in permanent posts by the Department of Education were assigned to a number of such Finishing schools, moving from one to the other on any given day. Most of the students in Finishing schools are older, generally less successful at regular school and could be from anywhere in the township or outside. Mr. Tshabalala's finishing school is

located at the school where he was originally assigned in Soweto. As a result of this interface between the two schools, Mr. Tshabalala often functions as part of the two schools simultaneously. For example, he was the de facto athletics coach at both schools due to lack of interest among his colleagues at both schools. The schools began with 130 Grade-12 students in 1996 but had grown to double the number in 1997. There were six groups of about 60 students per class and Mr. Tshabalala taught Biology to all but one group. At the beginning of 1998, the government suspended the Finishing school project for lack of money and Tshabalala was reassigned back to his old school.

Mrs. Nozibele Hlophe teaches at a boarding school in one of the townships around Durban. Boarding schools represent a special group of schools that are often privileged due to their ability to generate a good share of their own resources and revenues. Fees are much higher in boarding schools than in regular township schools for instance. These schools represent a kind of privilege mostly for students with middle and upper class backgrounds. Students from lower socioeconomic backgrounds often attend these schools as day scholars as opposed to boarders, although still the fees are relatively higher. Mrs. Hlophe is the science head at one of these schools and she specializes in physical science. As there are only two such schools for Blacks in the townships surrounding Durban, I will not discuss the many other details about the school to protect its identity and the people who work at the school. In our discussion with Mrs. Hlophe we did acknowledge the difficulty I would have in trying to protect the school's identity and hers. Both boarding schools are exemplary in terms of performance in the matriculation national examinations and have often featured prominently in the news media and policy research studies, which often do not disguise the names of the schools

or teachers studied. In spite of this difficulty, I seek to preserve the confidentiality of the research site and participants.

For purposes of writing this dissertation I have elected to discuss only three of the six teachers I observed and interviewed for the following reasons: First, I have eliminated all the teachers for whom no science lessons were observed. Because of sudden changes in the allocation of duties at his school, one teacher, Mr. Pule, was reassigned to teach only mathematics and not science. Second, of the three women in the study, Mrs. Hlophe's case seemed to raise many of the issues of this study in much more depth than I had opportunities to explore with the other two. The three case studies of Mrs. Hlophe, Mr. Tshabalala and Mr. Sithole are different both in content and scope to enable a sufficiently broad discussion of the major themes of this study.

Chapters four, five and six present case studies of each of the three science teachers who participated in the study. In each chapter, I introduce the teacher again more elaborately, discuss his or her visions and practice, and then provide an account of their life and work experiences.

INTERLUDE

INTRODUCTION TO THE CASE STUDIES

The next three chapters present case studies of the three science teachers whose practice I have characterized as transformative. Their cases each tell a story about how their practice is a constant struggle to steer their pedagogy away from a singular emphasis on "covering the material" to a much broader practice that includes three major themes of quantity, quality and equity.

Covering the material or what I have come to call the concerns with **Quantity** refers first, to the amount of examinable material a teacher is able to cover during his/her lessons, in order to "prepare" the students for the end-of-year matriculation examination. At another level, the "Quantity-concerns" refer to the number of students, in his/her previous classes, who have made it through the matriculation examination. That is, the percentage pass-rate a teacher has achieved previously with his/her grade-twelve science classes.

Teaching for "conceptual understanding" or what I have come to call the concerns with **Quality** refers to the kind of teaching that pays attention to the science concepts students learn in the science classroom, the meanings they make of these concepts, how these meanings are constructed and articulated, application of the concepts to personal life, and how the teacher assesses the students' understandings of the concepts. It also highlights the repertoire of instructional approaches and design of learning contexts that a teachers uses to facilitate such conceptual understandings of science.

Teaching **all** students or what I have come to call the concerns with **Equity** refers to a teacher's efforts to teach in ways that support the inclusion of **all** the learners in the classroom. These concerns included, in these three cases, such issues as how to use the students' own experiences to enhance their understanding of scientific concepts and when to let them use SeSotho, or another one of the eleven national languages to participate in the classroom discourse although such a language may not be the official language of instruction. The equity concerns also included concerns about when is it appropriate to selectively focus attention on girls in the science classroom.

The shift from an over-emphasis of "content coverage," to a situation where covering the content becomes the **basis for** and actually **enables** the achievement of conceptual understanding by **all** learners, is what highlights the practices of Mr. Sithole, Mr. Tshabalala and Mrs. Hlophe in this study as transformative. That is, the "content-coverage" becomes a vehicle for students to develop understandings of science and also provides the teachers with the space to include **all** students without having to worry about parental and district expectations for the completion of the syllabus and student achievement in the national examinations. The teachers' ability to demonstrate "coverage" of the syllabus, and good achievement by their former students removed the need for district inspection and close supervision of their work, thereby, allowing them the space to pursue their other goals of "quality" and "equity" in their teaching of science.

The stories of the three teachers are not necessarily parallel, but in presenting them I have tried for equivalence within the constraints of trying to highlight the salient features of each unique case. I have organized the stories around four major subheadings, that is,

- a brief description of the teacher's vision of transformative practice,
- a description of (an) instance(s) of this vision in his/her classroom and the dilemmas involved,
- a life history account of some of the influences on the teacher's personal history and work experiences, and finally
- an analysis of the important themes from the foregoing subheadings to account for why each of the three teachers engage in the kinds of practices I have described as transformative.

CHAPTER FOUR

COMPETING GOALS, CONFLICTING EXPECTATIONS AND THE VISION OF A TRANSFORMATIVE PRACTICE: THE LIFE AND WORK OF MR. MOVEMENT SITHOLE: [26]

DESCRIBING TRANSFORMATION IN MR. SITHOLE'S PRACTICE

Movement Sithole is a Black male in his late 30s, who teaches Biology and Afrikaans at a township school in Evaton. At the time of our first meeting for this study, he was in his 10th year of teaching, nine of which he has spent at his present school. Located in the middle of a newly developed neighborhood with less defined roadways, finding my way to the school was a little tricky although I had been to the school several times before. Once at the school, negotiating entry was also tricky in that I had to get clearance from the school security guard who keeps the gates locked at all times during school hours. Without an appropriate pass to show evidence of an appointment, clearance had to be obtained through the principal of the school who in turn had to confirm with Mr. Sithole before letting me in. This was a new access procedure designed mainly to regulate students' entry and exit during class times.

For a while since his initial difficulties with meeting the requirements of "covering the material," Mr. Sithole has been trying to craft a more "relevant" pedagogy for his science students. When asked to describe his classroom practices, he uses such terms as

[26] Names of persons and schools are all pseudonyms.

> independence, less dependent on the teacher, different teaching styles, breaking the monotony of the teacher in the classroom, group learning, giving chances to all students, preparing for the world, preparing for success, using (student's) personal experiences, using different words to show understanding and allow for different languages in class.

When abstracted from their context of development and use, as I have done here, these terms do not mean very much. Viewed against the language of voice, inclusion, conceptual understanding, collaborative learning, orchestration of discourse, and application of science concepts to authentic situations, that is often privileged by the current discourses on science education reform, Mr. Sithole's descriptions begin to acquire more significance. His language does not, however, conjure images of a revolution, but a revolution may just be the appropriate metaphor for his practice of science teaching at Uthukela secondary school in the dusty streets of Evaton.

His practice has shifted from his earlier concerns with just "covering the material," to include concerns with "quality" and "equity." How these shifts of emphasis from the one goal to the other play out in an actual classroom set-up is illustrated by the following example of Mr. Sithole's lessons on the "Nervous System and Physiological Co-ordination." Before describing the lesson itself, a description of the context is warranted.

CLASSROOM CONTEXT AND ENVIRONMENT

The setting is a large secondary school in Evaton, a township 50-km South of Johannesburg. The focus is on Mr. Sithole's biology classroom, which is a medium – sized school laboratory, with seating arranged in three rows of tables and chairs.[27] Each row has three large, movable tables put together and a set of chairs scattered around each

[27] See Appendix C for a sketch of the classroom and seating arrangements.

set of tables. In the first row (nearest to the door) are seated seven boys and six girls, and fourteen girls are scattered around the seats in the middle row, while five more girls and seven boys occupy the third and last row of the classroom organization (nearest to the teacher's/researcher's table). This is his grade-12 biology class.

Lighting in the room is provided by four filament-type lamps on the ceiling, with only one of these in good working condition. There is a front demonstration bench (on top of which is a broken overhead projector) and two long side benches on each side of the walls (with the windows). Behind the demonstration bench is the chalkboard, next to which lies a commercial model of the skeleton. The classroom walls are decorated with different kinds of student drawings of biological structures – ranging from human to plant morphological structures. Despite the faulty electric light system, the room was well lit from the rays of the sun on this otherwise cold August afternoon. With no heating system in place, and some broken windows in the classroom, everyone had their coats and jackets on during the entire lesson. As a participant observer in this classroom, I sat at the back of the laboratory, where Mr. Sithole has his table. I had to negotiate for some space on the table that was full of books and reference materials. As the students had just taken their mid-year examinations, Mr. Sithole's table was full of different bundles of exercise books well arranged by grade level. Several kinds of textbooks and reference material were also organized neatly on this table. Behind the teacher's table is a glass cupboard with a few plant specimens preserved in small bottles. Mr. Sithole sits right opposite the door facing (at almost an angle) towards the front bench and the chalkboard.

LESSON 1 AND 2: NERVOUS SYSTEM AND PHYSIOLOGICAL CO-ORDINATION

The day's lesson, a continuation of a section on **the Nervous System and Physiological Co-ordination** was the second in a series of about three or four lessons.[28] It is a section of the Human Physiology theme in the prescribed biology matriculation syllabus. As the syllabus stands, aspects of Human Physiology are first introduced in the grade-10 syllabus but are then 'forgotten', only to be resurrected at grade-12. This lack of continuity and proper sequencing in the curriculum is one of the conceptual blocks identified by Mr. Sithole as contributing to his students' struggle to understand the notion of a "system" and how it explains the co-ordination of bodily functions. Mr. Sithole was critical of the South African biology curriculum in this regard:

> ... For example, certain topics, they are not relevant, you see, to the pupils teaching wise, you know, especially in biology, like you see sometimes, you, Standard 10 (grade-12) there is no direct link what with of Standard 9 (grade-11) that there is a gap. For example, in Standard 9 they are dealing about the animal kingdom for instance, in Standard Eight they are dealing with tissues and cells and the digestive system, you see that and also population dynamics, you see that. Standard Eight now and at Standard 10 level they are doing almost the continuation of Standard 8, in other words the child rest in Standard 9 with a new system altogether, you see that. There could be a link from Standard 8 up to Standard 10 or rather from Standard 9 to 10 should be one system and then Standard 6 and 7 and 8 should be one system continuation and at Standard 9 another system. Ja, which is going to be related (interview, August 04, 1998).

Mr. Sithole's critique of the biology curriculum is framed by his three goals for science teaching. First, he worries about including **all** his students in the lessons. He discusses this concern in terms of the lack of relevance of subject matter to his students. Second, he identifies gaps in the organization and structuring of the curriculum, where related

[28] Mr. Sithole had planned three lessons for this unit, but based on his assessment of the students' understanding of the concepts and themes, he decided to add another lesson that would tie the unit together for the students.

concepts and subject matter are discussed in two separate grades, one, two or three years apart. As with many of the reformers who advocate for conceptual understanding in science teaching, Mr. Sithole proposes an organizational structure that would link concepts within and among grade levels. He proposes the use of phase organizers, for example using the concept of an ecosystem, to link subject matter presently found in grades 8, 9 and 10 - - which would be a junior secondary system. Subject matter for Grades 11 and 12 would also be linked in a similar way according to his proposal.

Mr. Sithole teaches biology twice a day to the same group of students. He runs an hour-long early morning class before school starts in order to "cover the material" and then sees the same group of students during the regularly scheduled biology lesson at various times during the school day. In the first lesson on the Nervous System and Physiological Co-ordination section, which Mr. Sithole taught in the morning of that day, he used commercial models of the skeleton and of the brain to discuss the various components of the nervous system.[29] He discussed the "three main components" of the nervous system, viz. the central nervous system, the peripheral nervous system, and the autonomic nervous system. Using his models, he then picked up each one of these components of the nervous system and discussed their composition. His discussion focused to a large part on the morphological and structural details (as opposed to the functional aspects).

In the second lesson (the main focus of my discussion), he was planning to focus on some of the functional aspects the nervous system. Coming to class a few minutes

[29] In addition to the regularly scheduled class period for biology, Mr. Sithole runs an early morning class (an hour before school starts) for his grade 12 classes four times a week (Monday to Thursday). The morning class, which began right after the mid-year school recess was designed to help students "cover the material" in preparation for their matriculation examination.

early, he began to draw three structures on the chalkboard: the Structure of a Multipolar Neuron; the Scheme of a Synapse; and A Schematic of an impulse across a Synapse.

As the students came into the laboratory, Mr. Sithole asked them to settle down and draw the structures in their books.[30]

T: O.K. Now we are going to discuss the movement of the nerve impulse.
T: (to the researcher) I want them to understand the transmission of impulses, before we discuss the structure of the spinal chord further.
T: First, draw the structures (that are on the board) in your notebook.

There was a loud buzz of activity for about 15-20 minutes as the students began to draw and talk in their small groups. Although most of the students have a textbook they share with at least one other person in the classroom, Mr. Sithole preferred them to get into the "habit" of drawing the structures in their own notebooks so that they can "own" them and get "practice." If part of being a scientist involves the ability to represent observations or ideas in words, models, pictures, charts, and other forms of communication often used within the scientific community of scholars, then Mr. Sithole wasn't taking this for granted. He was allocating time and space for his students to master these tools of participation within the scientific discourse community.

The student discussions in some of the groups involved comparisons of the representations of the structural features and debates about which representations were more or less accurate. In one of these groups, closest to where I was sitting, five or six students got involved in an argument about the representation of the **Synapse**. Their discussion was about the direction of the arrows that represented the (direction of) impulse. The arrows in the teacher's diagram all pointed in one direction - - from the

[30] Unlike the other subjects where teachers – and not learners - change classes, for biology it is the students that move to the laboratory where Mr. Sithole prefers to conduct his lessons. See appendix D for a sketch of the chalkboard work with the drawings.

dendrite of neighboring nerve cells into the cell body of the 'receiving' nerve cell (see Appendix D, for the drawings). One learner who was drawing from a textbook structure, however, drew some arrows showing impulses moving out of the cell body into an axon. When the other students saw his drawing, an argument ensued. The argument was about the fact that the latter student was showing an inconsistent direction of movement of the impulse. The exchange continued for a few minutes about why one representation was "wrong" and the others "correct." The students were deadlocked on what the "correct" way of representing the direction of impulse was.

To resolve the dilemma, they decided to examine a number of drawings from different textbooks. Two more textbooks were brought in (from the teacher's table) for comparison. One of the two new textbooks (brought in from the teacher's table) had a drawing of a synapse that was consistent with what the student in question had drawn. That is, two textbooks had one pattern of drawings and one other textbook plus the teacher's drawing had another pattern - - making it two against two. A resolution could not, therefore, simply appeal to the politically expedient solution of paying attention to the view of the majority, as there was no clear majority in this case, as I sensed they were inclined to do when they brought in the other two textbooks. After a series of second and third rounds of close examination of all the drawings (in the textbooks and on the chalkboard), they arrived at an insightful and interesting resolution of the debate.

Their resolution was that there was nothing wrong with all the drawings - - because the arrows were "not all on the same nerve cell." As one of the students put it (in his explanation of this insight to the others), the synapse was "like a traffic circle where you come in and circulate and then can go out in any direction." That is, nerve impulses

come into the cell body from different directions, and leave through any axon to the effector organ or muscle.

For some experienced teachers, this incident may appear unexceptionable and in fact appeared so to this researcher at the time of the observation. It was not until I saw several of Mr. Sithole's lessons and engaged him in a discussion of what his vision of a desirable classroom practice is, that it acquired more significance. Several things are worth noting about the students' discussion:

First, it occurred before the class had started any discussion on the functioning of a synapse, the transfer of impulses or the structure of nerve cells for that matter. Students seemed to make important **connections** of the key ideas with aspects of work that is normally covered in grades nine and ten, on mammalian and human tissues. I was not able to establish whether the subject matter connections the students were making in this particular case originated with their prior learning of the concepts from the earlier grades, or whether it was a result of their preparatory reading for the day's lesson, which Mr. Sithole makes a point to assign at the end of each day.

Second, the discourse was spontaneous within the group and in fact the teacher never became aware of it as he was busy with the other groups until the end of the class period when I brought it to his attention. What began as a small discussion about representations and drawings grew up to become a rich source of engagement in the subject matter of science. It became a source for collaborative construction of meaning.

Third, the discussion among the students took place in SeSotho (one of the eleven official languages of South Africa, not a medium of instruction at this level). SeSotho is a first or second language for many of the students in this classroom, although all

learning and assessment is officially conducted in English - - a foreign language for many of them.

Lastly, the students relied on their own resourcefulness to resolve the debate. The teacher or his chalkboard drawing was not authoritative enough on this issue. Even the one textbook that one student was drawing from was not enough to establish the "Facts" in this case. Several sources were needed and used. More importantly, however, is how the texts were used to construct new meanings on the transfer of impulse. The texts demanded interpretation and appropriation into the students' real world experiences. A metaphor that resonated with students' experiences was brought to bear on the discussion. Their metaphor of a traffic circle, however porous, enhanced their understanding of the concept of a synapse (as a functional unit of the nervous system). This is one instance where the notion of scientific authority was put on the table for scrutiny. Neither the teacher, nor the textbooks by themselves, were vested with this kind of authority. Students were constructing meaning out of what appeared to be a meaningless sketch of a synapse by one of their colleagues. Such an incident as observed in this classroom fills the (policy-practice) gaps in most of the science reformers ideas about changing the way science is presented to students in schools.

"That to me is what teaching and learning is about!" (Interview, August 04, 1998) was the teacher's excited response when I drew his attention to the incident. Pressed to explain what he meant, he drew my attention to three aspects of what his classroom practice was trying to achieve:

I. A safe and nurturing environment for collaborative learning ("group learning" as he called it) among his students;

II. A habit of "independent" exploration and learning for the students and "less reliance on the teacher";

III. Making the subject matter accessible to the students by "bringing in their experiences into the classroom." (Interview, August 04, 1998)

The excitement in Mr. Sithole's voice when he declared this incident as illustrative of what he was about in his classroom, sounded like a deep sigh of relief for someone who had finally found the right word or expression or event to showcase his ideas. As it turned out, he had not expected me to press him further about what he meant by his declaration. The incident seemed to provide some live evidence of all he had been trying to capture in words in our earlier discussions, on what he was trying to achieve in his classroom. This was more so because every time I went to observe his classrooms and ask him questions about what he thought of aspects of the lessons, he would later reverse the questions to find out what I thought of his teaching, his students, and their "chances of success" (which I was never sure whether he meant success in the matriculation examination or in life in general or both).

His questions or maybe my inability to engage with them in a very candid and forthright manner always made me feel uncomfortable during and after the interviews. Here was a colleague (or former colleague), with whom we used to spend lunch hour breaks (as teachers) together sharing experiences and discussing shared visions of a transformed society and education system in our country, trying to rekindle the critical collegial discussions that we shared, whose attempts I could feel myself turning down. I was more worried about 'changing the research environment' if I engaged in a critical conversation on aspects of his classroom practice. There were things I would have

challenged and engaged him on, in our 'shared visions' of transformation in the late 1980s and early 1990s that I felt awkward discussing in this case. For, to do that now could have led to different emphases in his classroom practice at the time of my observation, and I was not sure how and whether I would be able to resolve that for the purposes of this research study. Although I wanted to use the opportunity of observing Mr. Sithole and discussing issues with him to reflect on my own ideas and practices, I was conscious of the power differentials between the two of us and therefore avoided actions that had the potential to color what he was doing. Our relationship and discussions of his classroom practice were not the same as when we were both high school teachers sharing stories about how to survive and beat the system in preparing our students for a post-apartheid society. They were colored by the fact that I was now a policy researcher with one of the leading universities in the country. In addition, I had just returned from a few years of study abroad where I had acquired a Master's degree in Curriculum and Instruction and supposedly knew more about the teaching of science and curriculum issues we were discussing with Mr. Sithole. This placed uncertain burdens on our relationship, more so because we had not seen each other in the "new South Africa" (post-1994) where some of our ideals were supposedly now legitimate concerns for school reformers.

His classroom practice was, however, not a straightforward implementation of the three goals he enunciated in our conversations. It was much more complicated and murkier than is suggested by this summary. At other times, for instance, his classroom appeared no different from the many that have been studied and characterized as traditional: Consider the following excerpt of a **10-15 minute** segment of the class lesson

I have just discussed: (just after the students had finished drawing the structures in their notebook):

T: In the morning we introduced the nervous system. We said it is divided into how many parts?
SS: Three
T: Name them in your groups
SS: two minutes pause (after a little caucus by each group, comparing their answers) one student in each group raises a hand to answer the question
S 1: Central Nervous System (CNS)
S 2: Peripheral Nervous System (PNS)
S 3: Autonomic Nervous System (ANS)
T: Yes, each one of these three, the CNS, the PNS, and the ANS has only one type of nerve cells. The neurons.

- For example the Multipolar (or motor) neuron (pointing at the diagram on the chalkboard).
- As you can see here (pointing at the drawing), it is divided into two parts. (again pointing at the parts) The cell body and the axon.

- The impulse moves from the cell body into the axon and then its relayed to some other parts of the body where the stimulus originated.

- Another example, are the Unipolar neurons. These are found mainly on the inside organs such as the brain and the embryo.

- In the morning, we discussed the feeling of pain when a needle pricks you. We said this response is controlled by the .....?

SS: Autonomic nervous system

T: O.K. let's now look at the structure of the axon so that we can understand further how the impulses are transmitted

(Observation, August, 04, 1998)[31]

Mr. Sithole then spent the next **15 minutes** going over the structural details of the axon, and the cell body (completing the discussion on the nerve cells). He then began to discuss the movement of impulses, drawing attention to the chemical imbalances that facilitate this movement across the nerve cells. In this part of the presentation it was the teacher's voice that rose to prominence with students participating only when called upon to remember or make some connections to some other aspects of the syllabus. Although

[31] T = stands for Teacher; S= stands for particular student as denoted by a number S1, S2 etc.; SS= all students together.

still making an effort to engage students by asking questions and creating space for collaborative constructions, the lesson was moving along in a definite direction, pre-determined and driven by the need for him to get through some aspect of the content he thought important for the students to learn at that point in the unit. What distinguishes him from others written about in studies of modal practice, however, is how he makes a conscious effort to weave back and forth between the three goals of quantity, quality and equity within the same set of lessons.

For example, during the discussion of the movement of chemical substances that trigger nerve responses to particular stimuli, Sithole discussed the role of the potassium and sodium cations in the process. He then asked students to make connections to another section of the syllabus:

T: These cations (Na and K) move inside the cell body because of electrical charge differences. Where else did you hear of these two cations?
SS: (some students murmuring) (in the section on) Macro-nutrients
T: Yes, when we discussed the micro and macronutrients required by our bodies. That was in January, heh?
SS: Yes
T: Are these two, micro or macronutrients?
SS: silence (about a minute and half)
T: (rephrasing the question) Are they needed in large or small quantities in our bodies?
S2 (girl): micronutrients
T: Do you agree?
SS: (unsure) Yes
T: Why?
S3: (Inaudible)
T: Yes, they are micronutrients for animals. You better go and brush up on that section.

(Observation, August 04, 1998)

By this time, the 50 minutes class time had elapsed, but no one seemed to pay any attention to the bell as Mr. Sithole continued to finish his explanations of the movement of the impulses from the axon to the dendrite through the synoptic junction.

If I had completed my observations at this point, and had no discussions with Mr. Sithole about what was happening in his classroom, and had not seen the rich interactions among his students, I would probably have been justified in concluding that there was not much to characterize as transformative about his classroom practices. Yes, he seemed to be at pains to nurture an environment of collaborative learning. He required students to caucus their responses with their group members first before sharing with others in the class. Furthermore, he opened students' responses to a public process of verification, asking them whether they agreed or not and why. He was also enthusiastic about making connections between several concepts and themes studied earlier by his students. These latter aspects of his practice acquire even more significance in the context of the overall culture and practice of science teaching and learning in South Africa, which discourages innovation and learner-centeredness in the classroom.

Historically, the culture of teaching and learning in South African schools has tended to favor tradition over innovation, especially so, at those grade levels where the public national examinations matter the most (Mehl, 1990; Walker, 1996). In that context, it is not too difficult to establish that the aspects of Mr. Sithole's practice described here are non-traditional. However, contextualizing them further within his own learning and development, and life challenges and visions for a new society provides an added dimension to their significance and their potential for being transformative.

Consider, for example, how he concluded this particular lesson on the transmission of impulses and movement of ions across the differential in the nerve cells.

The lesson was now 5-10 minutes overdue (at the end of the school day), but there was still full attention and no sense of shuffling in anticipation of leaving the room.

T: We said the acetylcholine facilitates the movement of these charges from one axon to the cell body across the imaginary junction, the synaptic junction.

Let's compare this to something we all know, a telephone.

Now think about how it is possible that when you phone a person on the side he or she can respond?

S4: Because of technology
T: how does it happen?
SS: Pause (about 2 minutes)
S5: Because of the movement of positive and negative charges through the wire
T: Yes, through the movement of charge through the wire. Remember your telephone is connected to the poles on the street. These poles have wires that conduct charges from one point to another, when you have charge differentials.
SS: (some students seem confused as they try to make the connections between the telephone lines and the movement of impulses).

One student (S5) from the one group closest to the door (column one) spontaneously stands up and tries to clear up the confusion by doing a little demonstration.

S5: (to the teacher) you are the dendrite. You are sending a message to the muscle or the cable, (pulling one female student to join) and here is the axon.

I need two charges, the positive and the negative charges (points to two other students to join).

Using the teacher's chalk he draws a line (on the floor) between the teacher and female student (supposedly to illustrate the synoptic junction).

When the K-plus and the Na-plus (positive charges) move in and negative charges move out, then the message is transmitted until it reaches the dendrite.

As he tries to get the students who represent the charges to move in and out (to show movement of charges), there is confusion as more students contribute ideas on how to make the demonstration more meaningful. Some ask him to draw lines around the teacher and the female students to indicate the membranes through which these ions have to travel to reach the cell body or the axon. He gets a little confused, and some students from his group stand up and begin to add features to the (live) structures. By this time, there was so much noise and shuffling by a number of students in the class (all wanting to add something to the discussion) creating a commotion that began to attract some of the students from the other classes (who were leaving school or waiting for their friends outside Mr. Sithole's classroom). It is at that point, about 20-25 minutes after school time, that Mr. Sithole decided to stop the lesson, promising them an opportunity to do this demonstration again the following day.

(Observation, August 04, 1998)

Here again was an interaction of his principles at work: his students, working on their own initiative in response to the teacher's not so well formed metaphor about telephone lines and the transmission of nerve impulses, were collaborating on creating a different way of understanding the processes of transmission of the nervous impulses - - using their own experiences and resources. What began as an individual student's effort to clarify himself and help others understand the transmission of impulse across a synoptic junction through the telephone metaphor, spontaneously became a collaborative venture by all members of the class - - to create a metaphor for understanding the subject matter. In this case, the teacher was able to recede to the background and become a resource in a rather unfamiliar manner. That is, the teacher ended up as one of the apparatus for demonstration by the students, at a level more or less equal to all the other members of the discourse community in this classroom.

I have discussed the experience of these two lessons on the nervous system to illustrate several features of what I found intriguing about Mr. Sithole's classroom practices and also because I had the opportunity to observe Morapeli Tshabalala, the other biology specialist in the study, teach the same theme to his finishing school students. From these and other lesson observations I made of Mr. Sithole's classrooms, I found that focusing on the teacher and what he was doing during the lessons sometimes yielded a less than spectacular view of his classroom practices. That is, in this particular case, a broad characterization of lessons as either teacher-centered or student-centered was not a very useful way of looking at Mr. Sithole's practice. For the most part, the teacher commanded the center stage in this classroom but in ways that did not seem to colonize the processes of learning and construction of meaning by the learners. The

teacher provided both the space and the concepts for nurturing a useful discussion and debate among the learners. Students were learning about independence, initiative, science as a social construction, all in the context of learning grade-12 biology - - and, yes, they were also learning about important biological processes and concepts.

In other words, a sharper focus on what the students seemed to be learning in this classroom and the goals for teaching science was more useful in talking about his classroom practice as having the potential to be transformative. Students were engaged in very rich discussions and opportunities to learn, sometimes not in response to some great and extra-ordinary things that the teacher was doing but by engaging in processes of learning within a particular environment that he orchestrated in his classroom. Despite his visions of a new and transformed society that we shared from the days of apartheid, nothing in his treatment of the subject matter in the classroom was overtly political and about transforming the society outside of the classroom. Yet in many ways, his teaching of biology was just about that. He was challenging a status quo that provided too much structure for learning and too few opportunities for independent exploration and collaborative construction of meaning by the learners. As the slogan of the teacher's union for which he was one of the regional leaders declares, he was indeed "chalking up a cultural storm" within the system - - by (re)defining a new culture and identity of teaching and learning in South Africa.[32] For him though, this was all just part of striving to be a "better teacher," a "person who is always prepared in the subject and always trying to impart his knowledge and also to make the pupils understand the subject by

[32] The notion of the restoration of the "culture of teaching and learning" is a pervasive but confusing metaphor for transforming schools in South Africa. It is used in two senses by policy-makers, first to characterize what needs to change inside schools and classrooms in terms of teaching and learning, and

implementing various methodologies to alleviate such problems (as the pupils) they might have." (Interview, February 18, 1997)

A very quiet and soft-spoken person, Mr. Sithole is not the kind who would go out publicly and declare war on traditional practices to teaching despite his expressed dissatisfaction with those practices. His was a low-key effort at reconceptualizing science teaching in his classroom. In the next section I seek to locate his practices within the context of who he is at this point of transformation in South Africa and what seemed to drive his non-traditional practices to biology teaching in his classroom.

LIFE STORY OF MR. SITHOLE

At the time of our first meeting for this research, I had known Mr. Sithole for almost seventeen years. He was a high school friend whom I first met when we were both entering the ninth grade at Lwazi high school in one of the townships of Vereeniging. We had both come from different primary schools in the area and had achieved well enough to earn consideration at that academically rigorous high school at Lwazi. Although it had been a struggle for me to gain admission at Lwazi, because of administrative and bureaucratic hitches in our district, Movement had had no such problems of entry into the secondary school. He had come from a fairly respected primary school (for SeTswana speaking children) in the area.[33]

Movement was born and bred in Evaton Township in the early sixties. Although he does not remember any personal or family stories about the political events of the

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second to characterize the physical and external circumstances of schools that need to be restored e.g. the physical infrastructure of most school that need to be rebuilt or refurbished (see DoE, 1996; 1997).

[33] SeTswana is one of the eleven official languages of South Africa. It is also an official and major language of Botswana, a neighboring country in Southern Africa.

1960s, he was born and raised in one of the townships whose name invokes memories of strong resistance by the African peoples to the land dispossession and oppression by the minority government of the day. Part of the reason is that his family never owned land and had come to the township as tenants (from the rural areas). He grew up in a back room (which they rented) that was artificially separated to form a two-roomed house. With his two brothers and two sisters, they lived in this house until he began his teaching career in 1987 when he moved out to his own home. Later, he was able to arrange for his family to move into a bigger four-roomed rental house.

The oldest of the five children, he was the only one to reach beyond the matriculation level (grade 12) in his family. This is despite his family's strong encouragement on education of all the siblings. His mother, a domestic worker who often cautioned them against following her unwise decision of not completing her education before getting married, was eager for her children to get an education that would enable them to have better chances in the world. For Movement and his mother, his brothers and sisters were a bit of a disappointment:

> I could say its due to lack of discipline, self-discipline and also to respect for your elder, too. If your elder brother or if somebody elder to you tell you what you should do so that you should be able to reach your goals and you don't listen, you end up nowhere actually. So they (his sisters and brothers) never listened to me, you see. I always encouraged them that they should learn because in our days we are not living in days whereby we used to have cattle, so we have to depend on education.

For the Sithole family, the "power of an education" was never in question. Their mother came from a family of teachers, who had achieved a great deal within the system. His maternal uncle had risen to a rank of district school inspector in one of the rural districts and therefore the debate between tradition and western type education had long been settled for this family. As argued by Movement, the land dispossession had left Africans

with no land or cattle to raise but instead with an option of going to school in search of a better life.[34] Such an education was the one possession the oppressors would never be able to take away from him and other oppressed peoples of South Africa.

Getting the education, however, often proved challenging because of a number of factors, some political, some cultural and personal, and others structural and inherent to the education system. For instance, in many of the African townships of the Vaal Triangle (the equivalent of a county in the US), within which Evaton and Sebokeng are located, there were more schools provided for the SeSotho speaking peoples than any other group in the township. This practice, of providing schools for specific ethnic groups, represented a fundamental expression of the apartheid policy regarding residential segregation. The architects of apartheid had planned for Evaton and Sebokeng to be SeSotho speaking areas with no residents from the other ethnic groups. In practice, the policy had serious problems, as there were peoples of all ethnic groups who owned land and houses predating the apartheid policies of the 1950s or even the land acts of 1913. As a result, education departments were forced to provide at least one school per area that would cater to the needs of the non-SeSotho speaking groups. The one-school per area policy was never adequate for the needs of the community, thereby forcing some

[34] There is a bit of dilemma in the zoning of the school. The school was originally zoned as a school in Evaton, a semi-formal old residential area where Black people still owned land rights and had lifestyles that represented a rare mixture of the old traditional way of life and the new colonial and apartheid "modern" township life. Landowners in Evaton also owned herds of cattle, which grazed all over, what used to be vast areas of open land in the area. Relative to most new surrounding townships, Evaton remains underdeveloped. The area has a long history of resistance and boasts of one of the first teacher education centers created by the missionaries at Wilberforce Seminary and College. With the development of new townships in the surrounding area, coupled to the dispossession of land rights of the inhabitants of the area, sections of the area were split and rezoned into the emerging township settlements. As a result, the setting of the school is now sometimes referred to as Sebokeng, one of the new townships in the area. With these new developments of rezoning and dispossession of land, people's lives were transformed from being small time, subsistence farmers to working class persons who had to sell their skills and labor at the many steel manufacturing and processing companies in the three cities that surround these townships. A very limited

of the children to attend schools 20 or 30 kilometers from their homes in search of a school where the medium of instruction was the same as their mother tongue or the language spoken at home. Some parents, however, opted to have their children attend the nearest school and put up with the new language demands.

Movement Sithole's educational career also became a victim of these deliberate policies to segregate schooling in the country. As a SeTswana speaker, he was forced to attend a local primary school where SeSotho was the medium of instruction. He attended the school for the first four years of his schooling, until such time that the language issue caught up with him.[35]

T: And then from there I moved to Kabelo because I failed my Standard Two (Grade four) because at that school (interruption)

I: Kanye?

T: Kanye, Ja. They used to talk (Se)Sotho. I was not familiar with the (Se)Sotho language you see. Because we talk (Se)Tswana at home.

I: Okay.

T: Ja. My home language was (Se)Tswana. We use to talk (Se)Tswana. Sometimes, some of the terminology at school was very confusing. As I failed my Standard Two then I had to repeat it at Kabelo ...

(Interview, February 18, 1997)

His senior primary years, at Kabelo – a SeTswana medium school, were much better and more productive. Sithole excelled academically and developed positive ideas about teaching and teachers at his new school.

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number of subsistence farmers still remain in the area, and their cattle and sheep can often be spotted grazing close to the perimeter of the school fence.

[35] Movement's experiences of segregation in primary education are common experience for most youngsters who grow up in the "wrong areas" (i.e. not designated for their own ethnic groups). Similar to

No, I had that eager(ness) of learning because the people who were teaching. Ja. They were not playing, they were teaching. Even the principal was totally involved in teaching. So he was a person who was motivating us most of the time. Then I also passed his subject very well. I remember sometime I got, in the exam, I got a total in multiple choice, in Geography ... So I was very impressed. He was also impressed by my performance. Why, because I was a bookworm, you see. bookworm. I was always reading. I like reading. Ja. I like, I am someone who likes to have knowledge. Always asking other people. Always at home studying my books, you see. Every night do some home works and studying further any work. (Interview, February 18, 1997)

Upon completion of his senior primary schooling, Movement entered a mixed (language) secondary school at Lwazi where we first met in a grade nine class. Although Lwazi secondary was a school with a good reputation, Movement was not happy with his experiences there.

T: Then from there I proceeded to Lwazi where I did my Standard Seven and Eight (Grades nine and ten). So this is where now things seemed to go very slow. I didn't know what was wrong. Because high school level, I mean high school teaching was totally different to that of primary at Kabelo. Teachers were different at high school. They were totally relaxed. Some of them actually. (interruption)

I: What do you mean by relaxed?

T: Relaxed, not teaching with that eagerness of empowering kids with knowledge, you see.

I: mm

T: Especially the Afrikaans one. And some mathematician teachers were not showing that interest of seeing us, especially those who were slow learners in mathematics, you see. So, we had a problem. I had a problem actually to cope with their teaching methodology.

I: mm

T: So, somewhere, somehow then I lacked that interest there in mathematics. But then I had that interest before. So you could say the method of primary and that of a high school was totally different. You see that. So you see most teachers in high school were relaxed compared to that of primary. I don't know what was wrong.

(Interview, February 18, 1997)

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his experiences, being an IsiXhosa speaking youngster, I shifted my medium-language of schooling at

Our discussion of his negative experiences of the junior high school years at Lwazi identified several factors that contributed to that experience. First, there were the pedagogical factors: For Movement, the teachers' approach to subject matter, especially the Mathematics and Afrikaans teachers were not empowering. Their approach was fast-paced and tailored to encourage competition among the learners (who came from different primary schools and who were eager to represent their former schools well at the secondary school) in ways that Movement found destructive. As a result, he was flushed out of mathematics for the rest of his academic career.

This discussion of Movement's experiences at Lwazi offered me a rare opportunity to reflect on my own experiences at the school at that point in history. As we reminisced further on our high school experiences, it occurred to us that our friendship had been shaped by the rather negative experiences at the junior high level at Lwazi. Although we had known each other as classmates at grade nine, we got even closer as friends during the grade-10 year. We commuted together for six months (on the train rides) every Saturday morning to receive extra tuition on mathematics and physical science at the University of the Witwatersrand's Saturday school program for 'disadvantaged learners' in the province. On the three-hour return journey, we talked about all sorts of social issues, and also helped each other on the mathematics and science problems. Although there were four or five of us from the grade ten class, Movement and I were the more regular in the group.

I could relate to Sithole's articulation about the lack of attention to the not-so-bright (or to be accurate: the not-so-articulate and verbal in ways that are encouraged in the classrooms) children in the school, for things changed rather drastically for me after

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grade 3 and continued with IsiZulu until I graduated high school.

the mid-year examinations when most teachers realized that I had been the top student in the class. Indeed, I received relatively more attention thereafter, and could ask questions in class without anyone thinking that I was stupid. The need to attend the extra tuition on Saturday's therefore ceased for me thereafter. Put differently, the opportunities to learn at Lwazi increased and became more meaningful now that I was recognized as one of the good students. For Movement things did not change, and he finally opted out of the mathematics/science stream in grade-11, leaving biology as the only historical trace of his ties to the math/science stream. In grade-11, he registered for what is referred to as the general stream (or what should more appropriately be called the social sciences). It is clear, however, that before opting out Movement had made all reasonable attempts including registering and paying for transport and food at a Saturday school offered by a local university, to stick with the mathematics and science stream. The system, and more specifically his teachers, had in this case failed him dismally. The teachers' "lack of enthusiasm" and "lack of interest on the slow learners" are all part of the pedagogical factors raised by Mr. Sithole in analyzing his high school experiences (Interview, February 18, 1997).

The second set of factors he raised dealt with instructional guidance/supervision issues. Movement felt that unlike his experiences at the senior primary school where the principal was involved in the daily processes of teaching and learning at the school, at secondary level he noted the absence of strong guidance and supervision systems for the teaching and learning processes. Learners were also encouraged to compete each other ("to death") in order to give the school its otherwise spectacular reputation. His

experiences on what happens to the academic "other" in such schools and classrooms are an indictment of these traditional processes of schooling and accountability systems.

Before this transformation in his life as a student (who now had to convince himself that he couldn't do math and science, for he had not made the grade in the external high stakes junior certificate examination), he had to deal with another personal tragedy in his family.

> T: After that I decided actually to look for a job. I never got a job. I was looking for a job because of conditions at home.
>
> I: What do you mean by conditions at home?
>
> T: Ja. Conditions at home. Actually my parents had a problem. They were separating and then my mom could not afford to bring us up. So I decided to actually look for some job to assist her. So I couldn't get a job. It was now about eight months and the work I was looking for it was government work like a police or tickets officer. I went to such places. I never got such a job.
>
> (Interview, February 18, 1997)

Movement's personal history and circumstances of his existence (who he is and his experiences) had recommended him negatively for his job search in the structures of the apartheid government. In the police job, for instance, he was told that he was a few inches short of the required height to be a policemen. Whereas, in the train (ticket) officer, he was found to have had a prior record of having been arrested on a train, for failing to produce an identity document (when he in fact was not of age to be issued with one by the Department of Home Affairs). Having grown a beard at an early age, he had many such brushes with the law enforcement officers who often refused to believe his protests that he was underage in terms of the law. Although he was never convicted of any crimes, the records of wrongful arrest were never erased.

Throughout his ordeal of trying to find a job, Movement's mother had constantly advised him against leaving school, assuring him that things would be fine in the home even despite the changed circumstances. Four months into the new school term, Movement abandoned his job search and went back to school for grade 11. The odds were stacked against him, both in and outside of school. First, he had to persuade the school authorities that he would be able to catch up on four months of work and would not be a burden to his new school. He was eventually admitted on the strength of the representation of his former primary school principal, who spoke at a level that "made sense" to his counterpart at the high school. The only condition placed on his admission was that he would not try to get back to the "more demanding" math/science stream at that late stage of the year. Movement remembers the day of his (re)admission as one important day in his struggle for an education:

> It was 19th April and when I started to go to school at Thandile then for my Standard Nine (Grade 11). Actually they also never gave me a space because they said that I was very, very much late. So I nearly did not attend school that year, but then, due to some other circumstances, and the help of other eh, eh "timer" so they talked to the principal and then until such time he accepted me at school the next month.[36]
>
> (Interview, February 18, 1997)

The fact that he almost lost a year of secondary education remains indelible in his memory. I was never really able to establish further why this was so, except that those experiences of rejection he experienced during the job search and the near loss of an opportunity to pursue his studies together with other experiences over that period of time became significant in shaping his future relations with the apartheid state and its

[36] "Timer" is a street colloquial term for old man.

education structures. The year 1982 was same year in which he would later be detained, supposedly for his activities in the Congress of South African Students (COSAS).[37]

> (I remember that year) because I had a lot of problems, some of the problems like, eh, I had been arrested before 1982 during the uprising in Evaton and I found that was totally not called for because I never done anything wrong. I was presumed to be one of the COSAS members and yet I was not. I spent some days in the prison for nothing. We were mishandled by police. Such things you know encouraged me to actually want to be a lawyer so that I would be able to assist those people, who are mishandled by police in this country.
>
> (Interview, February 19, 1997)

The aggregation of his experiences drove him toward a well-formed consciousness against the oppressive systems of apartheid governance. He began to form an identity of resistance to the oppressive system(s), and conceptualized a role for himself in opposition to the system. That formation of an identity of resistance was more significant given that a few months earlier, circumstances within his family had driven him to look for a job within the very system he was now resolved to challenge. How this identity of resistance and his vision of himself as a "helper" of his people played out in shaping his classroom practice will be discussed later in this chapter.

Movement Sithole worked hard at high school and passed with a matriculation exemption (a kind of endorsement reserved for students who had achieved well enough to receive automatic permission for entry into university level). However, because of his financial circumstances, he was not able to register at university and instead took the cheaper route into teaching. Here's how he described his achievements at high school:

> Having come in late (I came first in my class). So that was showing the determination that I was determined to study and then to proceed with my studies and because always I was remaining behind after school trying to cover up for all they have done in my absentia and then from there Standard Ten (grade 12) as well. So, Standard Ten (Grade 12), well I passed it.

[37] The Congress of South African Students (COSAS) was the most vocal and active student organization formed in 1979 to challenge the control and manipulation of secondary schooling by the white minority government.

> Okay, I got an Exemption ... Ja. So I got that. So I applied to be a lawyer at eh or to study further doing a law degree at eh Rhodes University. So that was my first priority that I would like to be a lawyer or secondly, a journalist or thirdly, a teacher.
>
> (Interview, February 19, 1997)

After working hard to stay in school and succeed, the system again failed Movement in that he was not able to pursue his first or second choice of attending a university because of the economic situation of his parents. In fact, he had to scramble even to pay a R100 (about $16) registration fee at the college of education:[38]

> Ja. She (Mrs. Sithole) was a domestic worker and she was working in the shop, cleaning and so on. So and she had a relationship with the person who sent her there. Who was a relative to those people and told them that I don't have enough money to register, at least R100. So that family of my mother's friend, you know, okay, talked to that businessman of my problem so that I should be able to register. So they offered to help her. So I got to register for the course and it was late as well. (laugh). So I arrived late, at least a week later after registration.
>
> (Interview, February 19, 1997)

One of the remarkable things about Mr. Sithole is his ability to derive humor out of his otherwise hellish experiences of struggle for an education. Although the seriousness of the experiences was not lost, he often laughed when he told the story of how he nearly missed out on an opportunity to become a teacher because he was too poor to come up with the required R100 and when he told the story of his late registrations at senior high school and at college.

Journey into teaching

Armed with a R100 bill, Movement was able to enter college and begin his journey into the profession. Although he found the college experience enjoyable, he also found it to be a challenge academically:

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[38] Education at the college of education, as opposed to university, was free and paid for by the state in return for service to the state upon completion. Students, however, had to raise a registration fee before admission.

> At college it was demanding because I had to study much harder. Because we had to study all the subjects, you see to teach, like sports and eh, art. I remember I never had art at school, so I had to practice that and music also. And other subjects like Guidance and also education and teaching science. Those were other subjects that were new to me. So I had to learn and then the other one that I knew, of course, biology, was third and then Afrikaans. And Afrikaans, I was told to study Afrikaans because I wanted to study English. So I was told that the English class was full and the only subject I can take to support my biology was Afrikaans. And that woman (one college lecturer) told me that I won't have a problem and I won't fail it if I could just study the language like the other languages.
>
> (Interview, February 18, 1997)

His life at college was not only about balancing his work and putting more effort into the new subjects in his curriculum, he also had to use his spare time and weekends to raise money (by selling door to door a variety of cosmetic goods) to survive each day and week. Through his "small business" venture, he was able to help his mother in supporting the family:

> ... This cosmetics thing? It started in 1980 actually when the day when my father left my mother. And the day when I started to go to work after Standard Eight (grade 9). So I failed to get a job and then I decided to go back to school and to supplement that I had to sell something to help my mother to buy some clothes for myself, since she was not earning so much and to buy some goods and also to assist my younger brothers so that they can be something and proceed with their studies and should not depend solely on my mother... Ja, it was difficult. mmm. Because every weekend I had to think about Monday, transport, see that what I am going to eat at school and what I am going to eat the next weekend. You see. (laugh) And clothing you see, such things became problems to me because I had to travel by bus to school. Especially when I was at college. So, on the other hand, I had to achieve my education. It was difficult. Because every weekend, the time when I used to think that I would be sitting down revising, I was thinking about what I will eat at the weekend and during the week. So I had to schedule that for my small business. And I was sitting after hours. I was a worker. So, I sell almost everyday, even weekend, never a special weekend off. Never had such thing. Every weekend, even Sunday. Sunday I had to sell. Sometimes when I was not in church. So, I had to especially month end and fortnights. I have to. So that was the way around to survive. You see that if I was not doing that I would not be able to have money for transport and to buy some clothes for myself and some food for those people at home there.
>
> (Interview, February 19, 1997)

To cope with his demanding schedule of work in and outside of school, Movement developed a habit of coming to school early and leaving late - - in order to catch up with

his studies. This is a practice he has retained through his working years. As a teacher, he comes to school an hour early and leaves two hours later except on days when he has to attend classes (at a local university where he is registered for a degree in public administration). He uses the extra time for several purposes: extra-tuition for his grade-12 students or sometimes works out with his school athletics team (he is also the school sports master). An avid athlete, Movement has participated and completed the annual "comrades marathon" (a 90-km race dedicated to the heroes of struggle who fell on June 16, 1976) three times in the last seven years.

Upon entering college, Movement had very modest goals of helping others "achieve their goals" and "imparting (my) knowledge, especially in the subject in which (I) had much interest (biology)" (Interview, February 19, 1997). He was determined to share and use his experiences to provide better chances and opportunities for others in school. All the challenges in his life had contributed to his convictions to "change things." Many of his experiences in and outside of his professional life all seemed to contribute to this overall goal against the status quo.

MAKING SENSE OF THE CHANGES IN SITHOLE'S CLASSROOM PRACTICE

One way of reading this case study is as a story of one teacher's ability to balance his contradictory goals for science teaching with the conflicting social and professional expectations of being a teacher in South Africa. That is, while on the one hand Mr. Sithole was struggling to reconcile his three goals for teaching science - - "quantity," "quality" and "equity" - - he was also engaged in a process of justifying the kind of

practice that was emerging out of this struggle to reconcile the goals. The resulting practice went much against the images created by the dominant discourses on how to teach science in South Africa. For example, while the dominant discourse of "authoritarian surveillance" (Walker, 1996) created an expectation for his classroom approach to have a distinct emphasis on hierarchical relationships, his emphasis on democratic relationships and participation arising out of his goals for science teaching went against the grain in the profession. How is it that Mr. Sithole was able to balance these contradictions, in a way that they ceased to become contradictions for him, and maintain a practice that went against the grain? What kind of resources did he draw upon to sustain a transformative vision and practice? How is it that he was able to underplay the dominant conceptions of science teaching within the context of his own life and work?

The answer to these questions is not a simple one. It requires us to look closely at the events in his life experiences and the meanings they had for him in relation to his goals for teaching science. His life experiences provided various themes by which he defined his identity and enabled me to characterize him as a transformative science teacher. In other words, for Mr. Sithole to break free of the stranglehold of the dominant discourses that promote modal practices, he needed to see himself in a different light, not bound by these discourses. That is, he needed a powerful new identity as a transformative science teacher to substitute the imposed identities that support modal practices. This new identity of a transformative practitioner is a personal construction by Mr. Sithole from all his experiences as a Black student, science teacher, parent, community leader, and cultural being in an African society. The meanings he gave to

these experiences yielded certain identity forms in Mr. Sithole, which he was able to use in constructing an identity as a transformative practitioner. In my analysis of his experiences and how they all shaped his stance on transformative practices, four particular identity forms stand out: his African identity, identity as a leader and activist, the professional identity, and the identity as a learner.

African identity

Mr. Sithole is an African and has lived in the African townships of South Africa all his life. Despite the oppression and poverty so characteristic of these township communities, the social networks and values are still as intact as they were before apartheid took over on a grand scale. The social values, networks and ways of doing things by communities are often referred to as culture. Aspects of this culture such as the notion that "it takes a whole village to care for and educate a child" provide the intangible tools on which Mr. Sithole draws to construct a transformative identity. The proverb essentially neutralizes the idea of the "other" in teaching and learning situations. The "other" becomes your own, and teaching becomes a personal and cultural involvement. This ethic of caring for and helping the "other" is so obvious in Mr. Sithole's vision for equity in science teaching. It is not clear to me that he bases his pedagogy of inclusion on the tenets of some reform literature as much as it arises out of his cultural responsibility and care for **all** children in the "village." When I asked him, for instance, about how he makes decisions about who should talk in class, he explained it in terms of his desire to get everyone included, especially those who were not inclined to participate in the public settings of the classroom:

> ... sometimes those who have their hands up, you know, most of them are ones who continue to answer questions. Don't give the other kids a chance. Well the other ones, even though they are not raising their hands they know the answers you find that their hands are not actually up but its a little bit up, you see. They want to answer but they seem to be shy, I should think so. So I give them a chance to participate.
>
> (Interview, February, 19, 1997)

Equity for him is about giving **all** children a chance. This is not unlike his own situation, when as a prospective teacher education student an old "timer" from his church gave him a chance by offering to pay his registration fees. In fulfilling a cultural responsibility towards a village child, the "timer" opened up a chapter on equity for Mr. Sithole.

There is another way in which his pedagogy offered chances to his students, that is, achieving good results on the matriculation examination or his concerns with "quantity." The notion of providing chances for his students seems to reconcile his otherwise contradictory goals for conceptual understanding of science with covering the material and preparing for the examination. Since the matriculation examination is everything for the students and their chances for a job or further education in South Africa, it would be unwise to ignore the need for students to be prepared for this challenge. Despite his criticism of the matriculation examination, Mr. Sithole sees no contradiction in giving his students a chance to pass the examination, while pursuing his other goals of equity and quality in science education. As an African, Sithole could appeal to his cultural responsibilities as a father, as elder brother, as teacher and adult member of society to care for and educate **all** children under his care.

Whether it was his involvement in the "Lost Children's Group" who care for the lost and abandoned children in the area, or his involvement in the pre-school committees that are lobbying government to fund pre-school and kindergarten activities presently run by community and non-governmental agencies or his involvement with literacy classes at

a local "night school," or his biology teaching to his grade 12 classes, it all seems to form part of a conscious effort to contribute to the transformation of society and improvement of the life chances of others.

This cultural/ethnic identity form, however, does not only provide for positive features alone, but contains contradictory aspects of culture, which were equally available to Mr. Sithole. For example, although Mr. Sithole had over the years abandoned the use of "the stick," he was not opposed to its use in principle - - on cultural grounds. This expectation for him to act tough and yet be caring and democratic (or inclusive) in teaching science to his students is one of the dilemmas created by the appeal to this cultural identity form. It is obvious that Mr. Sithole chose the features of culture that resonated with his goals. How choices within choices are made, which help us achieve particular goals, remains a question on which further research is needed.

Identity as a leader and activist

From the time when Mr. Sithole was wrongfully arrested as a student, he has never looked back in terms of his development of an identity of resistance. Failing in his first choice to become a lawyer so that he would be "able to assist those people (that he had witnessed) manhandled by the police" (Interview, February 18,1997), he set out to become a teacher with a difference. Armed with a vision of a transformed society and a strong sense of activism, he set out to challenge the status quo in teaching. He described his vision and goal as follows:

> Actually there were many things that were happening in teaching that I disliked most. Especially now at Black schools. You see now. I thought that if I would be a teacher I would be able to change such scene, especially the one of being under-resourced and then most of the teachers being unable to impart their knowledge and the lack of interest in their teaching seems so

> and the actually the environment of our schools is bad...the conditions were really not conducive for being sports persons and for learning.
> (Interview, February 18, 1997)

Two primary concerns spring from this statement by Mr. Sithole. First, he worries about the neglect and under resourcing of Black schools generally. Second, he worries about the lack of support for teachers and the consequent low morale among them. These are two issues that drive his activism in and outside of the classroom. As a Black teacher, he feels a particular responsibility to the students in his classroom (all of whom are Black) and is not sympathetic to those teachers who give up on the kids because the system is not supportive. His approach as a regional leader of the largest teachers' union in the country is to "serve the kids" (Interview, February, 18, 1997) while fighting the "system" for better conditions of service. For him, working for change inside the classroom was intricately bound with working for change at another broader structural level of society. This included working with others to improve the conditions and resourcing of schools, and access to pre-school education and other social welfare and sporting services to (deprived) children.

It is this very ethic of leadership that sustains Mr. Sithole in his pursuit of classroom practices that go against the grain. As a high profile leader of teacher's union that has been in the forefront of campaigning for educational transformation in the country, and whose former president is the Minister of labor in the country, it is possible that Mr. Sithole sees himself as a trailblazer- - a guinea pig in the experiments for social and educational transformation. Since he has not seen the new reform curriculum proposed to transform education in South Africa, he is nobody's experiment but his own.

> So I have not seen the system (new curriculum) actually. What type of system is going to be implemented. I never got a chance to be, a chance to participate in this new curriculum. I don't know what type of curriculum it's going to be. Either, if I had a chance I would say either its positive or negative, I don't know... Teachers' organization are not involved in that. Ja, it's only the bureaucrats at the office who are trying to sort of make a curriculum.
>
> (Interview, February 18, 1997)

Although the language and intentions of the new curriculum would resonate well and support the transformations in Mr. Sithole's classroom, the processes of developing and implementing the new curriculum have been so controversial and contested that much of its appeal is lost to those teachers, like Mr. Sithole, who need it the most.

Coming out of a strong tradition of workers' leadership and political activism which emphasizes democratic principles of consultation, participation, democratic decision-making, it is no surprise to see Mr. Sithole play the science education game by the same rules. He presents students' responses to wider processes of discourse by asking others to comment on the response:

> ... to see whether those students agree with her before I can give my own resolution to the class. Ja, to see whether they understand the lesson the same way the other student who answered the question.... Sometimes I usually ask the pupils to answer the same question, if somebody is asking a question, I redirect the question to them.
>
> (Interview, February, 19, 1997).

The democratic approach to the science discourse enables him to pursue his goals of encouraging participation in the lessons. But, beyond that it opens up a window into the different understandings by the students. The notion of a "resolution," although derived from the political processes of reaching a consensus on an issue, have important relevance to science education. It suggests an approach to science as a social construction, presenting scientific knowledge as generated through processes of public discourse and agreement or conventions (to resolve differences between competing

positions). Discourse and social construction of science knowledge are two of the key features of the new reforms in science education internationally.

Professional counter-identity

The professional culture of teaching in South Africa is grounded on a premise distorted by the various discourses of apartheid. For example, the "teacher qualification discourse" (Walker, 1996) tends to undermine the sense of competence of many older teachers who are defined as "un(der)qualified." For the younger teachers who graduate from colleges of education with an inadequate preparation in subject matter,[39] building confidence to present the subject matter in ways that encourage students to question and participate more can be very challenging. Furthermore, the discourse of "authoritarian surveillance" (Walker, 1996) limits the ability of teachers to make professional decisions about what is appropriate to teach, when and how. The syllabus prescriptions are often over-determined, and all that teachers have to do is to go through the textbook page by page. Such professional expectations create and sustain a weakened sense of subject matter identity among many of the Black teachers in South Africa.

In a professional culture that seems to discourage innovation, to be different requires a very strong sense of self in relation to one's work and relations with others

[39] Entry requirements at Colleges of Education required less than what universities expected of prospective teachers. The latter often expected a first (roughly a C-grade) or second class (roughly a D-grade) pass in the subject of specialization. The result was that most Black teachers from colleges of education have less confidence and mastery of the subject matter. At the colleges, the curriculum takes them no further than what they already know from their grade 12 subject matter, since particular emphasis is placed on ability to teach the subject (more or less what Shulman (1987) calls the pedagogical content knowledge, PCK). Some universities have determined that the college curriculum gives teachers competence at a level one year beyond grade 12, and will therefore credit a college teacher with one year's worth of work if they pursue a

around the workplace. Upon graduation, Mr. Sithole set out on a path to be just that kind of a teacher who would be "different." He was determined to achieve better than many other teachers around him:

> I thought I would teach much better than the other teachers do. For example, either I try to improve myself to make children to understand the subject that I was teaching. Ja. Especially science-wise. Ja. I try to have resources for science. Constructing science without resources is useless ... A better teacher is a person who is always prepared in the subject and always trying to impart his knowledge and also to help the pupils understand the subject by implementing various methodologies to alleviate such problems of the pupils as they might have. By planning, I should think, planning, study further to improve your qualifications so that you must be having much knowledge and be able to share knowledge with the pupils, you see and have some knowledge that deals with the underachievers for some pupils have the interest but being unable to cope with such subject but you must have some other way round to encourage them so that they must be able to have interest in the subject and also to improve themselves. ... So must try to involve every pupil and to treat them equally.
>
> (Interview, February 18, 1997).

Mr. Sithole identifies four aspects of practice that needed his attention in order to construct a strong sense of professional identity. First, issues of equity in dealing with all his learners, paying attention to participation and relevance of subject matter to their lives. Second, excellence in presenting and responding to subject matter issues and students' questions and concerns. This involved developing a strong pedagogical content knowledge (Shulman, 1987) in science. Third, issues of promoting deeper understandings of the subject matter and paying attention to all students' ideas in the classroom, especially those less inclined to be involved in class activities. Lastly, issues of organization and management of the learning environment, with emphasis on proper planning and ability to improvise in terms of finding resources for science teaching. His experiences at the college of education and the in-service courses he attended in his first

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further diploma in education. Interestingly, though, college teachers who wish to improve their subject matter knowledge by pursuing a university degree receive no such credit or exemptions.

year of teaching had not prepared him adequately to assume such a strong sense of identity. He, therefore, had to rely on his resources to build up the competence and confidence in the areas he identified as needing attention. Learning became a vehicle through which he developed this strong sense of subject matter identity.

Identity as a learner

Although Mr. Sithole's first years in the profession were "horrible," in that he was "thrown in the fire" (Interview, February, 18, 1997) of unruly students who were caught up in the middle of an intense political struggle against the system of apartheid education, he wasn't swayed from the early ambitions of to be different. He spent his first two years (re) learning how to be a teacher under these conditions: how to deal with "discipline problems," how to prepare lessons that would capture the attention of students who did not see a future within the apartheid education system, and more importantly how to create avenues for the expression of his visions for a better society, better schools and better teachers. As a start, he enlisted with a non-governmental organization that was offering Saturday classes to matriculation students in the area. This Saturday school project brought his life full circle, as he was paying back his dues in a program similar to the one he had attended as a student, several years earlier. The significance of this Saturday program, however, lies in its effort to spread collaborative learning ("group learning") strategies to teachers in Black schools. Mr. Sithole became a beneficiary of their staff development programs on collaborative learning methods. What began as an extra hour's activity actually contributed a great deal in shaping his classroom practices

in non-traditional ways. He elaborated on the developments in his learning to be a "better teacher" as follows:

> Yes, I should think there has been a change because I am able handle the senior classes, even lower classes, in the same manner. I am able to bring some new methodology in class. Motivate pupils. Make some resources available, either the charts available or the pupils should bring some specimen to class so that to involve them in the learning situation. They should see biology is a living subject and they should be able to do some of the aspects alone, like those projects and in a sense I'm growing with the subject... I make biology a living subject by allowing the pupils to do the courses themselves. Either (they) bring some specimen to class. Like, eh, for example, if I am teaching rhizopus in biology, I will make them to prepare such at home. And to prepare it in that manner like it appears in the textbook. The characteristics and the location of that. How it survives in that condition and that when they bring that to class they must be able to see some of the things that appear there in that specimen which also appears in the text books and then I try to associate that with the text book and the real thing. In a similar sense it develops their mind, understand that the subject is living even though they cannot touch some of the aspect they seem to be abstract. Like reproduction wise, it is not possible always to see how it is reproducing but yet you see some of their structures, you see. In that sense you have that idea of how to understand and how to mind the subject.
>
> (Interview, February 18, 1997)

Mr. Sithole sees himself growing with the subject matter, from his abilities to teach both senior and lower classes equally effectively. He places emphasis on the growth of his pedagogical content knowledge and his abilities to work with and from the student's own life experiences. A pedagogical practice that sought to deal with connections between important themes in biology, that relied on non-traditional instructional approaches - - allowing students to work in groups and contribute their own ideas to the subject struck me as something as I had witnessed in Mr. Sithole's classroom at one point or the other during my visits. That was how he had characterized his changing classroom practice.

Movement is now a regional leader of a national teacher's union in and continues to campaign for the rights of teachers to improved conditions of teaching and learning in schools. Having completed a further diploma in biology teaching with a local distance university, he is now pursuing a degree in public administration. To fashion a strong

identity as a transformative science teacher under the conditions of teaching in the townships of South Africa is a complex task that requires a strong will, a consistent vision of change, and plenty of resources - - cultural, professional and educational - - and the mindset to engage in some form of action for change.

CHAPTER FIVE

MARGINALIZATION AND THE CONSTRUCTION OF A TRANSFORMATIVE IDENTITY

INTRODUCING MR. TSHABALALA, HIS VISIONS, AND COMMITMENTS TO SCIENCE EDUCATION

Morapeli Tshabalala, a bearded black male in his late-30s, is a six year veteran science and mathematics teacher at a large secondary school, Maxima, in a township south west of Johannesburg (SOWETO).[40] He was the most forthright of all the teachers in the study and whose classroom teaching I had the opportunity to observe the most and discuss with him. His school was less organized administratively, making it relatively less cumbersome to negotiate entry at any time when I wished to speak to him and/or observe his classroom. Mr. Tshabalala was very open about what he was trying to do in his classroom and often landed in trouble with his superiors about his non-traditional views and approaches to teaching and learning. In one such instance where he had asked students to work in groups on different kinds of projects in ecology, he ran foul with the office over his perceived demands on the students in his class. His description of the incident elaborates both his vision for science teaching and the varied responses from students and the school leadership to this vision:

> Well, you see you have students and you have to give them projects, so that, 'this is the project that you need to do; you organize an aquarium, you know, this class aquarium that you have, you find aquatic animals there e.g. fish which was the simplest that could be found.' You ask them that although it was very expensive but we have to make it. 'So combine the four of you. Either you combine money or combine whatever, sit down there and work with this project and then after you have bought all that accessories the aquarium, the fish, you know all the necessary the basic environment, the light and everything then you must put fish, the different type of fish, and you must be able to tell us exactly the behavior of the fish, must go there in the laboratory and study the behavior of this fish. Write a report on how do they feed? How do they survive? If one fish died, you must cry and be worried and investigate what happened. How many times you are supposed to change, may be once a month or a quarter or a week to change the water inside. What was the advantage of changing the water every week and not wait for three months or something like that. So you know something that will create some creativity on the side of the students. Then one student went to the office to complain that he cannot afford the project. And then from there, my principal, without even thinking, you know, deeply into the aim of the project, said I should stop all the projects. He actually asked me not to do this project.
>
> (Interview, February 17, 1997)

For Mr. Tshabalala, teaching and learning of science occurs better when located within the context of real life experiences. In this instance, students had to learn about the ecology and physiology of fish, their behavior, feeding mechanisms, structural features and other concepts important to the subject matter of science within the context of trying to raise fish in a school aquarium. Furthermore, students were learning science differently from the dominant approaches that promote detachment and emotional un-involvement in the name of "objectivity." Mr. Tshabalala expected them to be passionate about their projects and be willing to invest such resources as may be necessary to make it work, including raising funds for purchasing small scale equipment and necessities. Above all, he expected them to be "one with the organism" (Fox-Keller, 1985) they were raising by being compassionate to the animals. In a way that is so characteristic of

[40] SOWETO is an acronym for SOuth WEstern TOwnships, referring to a group of black residential areas located on the South Western side of Johannesburg.

feminist visions of science, he expected attachment to the experimental organisms (Fox-Keller, 1985).

Mr. Tshabalala described the purposes of these student projects, as not just aimed at creating fun in the classroom but also designed to allow for different and creative ways of communicating scientific understandings to this community of learners (Interview, February 17, 1997). Students engaged with each other in discourse communities of young scientists and were rewarded in the same way as they would have been in ordinary written tests. Performance assessment was, therefore, a major theme of Mr. Tshabalala's practice.

This kind of practice is indeed atypical and uncommon in most science classrooms, especially in developing countries. As Mr. Tshabalala's case illustrates, such a practice is also not always supported both by learners and school authorities:

> ... Ja, its just that unfortunate(ly) she (the deputy principal) decided to take a very quick decision, a very impulsive decision. Ja. They (deputy and the principal) stopped that. The approach was more of authoritarian, they never reported, that they wanted to know why they (students) were doing that. They just said stop that because parents are complaining. 'Now what are the parents complaining about? Can I see those parents that are complaining so that I am able to take them into the environment to see what the student had done so far. Maybe your one student was just dodging the task. So, therefore, he was able just to use his parents to complain, thats all.'
>
> (Interview, February 18, 1997).

In the case of Mr. Tshabalala's school leaders, the response was clearer and harsher. He was ordered to stop his ways of teaching science to that group of learners. Although his transformative classroom practices were shaken by that incident and he officially stopped the projects (students continued with them unofficially and he gave them marks for the work), he continued to embrace the vision of transformation in science education.

As with Mr. Sithole, Tshabalala's practice was constructed around the three goals of content coverage, conceptual understanding, and inclusion and equity. The meaning or emphasis of each goal differed slightly, however. For example, on the question of inclusion and equity, Mr. Tshabalala was more deliberate about including girls in, on his teaching of science by designing learning projects that allowed for girls to lead in the group work activities and the class presentations.

FEATURES OF CLASSROOM PRACTICE

I observed Mr. Tshabalala teach biology on five different occasions during my week-long visits to Gauteng in February and April of 1997. Throughout these observations, I left his classroom with a sense of confusion about his vision and practice of science education. For, in contrast to the vision he had articulated in our discussions of his classroom practice, what I saw in many of these observation sessions appeared to be only marginally different from the traditional forms of practice. "Content coverage" and "forms of classroom control" were the dominant features of what his classroom practices seemed to be about. His teaching was "defensive" (McNeil, 1986) and he seemed to be using subject matter to keep students under control and active during the lesson. In analyzing these initial lessons, I observed a preponderance of such phrases as "listen carefully," "a possible exam question would ask," "pay attention to this...," "are you listening," "what did I say yesterday?" which collectively began to suggest a specific use of subject matter in these classroom. He was keeping a tight control on what needed to be learned and how it would be learned. On a number of occasions, he would ask students to walk to the board and write down their responses to questions or demonstrate

something to their colleagues. Mr. Tshabalala still asked students different questions and got them to comment on each other's responses, but often called on them to look at their study guides for "more information" on the questions.

In a segment typical of this group of lessons Mr. Tshabalala taught a lesson in biochemistry, where he was reviewing the concept of "chemical bonding" and "the molecular structures of biologically important organic compounds." He came into the grade-12 class of about 63 students with a set of about six or seven study guides (summarized version of the prescribed textbook). With 63 students in the classroom, Mr. Tshabalala barely had room to move across the front of the room from one side of the chalkboard to the other. Accordingly, there was no room a teacher's table in the classroom and Mr. Tshabalala had to use part of the students' desk to put his papers and materials for the lesson (See Appendix E for a sketch of the classroom setting). As if familiar with the classroom routines, students began to move the desks which were organized into four rows of six, closer together to form random groups of about ten students per set of desks. Forming the groups meant that other students had to turn backwards to face other members of the group since their desks are designed in such a way that students can only sit facing in one direction. Six groups were formed to which he handed a study guide. After writing the title "organic compounds" on the chalkboard, he began a review of his lesson by asking questions on the previous lessons. Most of the questions he asked were direct factual questions to which students responded with short answers, mostly derived from the text in front of them. Here is a segment typical of these lessons:

T: What is covalent bonding?
SS: (silence...1 minute)
T: what happens in a covalent bonding?
S1: bond between non-metals
T: Yes, it often occurs between non-metals. Yes? (asking for more comments from the students)
S2: occurs between Carbon and Hydrogen
T: Yes, the C-H bond is one example of a covalent bond. Look at your study guides...
S3: Electrons are shared equally
T: Yes, it is the kind of bonding where electrons are **shared** (emphasis).
Teacher then writes down the three responses contributed by the students on
Sharing of electrons, between non-metals, with C-H as example (students also write down in their notebooks).
T: What happens when the electrons are not shared?
S2: they move to the one side (demonstrating the shift with his hands)
T: Yes, they are attracted to the one element. What do we call such a bond where the shared electrons are attracted to the one side?
S4: An ionic bonding.
T: Remember we are still talking about **shared** electrons, and non-metals
S4: Oh, a polar bond
T: Yes a polar covalent bond.

(Observation, February 18, 1997)

This review segment lasted about 15 minutes of the lesson, after which the teacher took over with some sense of urgency and spent the remaining 20 minutes of the 35 minutes class time teaching a new section on the molecular structures of a few biologically important organic compounds, viz. the alkanes, the alkenes, the alcohols, and the monocarboxylic acids. He illustrated how each structure was related to that of the other classes of compounds. For example: To derive Methanol (Alcohol) from Methane (Alkane), students substituted a hydrogen atom with a hydroxyl group and to derive Methanoic acid, they substituted two hydrogen atoms with an oxygen atom, and created a double bond (See Appendix F). During his presentation, student participation involved going to the chalkboard to complete the drawings on how each structure was derived from the other class of compounds once the teacher had explained the technique.

The teacher concluded the section with a selection of typical examination questions from a set of previous examination papers. With renewed vigor in the lesson, students took

turns answering the questions most of which were multiple choice questions and on that exciting note (with students feeling confident in their ability to answer questions from previous examination papers), Mr. Tshabalala ended the lesson for the day. This was the typical format of the lessons I observed during the first half of the year. First, there would be a review of work done previously, and Mr. Tshabalala would have such a hard time getting any kind of feedback from the students. Initially, I was left wondering if the students were uncharacteristically silent or were engaged in some form of resistance which took the form of deliberate silence in the classroom. After several observations, and looking at their excitement towards the end of the lessons, their silence seemed natural (i.e. it was not forced silence and did not appear to be an expression of resistance in any way). After the rather lengthy reviews, Mr. Tshabalala would then introduce a new concept for the day to be followed by questions from previous examination papers.

My observations of Mr. Tshabalala's practices left me confused for two reasons: First, his practices were not congruent with the ways in which he was talking about his vision for science teaching and learning, and I seemed to have trouble getting him to talk about the apparent contradiction. The second reason for my confusion was a methodological one. As I was only able to observe Mr. Tshabalala five times in the first half of the year, I was not sure if the apparent contradictions were merely a result of the flaws in the methodology, such that if I visited Mr. Tshabalala's classroom more regularly, I would be able to see a different kind of practice or that some other explanation of what was happening would emerge. Eventually, I had to ask more pointed questions of Mr. Tshabalala to understand better what was happening in the lessons.

As it turned out, the lessons I had observed were indeed atypical according to Mr. Tshabalala. In the previous year, for instance, his approach to the lesson on organic compounds had varied in some important ways:

> Ja, last year it was different because, one I had some borrowed material from the Funda Center (a local community college). Two, we had our media room last year. So, after I taught a lesson, I took them into the media room. Unfortunately this year, last year later they broke in and took all the video and the television...Yes. so it was different because I taught in a class first, I taught them almost in a similar way. The question that was different because I had more time to explore on it and then the next lesson was ready to develop on that by going out and looking through the video as such. So you learn and talk about more application of this stuff. We still have the media room but like I am saying to you, the video material, the tapes, Ja, the video itself and the television we don't have.
>
> (Interview, February 18, 1997)

In the previous year, Mr. Tshabalala spent a little more time on the topic allowing students to manipulate the ball-and-stick models he had borrowed from the community college. Instead of constructing the molecular structures on the chalkboard as they did in the lessons I observed, the previous year they had the manipulatives to construct these structures in their groups. Secondly, a commercially-made video on the real world applications of the biologically important organic compounds was shown to the students. The focus on application and hands-on activities for the learners had the potential to promote deeper conceptual understandings of the subject matter than it seemed students were getting from the observed lessons.

Why then was Mr. Tshabalala choosing to teach these set of lessons (on biochemistry) in the ways that he was doing? The short answer to the question is that: as with Mr. Sithole, Tshabalala was covering his back by "covering the syllabus" and preparing his students for the national examination. Unlike Mr. Sithole, though, his content coverage lessons were distinct and separate in time from the conceptual understanding lessons - - although both sets of lessons included aspects of equity. To

understand better his practice, one has to locate it within the context of his working life and conditions at the school where he was teaching.

At the time of our first conversation for this research project, Morapeli was in his second year of a secondment at Oliver Nyanda high school, a large finishing school in the area. Finishing schools represent a new kind of institution in South Africa, having emerged in the mid-90s as a replacement of what had hitherto been known as the adult education centers. The adult education centers were nothing but a series of classes and programs arranged for groups of learners who needed second or third opportunities to take the matriculation examination. These centers were specifically designed for learners who had been unsuccessful in their first attempt at the matriculation examination. They provided an after (school) hours tuition to these learners who could not be readmitted to their old schools, where they sat for the examination the first time around. The actual subject offerings were designed around the demand of the students. That is, subjects were offered only on the basis of some evidence of the demand, for example if more than eight learners were available for tuition. These adult centers were meant to be separate and distinct from another program of the department of education that was also available to the unsuccessful matriculants - - the night schools.

Despite the appearance of offering second chances to the grade-12 students who had not been successful the first time around, the adult education centers were a mockery to the concept of second chances. They were so poorly organized, under-funded, with limited personnel capacity, and were constrained in terms of time and space. As a biology teacher at one of these adult centers in 1992, I only had the opportunity to see my students twice a week, for a total of four hours, in a classroom environment where we

could not do much but talk and talk about the subject matter. Conceiving of a practice richer than that would have been difficult under these conditions. The adult education centers had to negotiate for two hours a day of free space within an existing school. As most secondary schools were busy until about four or five in the afternoons on most days, adult centers were often accommodated in primary school buildings. Even then, they were only offered rooms to do their teaching in, but no resources or facilities beyond. No laboratories, offices, staff rooms, copying facilities and other such infra-structural requirements were available to these centers. As for the teaching staff, we had our regular jobs elsewhere within the education system and only offered four hours-per-week of our time to these centers. In general, adult centers were poorly funded, badly administered and enjoyed low priority within the department of education. They were created to diffuse the political pressure created by the high failure rates in the matriculation examinations. For the most part, therefore, the second chance offered by these centers was a second chance in name only.

Against this background, it was not surprising that these adult centers were the focus of students' and community's ire and contempt. Though desirable, in the sense of providing for second chances, they were inadequate to the task. For this reason, most students who could find their way back to the regular schools for the second or third attempt at the matriculation examination, did so. In fact, at the beginning of every school year, community crisis committees (later called co-ordinating committees) were often formed to take up the plight of the students who needed second chances in schools. Different communities worked out agreements with local school inspectors and principals for the readmission of most of these learners - - against the department's official

prescription not to readmit the failed matriculants in regular schools. Finishing schools then emerged out this set of complex circumstances, where there was a consensus among all stakeholders in society about the need to provide more opportunities for learners to take and succeed in the matriculation examination. For most people in the black communities, adult education centers were, however, a dead option in this regard. The new government, post 1994, therefore had to consider other options and thus the concept of a finishing school was born. Finishing schools were to be more than what the adult centers had been. They were to be schools within schools, providing second and third opportunities for the finishing class only (the grade-12 candidates).

It is in this kind of an environment that I first observed and discussed science teaching with Morapeli Tshabalala. As he described it in our first conversation, his finishing school, Oliver Nyanda finishing school, was conceived of in December 1995 after the dismal matriculation performance by the class of 1995 in most schools in Soweto:

> ... in1995 they decided that because there was a high failure rate, lot of people wanted to come back and repeat matric (culation examination) and then they decided that in 1996 we should have a certain class that we allocate for repeaters class and I was then assigned to take that department as such. I was responsible for the finishing school...it is a separate school from Maxima but we share the same yard, the same campus and the same facilities.
>
> (Interview, February 18, 1997)

Oliver Nyanda Finishing was a school within a school. It was born out of a commitment to equity through the provision of second chances to black students who had otherwise been failed by the education system. Although concerns with equity were driving the formation of finishing schools, other concerns with excellence loomed large in the background. That is, there were concerns with the effects that the repeating students would have on the new class entering grade-12.

> Given that we have many requests that a student wanted to come back and repeat because there was high failure rate in matric(ulation). So, therefore, we felt that if we do not have special classes, we are going to have a blockage because students are going to be stuck in matric(ulation)... then would have more repeaters in the class. It was unfair to have people repeating in a class and one attempting matric(ulation) for the first time, so the best idea was to create special classes. Then we eventually decided just to call it a Finishing School, which is a part of the Community College as such.
>
> (Interview, February 18, 1997)

In many ways, therefore, the finishing school was constructed as a school for the "other," and not for the achieving students. As a school for the "other," its students and teachers were marginalized within the system. The student population, which was disproportionately female, was made up of students who had experienced less success and acceptance within the regular high schools. Many of them had attempted and failed the matriculation examination before:

> ... it is either people who did matric for the first time last year or second time. Rather, maybe they had a break and discovered, somebody wrote matric in 1992, maybe had a baby, and later said "No I have to attempt it again." So we normally accommodate those kind of people.
>
> (Interview, February 18, 1997).

The disproportionate number of female students is probably a result of several factors, including that females make up the largest number of matriculation candidates in South Africa and proportionally more of them fail than males (Arnott *et al*, 1997). Secondly, prior to the introduction of the new South African School's Act (SASA) in 1997, female students who fell pregnant during the term were summarily expelled from schools with no provision for any second chance within the regular schools.

With respect to the staffing of finishing schools, they were better off than their predecessors were - - the adult education centers. The problem of the marginalization of the staff at finishing schools, however, was more conspicuous as illustrated by the case of Mr. Tshabalala:

> Well, its just as unfortunate like I am saying it just looks like my contributions were taken as being very provocative, in a sense that when the whole thing (of the finishing school) comes in, it looks like they wanted to get rid of me by transferring me to another school. Yet they are helping me in a way. I don't know why. It is because, like I am saying I have been taken as the most provocative person, yes. Yes, I always come up with very different views and I want to take myself as very, very committed. Sometimes we will argue that because I challenge, I wanted to know why. They say that I don't co-operate. At a particular point I recall they wanted to write a report about me to the Inspectors and then I said go ahead, no problem, you can write. They say that do you know that what it does to your career and I said to them well I don't know that. You guys know because you are in the office. You have a right to, possibly you are or want more control of my life. So, you know we are actually in loggerheads but that has not de-motivated me, as such. Except unfortunately you cannot ask a student to do other extra things, extra curricular things.
>
> (Interview, February 18, 1997).

Mr. Tshabalala viewed his transfer to the finishing school as a punishment for his challenge to the status quo at Maxima secondary (his original school). His challenge to the hierarchical and oppressive relations with the school administration, and his challenge to modal practice, landed him at the finishing school. In many ways, his practice reflected his new set of circumstances. That is, he could not ask students to engage in "extra" activities without anyone higher up in the school ranks taking notice. Also, he now had to prove himself with a different group of students - - that were perceived as the "other" within the system. He viewed his transfer as a set up for him to fail. With this group of students, his non-traditional practices would run counter to the parental, societal, departmental, and students' expectations for a "finishing school." His interpretation of what a second or third chance means had to be balanced with the dominant views which constructed the second chances as just second or third attempt at the matriculation examination and nothing more. The students had to be prepared to "finish" school and nothing more. This was the context within which his practice was to be constructed.

In the last of the five lessons I observed in the first half of the year, just prior to the mid-year examination, Mr. Tshabalala took time to go over a few of the sections he

had covered in the first semester which were likely to be assessed in the mid-year examination. Although I was not making a longitudinal study of Mr. Tshabalala's practices, what I saw of his practice at the time of my second visit to Gauteng in April and my observations of him in the second half of the year and the following year, relative to what I had observed earlier, made him an interesting case for this study. His practice had shifted in very interesting ways as he got "familiar" with the students and the setting of his practice (Interview, April 18, 1997). In a revision lesson on the biochemistry section I described earlier, Mr. Tshabalala asked students to get into their groups of about 10-12 again, but instead of working from a study guide this time he asked them to assume roles as teachers for their classmates. They were to prepare "teaching and learning aids" to present a lesson that would describe the names of some biologically important organic compounds, their structural features, real world examples of their use and would conclude by identifying and answering a few possible examination questions on their chosen topics (Observation, April 18, 1997). Most students drew charts with the different components of their lessons and presented these to their colleagues. The interesting part about this lesson and the subsequent ones is that Mr. Tshabalala had found a point at which he felt comfortable to let go of his tight control of the class and the subject matter. There was now more participation from the students in the lessons, students took the initiative on decisions about what to present in class and how, they engaged in conversations among and between the groups about the subject matter, they practiced important skills of communication within the context of learning biology and preparing for the examination. Mr. Tshabalala was paying more attention to **who was participating**, and **how**, that is to issues of gender and language in the participation of

his students. When I asked him about the shifts, Mr. Tshabalala described his approach as follows:

> I like them to enjoy, to use whatever learning material or the teaching material, you understand. To play with the subject of the day or maybe the structure that was taught to them. Now if you take it a bit further it was just wrapping it as the part of the development of a lesson. Not necessarily delivering everything to them. They need to be part of it and they need to begin to play with some teaching material so that, you know, it is easy for them to learn. And once they stood up and developed confidence, even some of them because you know, they can't express themselves, they also learn then sometimes the technique of expressing themselves to their colleagues because that itself will help them out. Remember that I am just preparing them for the external environment, you see of possibly being able to discuss with colleagues and develop a confidence whey they are in front of them and contribute your ideas. Feel yourself among us, the different people that you meet and extend them into different challenges that will come with your studies. Depends what students are taking next year. So they must be able to develop that particular challenge. They must have confidence, must be sure of their facts and must be able simply just to take whatever difficult stuff, whatever it may be, just to play with it in their learning environment or you know, or be part of the lesson, you know. Because if I had to stand there and teach everything and I had to do it myself, then they are not part of my lesson. I cannot be convinced that everybody is part of my lesson. I either have people feeling comfortable when they come to the board, Then I am convinced that everybody, some people, you know, because of their colleague is doing something for them. "Something I am going to do it for myself." Its easier then and "at the end of the class when I go home, I have to go do this" (the students will tell themselves).
>
> (Interview, April 18, 1997).

Learning science was for Mr. Tshabalala an act of active engagement in the discourse community of science, as a social construction to which students will be expected to participate outside of school. Part of his expectations was for his students to develop confidence in their ability to participate within these social discourses. Furthermore he was more explicit about his attention to gender in the classroom:

> I have to admit, my experience, especially the African schools is that the girls adapt much quicker than the males but unfortunately, you know, sometimes because of time constraint and because when we want the class to close we miss that... girls are more, who speak more freely in the class and who try to socialize and that are willing to attempt any what's name but that also varies with the classes because if you go to the science class, you will sometimes get that reaction is almost equal at a particular point, you understand. It varies from, in that particular class you will discover that there are many women who will volunteer to learn very much but without

> being sexist, we will miss all those students who are very, very sharp to influence the others. May be tomorrow we will then look at the gender equality in class and say, hey why can't we have women. But at the moment I am allowing freely those who want to, sort of, people, the other group. I wouldn't like to see the other sex part of it eventually influence the others, you understand. But if the female are quite faster. Lets use them as an examples.
>
> (Interview, April 18, 1997)

Mr. Tshabalala struggles with the notions of gender equity and inclusive participation in his classroom. While on the one hand he consciously embraces a discourse of non-sexism, where he tries not to see the students' sex and its social meanings, he understands the limitations of such an approach in terms of promoting broader goals of gender equity in science education. He resolved the dilemma by calling on and actively seeking out the girls in his science classroom, thereby addressing the broader issue of equity even while temporarily suspending his immediate concerns with "inclusive participation." Group work, however, where girls could assume leadership roles while allowing for inclusive participation by all help to resolve the dilemma in ways that minimize the contradictions between his goals for teaching.

In the same vein, Mr. Tshabalala struggled with the issues of language in the context of equity and participation. While some of his students wanted to participate in the classroom discourses using their mother tongue, Mr. Tshabalala insisted that they use English but quickly backed off when one female student insisted on using IsiXhosa to respond to questions from her classmates:

> it was the question of her lingua franca, she stood up and spoke in IsiXhosa, of which that was wrong in the very multi-lingual environment you know, that was completely wrong she needs to speak in English. Here she was ready to, and very sharp (intelligent) but she was unable to express herself. She is very, very, very intelligent but we need to work on her weaknesses. You know, it's a trivial weakness, as such.... well the question is this, in an environment where we have almost seven languages at school. It is even more complex than her

> (original) school. We almost cover almost ten of the languages as such[41]. Some others will dominate. So the question is this, if they allow IsiXhosa so to speak, then what about SeTswana, then what about the SeSotho, what about the Tsonga, you understand. Then eventually I will have to apply the principles of this country to learn the eleven official languages, you understand. But now, just for the sake of being procedural, and two in trying to use the language that they are going to use in the exam. That is why I prevented her from using IsiXhosa, you understand. Politically there is nothing wrong, nothing wrong completely. But in terms of firstly preparing for the examination of which the question will be in English, then it is good that I should just allow them to use English....I suppose the woman can speak English because she got a very good symbol (grade in her first attempt of the matriculation examination). Yes, in biology, well you know, when I do the administration part of it, I normally check their previous year grades.[42]
>
> (Interview, April 18, 1997)

The language dilemma in Mr. Tshabalala's classroom has several dimensions: First the language diversity in his classroom, second the imperatives of the national examination, third is the need to provide his students with an infrastructure for practicing the language of power which they don't often have except at school or when they have to interact with white people in town, and lastly is the issue of student discourse and participation in class. For example, were he to allow one particular African language to be used in class, he risked marginalizing other learners in his linguistically diverse classroom. Whereas if he completely shut off students who were inclined to participate in their own languages, he would compromise his goals of equity and participation. Added to the latter set of considerations, is the expectation for him to prepare the students for the matriculation examination and the need to provide them with the language skills to negotiate the hostile terrain outside of school. All these factors complicated Mr. Tshabalala's task regarding language and participation. His was, therefore, a practical solution of drawing the

[41] Unlike in the case of Mr. Sithole in Evaton, Soweto is the largest Black township (s) in South Africa and is much more heterogeneous and linguistically diverse than any of the schools profiled in this study. It is, therefore, not uncommon to find more than seven language groups in a classroom.

[42] In terms of the rules for the matriculation examination, students who want to improve their overall performance in the examination (and their chances of getting a university entrance clearance) have to re-write all the matriculation subjects including those in which they might have done well previously. They take the subjects as a single package.

students' attention to the importance of using English, but also not allowing language to constrain the discourse in his classroom. With competing goals of equity and quantity, his was almost a no win situation.

In another lesson, with a "regular" group of matriculation students[43], I observed Mr. Tshabalala engage the same kinds of issues of language. The difference in the latter case was that the students in the "regular high school" were much more vocal on the issue and actually raised it and debated him on the need to use English. In that situation, Mr. Tshabalala backed off much sooner than in the case of the female student cited earlier. He had asked students to summarize the day's lesson in their own words and after several students tried to do this in English and getting stuck at certain points, they each continued in their mother tongue and asserted their right to do so under the new constitution of South Africa.[44] Mr. Tshabalala explained that once he had pointed out the need to use English for examination purposes, he saw no need to labor the issue further so as to prevent it from getting in the way of effective participation and learning.

I noted earlier that the lesson observed subsequent to the group teaching activities (referred to above) were much richer in terms of illustrating the non-traditional aspects of Mr. Tshabalala's classroom practice. Students participated more and Mr. Tshabalala was more at ease in pursuing the goals of equity, quality and quantity in the science classroom. How then do we make sense of this persistence of transformative aspects of practice in spite of the challenges and tendencies towards modal practice? And what

[43] In 1998, the Finishing school project was suspended by the government due to lack of funds and Mr. Tshabalala and other teachers at the finishing school returned to their original schools.

[44] The South African constitution recognizes eleven official languages, viz. English, Afrikaans, IsiXhosa, IsiZulu, SeSotho, SeTswana, Tsonga, TshiVenda, SiSwati, IsiNdebele, SePedi. Under this constitution, students have a right to an education in their own language, "where practicable." This reversed the previous government's policy of two official languages, English and Afrikaans.

meaning did his practice have on his life? To answer these questions, we need to understand his work within the context of his own life experiences.

LIFE STORY AND WORK EXPERIENCES

At the time of our first meeting for this research project, I had known Morapeli Tshabalala for at least thirteen years. We first met in 1984 at a special, all-expense-paid, pre-university program for Black students who had interests in science and technology careers. The program, offered by one of the Historically White Universities (HWU) in South Africa was sponsored by a consortium of South African companies and their American partners who had resisted the call for divestment in opposition to the apartheid policies of the day. Although most of us were younger at the time, politically we were wise enough to see beyond the pre-university program that was being offered. We joked about how the two sets of institutions, the multinational companies and the university concerned were using us as shields in their fight against political pressures to show a distinct break with apartheid. Few amongst that group of fifteen who were in the program had the political maturity and understanding that could match Morapeli's. Although we had been selected on the basis of our previous performances in science and mathematics and on the strength of the recommendations of our school subject masters, we spent long nights in debates and discussion about all sorts of political subjects other than the politics of science and mathematics. Morapeli's insights were invaluable in these discussions.

Despite the fact that our lives took separate directions after that pre-university program, most of us have kept close contact. Morapeli and I have remained friends ever since especially as we both ended up in the teaching profession. Although we had spoken

on the phone once or twice after my departure to the United States of America (USA) in 1992, when we met for the project, I had not seen him in over five years. After I explained to him that I was doing a research project on "science teachers who teach differently from the traditional practice," he invited me to take a look at his classroom. As he put it, "you (the researcher) might be interested in some things that are happening here." I quickly negotiated a release from work to do "a pilot study" on the two teachers in the Gauteng province. I used the opportunity to make similar arrangements with Mr. Sithole, another old friend who was teaching science in a different township in Gauteng and with whose practice I was familiar. Morapeli was, at this time, engaged to Boitumelo and they were expecting their first child. I soon found out that, although he was excited at the prospects of being a husband and father, he was also nervous about the commitment. He was unsure about the time commitments he would now have to make in view of his very demanding practices at school. As noted earlier, he was leading the finishing school initiative, which he believed provided him the space to pursue a potentially transformative agenda inside the classroom, in ways that he was not able to do at his old school. The Finishing school with its weaker leadership and the prominent role he was playing in its day-to-day running allowed him relatively more space to shape a potentially transformative agenda in his classroom. In many ways, he found time to be alone with his students without inspection from those in authority. His life story should help us understand what it is about his own personal circumstances that made him committed and willing to act out his transformative visions. And, how we can learn more about commitments to transformative practice from his life experiences?

The cynics at his school seemed to think that it was the influence of his college experiences that made him more "energetic" and "provocative." In an earlier case study I wrote for presentation at a conference, I described his college experiences and tried to relate them to what I was seeing in his classroom (Jita, 1997). Upon reading that paper, Morapeli was not impressed with the limited approach I had taken to talking about his life and how it shapes what he does in his classroom. He felt that his whole life experiences contributed in significant ways to the construction of an identity of a transformative teachers. His comments on the paper were as follows:

> I think it (the paper) was a very good examination actually. It presents a picture of myself - the comments you have made make me to realize, you know, that how important the informal discussion is... there are things that I did pick up, for example, .my speaking and my speech, you know. I also feel that there are other things that were overlooked. Yes, in the discussion as such especially, the educational side of it...the concentration of the whole paper was focused on the higher education, Ja. That is, mostly on my teaching on- on - about my college life. Yes and what I did at the college. The question is what happened in the high school? What is - what was my situation in the high school? What about the earlier life than that? Ja. What is the correlation between the primary life, possibly the secondary life and the tertiary life? So that when somebody look at the person and make some assessment they should be able then to make, you know, a link between the two and the changes in - Ja - in educational life. You know, starting from the primary one to – up to particular present.
>
> (Interview, July 23, 1997)

Although Mr. Tshabalala found something good to say about the paper, like the fact that he was able to look at a number of facets of his background and see some links between them and learn more about himself, he was not satisfied with other aspects of the paper. For instance, although articulated politely, I realized his discomfort with the unedited text (verbatim transcription) of his utterances. Despite his admission that his manner of "speaking and speech" reflected who he is, speaking and writing are two separate activities. Had I given him the opportunity to write his responses down, his language and utterances would have been more polished than I had reflected in my paper (and it would

still reflect who he is when he writes). This was an important research dilemma for me as I had come from a standpoint that seeks to grant voice to the participants in my project. I had been critical of previous research that speaks for the teachers. I wished to hear more of their authentic voices. I had not problematized this issue of voice in the way Morapeli was raising it. His argument was in line with Bakhtin's recognition of multiple voices and the choice of which voice he used at a given point was as important in defining him and his message. I have continued to cite his utterances almost verbatim although I struggle with the kind of characterizations others may make of him from these unedited citations. Secondly, despite the fact that Morapeli is not a life historian or researcher, he was convinced that something about the totality of his life experiences has made him what (and who) he is. That is, it was more than just what I had focused on that drives his classroom practices and life experiences in general. He felt that more needed to be said about his primary school experiences, high school experiences, and other 'changes' in the circumstances of his life. For him, it was his life as whole that needed to be examined and discussed to understand his practice.

I will now attempt to bring out some aspects of his life that may help us understand the interactions between his commitments and actions a little better.

The life story

Born in a "traditional Zulu family" of parents who were denied any rights to education, Morapeli has become one of only two children within the family of eight children to go beyond grade seven.[45] Reflecting on the situation of his parents, he blames

[45]Although Morapeli's mother and father had six children together, four boys (three older than Morapeli) and two girls (one older than him), they lived with and grew up with his half brother and cousin sister –

both the institutionalized racism within the South African farming sector and his "traditional African environment" for his parents' lack education and resulting hardships that they had to endure:

> Well I am saying, they were born in a Zulu traditional environment. You know, school generally was not encouraged as such and secondly, you are born in a white farm where any black kids were not allowed to attend the schools. And secondly, besides that you do not have faith then, you are just brought up in a traditional African environment as such, so you live in the way of the traditionalist as such, who don't specifically encourage the question of schools, the question of religion, the questions of "civilization" as such, you know. They suffer most of the hardship as such. So that is the type of life that my daddy comes from.
>
> (Interview, February 17, 1997)

His comments, however, suggest a differential influence of the two factors in his father's situation. That is, while the traditional environment did not encourage his father to receive education of the kind that was offered by the missionaries, he suggests that institutional racism and the relations of class exploitation between the white farmers and their black laborers prevented him from receiving any education. Through this system his parents were sure to remain an abundant source of cheap labor for the farming economy. The story of Morapeli's mother also follows a similar pattern, privileging her with only three years of education. This "traditional" African's ambivalence toward education in South Africa is well documented (Bozzoli, 1991).

Cultural conquest versus education for empowerment

The first schools in South Africa were established by the Dutch colonialists, for their slaves, in the Cape in 1658 (Behr and Macmillan, 1971). The Dutch East India Company (DEIC) which had brought its own slaves to work in the Cape began recruiting

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making it a family of eight children. The cousin sister, who came to live with them after her father (Morapeli's paternal uncle) passed away in her teens is the other member of the family who has advanced beyond grade seven. Like Morapeli, she's also a teacher in one of the schools in SOWETO.

local Africans of mixed origin to participate in their schools. Their recruitment drive, however, did not extend far enough to reach many of the indigenous African areas further from the outposts in Cape Town. It was not only until the missionaries came in, with the express purpose of 'civilizing' the natives, that western type education began to spread across to the indigenous populations of South Africa. The story of missionary expansion and the spread of their (western) forms of schooling is an all too familiar story of conquest and cultural imperialism (Carnoy, 1974). Missionary schooling was often used to destroy and substitute native cultural symbols and traditional educational practices with western type practices and belief systems (Mkhonza, 1997). With the missionaries, began the first systematic cultural conquest and conversion of the Africans in South Africa.

At the same time as this cultural conquest and conversion was happening, there was also a conquest of the Africans at the political and economic levels. The promulgation of the 1913 and 1919 land acts, which essentially dispossessed Africans of any land rights, accelerated the processes of conquest. Through these acts, white farmers were accorded land rights to vast agricultural and residential areas previously owned and inhabited by communities of African peoples. Coupled to the fact that most African at the time did not have a franchise, the conquest was thoroughgoing. Wealthy and educated Africans at the Cape were allowed to vote, however, thereby complicating the processes of resistance towards missionary education. The ambivalence on the part of some Africans toward missionary schooling arose from the fact that while missionary education provided a platform for political and sometimes economic advancement for the natives, it was at the same time a symbol and vehicle for their cultural and religious

conquest. Missionary education had as its primary goal, the conversion of the natives to Christianity and destruction of the traditional practices and ways of life. White farmers, who now owned not only the rights to the land inhabited by most Africans, also assumed ownership of the peoples who lived on the land. They apportioned to themselves the right to determine what would happen to all those who lived on their land, and their families. Missionary propelled cultural imperialism, combined with racial domination by the Afrikaners and the British, and with the working class exploitation of Black families by the white farmers to make for a vicious system of racialized capitalist exploitation in pre-apartheid (pre - 1948) South Africa. It is this system of combined forces of domination and exploitation to which Morapeli's parents were victims.

Taking the only logical escape route out of the farm labor bondage, his parents relocated to Soweto - a new township that had been created to keep black workers out of the city of Johannesburg after work hours. This is where Morapeli was born, just after the sociopolitical tensions of 1960 that resulted in the life imprisonment of Nelson Mandela and his comrades with scores of other people killed or fleeing the country. He was born in an area of Soweto called Zola - - often referred to as "deep Soweto" because of its distance from the Soweto highway where most white folks and others who live outside of the township would end up on their tours to the area. Soweto highway is just on the outskirts of the township, and areas closest to it are considered friendlier to tourists, most of whom are white folks from the suburbs or from abroad. Deep Soweto on the other hand, which is made up such places as Zola, Emndeni and Naledi, is considered dangerous and less friendly to outsiders.[46]

[46] This is most probably a stereotype, however, as most white folks and tourists never even get to these areas because of their unfamiliarity with the places and the roads. As far as I can establish, to this day,

Early education

When Morapeli was seven years old and getting ready to begin school he lost his older brother to a short illness. According to Mr. Tshabalala, the tragic experience of losing his second brother was a significant turning point for his father. It drove him closer to the Christian faith as he "became more of a pastor-like at the church" (Interview, February 17, 1997). It is under these conditions of a family that had been transformed so much, both by culture and religion at the one level and by the major political and economic "regimes" of the 1960s at another level, that Morapeli began his schooling at a primary school in his neighborhood. His family believed very much in the "power of education," that it would provide the children with better chances at life than the parents had. His early experiences of school were not pleasant as he had to deal with negative teaching practices and bullying by others at school. (Interview, February 17, 1997). Change came in his life, at the beginning of the senior primary phase of schooling (grades 5-8).[47] At this level, the bullying stopped, and the teachers were more committed to a richer program for the learners. School started an hour earlier, with the first hour devoted to a number of things over the week. Sometimes it was academic development, and at other times it physical and athletic development (Interview, February 17, 1997). Morapeli tasted success both inside and outside of the classroom and schooling became less of a nightmare. He continued his primary schooling until another set of tragic

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there has never been a (tourist) map of any of the black townships or residential areas of South Africa. The names of the three areas, for instance, have a much more positive meaning than the concept of "deep Soweto": Zola means a place of calm; Emndeni means a place where families live; and Naledi means a place where stars shine.

[47] The lower and higher primary phases were often offered at separate schools. This trend has now been reversed, yet again, in the history of Black schooling in South Africa. Primary schools now offer both lower and higher levels in a single building.

circumstances forced another transformation in his life and that of his family. This time the tragedy was both personal and political. Just as he was entering secondary school with one of his remaining brothers, the political tragedy of 1976 disrupted their advance.

The events of June 16, 1976 and their impact on Mr. Tshabalala

The Nationalist Party (NP) which had won the 1948 elections on a promise to Afrikaner domination of social life proposed a new language policy for Black schools that would be implemented in 1976. Black children were to learn an equal number of subjects in both English and Afrikaans as media of instruction. This meant a radical change for most black children who could barely cope with Afrikaans as a compulsory foreign language in their curriculum, and with one other foreign language (English) as a medium of instruction. To add Afrikaans as a second medium of instruction would not only have been burdensome but would have entrenched the dominance of the Afrikaners over Black people in South Africa. Academically, the situation would also have been untenable as some related subjects would have been learned in different languages. For example, a student would learn mathematics in English and Physical sciences in Afrikaans. Making sense of mathematical and scientific concepts in two different foreign languages was an impossible demand on Black children. Faced with the choice between these two foreign languages of domination, most people in the black communities opted for English.[48]

In its miscalculation, the nationalists attempted to force this policy through even though there had been various community and parliamentary voices against it. Things

came to a boil when in June 1976, students decided to challenge the government on this new school policy. On June 16, 1976 riot police mowed down groups of unarmed Black children who had gathered at a soccer stadium waiting to be addressed by their leaders on the planned protests. This marked the beginning of what was to become a full scale and sustained onslaught by the white "Nationalists" against Black children, in many townships across the whole country. Morapeli's entry into secondary school was caught up in that national tragedy of June 1976. His descriptions of the 1976 and 1977 tragedies capture the sense of chaos and leadership crisis that had developed as a result of the killings and the jailing of student leaders and the abdication of duty by government officials:

> . ... (a)round about 1976, we shifted into the Secondary School but then because of this uprising (it was decided that) no people should attend school until the government changed the laws on the languages and the use of Afrikaans - because the government was trying the suppress English as one of the main subjects of teaching, the medium of instruction of course...I had to delay for two years, because 1976 we did not attend school, 1977, at a particular point we had to stop...It was just unfortunate that there was chaos, there was no governance at all. Both in terms of local government and provincial, especially in my area. It was the most violent area, I mean a lot of people were taken to jail. A lot of student leaders around were in prison. So it was very, very difficult to operate without the leaders. Soweto itself was then a police state or rather a soldier's state, or towns rather. So as a result it was difficult for us. So, I had to be moved from that environment.
>
> (Interview, February 17, 1997)

Tshabalala's descriptions of the 1976/77 tragedies express ordinary students' concerns at the time. He worried a lot about the absence of responsible leadership. Given that he had just graduated from primary school at the time, his cry for leadership both from the adults who were operating the local and provincial government offices and from the more senior students who were leading the protests (most of whom had either been jailed, killed or

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[48] It is not clear what the rationale for this choice was, but speculation is that English provided a better means of communication at a much broader level (than Afrikaans which was a local creole of the Dutch settlers with their slaves at the Cape during the 19th and the early parts of the 20th century.

skipped the country to avoid detention or to train as freedom fighters) is understandable. His emphasis on governance and leadership (or lack thereof) in analyzing the 1976/77 events is quite curious. Later, I will explore further the whole theme of leadership and governance for Mr. Tshabalala, since it comes out again both in his college years when he becomes one of the student leaders, and again during his teaching at the finishing school when he assumes leadership of the day-to-day running of the school.

Post-1976 schooling experiences

At the beginning of 1978, when things got back to some degree of normality, his family had once again been transformed in very deep, significant and tragic ways. Their count on the losses resulting from the 1976 onslaught went beyond the two years of secondary education that Morapeli had lost, but his brother had also been lost in the tragedies. He was overcome by the tear-smoke that was often used to disperse groups of students in schools or on the streets. Morapeli was by now the only remaining boy in the family, having lost three of his brothers in two decades, one in 1957, another in 1967, and the last one in 1977. His father had also passed away on New Year's day of 1978. The circumstances of his family had now been changed radically, with the loss of the main breadwinner of the family, his father.

While the whole family was in grief, concerns about Morapeli's safety demanded prompt action from his mother. When his father died, the family had been making plans for Morapeli to taken out of Soweto to a place of relative calm - - in the rural areas of KwaZulu-Natal. He was to begin his secondary schooling there. When I asked him

about the decision to go away from Soweto, he saw it as the only way he survive and pursue an education:

> Well, there was no choice. I was the only boy remaining, actually. In a sense that I was a young boy who was remaining because my elder (half) brother never stayed long with us, so I was the only person to remain in the family. So the only way of saving me because at a particular point the police were raiding from house to house. Checking for all the males, checking for all the boys. So it was difficult and I had to move to (KwaZulu-) Natal.
>
> (Interview, February 17, 1997).

Although evading the government networks was not easy for Morapeli, he eventually found a place in a school 250-km away from home, in the northern part of KwaZulu-Natal.[49] He lived with relatives and walked three to four kilometers to and from school daily. His stay with relatives was short-lived as he moved from one relative to the next until he decided to rent a place of his own. Since he was a freelance amateur photographer, he used those skills to generate the income he needed to pay the rent. In this way, he made enough money to survive on his own, and as he put it he would have been able to "pay three times as much of what they wanted (for rent)."

On his own initiative and resources (both financial and human), he managed to get himself accepted into one of the most prestigious boarding schools in the region, and probably in the country as whole. The school, Ohlange high school was (and still is) a well regarded boarding school for Black people, with a very rich social and political history in South Africa. Founded by the first president of the African National Congress

[49] The Department of Education had by this time issued a directive for schools not to accept students from Soweto and other urban townships without prior permission from the head office in Pretoria. Secondly, to be accepted at a local area school one had to produce a residential permit which indicates that you were either born there or that your parents live and work in the area. On both counts, Morapeli came through by forging documents and paying bribes to the various layers of gatekeepers.

(ANC)[50], Dr. John Langalibalele Dube, the school boasts of a diverse and prominent list of alumni including some of the current parliamentarians, academics, and business people in the country. In many ways, the school was a bastion of Black pride, attracting Africans from far and wide across the whole continent of Africa. Ohlange was the first school, in South Africa, to be started by black people with the aim of liberating themselves from white domination and missionary imperialism. Dr. J.L. Dube, the founder of the school, was a theologian (of the African Evangelical church) who studied at Tuskeege under the tutelage of Booker T. Washington and had been exposed to the debates of the Black nationalists in North America and the Caribbean in the last quarter of the 19th century. Although he was of the royal family, and thus born to lead, he opted out of the hereditary leadership position and chose a more religious and political leadership position instead. He became a pioneer and leader in the African Evangelical Church. He also led a campaign to collect contributions from the community for the building an institution for Black education - -the Ohlange school complex (Ohlange began with three different levels of education, viz. The lower primary school level, the higher primary level, and the secondary level). In the process of raising these funds (from within the community), he used his "hereditary powers" as heir to his father's throne, to sell some of his cattle and 'tribal' land as a personal contribution to the initiative. The whole notion of self-reliance formed the central pillar of his fund raising campaign and leadership. The name of the school itself was another signifier of this principle. It was to be a community school and was named Ohlange, which means "Nation" (or Nationality). Mafukuzela, J.L. Dube's community name (which means

[50] The African National Congress, is one of the oldest liberation movements in South Africa which won power to govern the country in the first democratic elections in 1994. The party was, until recently, led by

someone who works hard), had himself had transformative experiences both in South Africa and abroad. He had, as a result, reconfigured his basis for leadership and power within the Black community. Rejecting the traditional notions of hereditary rights to leadership, he used his commitments to the liberation and self-reliance of the Black people to build an institution that would compete with and challenge the dominance of missionary ideals. His commitments, visions and actions transformed many lives well beyond his time and reached others beyond the borders of his own country.

With this background in mind, it is not surprising that Morapeli's aspirations were also (re) modeled by the Ohlange experience. Describing the shifts in his aspirations at the new school, here is what he had to say:

> ... This is where my life changed actually, where I got into the class and found that everybody wanted to become engineers, some wanted to become lawyers, and doctors. There was a very competitive spirit. Secondly this is where I discovered my ability that I have got, you know, mathematical abilities as such, because I come into a school where people just knew themselves 'I am number one in this class', somebody said 'I am number two'. 'If you want math come to me'. Somebody else said that 'if you want English, come to me'. We never get beaten by anybody. So that's the competition that was within the class. So, in a sense it helped me a lot to adapt to Durban....
>
> (Interview, July 23, 1997)

The Ohlange experience provided further resources for the transformation of Morapeli's life experiences. His dreams for the future took on a different character. Career options widened for him at Ohlange, and like many of his classmates, he aspired to be an engineer. In addition to the school's focus on achieving excellent results in the matriculation examination, students at Ohlange were given extensive lectures on African history and the politics of the school. They were also taken on scheduled visits to J.L. Dube's grave (within the school premises), to pay their respects and make their pledges

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president Nelson Mandela - who has now been succeeded by his former deputy Thabo Mbeki

to take his work forward. Visits to the local community which included service learning projects were also used both for pedagogical and broader purposes of building students' commitment to the ideals of social transformation in the way Mafukuzela had done for them:

> You see the spirit that the students have has always been taken from the founder of the school. They say, "you are in Mafukuzela's place, you must understand the term Mafukuzela - - 'Man who struggled' - - understand. To lead his nation. So, all of us were ordered to use the same spirit, we had to work and struggle hard, you see, to be something. So you discover that the encouragement we got from the institution, the encouragement we got from reading about the founder and being told about the founder of the school you know and being taken into his grave when you arrive in there 'there lies the man who worked hard for what you see around here', you understand. And he died in 1946, very ill but eager to go forth. So, that itself motivated a lot of students as such, motivated all of us, do you understand? One of the things that helped us a lot was having political speakers coming to Ohlange itself. It was a great motivation because that kept my interest, you know and the focus on politics, you know, from high school to college and even outside - even to today. You studied that, some of the student who studied at Ohlange became politically motivated and they became great leaders as such, you see. You find leaders like Luthuli, who actually lived within about- - I think - - it is about forty kilometers from Ohlange, which is in a place called Tongaat, you know.[51] Those are the people we got motivation from and from Mafukuzela himself. There were a lot of motivations. That is why President Mandela, in 1994, went to cast his vote at that institution because that was an institution which was built out of hardship and the grave of the first president J. L. Dube is there, so he (Mandela) had to lay to lay a wreath and then go in and vote.
>
> (Interview, July 23, 1997)

The historical significance of Ohlange and the kinds of experiences he was exposed to at the school collectively shaped Morapeli's political outlook and in many ways helped him craft an agenda for transformation in his own work. How these experiences played out in his life as a teacher is an important question for this study.

Although Morapeli had gone to KwaZulu-Natal in search of a decent chance at a secondary education, he got much more than he bargained for. He got himself admitted into a school with a lot of social, cultural and political capital. He developed both politically and spiritually (by now he had joined the Seventh Day Adventists), to the

articulate Morapeli I first met at the pre-university program in 1984. At Ohlange, his life became transformed in ways he could never have anticipated, growing up in "deep Soweto" in the 1960s and mid 1970s.

After completing high school at Ohlange, and working briefly for a year and half as a teacher in a private school, Mr. Tshabalala went to a teacher' college in the Johannesburg area. After four years of work, he completed a secondary teacher's diploma with specialties in mathematics and biology. He began his teaching in 1992 at a township school in Soweto, teaching science and mathematics to various grade levels at high school. He has also pursued interests in music and sports at school and in the community.[52] At the time of our first interview for this study, he was the de facto sports master of the two schools where he worked (the finishing school and the parent school to which the finishing school was attached). While at high school and at the college, he had been active in student politics and served on various committees in this regard. He is also an active member of his religious community, taking over from where his father left off although in a radically different religious community - - the Adventists. Becoming a teacher was not a straightforward decision for Mr. Tshabalala. A number of existential circumstances, which have a bearing on who he is and the kind of teacher he becomes shaped his decision and approach. In the next section, I examine the issues that shaped his entry into the profession.

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[51] Chief Albert Luthuli, who became the last president of the African National Congress before it was banned in 1961, went on to become the first Nobel peace prize laureate from South Africa.

[52] Recently, Mr. Tshabalala appeared as a guest in a local television news cast of the South African Broadcasting Corporation (SABC), giving perspectives on the Black school rugby development program in Soweto, in a discussion of sports transformation in South Africa (reviewing progress in transformation of what used to be " whites-only" sports in the country).

THE JOURNEY INTO TEACHING

Asked why he became a teacher, Mr. Tshabalala refers to his strengths in "helping others" and his ability to explain complex details, as motivating him into the profession.

> I started teaching in 1986. In 1987 I was full with work, I had spent most of my time (on teaching my students), this is where I discovered my talent. That I am very good in teaching mathematics because I have got approaches, and that I am good with students, they always listen, rating me as one of the best teachers at the end of 1986. In 1987, you know, I discovered that I was helping a lot of people. The question was that I had no papers, no diploma at all. Then 1988 I decided, I have to go straight to the college. Then I went to the college. Actually that was the first eye-opener course that I ever done in my life.
>
> (Interview, February 17, 1997)

The experience of teaching as an "unqualified" teacher in a private school, together with his experiences as a student at Ohlange high school where he was frequently asked to help out in explaining subject matter to his classmates brought him closer to teaching. Though the "desire to help others" and his strengths in "explanations" were the motivating factors, they were not the decisive factors. The ultimate decision to enter the profession was determined by a complex web of life situations that saw him unable to gain entry into university to pursue his first career choice in engineering. He then registered for a degree in commerce through a correspondence/distance learning university, but ran out of funds in mid-stream and had to find a "way to survive." For him, like most teachers of his generation, Morapeli's entry into teaching was never a straightforward career choice. It was dictated by the complex set of political, social and economic conditions of his existence. Unlike many others, teaching was actually a distant choice among his career options (though remote indeed). It was only after a year and half of what he considers a "rewarding experience," of teaching in a private, under-resourced inner city school that had been established in response to student flight from township schools (which had broken down in terms of the "culture of teaching and

learning"), that he saw his way clear into the profession. Asked about the decision to teach, Morapeli responded as follows:

> Let me start by saying teaching was one of the challenging things, but if you have gone to a college, you were sure of finding a teaching post. And secondly, I had to work because I had no (financial) base. My mother was struggling. She needed the help, and studying through university, especially correspondence university, was going to waste a lot of time and I needed something that would redirect me to a career and to work to survive. So I felt that I should then join teaching. Then I joined teaching, you know. Remember, I already since from Standard eight (grade-10) class I had been helping my colleagues in the class so that itself, you know, motivated me a lot and the experience of working 1986 half and the full 1987, that itself motivated me a lot. But the only problem was that I was just calling myself a teacher but I had no papers.
>
> (Interview, February 17, 1997)

The practical concerns of job security also came into the picture in his decision to become a teacher. In fact, up until about the early 1990s, teaching was probably the most secure and decent employment for Black students who aspired to some form social mobility. The job came with a promise of a guaranteed housing subsidy, which made it attractive in a context where descent housing was privilege, and generous medical insurance for all those dependent on prospective teacher in addition to the opportunity to "help" raise and educate children in the community. As with many other features of a discriminatory society, the levels of security varied by gender. Women were relatively less secure than their male counterparts. For instance, falling pregnant as a single female guaranteed a loss of the privileges and similarly married women had to give up their families before they could qualify for a housing subsidy.[53] Most significant is the fact that Mr. Tshabalala's decision to return to college was influenced by the desire to challenge the "teacher qualification discourse" (Walker, 1996) in Black education. For, although he felt good about his teaching at the private inner-city school, without a credential, he

would never be adequately recognized for it by the education system and his contributions would remain marginal in the larger scheme of things in South Africa. Morapeli believes that he entered college "badly prepared" for teaching, though. In his opinion, the high school experience had merely capitalized on his strengths in the sciences and mathematics - - bringing them more into the open and leaving his weakness in the languages intact:

> Then I went to the college. Actually that was the first eye-opener course that I have ever done in my life. It looked like my first day of school, because I met people who quickly discovered that I got an English problem, they sat on top of my head.
>
> (Interview, February 17, 1997)

Part of his preparation to become a teacher included a language development program. At the college, he came across a number of teachers who were willing to assist him to develop into the kind of teacher he wanted to be. They engaged him, on his weaknesses and were very demanding of him in this regard. They gave him a second chance that both his high school and the universities (that rejected him for his first choice careers) had failed to provide. He was given a very demanding program that would help build his language competence (Interview, February 17, 1997). Not only was the program designed to meet his immediate needs, but it was shaped in such a way that it appealed to his experiences as an African student in a college that recruited most of its staff from a pool of English-speaking white lecturers in South Africa:

> ... What I was happy about (is that) they taught me to think, through African literature as such, you could learn a lot because they were teaching African literature, sort of, they were teaching what you know, lets say, most of the books were talking about African life, traditional life, African leaders, political leaders. I mean they talked about the whole African genesis as such and how African history developed.
>
> (Interview, February 17, 1997).

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[53] Most of these policies and practices have since been outlawed by South Africa s new constitution which was certified as the supreme law of the land by the constitutional court in Mandela in 1997.

From his descriptions of some of his college experiences, one gets a sense of a vibrant community where teachers paid attention to his needs and interests, engaging him with curricular activities and allowing him to develop as he chose within the program. At the end of four years Mr. Tshabalala qualified as a teacher and set off to begin his new career (yet again!) at a well built but poorly resourced township school in Soweto. Mr. Tshabalala taught at Maxima until 1996 when he was seconded to the Finishing school. The Finishing school began in 1996, with about 130 students. They used the same building as his original school but were managed separately by a new principal and staff. This is where I first observed him teach the science lessons discussed in the first segment of this chapter. As noted earlier, Mr. Tshabalala saw his transfer to the new school as an attempt to marginalize him for his questioning stance towards the administration and for his classroom practice that went against the grain. Determined not to let the experience (of being marginalized) break his spirit, Mr. Tshabalala quickly rose to the challenges at the new school. Because of his commitment to the notion of "second chances" at the Finishing school, he took charge of a number of responsibilities to make the school and its idea of "second chances" viable. Some of the responsibilities that he took up were management responsibilities like publicizing the school to the community through various community radio programs, admitting the new students and allocating them to various classrooms in the school. All the leadership roles he took up at the Finishing school were voluntary and not paid for. For him, the Finishing school provided a window of opportunity to pursue his visions of crafting a potentially transformative practice:

> Now this is where I could practice my own independence with my students as such.
>
> (Interview, June 18, 1997).

Despite all the constraints referred to earlier, Morapeli's classroom practice contained elements of a very progressive practice. He had students working in groups, drew from their experiences to present lesson material, allowed them to participate more in the lesson, asked them to take the classroom floor to demonstrate things to their classmates on the chalkboard, and allowed them to engage in rich discussions of each others ideas. His expectations went beyond the demands of the matriculation examination, although he held his students to its standards as well.

Tracing the development of his classroom practice over time leaves one with some sense of despair at the thought of what it will take to sustain such practices. Morapeli is up against very tough challenges, human and structural, and he is fully aware of this. His story paints a picture of a profession that militates against change, directly through sanctions or indirectly through the intervention of third party stakeholders and lack of support. Both his colleagues and the system he works for were not supportive of efforts at change. How is it that he is able to continue with this costly and risky agenda of classroom change?

What makes the case of Mr. Tshabalala more significant is the fact that a fairly large number of Black teachers in South Africa have experiences that are somewhat similar to his; having lived under apartheid and having their "careers" as students and their family lives disrupted at several points due to the politics of the time, and having entered the profession through the college of education (as opposed to the university qualification) route which was cheaper, often considered less demanding, and more certain in terms of completion time and employment prospects. The experiences of Mr.

Tshabalala thus provide a window into the major themes in the lives of the many in his cohort. Understanding his life experiences and how they shape his identity as a transformative teacher, therefore, helps us understand a lot more about teachers and teaching in South Africa and elsewhere. To engage in a practice that challenges the traditional models of teaching in South Africa, Mr. Tshabalala had to have developed a strong counter-identity to help him resist the status quo. He used his experiences and personal history to craft such a counter-identity of resistance.

MARGINALIZATION AND THE CONSTRUCTION OF A TRANSFORMATIVE IDENTITY: A RESTATEMENT

The major theme in trying to make sense of Morapeli Tshabalala's experiences in relation to his commitments and actions in the classroom practices revolves around his own marginalization within the education system, and how he struggled to overcome it by constructing an counter-identity at each level of education. His parents' belief in the "power of education" became for him an ideology through which the counter-identities were constructed.

As with Mr. Sithole, Morapeli grew up in the African townships, and lived many of the values of his community. In his discussion of his practice, he also speaks in terms of "helping others" who are less fortunate in his community. For him the issues are a little different though. His concerns with inclusion are located firmly within a context of his own multiple marginalizations within the education system. That is, the counter-identities he used to craft what I have referred to as a transformative practice has its origins in his attempts to resist his own marginalizations with the education system. The

most salient experiences of marginalization from which he crafted his multiple identities of resistance were in respect of his **race, socioeconomic status, limited success in learning the two apartheid official languages**, and his **teaching of the less successful students** at the finishing school.

Racial identity

First, on the basis of race, he was offered an education that was inferior to his counterparts in the white, colored and Indian suburbs of South Africa. Up until 1994, Black education was funded at less than half of what schools in the suburbs were receiving in the form of government subsidies (SAIRR, 1995). These funding patterns had an impact on the types of resources schools could provide for educating the different groups of learners. Consequently, Morapeli received most of his early education in schools that provided very limited opportunities for success and development. As if that was not enough, his early secondary schooling was disrupted for two years while authorities tried to push through a language policy agenda that would legalize the marginalization of Black students in schools across South Africa. The minority government tried to force its policies on Afrikaans to children in Black schools, a move that would have made it much more difficult for Black learners who wanted to leave the country in search of a better education abroad. Under these circumstances Morapeli still managed to construct a counter-identity. His counter-identity was based largely on the aspirations of his parents for all their children. His parents constructed their lives around the need to provide better opportunities for their children and the need for a "good education" featured prominently in their aspirations. From the time they decided to run

away from the farms, to spare their children of the hassles of forced labor on the farm, the Tshabalala's had resolved for themselves the debate on the need for a good education for their children. For them, education was a powerful tool for liberation that no one could ever take away. With these kinds of values and emphasis on education, Morapeli stayed in school and sought better opportunities for learning, until he was himself in a position to create such opportunities for others less fortunate than him.

Socioeconomic identity

The second form of marginalization he experienced was based on his socioeconomic status. This is the kind of marginalization he experienced when he arrived at the exclusive boarding school in KwaZulu-Natal. Unlike many of the students at the school, who were from rich backgrounds, his was a very modest home. In fact, his parents had only enough to pay his initial fees into the school. He had managed to get himself admitted into this exclusive school, and was not about to give up on the opportunity because of his modest background. To survive and stay in school, he did everything possible to raise funds including doing laundry for his classmates for a fee and taking pictures at every school function he could attend (Interview, June 18, 1997). He developed a counter "identity of excellence" in order to gain acceptance and favor from his schoolmates as an outsider from Johannesburg:

> ...There was a very competitive spirit. In June I was top (in mathematics) because after June I was marked as "this guy is dangerous" and people started noticing. Ja, then during study time, I used to help my friends especially those who came from Johannesburg, and other colleagues that I was taking the same courses with.... that motivated me a lot. This is where I discovered possibly I should take teaching but initially I had thing of wanting to become an engineer.
>
> (Interview, February 18, 1997)

The desire to do well at school in order to gain acceptance and recognition from his classmates is what I refer to as the "identity of excellence." It is a counter-identity that Morapeli constructed due to his experiences of marginalization at the school. Although this "identity of excellence" did not directly impact on his socioeconomic status, it improved his status and acceptance by others who were more privileged than he was and allowed him the opportunity to receive an education similar to some of the privileged within his community.

Special education identity

At college he was marginalized as a less successful learner in the official languages (then, only English and Afrikaans). Mr. Tshabalala was never as successful in the two official languages as he was in his mathematics and sciences. In the matriculation examination, he obtained lower grades for the languages and excellent grades for physical science, mathematics and biology. By rule, however, he could not be granted a matriculation exemption with this mixture of grades. Languages, more especially English, weighed heavily in determining the quality of a pass that was awarded at the matriculation level. He entered college with this combination of matriculation grades and was immediately identified and labeled as a special language case. His marginalization at the college only became significant in the context of him being labeled and placed in the "special program" of language development. Other than that, he was an excellent student, who led the school in many activities including choir music, athletics and mathematics teaching practice. It is at the college that he began to develop a strong counter-identity to some of the dominant practices in education:

> Well it (the college program) was very good even though it was a very intensive program, but it did help me in many ways because it raised some areas, and especially also exposed my weaknesses and most of my weakness were really corrected. Secondly, I also developed more from college because I needed to look at the career of teaching as such. I need to look at that various teaching methods that I needed to have in class and the approaches that I needed to develop before I go to class. I was exposed to a variety of things... so I think college in a way prepared me for everyday life. I don't regret why I went to the college.
>
> (Interview, February 17, 1997).

For Morapeli, college life was about preparation for everyday life as a teacher. As in the case of Sithole, from his experiences at college he came out with a strong sense of pedagogical content knowledge and a vision of teaching the marginalized in schools. It is not clear, however, that he came out with an equally strong vision in terms of teaching for conceptual understanding, from his college experiences. He continues to study science part-time through a distance learning college "in order to improve" his own understanding of science.

Teacher of the "other" identity

The last form of marginalization is what Morapeli talked about in respect of his secondment to the finishing school. Unlike Mr. Sithole who was leading a quite revolution in his classroom, Mr. Tshabalala was an open book. He questioned and had strong opinions on the status quo in his classroom and in the school generally. He worked openly with an agenda of change in his classroom. He developed a professional identity counter to the dominant prescriptions of apartheid education, and thereby made the authorities at his school less comfortable with their own practices as much as they were with his. He deliberately sought to include girls in science teaching, used the experiences of his learners to talk about the subject matter, and became an advocate for the marginalized learners at the finishing school. As a result, he was often marginalized

and silenced. He was deliberately seconded to the finishing school where he would struggle to reconcile his vision of a transformative practice with the public expectations to drill the less successful students for the matriculation examination. As his district leadership put out a directive to all schools in the district, he was expected to draft a specific (development) plan to show how he would achieve a 5% increase in the matriculation pass rate at his school as a contribution to the provincial campaign to increase the pass rates in Gauteng (Circular No 5/1997). Indeed, he struggled with these expectations, and for a time it almost seemed he had given up on the transformative agenda to science teaching. But as he explained it, his practice has always been what I have characterized as transformative, only that it sometimes takes longer for him and the students to get going on the vision (Interview, August 1998). As a result, his vision was stronger on equity and quantity issues and less so perhaps on quality issues as defined in Chapter four.

Morapeli Tshabalala' s is a case of a practice that is constructed around the need to provide the students with the tools for crafting their own counter-identities that will enable them to participate fully within the processes of social transformation in South Africa. By providing them with meaningful opportunities to learn science and be successful in the matriculation examination in the context of addressing forms of discrimination characteristic of a majority of science classrooms in South Africa, Mr. Tshabalala is able to make strides towards his vision of a truly transformative practice.

CHAPTER SIX

SUBJECT MATTER IDENTITY AND THE CONSTRUCTION OF A TRANSFORMATIVE PRACTICE

INTRODUCTION: GOALS FOR TEACHING SCIENCE

As described in Chapter 3, the case studies of Mr. Sithole and Mr. Tshabalala constituted a phase I component of this study. In Phase II, a survey of teaching practices of 87 science teachers in KwaZulu-Natal was undertaken. One of the major reasons for this undertaking was the desire to locate the practices of transformative teachers within a broader context of school and classroom practices across the range of schools found in the region. Many of the policy players I had talked with about the study identified the gap in local understanding of what was happening in most science classrooms across the province. The discussion of Mrs. Hlophe in this chapter is thus located within this overall context of the research on the practices of other teachers surveyed in the province.[54]

Based on the initial analysis of the data from my observations and conversation with the two teachers from Gauteng, Mr. Sithole and Mr. Tshabalala, I designed a questionnaire with items that would help me to select a few teachers whose practices could potentially be read as transformative. The questionnaire contained several groups of items on topics that I had found to be important in our conversations with the Gauteng

[54] The general findings from Phase II of the study are reported in depth in a monograph published by the EPU (See Jita, 1998).

teachers.[55] On the basis of her responses to some of the topics of interest and on the strength of her school's nomination by a number of the teachers and policymakers I spoke to, I asked Mrs. Hlophe to be a participant in the study. She was also highly recommended by her school principal whom I had met briefly at a local community meeting unrelated to the research.

There were several areas of interest in the questionnaire to which Mrs. Hlophe provided very interesting responses that suggested a very deliberate classroom practice on her part. First, I noted her strong drive and affinity for the subject matter of science. Her responses to a set of questions about her motivations for taking up teaching all placed emphasis on her "love of" and desire to work with the ideas of science, as opposed to being motivated by her role models who were teachers or by the employment conditions in the profession or even by the desire to work with young people. Hers seemed to be a strong sense of identity constructed around the subject matter of science. This emphasis on subject matter came showed up again in her responses to questions about how to characterize a good science teacher. Her responses rated items such as "obtain high pass rates," "teach pupils to think critically," "know one's subject matter," and "read professional journals in the discipline" as very important in defining a good science teacher, relative to other items like "fight for better conditions," "be involved in sports," and "involvement in campaigns for social justice."

An overall analysis of her responses began to suggest a particular set of goals and emphasis in her classroom practice. Her responses to items about the emphasis of her questioning style in the classroom gave a very distinct impression of a teacher who

[55] See appendix A for a copy of the questionnaire. Included also is a schedule with a listing of the areas of interest that I used for purposes of identifying teachers for further interviewing and observation and on the

"never" questions for the correct answer but instead uses questions to get at students' understandings of the concepts. She asserted, for instance, that she never "corrects students' errors in front of the class" and never "calls on another student for a correct answer." Instead she "asks a student (who cannot give an answer) another question" or calls on "students to discuss the question and the answer." Her style of teaching also emphasized group work and collaboration among the students. In contrast to the three goals of teaching for Mr. Sithole and Mr. Tshabalala, Mrs. Hlophe's goals for teaching focused primarily on preparing students to do well on the examinations by developing rich conceptual understandings of the major concepts of science. In our conversations about her responses and later about her observed classroom practices, the two themes of **accountability** and **conceptual understanding** came out as the major anchors of her practice, although her style of presentation also sought to bring out the voices and experiences of **all** her students.

Before the conversations, her questionnaire responses were puzzling in a few respects that made her an even more interesting candidate for this study. First, although she was low on the need for advocacy for "social justice" and "better conditions for teaching," she believed very strongly in the importance of teaching students about "the relationship between science and culture," the "relationship between science and socioeconomic development" and the need to "apply science concepts to real life." This was despite her citation of "resources" as a major factor that limits her teaching of science. The second issue was the fact that in spite of her qualifications and her views on the importance of reading professional journals and newspapers and the need to "improve one's knowledge of science," she was negative about the need for teachers to register for

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basis of which Mrs. Hlophe was selected for participation in this study.

higher qualifications. Based on these puzzles and understandings emerging from her questionnaire responses and the recommendations of her principal and subject advisors, I arranged to observe and interview her about her beliefs and classroom practices.

A VIEW INTO THE CLASSROOM: PART I

Mrs. Hlophe teaches a physical science course to 10th graders and mathematics to 11th and 12th graders at Khulani secondary, an elite boarding school in KZN. She is also the school's science Head of Department (HOD), one of several women occupying senior positions at the school including the position of deputy principal. On all the occasions I was able to visit Mrs. Hlophe's classroom, she was teaching a chemistry section of the syllabus. In my observations of her lessons, I noticed that she began all the lessons with some kind of a problem to be solved. Sometimes the problem was a real-world problem, while at other times it was a constructed situation to help students grapple with particular concepts in the subject matter. For example, when she taught a section on molecular orbitals to her 10th graders, the problem to be solved was on how to use the molecular structures of the atoms and molecules of particular elements to explain their behavior in different chemical reactions. She combined this section with another on the periodic table and gave the students groups of elements from the periodic table (e.g., the "Noble Gases" or Group VIIIa elements and the "Alkali Metals" or Group Ia elements) and asked them to predict which ones would react more or less and why. This was not a kind of problem that related directly to the life world of the students, but as she explained it to them, it formed a basis for later discussions about how and why things react in the way they do in industrial chemical and natural reactions. The constructed problem was rich,

conceptually, as it allowed students to integrate different concepts in science and make defensible predictions based on their understandings of scientific models of subatomic organization and motion.

In other lessons that illustrate her use of problem posing approaches for conceptual development, she used stories to set up the specific scientific problems for students to solve. The stories she told were often real-life stories or constructed tales from the events that are common within the culture of the students. In one such story that she used with her 10th grade class, she was able to explore ideas about phases of matter and energy (sound and heat) in a way that located their discussion within the cultural context of her students. In one of our conversations, she described the lesson in the following way:

> You know, like I told them the other day, "You know I have got a problem at home. Mr. Hlophe (her husband) likes tea so much but my problem is that whenever I make him tea I have to boil water first." and they said "Ja, like dah, everybody does that." But I have to boil water, make tea, and take ice cubes put them in the tea. "Ice cubes?" and I said ja, and then I said can anybody try to explain why, you know, is this man bothering me? Does he want to chase me away from home or what? Because, I don't understand, if he wants cool drinks why doesn't he ask for Coke or Sprite or something cold? Why does he want tea? I have to plug the kettle, put the water on and then make it cold. You know, and we will start discussing maybe because you know, okay, okay. What's the effect of ice in that, right? Now try and think what would happen when you know, ice gets into the hot water? What happens? And then they would say "Ja, I have seen it. It cracks. It makes a sound." "Ja, what makes the sound?" Why? And then they start saying, "Okay, so we go back to the particle model of matter when ice gets heated up, what happens to the particles, where is the sound coming from?" They link it with the (theme on) sound we did. So, it's eh... you know, just that relaxed mood when I introduce a lesson, go to class, don't have a book, just sit on the table and we just talk, you know.... At the end of the lesson, okay, ja, now you will find this on pages so. Do that for your homework and then tomorrow we will go to the lab and do this and this and this and this, you know. So, now they know that what the (theme on) heat that is in this book, the (theme on) sound they have learnt in this book, it relates to Mr. Hlophe wanting tea at home. Ja, you know, you link what you do in class with, with the outside life.
>
> (Interview, August 28, 1997)

Several observations can be made about the nature and content of the story described in Mrs. Hlophe's comments.

First, it is a story about culture. It describes an everyday event which students can identify with, that of making tea for Mr. Hlophe in this case. Second, although it is not clear that Mrs. Hlophe had it as one of the major issues of the story, it provided opportunities for students to reflect on the culture and some of its practices. Some of the questions she raises rhetorically in telling her story, such as "Is this man bothering me?," "Does he want to chase me away?," or even the question on the meaningfulness of his request for tea with ice cubes, had the potential to provide opportunities for examining the power relations embedded in these kinds of family relationships within the culture. Many of her students, as natives of the culture, do not have as many opportunities to examine critically some of these taken-for-granted practices. In addition to its richness for exploring scientific processes, her story also presented an opportunity for a critical discussion of culture and its practices. However, unlike Mr. Juluka who took the risk and allowed his lesson on the "human circulatory system and the heart" to cross the borders of science into a discussion of housing and urban policy in South Africa, Mrs. Hlophe's goals for the lesson were different. She was primarily focused on getting students to develop deeper conceptual understandings of the subject matter of science through the use of the culturally relevant lesson material. It was not clear from our conversations that a cultural critique was as much a part of her plan as the desire to move students to a conceptual understanding of the subject matter was. This leads me to the third point about the story, that is, in addition to its cultural content; the story has a science content. It allowed for a discussion about sound, the phases of matter, conservation of energy, and

the scientific explanations of changes in matter and energy. It is these concepts and explanations of scientific phenomena that Mrs. Hlophe seemed to have intended for her students to understand and develop during the lesson.

Fourth, the story is about the use of scientific knowledge and phenomena in everyday life. In this case, it is about the relationship between science and culture - - a relationship that never ceases to be problematic. Oftentimes culture is proposed as an explanation for lack of opportunities in science, especially for women. Many of the cultural practices within Africa have not escaped such criticism with regard to the roles that they assign to women and girls in schools and society (Osler, 1997a; Sebakwane, 1997). Against the backdrop of the criticisms of culture and its role in limiting opportunities for young women to pursue science, Mrs. Hlophe's stories, which bring out processes and experiences from the home into the public discourse of science become very significant. What makes the lesson exceptional is her use of what is normally a cultural practice of domestication and oppression, that of making tea for a "demanding husband," in a way that sheds it of its oppressive features to become a tool for reflection and empowerment in the science classroom. She ably brought the private into the public sphere in ways that those who have felt oppressed by the cultural practice could still use the experience to make sense of their world. The limits of what she could achieve within the framework of her primary emphasis on conceptual understanding, as opposed to adopting a broader framework that includes cultural critique, was noted earlier. My point in this dissertation is a cautionary one for many of the science reformers who advocate a practice that incorporates culturally relevant materials and ideas. It is not enough to bring

in materials and experiences from the students' life world, but how such materials and ideas are used in the classroom is of equal importance in transforming science education.

The final point about the story is that it illustrates, concretely, Mrs. Hlophe's attempt to orchestrate a "relaxed classroom environment," that is safe for taking risks intellectually. As she described it, "The science stories from the (social) world of the learners help to take out the tension in the classroom" (Interview, August 28, 1997). She hypothesized that in view of the students' familiarity with the examples, stories and themes from the culture, they would relate better to the science concepts and principles conveyed by the stories and examples.

When Mrs. Hlophe was not telling a real-life story to lay out a scientific problem or constructing a simulated problem from the subject matter, she engaged her students in hands-on laboratory activities in ways that approximate events in the real world. In one of the hard core chemistry lessons Mrs. Hlophe planned to simulate the industrial preparation of nitric acid in the laboratory. It was interesting to note her changing role in the lesson - - from that of being a story teller who leads the discussion and questioning, to that of being a leader in a process of collaborative inquiry into aspects of a scientific experiment that failed to yield the expected results even after several trials and variations. The lesson took the form of a laboratory demonstration of the **Preparation of Nitric Acid through the catalytic oxidation of Ammonia**. The demonstration was used as a basis for discussing two industrial processes involving nitrogen viz. the Haber process for preparing ammonia, and the Oswalt process for preparing nitric acid. In the next section, I will discuss some aspects of the lesson that help bring out the important features of Mrs.

Hlophe's classroom practice. Before that discussion, however, it is important to say something about the context within which her practice develops.

SCHOOL AND CLASSROOM CONTEXT

Mrs. Hlophe teaches at one of the elite schools in the townships of KwaZulu-Natal. As noted earlier, she is the head of science at the school, a position to which she was appointed nine years ago when she first moved to the school. Prior to her move to Khulani high school, she taught science at another elite boarding in the province. Her move to the new school was in response to a newspaper advertisement of a senior position at the new school. According to her principal, she was one of the 'best qualified' science teachers on the interview list when she applied for the position (Interview with the Principal, August 04, 1997). In the context of an education system where fewer than 40% of the science teachers had any qualifications at all in science, a university degree with a science major was indeed an asset.[56] For Mrs. Hlophe the move to Khulani secondary represented an opportunity to advance within the profession and get recognition for her abilities and strengths as a science teacher. Here is how she described the move to Khulani:

> I applied, I got interviewed, which means I performed well because I got promotion and then I got the senior post.
>
> (Interview, August 28, 1997)

Although she had no doubts about her qualifications for the senior position, the appointment of several women as senior teachers at Khulani, including Mrs. Hlophe and

[56] The school was administered by the Department of Education and Culture in the homeland of KwaZulu. Research by Reddy, *et al* (1997) suggests that the percentage of qualified science teachers in the homeland of KwaZulu was less than 40%. KwaZulu has since merged with Natal, an area around Kwazulu which was administered by the central government and preserved mostly for white people and urban Blacks. The province is now called KwaZulu-Natal.

one of the two deputy principals, was indeed a significant sign of change within the education system where men dominated most of the senior appointments in secondary schools. This was more so for Khulani, a school that had been conceived of as an elite boarding school for boys. Due to the rising demand for science and commercial education by girls, however, the idea of a boys' school faded before it could even take root. Forced to admit girls in its first year, the school had to quickly convert one of the dormitories built for boys into girls' rooms. As a legacy of its conception, Khulani continues to admit more boys than girls, especially those who live in the student dormitories. There remains two blocks for boys and one for girls in the housing facilities at the school.

As a special school, designed to be one of the elite schools, and sponsored by a number of large corporations in the province, Khulani was designed to provide higher status to those who could afford to pay to attend the school. Access to the "cultural capital" (Bourdieu, 1977) of the school is facilitated by the rather close involvement of the large corporations in the affairs of the school. With its technical, commercial and science streams, it was hoped the school would be a resource for industry with regards to the supply of an educated workforce. Or if industry did not need them as workers as has been the trend throughout the 1990s with an economy that is continuously shedding jobs instead, the hope was that there would still be political and financial spin-offs for the corporations' contribution to improving Black education. It is interesting to note, however, that even though girls were originally not meant to benefit from the cultural capital at the school, significantly more women were appointed to senior positions than in many of the regular high schools in KwaZulu-Natal. The reason for this is not clear, but

may have something to do with the nature and quality of the applicants and the processes of appointment at the school. As a school that was built and sponsored by captains of industry to, among others, win political favor from the anti-apartheid movement at the time, the criteria for selecting teachers was different. The selection processes were more open and public, with a selection committee made up of representatives of industry and the officials of the Department of Education in KwaZulu making the decisions on appointments. This was a variation (or actually a deviation) from what had been the normal procedure of recommendations by the circuit and district inspectors who themselves often delegated the task to school principals. The school principals, many of whom are men, would in turn promote members of their own clubs and networks. Women, however qualified, were disproportionately prejudiced by these appointment procedures.[57]

The formal program offered at the school seems to confirm the hunch about Khulani serving as a place where dreams are shaped or shattered. According to the principal, all the grade-12 students are made to enroll for one extra subject in their final year of high school, increasing their course load to seven subjects. As the seventh subject is not used to compute the student's average grade, it only works to their advantage in that it is included in their certificates only if it is passed but not added to the grand total in calculating the student's average percentage. Historically, most White schools register their students in seven, eight or more subjects for the matriculation (Grade-12) examination. The down side of this subject packing is that students may end up with

[57] Under the new legislation, the SASA, appointments are made through an even more public process of interview and selection by a committee that includes representatives of the Department of Education, the Teacher Unions, The Parents committee of the school, and the teaching staff of the particular school.

more subjects than they can cope with, leading to a drop in their performance overall. In addition to the subject-packing at Khulani, all the matriculation students have to write their examination with at least four subjects on the higher grade to ensure that they qualify for a matriculation exemption.[58] Given this deliberate design of the formal curriculum and the conditions of relative privilege at Khulani, the school has consistently achieved between 98 – 100% pass rates in its matriculation examination. In 1998, for example, when the provincial percentage pass rate was below 50%, Khulani still managed to achieve above 90% pass rate.

The context at Khulani is such that the expectations for both students and teachers are immense. The students are expected to consistently achieve high on the national examinations. Such an environment may begin to conjure images of highly structured classrooms with teachers beating hard on the national requirements. Most schools that do well on these examinations, especially the formerly whites-only schools, have used that model successfully in the past (Personal Conversation, Science subject Advisor, May 1997). An alternative view, however, is the one illustrated more graphically by the case study of Mr. Sithole. Mr. Sithole works hard to establish a good track record in the matriculation examination pass rates so that the need for tight instructional supervision, especially by the inspectors, is removed, thereby providing him with the space to stretch

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Provisions are also made for the appointments to be challenged in cases where the candidates are not satisfied with the conduct of the selection process.

[58] For matriculation examinations, students have a choice of writing their subjects either on higher or standard grade. A third option called the 'lower grade' was only available to white candidates. The number of subjects written on higher or other grade determines whether a student receives an endorsement that allows him/her automatic entry into university or not. Therefore, the more subjects one has on the higher grade, the better the chances of receiving the endorsement (called an exemption in South Africa). A healthy balance is therefore needed, where students take a certain number of subjects on the higher grade and others (supposedly the most difficult for them) at other levels. Schools often find ways (not entirely legal) of making these selections for their students. Given that most schools are only interested in the number of passes, not the quality, they often encourage students to register as few subject as they can on the higher grade, thereby limiting their chances of going to university.

the classroom curriculum with the students. What students learn in the science classrooms like that of Mrs. Hlophe at Khulani secondary is not immediately obvious from a description of the school context. A much closer view into the classroom is needed to make such a determination about what science is taught and learned in her classroom.

A VIEW INTO THE CLASSROOM: PART II

All of Mrs. Hlophe's chemistry lessons that I was able to observe, took place in the physical science laboratory of the school.[59] The laboratory is very modest with three rows of workbenches, each with its own sink and water outlet.[60] Mrs. Hlophe worked from a demonstration bench in the front of the room near the chalkboard. From time to time, she would disappear into the chemical reagents' room in the front of the laboratory behind the chalkboard. A group of 34 students, her largest class, sat on the three benches in row 1, with three of the four girls in the classroom seated together in Bench no 1 in the front row (one girl was absent on the day of this observation).

A few segments from the lesson will illustrate some of what I found to be the notable features of Mrs. Hlophe's classroom teaching. The lesson was a continuation of work begun the previous day when the learners had tried to prepare oxygen by heating potassium permanganate to release the oxygen gas. In their first attempt, the experiment failed to release the required oxygen gas.

On one side of the chalkboard, Mrs. Hlophe had written a "simple procedure" for the day's experiment:

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[59] The school has two science laboratories, one for biology and another for physical science.
[60] See appendix G for a sketch of the room and seating arrangement.

1. Put Concentrated ammonia in test tube and heat
2. Pass Oxygen through the solution
3. Hook the heated Platinum/Copper to the side of the test tube
4. Record

(Observation, September 04, 1997)

Approaching the task like a seasoned senior laboratory scientist working with novices, she began to engage her students on how they were going to get their reagents or more specifically the reactants they were interested in for the experiment. That is, she asked them questions about how they would go about preparing the Oxygen needed for the oxidation of Ammonia and how they would then prepare the required Ammonia. Before students could answer the question she continued her introduction of the lesson (suggesting that she was using the question rhetorically to set up a problem for them). She then told her students that they were about to solve the same problem that the Germans confronted during World War I. Her single lesson deliberately integrated different sets of chemical processes and reactions in order "to explore the ways in which chemists typically go about solving complex problems of everyday life" (Observation, September 04, 1997). As she continued to introduce the lesson, she briefly told the tale of how the Germans who were using sulfuric acid to generate nitric acid for their explosives could no longer get their supply of saltpeter (sodium nitrate) from Chile. As a result, they had to find alternative ways of making the nitric acid they needed for their bombs. To bypass the ban on the sale of Chilean saltpeter, the Germans discovered a longer process to make the nitric acid. The process combines two chemical reactions or processes now called the "Haber process" and the "Ostwalds process" named after the scientists who made the discoveries, Fritz Haber and Wilhelm Ostwald respectively. She opined that the discovery of this alternative method by the Germans is what prolonged the World War. The students listened attentively to the story and frequently interjected

with questions that sought clarification or restatement of what she was saying. They asked such questions as "What is saltpeter?" "Where is Chile located geographically?," "Are Haber and Ostwalds German names?" to which some of the students in the classroom volunteered answers. The students themselves at the direction of the teacher answered all the questions. After about 10 minutes of introduction, she went back to her original question about how the students would prepare the reagents for the day's experiment.

S1: (on the basis of the theory discussed in earlier lessons) Well, I will react concentrated Sulfuric acid with any Nitrate Salt.

T: Go ahead, take Sodium Nitrate (a salt) and work out the equation to test that.

S2: (interjecting) No, he is confusing Oxygen (preparation) with preparation of Nitric Acid from Nitrate salts of alkali metals.

T: Yes, can you see S1 (By now S1 has realized his mistake and was ready to take another shot at the first question again) ... O.K. let's think about it some more.

Pause (1min)

T: Because of what happened yesterday - - referring to the failed attempts to generate oxygen from potassium permanganate - - today I'm going to use Potassium Nitrate. What am I going to prepare?

SS: (No response while learners brainstorm among themselves.)

T: Today I am going to use Potassium Nitrate and Manganese dioxide and not Potassium Permanganate to prepare what?

S3: Oxygen

T: Yes! Oxygen.

There was a pause of about two minutes while the teacher tried to set up the experiment using a spirit bulb to burn the salt (as there was no gas in the laboratory). The experiment involved connecting the production of Oxygen from the thermal decomposition of Potassium Nitrate; and using the oxygen released to oxidize ammonia.[61] After two

[61] See Appendix H for the experimental set up.

successive attempts by the teacher to conduct the experiment with no signs of success, learners began to interject possible explanations for the failure of the experiment:

S1:	There is not enough oxygen being released.
T:	Yes, oxygen is a good combustion agent (implying that the fact that the oxygen indicator failed to burn continuously confirmed S1's explanation.) What are the other reasons?
S2:	Problem is with the poured indicator.
T:	Explain that....
S3:	(Interjects) The problem is with the platinum that we are heating.
T:	What about it?
S3:	By the time it's taken to the flask, it's already black and has lost heat.
T:	(Writes the two explanations proposed by the students S1 and S3, on the board): "not enough heat/catalyst loses heat before being introduced into the flask."
S4:	The solution is still basic and not acidic.
T:	What's the connection between that and heat?
S4:	(Pauses to think)
S4 + S6:	Propose a method to check if the ammonia solution in the flask is acidic or not – ammonia combines with oxygen to yield among others nitric acid. Can we use the indicator? (Pointing at the litmus paper)
T:	Yes, but I don't want to write that down because it relates somehow to reason number one i.e. not enough oxygen.
S7:	The problem is really with the catalyst. We need the catalyst; it needs heat to work.
T:	Yes, the catalyst would continue glowing if the experiment worked.

At the end of this discussion, the teacher conducted the experiment again using Potassium Permanganate and again it failed. She again discussed possible explanations for the failure with the learners. Then she again tried with the 'salt peter' (Sodium Nitrate) and again the experiment did not work and students reasoned with her on the possible explanations for their findings. She promised to bring in another salt that released oxygen, that is, potassium chlorate, for yet another attempt.

By this time, the class was vibrant with activity and discussion. Students reformulated their seating groups into even smaller groups to explore their explanations for the failure of the experiment. Mrs. Hlophe left them for a while (about 3 minutes),

while she returned some of the reagents to the reagents' room. Upon her return, she refocused their attention to the problem of the day by writing out the chemical models (equations) that explain the reactions they were trying to demonstrate. These chemical models were then discussed drawing upon previous knowledge as she continuously asked students if they'd ever seen some of the chemical compounds involved in the reactions. Students provided physical descriptions of some of the compounds they had seen. For example, students started to talk about the medicinal use of potassium permanganate, whose name in IsiZulu means all cures or medicine for all diseases, suggesting its medicinal use for treating a number of common illnesses within the culture. The lesson ended with a reading assignment on the reactions of nitrogen in the textbook.

SOME IMPORTANT FEATURES OF MRS. HLOPHE'S PRACTICE

Several important features are worth noting about the lesson just described. First, Mrs. Hlophe had no problems working through the failed experiment. Every time the experiment failed, she would engage students in a scientific discussion about it and then go on to demonstrate an alternative way of setting it up with a different set of reagents each time. She had no problems responding to the exigencies of the moment that required her to think differently about the subject matter and demonstrate that to her students.

Second, throughout the various experimental trials, she kept her learners' attention and participation by frequently asking them to reason with her through what was happening. Her questions were constructed in such a way that the learners had to use scientific concepts to reason and account for the particular observations they were

making. Hers was an environment typical of real life-settings where supervising scientists induct novices into the problems of experimental work in science laboratories. In such settings, it is not uncommon for neophytes to be inducted into the field by using exemplars, familiar problems and other major experiments in the discipline, more akin to what Thomas Kuhn (1970) refers to as the initiation into the 'dominant paradigm'. In this case, the teacher was using a familiar experiment in science on the preparation of nitric acid to induct students into the dynamics of conducting scientific experimentation in the context of exploring important concepts in the science of chemical reactions. Her design of the classroom environment was such that learners were encouraged to take intellectual risks by proposing various explanations for their observations. Most of these explanations were well reasoned and plausible and she accepted them, often, with a requirement for the students to elaborate on what they meant and/or to relate their responses to the problem at hand. There were some distinct lapses, however, when she failed either to acknowledge or to probe a learner about his/her explanation. In the foregoing illustrative segment of her lesson, one instance of such a lapse occurred when she failed to push S4 to relate his prediction that the acidity or otherwise of the solution had something to do with the problem of not being able to demonstrate the presence of oxygen. Such lapses were few and far between, though. For the most part students in her classroom did expect to be asked for elaboration on their responses or explanations. I found it remarkable that an experiment that had failed repeatedly was being used as an opportunity for rich learning in this classroom, attesting to what I think is Mrs. Hlophe's comfort in the "neighborhood of science" (Roth, 1987).

Another interesting aspect is how she set up the problem for the day in her introduction. She located it within human experiences of World War I, and the interactions of science and society. She was using the subject matter to raise issues about the use and misuse of science in the service of war during World War I. This was a very powerful contextualization of a robust chemistry lesson. Through the failed experiment, she was able to set up a powerful context for conceptual understanding of science, the major goal of her practice. Missing from her discussion of the social impact of scientific knowledge were critical ideas about power, knowledge, and social reconstruction. For example, in her discussion of the events of World War I, she made no references to the circumstances that led to the war, its consequences, lessons from the experience and other such important historical details. Although I felt she had succeeded in using the brief historical sketch of aspects of the war to set up the science problem for the day, I wondered about why she had not explored other issues of historical significance about the war, as a way to connect science to issues of equity in society. In her response to my musings about this, she acknowledged that she had held back on some of the historical details deliberately because she felt that the connections would not be immediate for her students. Her decision was influenced by the dictates of the present curriculum, which provided her students with no opportunities for learning about the history surrounding the events of World War I or II. She made a judgement that her students, who were pursuing either a technical or science stream, and therefore do not take history as one of their subjects, would be confused if she got into further details about the war. Again, unlike Mr. Juluka, Mrs. Hlophe felt constrained by the dictates of the curriculum prescriptions into limiting her "border crossing" to the discipline of history. Although she was

enthusiastic about connecting science to society through exploration of real-life problems in her classroom, Mrs. Hlophe was hesitant about linking the subject matter from the different disciplines of science and history in this particular case. She viewed the discussion of World War I as firmly located within the discipline of history (and not science) which her students would not have the tools, the interest or the privilege to study at their particular school. As a technical, commercial and science school, Khulani provided no place for history or social studies in its curriculum offerings. A subtext of this story is the fact that Mrs. Hlophe did not view the absence of a connection to history as a limitation of the present science curriculum that requires her to intervene by helping students make the connections.

The demonstration lesson provided students with opportunities to practice some of the important scientific skills and "habits of mind" (AAAS, 1989) such as brainstorming, identifying problems, and attempting to solve them by providing plausible scientific explanations and testing them out. Uncharacteristic of Mrs. Hlophe's lessons, the experience also provided students with a rare opportunity to question the distribution of resources in schools and society. Since they were using Copper as the catalyst for the reactions instead of Platinum that is suggested in their textbooks, the students began to ask serious questions about the provision of facilities to their school and others in the townships. They asked about the lack of electricity in their laboratory, which forced them to use a spirit burner which some felt did not give enough heat for the chemical reactions in the experiment. Given the relative privilege of their school compared to many others in the township, it was significant to hear students begin to even think and articulate ideas on these issues of power and privilege. Their cushioned environment at

Khulani had the potential to insulate them from many of these aspects of the real world of learning experienced by many of their counterparts in the township (non-boarding) schools. Schools such as Khulani were designed to provide a buffer effect within the black communities - - where schools that are better off would counterbalance any serious challenges to the authorities on the question of resource provision for Black education. That is, the wealthy in society could cite such schools as examples of what all the others could achieve, (only) if they made the right connections with business and industry. I noted, however, that in spite of Mrs. Hlophe's obvious enjoyment of the unsolicited comments on the resource provision question, she neither commented nor entertained discussion of the issue except to acknowledge a student when he/she was on the floor and chuckled a little at their comments. She was not wholly comfortable with this subject and just chose to manage the students' discussion without encouraging or linking it to her subject matter.

In many other settings, a failed experiment or lack of appropriate reagents would be enough reason to lock the laboratory and opt for a strictly theoretical discussion of the chemical reactions. After all, the end-of-year examination only requires students to know how to read and write the chemical reactions on a paper-pencil test. Why then was Mrs. Hlophe doing the kind of things she was doing in her classroom? As Somers and Gibson (1994) would suggest, she acted the way she did because of who she is. In the following section, I explore the life story of Mrs. Hlophe.

THE LIFE STORY OF MRS. HLOPHE

Mrs. Hlophe is a Black woman, in her mid-40s, who grew up and lived in the Eastern Cape before relocating to KwaZulu-Natal to work and begin her own family life several years ago. She continues to live and work in KwaZulu-Natal to this day. In contrast to the stories of relative poverty and working against the odds to get the most basic of opportunities for an education by the other two teachers in the study, Mrs. Hlophe's struggles were not about wealth or resources but more about excellence in pursuing her own educational goals. Born of a middle class family where her mother, her brother, her uncle and two older sisters were all teachers, hers was not a struggle about funding for her education. Her parents could afford and had indeed made plans for her to pursue her dreams beyond high school education. Within her family, there was never any doubt that she would go beyond high school even though secondary education was not cheap and readily available within her community (Interview, August 28, 1997). She began her primary education at a township school in the Eastern Cape and stayed within the township through 10^{th} grade - - the highest grade level at the local secondary school.

Opportunities for education beyond grade-10 were thus limited within her community and many of her counterparts in the township were deprived of a chance to study beyond the level of grade-10. Although her own situation was different in that her family could afford to send her elsewhere for further education, Mrs. Hlophe was quite conscious of the dilemmas that confronted many of her schoolmates in the township with regards to further education. In our conversation about her early education, she expressed this consciousness as follows:

> I went to a secondary school, the only secondary school in the town and eh, it would go up to, from Form 1 (Grade-8) up to Form 3 (Grade-10). Thereafter, I had to go out of town for further education or go to the local factories and work. If your parents could afford to send you to a boarding school or to Riverside (the nearest city), you know, which was thirty minutes or twenty minutes drive from home then you could attend school for further education but most parents could not even afford their own fares to their places of work. So, if you passed your form 3, you had to go to work. Ja, at least work for some time, gather some funds and then go back, if you are keen. So from there, from Standard 9 (Grade-11), as it was called those times, I went to Healdtown High school, a boarding school in another part of the Eastern Cape.
>
> (Interview, August 28, 1997)

As with other children from the Black townships of South Africa, many of Mrs. Hlophe's schoolmates could not afford the cost of further education under these circumstances. Some would opt out of school to work and raise funds and return to schools years later to complete their high school education. The legacies of apartheid and colonialism of the past in South Africa shaped their experiences.

In the latter part of the 19th century, the colonial government adopted policies that prioritized vocational and elementary education for the "natives." Based on those policies, only schools that incorporated training for work for the Africans were funded by the colonial government. As argued in Switzer (1993), when the colonial settlers gained control of their own legislative affairs from the imperial government in England in 1872, they deliberately limited the funds available for African education and channeled more into elementary schooling. Missionary schools were encouraged to limit African schooling to Grade-6, and offer advanced training only to "those that could be employed as elementary school teachers, semiskilled artisans and domestic servants" (Switzer, 1993, p 132). Many of the missionary schools that provided education to Black people, therefore, incorporated an almost compulsory phase of "teacher training" as the preparation for work after grade-6 (and later after grades-8 and 10, when the

requirements for teaching changed) in order to qualify for the government grants. When the apartheid government took over the control of Black education in accordance with newly passed laws in 1953, especially the Bantu Education Act of 1953, they inherited much of this colonial scheme for Black education.[62] In line with their own policies of racial segregation and the "hierarchy of the races," the apartheid government continued to emphasize only primary education for African and teacher education to provide workers for many of the newly created primary schools in the Black communities. In this way, the education of Black peoples was deliberately underdeveloped and channeled towards teaching and teacher education at the teacher-training colleges (now called "colleges of education").

In one sense, therefore, Mrs. Hlophe's background placed her in a position of privilege, as she was able to pursue her senior secondary schooling in one of the missionary boarding schools in the Eastern Cape. Boarding schools were a major contribution of the missionaries to Black education for over a century, as they offered very strong programs of post-primary education. Many of their programs were similar to and accredited by the same institutions as many of the common schools in England, thus ensuring reasonably high standards of education for Africans who could pay their way into these institutions. Only partially funded by the colonial government, the missionary boarding schools had to rely on student fees to meet their costs and over the years had to shoulder more and more of the financial burden for running the school. When the

[62] As noted earlier, the Nationalist government came to power in 1948 on a mandate for racial segregation in South Africa. Accordingly, the central government took over the control of Black education, which had hitherto been under the control of missionaries and provincial education departments. In addition to the central control of Black education, the Bantu Education Act of 1953, which became the primary guide for the underdevelopment of Black education, provided for expansion mainly at the primary school levels. According to the architects of apartheid education, Black students were to be given only the kinds of skills

apartheid government took over Black education in 1953, many of the missionary schools closed down in protest and only a few remained, albeit under very strict conditions and curriculum prescriptions from the new government.

Healdtown was no ordinary boarding school, as it was a school with a long tradition of excellence and opportunity for Black students. Built by the Wesleyan missionaries as part of the "Watson Institutions" (as the Methodist schools were called) in the 1840s, Healdtown became a key institution for post-primary education of Black people in the Cape. By the turn of the century, Healdtown had come to be regarded as the "best teacher-training institution of its kind in the Cape" (Switzer, 1993, p.129). Mrs. Hlophe's high school education, therefore, was relatively prestigious and prepared her decently for her life and activities beyond high school. Recounting her experiences at Healdtown in view of her own experiences as a teacher in KZN, the contrast was very clear:

> When I think back to my own schooling comparing it with what's happening now that I am a teacher, I feel I was fortunate to go to Healdtown you know, for my high schooling and learning. Healdtown was an institution that had everything. We had the best laboratories. There was a junior laboratory, there was a junior block for Standard Sixes Grade 8) up to Standard 8 (Grade 10) and there was a senior block. The junior block had everything - - it was a complete school on its own you know, and the senior block was like another school, all round, as I said, you know. Unlike with what I have observed in our (Black) schools where we have one laboratory for every. That little lab we have been to (for the class observations), its used by the whole school and sometimes there is a clash, because of eh, I am doing science and somebody you know, sometimes three people want to use it and then we have to take apparatus from there to class. Eh, I hope, I hope that is going to come to an end and I think Healdtown was in that position because it was run by White people. So it was of the same standard with the whites' high schools, in the neighborhood. You know, they all live together in Riverside and ...you know they would just take up the phone and phone whoever needed to be phoned for whatever. We used to have truckloads of materials coming to school and now it puts one in a difficult situation when we have to improvise and theorize about things that

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they would need for work in their "reserves" and not to be prepared for competition with white students for any advanced training (Rose and Turnmer, 1975; Kallaway, 1984).

> you know are so easy to understand when you actually see them and do, you know. (Interview, August 28, 1997).

In describing her own schooling at Healdtown, Mrs. Hlophe talks about the rich experiences she had where her teachers used all kinds of manipulatives to foster an understanding of science. Their laboratories were fully equipped and the teachers highly qualified in their subject areas and spared no effort in maintaining the good reputation of the school both in academics and Christian values of the missionary establishment. After completing high school, with a matriculation exemption, she studied chemistry at one of the Historical Black Universities (HBUs) in the Eastern Cape. Although she was well groomed academically at Healdtown, she was, by her own account, socially "not ready" for life at the university (Interview, August 28, 1997). Life at Healdtown had been tightly regulated and students there had little experience with the kind of independence she was to find at university:

> I went to the University for a B.Sc., which took me five years to complete. Instead of the normal three years... Well, you know, there where, there were courses (in the science department) that we used to know that they were not for everybody. Those would be just impossible (to pass), and I think basically more than that it was being unprepared for university life. So, coming from a town where nobody went to school after Form 3, you know - it was a few individuals who would go there. So you would not have role models that knew what university life was all about because most of us would complete Form 3, go for primary teacher's education, come back and teach, you know. So, even in my family I was the first one to go to university. I had no idea what university was going to be like. I didn't even know whether I should go on with B.Sc. or I didn't even know what B.Sc. was all about. You know, so I chose B.Sc. because in my matric I was already in the stream of mathematics, science, and biology. So, I thought rather than starting something new, let me go on with what I already know and fortunately for me, I was doing fairly well in those subjects. So, I thought, rather than going and do law, or commerce, you know, new things, let me just stick to what I know. You know, and due to the lack of vocational guidance, you know, in our schools at the time, we wouldn't know what all those things were about. You just look at the people in your township and say, I want to be like so and so who is a priest, I want to be like so and so who is a lawyer, without knowing what is involved, you know in the studies leading to that. So, I would say it's a combination of those things and it was in the early seventies, the whole country was unstable at the time. You would go on strike for months, come back and

> you would have tests under pressure and you would fail. So there was a lot of, it's a combination of a lot of things.
>
> (Interview, August 28, 1997)

Her experiences at university were shaped by a complex set of conditions in her life. Being a first generation in her family to go to college and surrounded by many role models who were doing things other than what she was pursuing, together with the political and academic pressures on students of the 70s, her academic success at the HBU did not come easily. It took more patience and perseverance on her part and confidence in her abilities and the power of an advanced education by her parents, to see her through university. On the recommendation of her parents, she completed a Bachelor of Science (B.Sc.) degree and then pursued a Higher Education Diploma (HED) at an Historically White University (HWU) in KwaZulu-Natal.

As was the case with Morapeli Tshabalala, Mrs. Hlophe found her experiences at the School of Education very fulfilling and enriching, both personally and academically (Interview, August 28, 1997). She developed a whole new confidence in herself and her abilities to teach. Her experiences of learning to teach were intricately bound up with the development of her own sense of self. That is, learning to teaching was about improving and making herself a different and better person. For instance, she had to develop confidence in her ability to speak in such public settings as classrooms:

> It (the teacher education program) has changed me, it has. I think it has helped. I had a problem. I was so very soft spoken that I was inaudible. When I got to the University, eh, I had to attend speech and - eh, what do you say, speech and drama just to cure that. So I took up that short course (in speech and drama). It was for a semester at the University and you had to practice and practice, you know, until I got it right and with time, it has helped
>
> (Interview, August 28, 1997).

At home, she learned from her mother, her sisters, her brother and her uncle who were all teachers. Mrs. Hlophe characterized these conversations about teaching with her

kin as rich and formative in terms of her own development of a professional identity as a teacher:

> You know, when we meet in a family union it is just like a teachers' conference, or something because we always talk about "shop," we talk about NATU (the Natal African Teachers' Union), we talk about CATU (Cape African Teachers' Union). You know, about syllabus, you know about problems of teaching...
>
> (Interview, August 28, 1997).

Mrs. Hlophe's professional development began from within her own family of teachers where they shared stories and compared notes about teaching across three different provinces, where the different members of the family were employed. Through these experiences and family conversations about teaching, over the years, she has grown to be the strong teacher leader whom I met at Khulani secondary. Her growth has come in spite of the limited formal opportunities offered by the Department of Education for the professional growth of teachers in its employ. Mrs. Hlophe continues to seek out further opportunities for growth and development in preparation for her leadership roles at the school. At the time I visited her school, she had just returned from an 18-months leave of absence to pursue a Masters degree in educational counseling at a university in the USA. This latest development in her life was motivated by the need to equip herself with the skills to deal with the "psychological" blocks to students' learning of science and mathematics:

> They (the students) are so fearful of these subjects (mathematics and physical science), some of them even fail on the first day just because (they say) "We are doing math," you know, "We are doing science," "We are going to fail," you know. So, this is what made me decide I had some skills which I am going to use for class to be able to handle this because to me it presented itself as psychological problem and the little psychology I have done didn't give me enough skills to deal with it in class, you know. Making them know that it's okay, you know. So, I decided to go for it.
>
> (Interview, August 28, 1997)

For Mrs. Hlophe, learning science and mathematics begins with the development of the students' sense of self as science and mathematics learners. Her vision for her role as a science teacher involves helping the students gain confidence in themselves as learners of science. Learning to be a counselor was, for her, an important step in preparing for this expanded role she has defined for herself in relation to the students' learning of science. As with counseling, her teaching of science is built around caring for each student in much the same way as a counselor would base her practice on the individual improvement of each client under her/his care. Learning in her classroom is thus as much about the subject matter of science as it is about the improvement of each individual student. It is on this basis that her non-traditional approach to the teaching of science, which places emphasis on the subject matter while simultaneously incorporating the experiences of the students, can be understood.

MAKING SENSE OF MRS. HLOPHE'S CLASSROOM PRACTICE

In the scheme of the vision of transformative practice that I drew up from the stories of Mr. Sithole and Mr. Tshabalala, which described three areas of emphasis for their practice, Mrs. Hlophe's practice would fit all the criteria for a transformative practice. She taught her students in such a way that they would be able to succeed in the national tests, while developing deeper conceptual understandings of the important scientific themes. She was also intent on including all students in the lessons by incorporating examples and stories from their life experiences. Her primary focus was different, however, making hers a different form of a transformative pedagogy. In contrast to the other two teachers in the study, she placed more emphasis on the goal of

deeper conceptual understandings of science by the students. Her goals of including experiences from the life world of her students, and helping them be successful in the examinations, were driven mainly by the goal of conceptual understanding of science. That is, instead of dancing to the tune of cultural relevance in designing her pedagogy, she was instead singing the lyrics of cultural relevance to dance to the tune of conceptual learning.

Her practice incorporated some important features of what researchers have characterized as a pedagogy for conceptual understanding. For example, most of her lessons were hands-on laboratory sessions where students participated in recreating some of the key experiments in the field of science. When asked about the significance of laboratory work in her lessons, she confirmed that about four out of five of her lessons involved some experimental work in the laboratory. The nature of the experiments varied with the subject matter of the day, from those that involved the learners in conducting experiments themselves to those that required them to participate actively in a demonstration by the teacher. In both kinds of experimental lessons, Mrs. Hlophe always asked the challenging questions that prompted her students to reason along as they engaged in the scientific experimentation. Although most of what students talked about in the lessons was prompted by her questions, there were instances where students responded to each other's questions and inputs. For instance, students often challenged each other's explanations of why things were not going as expected in an experiment.

Mrs. Hlophe carefully designed and managed rich learning environments in which her students explored the fundamental ideas of science using their experiences of the real world. In a similar way to the examples of Mr. Sithole and Mr. Tshabalala, she

constructed her practice so as to include **all** students by drawing aspects from their cultural world, either to set up a problem for the day or a conclusion, or as part of an assessment task of some important concepts. But unlike both Mr. Sithole and Mr. Tshabalala, Mrs. Hlophe does not exploit her discussion of the students' or her own experiences for social purposes. She, almost, deliberately limits her discussion of the real-world experiences to purposes of conceptual development of the subject matter of science. Subject matter is the important theme for organizing her practice to pursue the goals of what I have called a transformative practice. In the following section, I discuss how this strong subject matter identity helps to explain Mrs. Hlophe's version of transformative practice.

Subject-matter identity and transformative practice

The observations and interviews with Mrs. Hlophe confirmed my earlier hypothesis about the dominance of subject matter in her identity as a science teacher and her construction of a transformative practice in her classroom. Unlike Mr. Sithole or Mr. Tshabalala, Mrs. Hlophe was a science major with a university degree and a stronger attachment to the subject matter of science. Her background in science was also much stronger and her pedagogy showed that she was more comfortable, than any of the other teachers in this study, in the "neighborhood of science." She designed more hands-on laboratory experiences for her students; most of which did not work as intended or as described in the textbooks. Her stronger background in science, however, allowed her to perceive of different ways to alter the experimental procedures in the thick of things when the recommended methods did not work. In addition to her versatility with

methods and content of the experiments, she would challenge the students to reason with her about the changes she had made. She was confident in her subject matter knowledge and only used the textbook sparingly, and in fact, predictably at the end of each lesson when she wanted to draw the students' attention to sections of the textbook that they had to read and work on for homework. She was strong in both the content and methods of science and in designing appropriate learning experiences for the students in her classroom.

Prior to her recruitment to Khulani secondary, she had worked at a science school (a special school whose curriculum only provided for one stream, the science stream) in one of the townships of KwaZulu-Natal. Accordingly, her affinity to the subject matter of science has been influenced in some important ways by this prior experience of teaching at an exclusive science school. Teaching at the science school offered the advantage of a focused program with all the facilities and resources dedicated towards science teaching and learning. The kinds of conversations with colleagues, the cultures of working and the networks she built in that context were driven by the common subject matter of science that she shared with colleagues at the school. The whole school formed what could be termed a "professional community" of science practitioners that includes teachers and learners. Such a professional community and its norms had the potential to shape Mrs. Hlophe's identity as a science teacher in much the same way as other subject specialists within many of the departmentalized high school organizations are influenced (Grossman and Stodolky, 1994; 1995; Little, 1993; Siskin, 1994). As the literature on professional identity (e.g. Little, 1993; Talbert, 1995) has uncovered about teachers who work within subject departments, Mrs. Hlophe enjoys teaching science and is loyal to it.

She crafts her pedagogy carefully around the major themes of the discipline that are part of the curriculum for her students. Her subject matter identity is stronger than that of any of the teachers I studied for this dissertation.

The fact that Mrs. Hlophe is the head of the science department at Khulani secondary school has its own significance in her construction of a strong subject matter identity. Unlike the two men in the study who also had leadership identities which they drew on to craft their classroom practices, Mrs. Hlophe has defined her leadership role in a bounded fashion that focuses sharply on science as her terrain of influence. Through her own practice, she sets the teachers in her department a standard when it comes to teaching the prescribed curriculum in ways that enhance conceptual understanding as opposed to just cramming the subject matter for the examination. In an illustrative example of how she plays out the leadership role for all the teachers in her department to see, she described a situation that she found at Khulani upon her return from the study leave in the USA. When she reported for work in October, she found a group of 10^{th} graders who had only covered five of the prescribed 19 chapters in the school textbook. Out of dissatisfaction and frustration, the parents and the students had just forced their science teacher to resign and Mrs. Hlophe had to step in and replace the teacher at that point. Instead of setting the end-of-year examination in November out of the five chapters and giving students A s and B s, Mrs. Hlophe felt she had to set an example about teaching all the important concepts in the textbook before allowing the students to next grade level.

> I just talked to them (the students) and I changed their spirits and said "Guys, we have to finish this book (the textbook). There is no way you are going to take examinations in November, because I can test you off these five chapters and you can all get A's but next year the teacher who is going to teach you standard nine(Grade-11) is not going to go back" you know,

> "he is going to proceed and this is the foundation of what you are going to learn in science years later, so we are canceling exams for physical science. You are just going to work hard when everybody else(in the school) is taking their exams. We will be busy doing the work. When they finish exams and go home we will stay behind. Its either you are committed to that or you just forget about this and then you repeat Standard 8 (Grade-10) next year because there is no way you are going to go to Standard 9 physical science not having done this work." Some where happy, some where grumbling, you know, but we ended up pushing the work. They didn't write exams in November. So, as we went along I assessed everyone continuously so that at least they should have a mark (grade) that they are going to go home with. But we finished the whole thing.
>
> (Interview, October 03, 1997)

Mrs. Hlophe has positive reviews for the 10th grade physical science curriculum, except for the fact that teachers are not well supported by the Department of Education in their teaching of the subject. Facilities and supplies are hard to come by from the Department. In view of her opinions about the importance of the content at Grade-10 in providing students with a firm background for further learning in science, she was determined to help the students learn the important concepts and "finish" the textbook. In her role as an instructional leader for the science at her school, she considered it important to set an example about the commitment to the prescribed subject matter - - and "not just a few chapters that a teacher may feel comfortable with" but all of it (Interview, October 03, 1997). To achieve her goals in this regard, she drew up an elaborate scheme where she enlisted the support of parents, teachers and the administration to get the 10th graders exempted from the "final examination" in physical science. She also arranged for them to continue attending classes even after all the other students had left for the end-of-year holidays.

Her strong commitment to the subject matter and the prescribed curriculum are the ingredients for a potentially traditional practice. Science as taught in schools and universities in South Africa and elsewhere has not embraced transformative themes that

feminist and other critical scholars advocate. An overriding affinity towards science may thus become a constraint for a teacher who wishes to embrace transformative practices. How is Mrs. Hlophe's non-traditional pedagogy to be explained then, in the context of her strong subject matter derived teacher-identity? As we saw in the latter example, Mrs. Hlophe was able to negotiate out of the prescribed end-of-year grade level examination for her students, in favor of some form of continuous assessment of the learners throughout the lessons. She gathered alternative evidence of the students' competence and assigned grades on that basis. Her approach to assessment, like other aspects of her pedagogy, was non-traditional and would be unexpected of someone with a strong affinity to a discipline that is largely traditional as science and science education are.

Part of the explanation for her classroom pedagogy lies with her own experiences and identities, which interact to shape what she does in the classroom. In addition to her comfort with the subject matter and its methods, and broad pedagogical content knowledge to craft meaningful learning experiences for her students, and her membership of the professional discourse communities, Mrs. Hlophe has another identity as an educational counselor. Counselors and other practitioners in professions of human improvement tend to rely more on their clients' willingness and ability to take an increased role in the activities of their improvement (Cohen, 1989). It is not surprising that Mrs. Hlophe's practice is the way it is. With identities as a science teacher and an educational counselor, Mrs. Hlophe can play both roles of a teacher and counselor at the same time, allowing for a more constructivist approach to learning in her classrooms. She can use her subject matter knowledge, knowledge of the learners, and instructional

approaches in tandem with her practices of human improvement derived from educational counseling.

Another clue to her non-traditional approaches to classroom practice may be traced to her experiences of learning to become a teacher. As someone who was shy and could not bear to speak to more than two people at a time (Interview, August 28, 1997), she was encouraged to take classes in Speech and Drama as part of her teacher education program:

> It (the teacher education program) has changed me. It has, I think it has helped. I had a problem. I was so very soft spoken. I was inaudible. When I got to the University I had to attend Speech and Drama just to cure that. I took up that short course. It was for a semester and you had to practice and practice, you know, until I got it right and with time, it has helped in many other ways like acting and stage management.
>
> (Interview, August 28, 1997)

The Historically White University (HWU) she attended has a fairly well reputed Speech and Drama department in South Africa. Although she took the program in Speech and Drama to build her confidence and ability to communicate with larger audiences, and not necessarily for it's creative aspects, it is possible for these creative aspects of the program to be available as an additional resource for crafting a non-traditional pedagogy in her science classrooms.

A final point about the resources for crafting a non-traditional pedagogy has to do with the context of her work experiences. Mrs. Hlophe teaches 10th grade science at a fairly privileged school with more resources than the regular schools in the townships could ever wish for. Secondly, as 10th grade science teacher, she did not have to contend so much with the burden of preparing students for the national matriculation examination, although her practice does not depart from what she does when her rotation to teach Grade-12 comes. As a member of her school's management team, she also has better

opportunities to articulate her ideas and receive a sympathetic ear from her colleagues in management. Add to all that, the kind of reputation she had built over the years at the science school and at Khulani, which allows her superiors to trust her even on her less conventional ideas. She is thus able to take risks on the kind of practice that involves fundamental change in the students' ideas and which may take a long time to develop and bear fruit:

> I would just say good teaching is the one that's going to result in a change, you know, to the learners. If from a teaching they have learned something new, which makes them change either their perspective on things or in their life and then I would think that is good teaching. I think this is not something that you can achieve in one lesson. Its something you can achieve as you go along so that when you take stock maybe after six months or after three months you can look at them and say "Okay, (it) looks like they have moved from that point to that point."
>
> (Interview, October 03, 1997)

Her expression on good teaching also contains a very important cautionary tale for those of us who wish to study such forms of good practice. Such practices, as she correctly points out, develop over long periods of time. In our rushed attempts to identify and describe such a practice by investigating what teachers do in their classrooms on particular days, we run the risk of missing the boat on the genesis and development of transformative practices.

CHAPTER SEVEN

REVIEW OF THE FINDINGS, IMPLICATIONS FOR POLICY AND PRACTICE AND RECOMMENDATIONS FOR FURTHER RESEARCH

REVIEW OF THE STUDY

The purpose of this study was to investigate the construction, by Black secondary school teachers, of practices that have the potential to provide students with much deeper skills and understandings to participate in the processes of social transformation and reconstruction in South Africa. Based on my own intellectual history and grounding in the literature on critical theory and pedagogy, and my experiences of participating in the struggles to transform classroom practice as part of the political struggles for social justice in South Africa, I have characterized such a pedagogy as **transformative practice**. Using Giroux's (1985; 1986) notion of "teachers as transformative intellectuals," Jackson's distinction between transmission models and transformative traditions of teaching, and my own teaching practice within the context of trying to define a "people's education for people's power" (Kruss, 1988; Mashamba, 1989) in South Africa, I defined transformative practice as the kind of teaching that pays attention to the issues of **voice** and **inclusion** for **all** students and whose potential **consequences** for students are transformative for themselves and their social world.

In carrying out the investigation, I was guided by three research questions:

- What do some examples of transformative practices in South African classrooms look like?

- What are the personal, social, cultural, professional, historical and political factors that help shape classroom practices of the teachers who engage in transformative practice at various points in history in South Africa?
- What does this suggest about what form(s) of transformative practices should be fostered and how it/they might be fostered?

My review of the literature in science education pointed to a gap in our understanding of the non-traditional models (or the non-transmission models to use Jackson's language) of teaching that can be characterized as transformative and how to account for them. We are beginning to know more about the different versions of these non-traditional models in science education, thanks to the work of researchers in the "feminist frameworks to science education," "cultural frameworks," "conceptual understanding or constructivist frameworks," science-society-technology (STS) frameworks." We know much less, however, about the "eclectic frameworks" that seek to combine aspects from a number of these other frameworks, in order to define a practice of science education that promotes conceptual understanding of the key ideas of the discipline while paying attention to issues of social justice in the classroom. Rodriguez's (1998) **socio-transformative** framework which combines the concerns of the social constructivists and the concerns of multiculturalists, and Osborne and Barton's (1998) **liberatory pedagogy** framework which brings together the feminist concerns and critical theory are the most recent examples of such eclectic frameworks. Transformative practice, as defined in this study, is another example of the eclectic frameworks. It pays attention to issues of **voice**, **inclusion** and **social consequences** of teaching and learning science. Very little work has been done to describe grade-level classroom attempts to realize the goals of any of the

eclectic models to science teaching, and from my review none has been done from a life history perspective. My study is the only example, I'm aware of, that uses a life history perspective to investigate pedagogical change in the classrooms of Black secondary school science teachers in South Africa.

The major assumption on which this study was based is that teachers construct their classroom practices fundamentally on the basis of **who they are, what others think of who they are**, and **how others define them**. Data on the life history accounts of what it means to teach secondary school science differently and specifically what it means to the teachers who engage in such a practice under conditions not particularly favorable to such innovations was collected through interviews, observations and a questionnaire. Chapters four, five and six presented the case studies of three science teachers whose classroom practices I have characterized as transformative. The three cases gave us a portrait of what transformative practices look like, and what it means to engage in such a practice in some South African schools. Each case study described the vision of transformative practice that guided each teacher's practice, analyzed instances of classroom teaching based on the vision and then presented a life history account of why each teacher did what he/she did in his/her classroom.

DISCUSSION OF THE FINDINGS

QUESTION 1: What do some examples of transformative practices in South African classrooms look like?

With regard to the classroom practices of the three science teachers I observed, this study found a surprising similarity in the themes that defined what I have referred to

as transformative practice for each of the teachers. Although they all worked under very different circumstances and brought to bear very different personal histories, their practice was defined by a focus on the following three themes:

- "covering the content" and preparing their students to succeed in the national examination,
- developing deep conceptual understandings of the subject matter, and
- including all students in their teaching by constructing what other researchers have called a "culturally-relevant" pedagogy (Ladson-Billings, 1994; 1996).

I have referred to these three themes as concerns with **"quantity"** or **"accountability," "quality,"** and **"equity"** respectively.

The similarity was surprising in the context of the South African education system where concerns with "quantity" seem to drive everything in the classroom, with only occasional focus on "quality," especially at the grade-12 level where students have to sit for the high stakes national examinations. Only recently has there been serious mention of "equity" in discussions about curriculum and pedagogy, even then only for the grade-1 and 2 teachers for whom a new national curriculum has been adopted by the government. The similarities, however, end here as each of the three teachers put a slightly different spin to the meaning of this vision of transformative practice in his/her classroom. Working under different conditions of practice with varying resources for change, each teacher constructed a different version of the transformative practice defined by the similar vision.

Mr. Sithole, who teaches at a regular township high school, worked with a group of Black students who come from a predominantly low-income neighborhood, and for whom the national matriculation examination has the potential to open doors to further opportunities in and outside of school. Despite the time constraints and the lack of resources in his school, Mr. Sithole ran two parallel programs for **all** his students in order to help them succeed in the national examination whilst also setting up a context for pursuing his other goals of "quality" and "equity." In his context, the national matriculation examination was the major accountability scheme within which his vision of a transformative practice had to be negotiated. For this reason, Mr. Sithole did not experience his vision of a transformative practice that incorporates the three themes of "quantity," "quality" and "equity" as contradictory, as much as he experienced it as presenting implementation problems of inadequate resources, time and support from the educational authorities. His was a case of a localized effort, within his classroom and immediate community, to change the lives and opportunities of a group of students who have traditionally been excluded from science and science education. If Mr. Sithole had difficulties finding support to make the small and localized changes that affected the lives of his group of students, we are left to wonder about the possibilities of making such changes affecting more than one group of students across his school and across the entire school system of South Africa.

In contrast, Mr. Tshabalala, who teaches in a finishing school crafted his practice under a very different set of conditions and constraints. By its very nature as a school for students who wished to have second or more opportunities at the national matriculation examination, the finishing school was even more attuned to the accountability demands

of the national examinations. If success in the matriculation examination meant a lot for Mr. Sithole's students and community, then it meant much more for Mr. Tshabalala's students and their community. As a recent political experiment at broadening the democratic opportunities to education, finishing schools were closely watched by many others within the political and educational system. This raised the stakes even higher for Mr. Tshabalala. It is, therefore, not surprising that the story of Mr. Tshabalala reads like that of someone who constructs two different sets of practices for the different seasons of the academic year. That is, his classroom practice put emphasis on different aspects of the vision (of quantity, quality and equity) at different periods of time during my observations. What is remarkable about Mr. Tshabalala is his patience in working with the students' and community's expectations around the national examination, to ultimately craft a non-traditional practice that has the potential to make even more meaningful their vision for providing multiple opportunities for the less successful students at the finishing school. Unlike Mr. Sithole and Mrs. Hlophe, Mr. Tshabalala's was a high profile challenge to the status quo and its marginalization of the alternative definitions of the teachers' lives and work experiences. As a result, the alternative definitions of teaching science to the "other," as exemplified in his practices, were challenged even more, raising important issues about the conditions necessary for sustaining a reconceptualization like his.

Mrs. Hlophe, in contrast to both Sithole and Tshabalala, is the Head of Department (HOD) at a relatively privileged boarding school with better facilities and resources for crafting an effective practice of science education. Add to that the fact that she taught a 10^{th} grade physical science class where the demands of the national

matriculation examination feature less prominently than in the other two cases. Mrs. Hlophe's vision of transformative practice was rooted more firmly within the quality concerns and included experiences from the life world of her students, but deliberately avoided social and political issues arising from the topics of her lessons. As a result, she was thoroughly constrained in what she could do with and how far she could go with the students' understandings and insights arising out of her lessons. Hers is a case of a very deliberate act of instructional leadership on how to craft a transformative practice in a context where to be openly critical and political is not only dangerous but may be suicidal, both figuratively and literally (see discussion of context later). In many ways, Mrs. Hlophe's situation was even more precarious and raises important questions about the construction of and support for alternative discourses and practices in science teaching and learning. But more importantly, her situation also raises questions about the meaning and consequences of such discourses and practices for those engaged in them. These case studies of the three science teachers help us understand better not only what transformative practices are but also how they are constructed in different contexts. Three sets of resources were found to play a critical role in whether or not and how each teacher constructed his/her own version of what I have referred to as transformative practice, that is **subject matter**, **context**, and the **resources of biography**.

Subject matter as a resource in transformative practice

In all three cases, subject matter was important for defining the goals of transformative practice. In the case of Mrs. Hlophe, her whole identity as a

transformative teacher was defined around the subject matter of science. That is, the subject matter was a major point of reference for her changing practice.

With the three teachers differing in their attachment to and levels of comfort with the subject matter of science, it was inevitable that the subject matter would present different opportunities and challenges to the teachers, making it more or less difficult to use it as an anchor for crafting a transformative practice. Mrs. Hlophe, for instance, who is a chemistry major from a local university was able to use her superior command of the subject matter to craft a practice that places emphasis on "quality" while paying attention to both "quantity" and "equity." Mr. Sithole and Mr. Tshabalala who are college-educated teachers (as opposed to university educated) had relatively fewer opportunities to explore the subject matter deeply at tertiary levels of education. As a result, their use of and reliance on subject matter to craft an identity of a transformative teacher varied slightly from that of Mrs. Hlophe.

Mr. Sithole took up an identity of a life-long learner of science while working with his students to develop deeper conceptual understandings of the subject. She enlisted for further education courses in science education that placed emphasis on subject matter development. As a learner of science himself, he became much clearer about the goals and processes of learning science as much as he was about the goals for teaching it. That is, taking up an identity of a life-long learner of science allowed him to step into her students' shoes, even if only for a moment when he was not in front of them.

Mr. Tshabalala on the other hand, relied on his superior training at college on instructional design and methodology and his prior experiences of teaching science, to build a rather strong pedagogical content knowledge (Shulman, 1987) which he used to

craft his own version of transformative practice. He was comfortable with the subject matter of science and helped his students explore the important concepts with relative ease.

We learn from the case of Mrs. Hlophe that subject matter does not only present opportunities which enhance the efforts to construct a transformative practice but can sometimes become a constraint. When teachers of science become attached to their subject matter and science education programs at school as Mrs. Hlophe is, it is sometimes difficult to move in and out of it to explore related content areas such as history that may arise in the context of a science lesson. This raises an important question about whether it is possible or even necessary for teachers of science to move comfortably outside of their areas of specialization during their teaching. If the current versions of teacher education programs in South Africa and elsewhere, which emphasize a high degree of specialization persist, then it is conceivable that teachers of science will continue to have problems with aspects of the subject matter that require them to "cross borders" into other disciplines. Programs in schools and teacher colleges that seek to blur the borders between various subject matter, e.g., through interdisciplinary curricula or team teaching or thematic teaching, acquire new meaning in the context of the lessons about the potential for subject specialization to act as a constraint in crafting alternative teaching practices. Such in-school programs and the teacher education programs that are designed to produce liberally educated teachers present science teachers and others with opportunities to learn to teach comfortably in and out of their respective disciplines. In the context of the current trends in science reforms that seek to change what and how students learn science, by focusing on **key ideas** in the subject matter and paying close

attention to issues of **voice** and **inclusion** in science, it is inevitable that science teachers will be called upon to deal with issues outside of their traditional discipline.

Context as a resource for transformative practice

A number of researchers have drawn attention to the important role played by resources in reforming classroom practice (Anderson, 1999; Ball and Cohen, 1995; Jita, 1998; Spillane *et al*, 1995; Spillane and Thompson, 1996;). In contrast to earlier studies, the latest work has sought to broaden the notion of "resources" beyond just the focus on material resources. Spillane *et al* (1995), for instance, included such things as teachers' knowledge, commitments and disposition, time, funding and labor and professional networks in their discussion of resources that explain the variations between reforming and non-reforming districts in mathematics and science. In their work at the National Center for Improving Student Learning and Achievement in Mathematics and Science (NCISLA), Anderson and his colleagues define (organizational) resources to include material resources, e.g. teaching tools, school buildings, and school budgets; human resources, e.g. teachers' knowledge, leadership, and access to people with expertise; and social resources, e.g. the professional standards, shared social histories and a technical language (Anderson, 1999). In this broadened sense of resources, it is not only schools and classrooms which have more resources that have a better chance of sustaining transformative practices, but those with better organization of the different types of resources to support the vision of transformative practice.

This study found that each of the three teachers worked with different sets of resources to construct his/her own version of transformative practice within his/her

particular context. The ease with which they were able to construct these practices also varied with the nature and organization of the resources available to each one of them. For example, Mrs. Hlophe worked in a materially well-resourced boarding school, with a steady traffic of researchers and policy-makers from local universities, government research departments and industry forming rich networks for teachers at the schools. With the experience of a veteran teacher in the profession, and her strong academic grounding, Mrs. Hlophe had the ingredients for crafting her transformative practices with relatively much fewer hurdles to overcome. However, the very strengths of her context were also a limitation that Mr. Sithole and Mr. Tshabalala did not have to deal with. For example, the fact that she teaches at a school in KwaZulu-Natal, where open political activism is tantamount to signing your own death warrant, constrained her practice in some important ways.[63]

Both Mr. Sithole and Mr. Tshabalala were not so fortunate. Theirs was a situation of poor provision of material resources, with relatively little human and social resources in their schools to work with. Their stories of practice suggest that they both found different ways of organizing the resources they had, in ways that helped their efforts at crafting a their versions of transformative practice in their classrooms. Mr. Tshabalala, for instance, assumed a leadership role at the finishing school and used it to shield himself from external pressures while crafting a transformative practice in his classrooms. That is, since the finishing school did not have positions for a deputy principal and a head of science, Mr. Tshabalala assumed both roles on a voluntary basis.

[63] Although the political violence of the 1980s and early 1990s has subsided significantly, many people in KZN including teachers are still hesitant about "coming out of the closet" in terms of their politics.

As a consequence, he became a de facto instructional leader at the school and had the space to pursue a transformative agenda in his classroom.

Mr. Sithole, on the other hand, used his leadership positions in the teachers' union and in the community as an important (human) resource for crafting his non-traditional practices. Besides shielding him from unwelcome attention by the school authorities, his leadership roles in the community gave him access to knowledge, skills, and professional networks that he could use to craft his classroom practices.

"Resources of biography" or Personal history

Through the stories of the three teachers we learn about another category of intangible resources on which very little research has been done to date. This additional category of resources is what I call the "resources of biography" or personal history. It includes such things as one's **experiences of marginalization, experiences of growing up or living in a particular culture** and the **experiences of participating in certain kinds of social or political activities**. How such resources of biography are used to shape classroom practice is the major theme of the stories of the three science teachers I studied in this research project. What makes it difficult to conceptualize and study the role of these resources of biography as opposed to the other resources (material, human and social) is the fact that they are intangible and inaccessible until teachers begin to consciously reflect on them. As Dewey (1938) asserted about the power of an (educative) experience, it is a potential that leads to further meaningful experiencing. Such further experiencing, however, can only result from a conscious reflection upon the

prior experience. Indeed, experience without a framework for its interpretation is useless, as is a framework without experience (Bromley, 1989).

(i) Experiences of marginalization as a resource for transformative practice

In telling their stories of growing up Black in a South African society characterized by the discourse and policies of racial discrimination, each of the teachers tells a story of marginalization in schools and society in general. As students, these three teachers had to contend not only with the inequities in the provision of resources in their schools and opportunities to learn but had to experience school through a curriculum that marginalized and trivialized their own life experiences. When it was not silent on the broader experiences of Black people in South Africa, the apartheid curriculum often denigrated these cultural experiences. This marginalization of the Black experience in South Africa was, however, not uniform with the result that each of the three teachers tells a slightly different story about his/her experiences of marginalization.

Mr. Tshabalala and Mrs. Hlophe, for instance, constitute the two opposite ends of the spectrum in their experiences of this marginalization. For Mr. Tshabalala whose class background put him in the lower echelons of the socioeconomic strata, the experiences of marginalization were more extensive. He experienced marginalization on the basis of his **race; socioeconomic status; label as a less successful learner** of what was then the two official languages, English and Afrikaans; and later as **teacher of the marginalized learners** (the "other" in the system) at the finishing school. His story describes how he engaged in a complex process of (re) interpretation of these experiences of

marginalization to author counter-identities that sustain him and his practice of a transformative pedagogy.

Mrs. Hlophe, on the other hand, had a relatively privileged background and schooling experience which played an important role in moderating her experiences of marginalization. Hers is a story, perhaps, of marginality based on her **identity as a Black** person in a society defined largely by white racist priorities.

Mr. Sithole whose experiences of marginalization would fall somewhere in between those of Mr. Tshabalala and Mrs. Hlophe experienced **race** and **ethnicity**, as the most significant categories that shaped his experience of schooling.

(ii) Experiences of growing up and living in a culture

All three teachers in this study grew up and continue to live in the African townships of South Africa. In the context of their own marginalization as members of the African community, their struggles for an education were not just goals for individual achievement but were really a part of a much larger struggle to reaffirm a culture and its people. For them to receive an education was part of raising the cultural, ethnic, or sometimes even the racial group in much the same way as the Black American women teachers talk about their teaching of Black students in Casey's (1993) study. The important point is that their education became a communal goal for self-development of a people. Mr. Sithole, for instance, described how a member of his church community paid for his registration fees at the college of education when his family could not raise the required minimum payments. He characterized this event as one of the important turning points in his preparation to become what I have referred to as a transformative teacher.

Although Mr. Tshabalala's experiences were similar Mr. Sithole's with regard to other community people getting involved in helping to pay for his education, his own turning point came when he got the opportunity to attend the first African boarding school to be founded by an African (leader) in South Africa. As a school founded by Dr. J.L. Dube on the principles of **self-reliance**, Ohlange high school provided Mr. Tshabalala with a tangible experience of what the principle of self-reliance could mean in practice. In his story he talks about how he developed culturally and politically at Ohlange when he learned about the lives and sacrifices of people like J.L. Dube who sought to build the African community.

In talking about the cultural influences on her own identity construction, Mrs. Hlophe refers to the **cultural discourse** in her community which already allocated her a place of leadership within the community once she completed her studies. That is, it was expected of her that she would pass the junior certificate examination (grade-10 national examination) at the local school, go on to one of the missionary boarding schools (which had a good reputation of educating Africans) for senior secondary education, proceed to a university, and then return to the community as a teacher, lawyer, or doctor (some of the eminent professions within the Black community).

(iii) Experiences of participating in social, cultural, political, religious and professional organizations and activities

The social and political activities were more pronounced for the two college educated, younger male teachers in the study. They used these activities mainly to develop and pilot ideas about such concepts "democratic leadership," critique of social

and curriculum ideas, social participation and construction of counter-identities of resistance. It is these ideas, developed formally in the structures of political and social organizations and informally in the social and political networks that Mr. Sithole and Mr. Tshabalala sought to bring to their teaching of science in ways that I have characterized as transformative. Both Mr. Sithole and Mr. Tshabalala had been active members of students' resistance organizations at school and college. In this role, they were privileged to a number of opportunities to collectively discuss and critique their own experiences of schooling and marginalization and to formulate counter proposals to the status quo. That collective identity of resistance developed in the context of the student movements helped to shape their own individual identities as transformative practitioners years later. As described in chapter two, many college educated teachers have relatively limited experiences with broader philosophical debates on curriculum and teaching because of the illiberal nature of their college preparation programs and the tight control on such discourses and critiques by the apartheid government. It is in that context that the experiences and networks that these teachers developed in the social and political activities became important for visualizing alternatives to the traditional practices of teaching science.

Mr. Sithole, for example, used the knowledge he gained during the in-services courses he had attended as a teacher at an alternative Saturday school community program for Black students who attend schools in the townships. He talks about his learning about "group work" and "co-operative learning" in these in-service workshops. He even had mentors assigned to observe and help him introduce these instructional practices in his classroom at the alternative school program.

As a former leader of student demonstrations against discriminatory policies in the education system, Mr. Tshabalala was not discouraged by the hostile response to his non-transmissive approach to teaching science at his school. Although he was perturbed by it, he did not abandon his new ways of teaching. Instead he adapted his practice in such a way as to make time for a deliberate focus on "covering the content" while pursuing the other goals of "quality" and "equity."

For Mrs. Hlophe, who is a university graduate in science and a veteran teacher of science in KZN, it is the professional networks and to a small but significant extend her religious community that provided her with the ideas and the opportunities to author an identity which I have characterized as transformative.

A key point from the foregoing discussion is that, it is not only the experiences of marginalization, or of growing in a specific culture or of engaging in certain kinds of social, political, religious and professional activities that provide a person with the resources for crafting a transformative practice, but a conscious reflection on and willingness to learn from these experiences that makes them available as resources for crafting such a practice.

IMPLICATIONS FOR POLICY AND PRACTICE

This study has provided a life history account of the transformative practices of three secondary school science teachers. Its design as a set of case studies prohibits wide generalizations to all science teachers or teaching in South Africa (Stake, 1995). However, researchers engaged in studying reform practices and accounts of how they are constructed in specific classrooms have a set of cases to compare with. The contexts of

these cases and the perspectives from which they were developed should be taken into account when drawing such comparisons and insights from the study.

An important implication of this study with respect to investigations of transformative approaches to teaching is the need to recognize the fact that such practices take time to develop and may vary across teachers and contexts. Researchers need to adopt methodological designs that sharpen the focus on these variations across contexts and persons.

A second implication of this study relates to the need for the South African education system to develop a single and consistent vision for transforming science teaching and learning in ways that would ensure the inclusion of and sponsorship of the voices of the previously marginalized Black people in the curriculum. The government's new curriculum 2005 reform program begins to provide such a vision for change in the South African classrooms. In its vision, curriculum 2005 reform defines nine specific learning outcomes around which all science education in schools is to be constructed. That is, the

- use of process skills to investigate phenomena
- demonstration of an understanding of concepts and principles, and acquired knowledge
- application of scientific knowledge and skills to problems
- demonstration of an understanding of how scientific knowledge and skills contribute to the management, development and utilization of natural and other resources.

- use of scientific knowledge and skills to support responsible decision-making
- demonstration of knowledge and understanding of the relationship between science and culture.
- demonstration of an understanding of the changing and contested nature of scientific knowledge
- demonstration of knowledge and understanding of ethical issues, bias and inequities related to science and
- demonstration of an understanding of the interaction between science and socioeconomic development (Republic of South Africa: Department of Education (DoE), 1997b)

The power of this curriculum 2005 reform vision lies in its breadth and depth in covering a broad range of important ideas from different reform movements as noted in chapter two. It includes ideas about science and culture; science, technology and society (STS); science and (in) equity; conceptual understanding and science as a contested social terrain. It thus constitutes a strong vision for a potentially transformative practice across the many schools and classrooms in South Africa, injecting issues of social justice, culture and socioeconomic development into the science classroom. The cases in this study show how different resources make it easier or difficult for teachers to realize visions of transformation. This vision of the curriculum 2005 reform will, therefore, only make sense in a context of adequate provision of resources for teachers to carry it out in their classrooms. Different kinds of resources such as material, human and social resources need to be provided.

Closely related to the above is the third implication for the need for the teacher education programs, both pre-service and in-service, to provide teachers with strong grounding in the key ideas of the content they are expected to teach and to do so in ways that encourage them to construct their own understandings and also promotes an interdisciplinary approach to the learning of these ideas. These programs should also pay attention to developing the teachers' capacities to make the content more accessible to their learners and comfort to interact with students' ideas on the content.

Finally, a major finding of this study relates to the need to pay attention to the "resources of biography" or personal history that each individual teacher has, as a potential for supporting transformative approaches to teaching. Teacher education programs and in-service workshops should be re-organized to allow for teachers to reflect on their experiences in and out of school and to provide them with the frameworks and the tools for such a reflection. As Raymond *et al* (1992) observe, such experiences indeed serve as "lifelong references for teacher identity"(p.150), a resource which maybe crucial for some teachers as they seek to craft and sustain a non-transmissive classroom practice. Only through such a deliberate reflection can personal experience be available as a resource to support an innovative practice.

RECOMMENDATIONS FOR FURTHER RESEARCH

This study investigated the construction of teaching practices that are aimed at including all students in learning the key ideas of science and helping them to develop a voice for participating in the discourses in and outside of the science classroom. It was

focused on the practices of three secondary science teachers, two men and woman, in Gauteng and KwaZulu-Natal provinces respectively. Further research is needed to:

- provide more examples, in different contexts, of practices that bring together the concerns of several strands of reform ideas around social justice, conceptual understanding and accountability.
- conceptualize of other ways of defining a transformative practice, especially in the context of a changing South Africa.
- understand better what the rubric of "resources of biography" includes and to explore the interactions between these kinds of resources and the material, human, and social resources.
- Given that this research focused more on the teachers and their practices which I have characterized as transformative further research is needed to find out what students actually learn in the classrooms of transformative teachers from a student perspective and whether or not their conceptions of and interactions with science change as result of learning in transformative ways.

AN EPILOGUE

Writing this dissertation has been an intellectual journey of sorts. It is a journey that began, perhaps, with my puzzling about my own classroom practice. I wondered about what it would take for teachers to engage in a practice that seeks to include the experiences of **all** students and provide them with deeper understandings of the key ideas in science. As a young teacher, ten years ago, I had tried to develop such a practice in my own mathematics and science classrooms with very modest results at best.

I remember clearly how as a first year teacher at a high school in Evaton, South Africa, I caused something of a stir when I shared with my colleagues that I thought more than half of the students in my mathematics class were likely to fail the regional end-of-year examination. This I said in a meeting of the entire academic staff of the school in response to a question by the principal for teachers to identify students in their classrooms who were "at risk" of failing the examination at the end of the school year. What caused the stir is not the number of students I had identified as being "at risk" but the fact that I had dared to say this in public or more particularly to those charged with organizing and managing teaching and learning in the schools. As I came to realize later, it was not that the teachers at my school did not know that the children I was teaching mathematics to were "at risk" or that none of the children in their own classrooms were at such a risk, but the professional culture of teaching then, and perhaps still, does not allow for such a public discourse on what goes on behind the closed doors of each teacher's classroom. An admission that even one student was "at risk" was a sure way to invite "critics" into one's classroom to "check" on what is going on or not going on. There could have been many like Mr. Juluka in the academic staff at my school, but none of us

as staff members would ever find out about it or even have opportunities to observe and learn from their practice. We all practiced within a professional culture that encouraged a conspiracy of silence about what it was we were doing in our classrooms, right or wrong. Mr. Sithole's low profile revolution in his classroom is, therefore, cultural in this sense.

Indeed the school principal asked several senior teachers at the school to go into my classrooms and work with me on the problems. For many reasons which included the fact that I was the only one on the staff with a science degree from a fairly well respected Historically White University (HWU), and that I had taught sections of the work in both science and mathematics for the other teachers when they felt less comfortable in their classes, many of the senior teachers declined the principal's invitation into my classroom. Those who did take it up only came in to reassure me that there was nothing miraculous they or I could do with a group of children who were not "mathematics or science material."

I also heard it from the students that they enjoyed my mathematics classes much more than they had ever done before in their careers as students, but that they also expected to fail the examination at the end of the school year. This was partly because, as they put it, mathematics was just "not their line." There had to be something I could for these children to learn mathematics and science concepts in ways that enhanced their understandings and still make them feel good about their chances to succeed in the regional examinations. But what it was, I was not sure. For much of what I saw around me was either beating them (literally) to get ready for the examination or teaching them to enjoy and understand the key ideas of the subject matter but in ways that did not necessarily guarantee their readiness for the regional examinations. I couldn't do both or

even if I had wanted to wouldn't know how. As an activist in the "people's education for people's power" movement in the mid-1980s, I had rejected the state curriculum and its accountability schemes such as the regional or national examinations. I had read Mathonsi's (1986) extensive analysis of how the state manipulated and used these examination results as a "mechanism of social control" of Black people and their aspirations.

I experienced a similar dilemma in my teaching of science except that in science I gravitated more towards teaching for the examination, although I was aware that some of my students hardly made any sense of the science concepts I was teaching. Since I was teaching grades 11 and 12 science, I felt guilty about the need to prepare these students for the national matriculation examination. By the end of the year, my science students, unlike the mathematics ones (where I was teaching a grade10 class), could take the matriculation examination and succeed, but this was less of a reason for me to be proud. I felt trapped in this dilemma and to be honest it cut right through my heart.

The power of the stories of the three science teachers in this dissertation, for me, lies with their ability to demonstrate the art of what many of us would consider the impossible. That is, teaching science in ways which ensure that all students have the opportunity to develop the **conceptual understanding** of the key ideas while also developing their own unique **voices** for participating in the social discourses in and outside of the classroom. This, they do without being oblivious to the **accountability** schemes that define their lives and those of their students. In reading the stories of Mr. Sithole, Mr. Tshabalala and Mrs. Hlophe, some of what I did in trying to develop my own classroom practice is affirmed and some of it not. And further still, some of my

experiences are cast in a different light now that I have read the stories of these three teachers. Developing these stories of transformative practice in South Africa has allowed me to reflect on my own experiences and struggles, some of which I had deliberately buried far away in my memories. Part of what I take with me from the experiences of doing this research and writing it up in the way I did is about how to **open up,** first to myself and then to others about why I do the things I do, personally and professionally.

I do have a story to tell, therefore, about my own experiences and struggles to be who I am and why I choose to engage in the kinds of professional practices, both in terms of the research and/or teaching that I do (or hope to do). It does not feel appropriate, however, for me to tell it in this same document where I have been privileged to the inspiring and rich stories of Mr. Sithole, Mr. Tshabalala and Mrs. Hlophe. This dissertation is primarily a small contribution to the struggles to lift their voices as teachers and to tell their stories of practice without overwhelming them with theory and my own stories. To the extent that it has been unavoidable to impose a perspective on their stories, as the primary writer of this dissertation and a vehicle through which their stories are articulated, enough of the damage has been done. As I continue on this intellectual and professional journey, there will be more opportunities to tell my own story.

I pause to consider the implications of this study for my own professional practice beyond this research. As I look back at my experiences with research on reform or transformative practices, I hear three different voices begging for an answer to the same question: "Are we on the right track?" A teacher in one of the Michigan Statewide Systemic Initiative (MSSI) focus districts whose classroom practices I had observed and

written about, asked me a few months later if I thought he was "on the right track." I responded by saying that although I was also not sure what the right track was, I thought there were some interesting things I had seen in his classroom. I gave a similar response to Mr. Sithole when he asked the same question. This question was asked of me again with the other researchers I worked with at the Education Policy Unit (EPU) of the University of Natal by a senior government advisor to the national minister of education. His was in reference to the new education policies designed to change classroom practice in ways that would make the experiences of **all** learners more meaningful than has been in the history of South Africa.

I offer the stories of these three science teachers as part of the response to all these three voices I have identified in the foregoing discussion. Further stories of transformative practice, the resources available for its construction, and the policy framework that supports it are needed to develop a much more comprehensive response to the question of whether we are on the right track.

A TRANSFORMATIVE PRACTICE?

In a comprehensive matrix developed for analyzing secondary school science teaching, Gallagher and Parker (1995) characterized modal practice in science teaching as, among other things, dominated by factual content with no examples or interconnections to the real world events, or even to the key ideas of the subject matter. Gallagher and Parker's (1995) matrix also draws attention to how such a practice tends to be "teacher-dominated" with very few opportunities for student-student interactions and integration of student ideas into the subject matter of science. Many observers of

education in South Africa have characterized the practices of Black teachers in the system as modal and highly "didactic" to use Gallagher and Parker's terminology (HSRC, 1981; Macdonald, 1993; Macdonald and Rogan, 1988; Nduna-Watson, 1995). This is even more so for the Black science teachers. As Macdonald (1993) observes, the classroom practices of most Black science teachers are shaped by at least three related features, that is the syllabi, the textbooks and the national examinations. The syllabi lack relevance to both the students' and the teachers' life experiences (HSRC, 1981), and tend to be both "academic in content and difficult" for the students (Macdonald, 1993: 38). The only comprehensive study of (science) education in Black schools post-1953, when the Bantu Education Act was introduced, was conducted by the Human Sciences Research Council (HSRC) in 1981. Based on the extensive evidence collected by its researchers, the HSRC concluded that the teaching in most science classrooms in South Africa, but especially in the Black schools, prioritized factual knowledge, disregarded student experiences, and focused too much on tests and quizzes for exam preparation (HSRC, 1991). Similarly, Macdonald and Rogan (1988) identified a number of didactic "teaching approaches" that were common to many of the Black science classrooms in South Africa. Their list includes such things as 'teachers' state the facts," "tells the students," "inspects" and "corrects" while students' activities were characterized by "listen(ing)," "watch(ing)," "copy(ing) notes," and "answer(ing) exercises." Nothing in their observation of "ordinary" science classrooms (ordinary as compared to classrooms of teachers who had been targeted for intervention by the Science Education Project, SEP, which helped them infuse some hands-on activities in their teaching) suggested a deeper interaction with the subject matter of science by the students.

Modal practices of science teaching in Black schools have had devastating consequences for students, both in terms of denying them **access** to science and reducing their opportunities for **participation** in the social discourses in and outside of the classroom. The stories of Mr. Sithole, Mr. Tshabalala and Mrs. Hlophe become much more significant in this context of a pervasive commitment to modal practice in South African classrooms. Their pedagogy is different. It seeks to provide better opportunities for **all** students to engage with the **key ideas** of science through the medium of their experiences, while also developing a **voice** through which to **participate** in the social discourses in and outside of the classroom. In their classrooms, students got opportunities to construct meaning, engage in discussions with others about their own constructions, (re) present their social experiences, and relate the subject matter of science to their life worlds. Indeed their classroom practices were radically different from the modal practices described by Macdonald (1993), or by the HSRC (1981) reports, or even by the Gallagher and Parker (1995) matrix on didactic practice.

The classroom practices of Mr. Sithole, Mr. Tshabalala and Mrs. Hlophe are located within a broader context of a social experiment in transformation towards a democratic society in South Africa. Voice and participation are some of the key instruments for the realization of this social transformation in South Africa. In this context, therefore, the practices of the three secondary school science teachers have the potential to empower students with the tools for engaging meaningfully in social transformation.

In the light of the foregoing discussion, I have characterized the practices of Mr. Sithole, Mr. Tshabalala and Mrs. Hlophe as transformative. But if a transformative

practice has a lot to do with the consequences of students' understandings and knowledge, in terms of their own participation in changing the social discourses and material conditions outside of the classroom, then the question of whether the practices of these three teachers I studied is truly transformative remains. For we do not know what the students did (or will do) long after they have left the science classrooms of these three teachers. Were they (the students) to participate in the broader struggles of social transformation in South Africa, then maybe a claim as to the truly transformative nature of Mr. Sithole's, Mr. Tshabalala's and Mrs. Hlophe's pedagogical practice could be made. However, it would still be difficult to isolate the impact of the teachers' influences on the students, thereby making us forever uncertain as to whether the three teachers' practices were truly transformative.

Part of what drove this study on transformative practices were my experiencing of my own teachers' pedagogical practices, especially those of Mr. Juluka, as transformative. In many ways, this study was my attempt to find and understand the practices of other Juluka's in the education system. I cannot claim to have been entirely successful at that, partly because as I have discussed in this study, a transformative Mr. Juluka for me was not necessarily transformative for all of my classmates. An important aspect in defining a truly transformative practice has to do with whether the students in the teachers' classrooms experience it as such. The story of transformative practice is, therefore, somehow a story to be told by the (former) students of the transformative teachers. This dissertation has largely been my telling of the stories of the three secondary school science teachers, and therefore remains incomplete until we know the

stories of the students, present and past, and their experiencing of the teachers' pedagogy in relation to their own life experiences.

Through this study, the evidentiary burden for defining a truly transformative practice has been raised. The stories in this dissertation, therefore, provide only part of the answer to the question of what a truly transformative practice is. In that context, more stories about what transformative practices looks like for other teachers and their students need to be told in order to develop a much more comprehensive response to the questions of whether we are truly on the "right track." With the skills and experience developed, especially in the course of doing this research, I hope to contribute further to the various efforts to define a much clearer response to the teachers' and policymakers' questions about defensible classroom practice.

APPENDICES

APPENDIX A

RESEARCH INSTRUMENTS

1. Questionnaire
2. Topics of interest on the questionnaire
3. Observation and Interview Protocols

QUESTIONNAIRE FOR SCIENCE TEACHERS[1]

A research project to examine the teaching of Science and the school and classroom contexts within which Science teaching occurs, is being conducted by the Education Policy Unit (EPU), located at the University of Natal, Durban in a selected sample of schools in the KwaZulu-Natal province of South Africa. Your region's Chief Director has agreed for the region to participate in this project.

Completion of this questionnaire is an important aspect of the research project. The questionnaire requests information about your academic and professional background, instructional practices in your classroom, things that constrain these practices and your beliefs and attitudes towards the teaching of Science. Your responses are very important as they will help to describe the teaching of Science within this sample. Some of the questions are adapted from a version of the instrument used by the Third International Mathematics and Science Study (TIMSS) which was recently conducted in over 41 countries, including South Africa.

The information given in the questionnaire will be treated with strict confidence. You, your students, your school and your circuit will not be identified by name in any transcripts or reports of this research. Identification numbers on this survey are used primarily for internal record keeping. Based on some responses, a few teachers will be asked to participate in a subsequent interview and classroom observation. The name sheets attached to this questionnaire will only be used to identify teachers for the follow-up observation. Only the researcher(s) will have access to these names (and for research purposes only). Classroom observation will require no more than 6 hours (about 6 double periods) spread throughout the school year.

Your participation in this research is entirely voluntary. You may choose not to participate at all or not to answer certain questions without any penalty to you. It is estimated that this questionnaire will take approximately 60 minutes to complete.

If you desire further information about this research, you may call or write to Loyiso Jita at: Education Policy Unit (EPU), University of Natal, Durban 4041; Tel: (031) 260-2641.

Your co-operation in completing this questionnaire will be greatly appreciated.

[1] Science Teacher: refers to any teacher who is involved in the teaching and learning of any one of the Science subjects including Biology, Physics, Chemistry, Physiology and General Sciences.

SECTION A (Tick relevant box)

1. How old are you?

under 25	☐
25-29	☐
30-39	☐
40-49	☐
50-59	☐
60 or more	☐

2. Are you female or male?

Female	☐
Male	☐

3. Which of the following labels best describes you? (note: these labels may be problematic to some, but are used to disaggregate data based on the legacy of South Africa's immediate history).

African	☐
Coloured	☐
Indian	☐
White	☐
Other (please specify)	☐

_____

4. What is the highest level of formal education you have completed?

3 year teacher's diploma	☐
4 year teacher's diploma	☐
Degree but no specific teacher certification	☐
Degree plus teacher certification	☐
Senior degree but no teacher certification	☐
Senior degree plus teacher certification	☐
other (please specify)	☐

_____

5. By the end of this year, how many years will you have been teaching altogether? (to the nearest whole number).

1-3	☐
4-6	☐
7-9	☐
10-14	☐
15-25	☐
26-33	☐
34 or more	☐

6. Is your appointment permanent or temporary?

a) Permanent ☐
b) Temporary ☐

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7. What is your position at the school?

a) Principal ☐
b) Deputy principal ☐
c) Head of department (Science) ☐
d) Head of department (other) ☐
e) Teacher (post level 1) ☐

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8. Which of the following statements best describe your initial motive(s) for entering the teaching profession?

	not at all	a little	quite a lot	a great deal
a) Contact with youth; at ease with young people	☐	☐	☐	☐
b) Love of the subject matter	☐	☐	☐	☐
c) Desire to share one's knowledge	☐	☐	☐	☐
d) Role modeling: influence of former teacher(s) or of parents who were teachers	☐	☐	☐	☐
e) Access to higher social status	☐	☐	☐	☐
f) Success as a student	☐	☐	☐	☐
g) Compensating for a perceived educational deficit: desire to 'do better than one's own teachers'	☐	☐	☐	☐
h) A way of earning a living	☐	☐	☐	☐
I) Favourable working conditions	☐	☐	☐	☐
j) Job security	☐	☐	☐	☐
k) For lack of something better	☐	☐	☐	☐
l) Other (please specify) _____	☐	☐	☐	☐

SECTION B

9. At which grade level are you teaching Science[2] during this school year?

	Yes	No
a) Grade 8	☐	☐
b) Grade 9	☐	☐
c) Grade 10	☐	☐
d) Grade 11	☐	☐
e) Grade 12	☐	☐

10. How many students are in your class? (Write in the number)

	Boys	Girls	Total
a) Your biggest class	------	------	-------
b) Your smallest class	------	------	-------
c) On average per class	------	------	-------

11. What other subject(s) are you teaching during this school year?

	Yes	No
a) Mathematics	☐	☐
b) Languages	☐	☐
c) Social Studies (geography, history, criminology, biblical studies etc.)	☐	☐
d) Industrial subjects and/or Creative Arts (including home economics	☐	☐
e) Commercial Subjects (e.g. economics, business economics)	☐	☐
f) None (only teach Science)	☐	☐
g) Other (please specify)	☐	☐

_____

12. **For how many single periods are you formally scheduled to teach each of the following subjects during the school week? (Count a double period as two single periods).**

a) Science	----------
b) Other (Subjects)	----------
c) None (Free periods)	----------

[2] Science Teacher: refers to any teacher who is involved in the teaching and learning of any one of the Science subjects including Biology, Physics, Chemistry, Physiology and General Sciences.

13. Approximately how often do you have meetings with other teachers in your subject area to discuss and plan curriculum or teaching approaches?

Never	☐
Once or twice a year	☐
Every other month	☐
Once a month	☐
Once a week	☐
Two or three times a week	☐
Almost everyday	☐

---

14. Which of the following Science related activities have you participated in during the past year? Indicate approximately how much time you spent in each activity.

	5hrs	6-12hrs	12hrs or more
a) Attended a national **Science association/ organisation** meeting	☐	☐	☐
b) Attended a regional/provincial **Science teachers'** meeting	☐	☐	☐
c) Served in a school/district/provincial or national curriculum committee dealing with **Science**	☐	☐	☐
d) Local teacher discussion or study group **focusing on Science**	☐	☐	☐
e) Attended a professional development session(s) on **Science** (please specify under f & g)			
f) _____	☐	☐	☐
g) _____	☐	☐	☐

---

15. Indicate your familiarity with each of the following documents:

	never heard of it	not familiar	fairly familiar	very familiar
a) Curriculum framework for general and further education and training	☐	☐	☐	☐
b) Learning Area Committee Reports	☐	☐	☐	☐
c) Curriculum 2005: lifelong learning for the 21st century	☐	☐	☐	☐
d) Natural Sciences Report (technical committee and support team)	☐	☐	☐	☐

---

16. In your view, to what extent do the following limit how you teach your Science class?

	not at all	a little	quite a lot	a great deal
a) Students with different academic abilities	☐	☐	☐	☐
b) Students who come from a wide range of backgrounds (language, economic)	☐	☐	☐	☐
c) Uninterested students	☐	☐	☐	☐
d) Disruptive students	☐	☐	☐	☐
e) Parents interested in their children's learning and progress	☐	☐	☐	☐
f) Parents uninterested in their children's learning and progress	☐	☐	☐	☐
g) Shortage of instructional equipment for student's use	☐	☐	☐	☐
h) Shortage of equipment for your use in demonstrations and other exercises	☐	☐	☐	☐
i) Shortage of books and libraries	☐	☐	☐	☐
j) Inadequate physical facilities	☐	☐	☐	☐
k) High student/teacher ratio	☐	☐	☐	☐
l) Low morale among fellow teachers/ administrators	☐	☐	☐	☐
m) Low morale among students	☐	☐	☐	☐
n) Threat(s) to personal safety or safety of the students	☐	☐	☐	☐

---

17. To be a good Science teacher, how important do you think it is for one to:

	not important	not sure	important	very important
a) Be actively involved in campaigns for social justice	☐	☐	☐	☐
b) Maintain student discipline in class	☐	☐	☐	☐
c) Organise sporting activities	☐	☐	☐	☐
d) Fight for better conditions of service	☐	☐	☐	☐
e) Satisfy the requirements of the science syllabus	☐	☐	☐	☐
f) Obtain high percentage pass rates	☐	☐	☐	☐
g) Constantly try to improve one's teaching ...	☐	☐	☐	☐
h) Teach pupils to think critically	☐	☐	☐	☐
l) Use science lessons to discuss problems of the wider society	☐	☐	☐	☐
j) Know one's subject matter	☐	☐	☐	☐
k) Read professional journals and books about Science education (e.g. *Science Teacher*, *Archimedes* etc.)	☐	☐	☐	☐
l) Read journals and books in the discipline of one's teaching (e.g. Physics, Zoology, etc.)	☐	☐	☐	☐
m) Read local and national newspapers	☐	☐	☐	☐
n) Register for further education (degree, diploma, in-service courses, etc.)	☐	☐	☐	☐
o) Other (please specify) ..... _____	☐	☐	☐	☐

18. Using your answers to question 17 (above), would you consider yourself a good teacher?

a) Yes ..... ☐
b) No ..... ☐
c) Uncertain ..... ☐

19. List the <u>three</u> criteria from question 17 (above) which were most important in your assessment of yourself (in question 18). (Choose from letters a-o of question 17).

1) ..... 2) ..... 3) .....

SECTION C

20. To what extent do you agree or disagree with each of the following statements?

	strongly disagree	disagree	agree strongly	agree
a) Science is primarily an abstract subject	☐	☐	☐	☐
b) Science is the same in all cultures	☐	☐	☐	☐
c) Some students have a natural talent for science & others do not	☐	☐	☐	☐
d) Focusing on rules is a bad idea. It gives students the impression that the sciences are a set of procedures to be memorised	☐	☐	☐	☐
e) If students get into debates in class about ideas or procedures covering the sciences, it can harm their learning	☐	☐	☐	☐
f) Race, class and/or gender matter in the teaching of Science	☐	☐	☐	☐
g) Race, class and/or gender matter in the learning of Science	☐	☐	☐	☐

21. When planning Science lessons, how much do you rely on:

	never	rarely	sometimes	always
a) Your own previously prepared lessons	☐	☐	☐	☐
b) Other teachers or science specialists in your school	☐	☐	☐	☐
c) Student textbooks	☐	☐	☐	☐
d) Other textbooks or resource books	☐	☐	☐	☐
e) Past examination papers	☐	☐	☐	☐

22. In planning Science lessons, what is your main source of written information when:

	own experience	school textbooks	syllabus document	past exams & study guides	library books
a) Deciding which topics to teach	☐	☐	☐	☐	☐
b) Deciding how to present a topic ...	☐	☐	☐	☐	☐
c) Selecting problems, exercises for classwork	☐	☐	☐	☐	☐
d) Selecting problems for assessment and evaluation	☐	☐	☐	☐	☐

23. To be good at Science, how important do you think it is for students to:

	not important	somewhat important	very important
a) Remember formulae and procedures	☐	☐	☐
b) Understand concepts and principles	☐	☐	☐
c) Understand the relationship between science and culture	☐	☐	☐
d) Think in a sequential and procedural manner	☐	☐	☐
e) Understand the contested nature of science	☐	☐	☐
f) Understand the interaction between science and socio-economic development	☐	☐	☐

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24. In your Science lessons, how often do you usually ask students to do the following?

	never or almost never	some lessons	most lessons	every lesson
a) Explain the reasoning behind an idea	☐	☐	☐	☐
b) Represent and analyse relationships using tables, charts, or graphs	☐	☐	☐	☐
c) Work on problems for which there is no immediately obvious method of solution	☐	☐	☐	☐
d) Write explanations about what was observed and why it happened	☐	☐	☐	☐
e) Apply concepts and principles to real life problems	☐	☐	☐	☐

---

25. In your Science lessons, how frequently do you do the following when a student gives an incorrect response during a class discussion?

	never or almost never	some lessons	most lessons	every lesson
a) Correct a student's error in front of the class	☐	☐	☐	☐
b) Ask the student another question to help him or her give the correct response	☐	☐	☐	☐
c) Call on another student who is likely to give the correct response	☐	☐	☐	☐
d) Call on other students to get their responses and then discuss what is correct	☐	☐	☐	☐

---

26. In Science lessons, how often do students:

	never or almost never	some lessons	most lessons	every lesson
a) Work individually without assistance from the teacher	☐	☐	☐	☐
b) Work individually with assistance from the teacher	☐	☐	☐	☐
c) Work together as a class with the teacher teaching the whole class	☐	☐	☐	☐
d) Work together as a class with students responding to one another	☐	☐	☐	☐
e) Work in pairs or small groups without assistance from the teacher	☐	☐	☐	☐
f) Work in pairs or small groups with assistance from the teacher	☐	☐	☐	☐

Thank you for the thought, time and effort you have put into completing this questionnaire. To facilitate possible follow-up activities, will you please fill in the following details:

Name: .....

School: .....

.....

Telephone: .....

Thank you.

.....

APPENDIX A

QUESTIONNAIRE ITEMS GROUPED BY TOPIC FOR PURPOSES OF SELECTING TEACHERS FOR FURTHER CONVERSATIONS AND OBSERVATION

MOTIVES FOR TAKING UP TEACHING: QUESTION 8

Work with youth

a) Contact with youth

Subject matter of science

b) love of the subject

c) desire to share one's knowledge

f) success as a student

Early experiences with teaching

d) role models

g) perceived educational deficit

A job

h) a way of earning a living

i) favorable working conditions

j) job security

k) for lack of something better

FACTORS THAT LIMIT TEACHING PRACTICE: QUESTION 16

Student population

a) different academic abilities

b) wide range of backgrounds

Students' attitude/behavior

c) uninterested students

d) disruptive students

m) low morale among students

Teacher attitude

l) low morale among teachers

General attitude/behavior

c) uninterested students

m) low morale among students

e) parents uninterested in the children's education

l) low morale among teachers

d) disruptive students

n) threat to safety

Resources

f) shortage of instructional equipment for student use

g) shortage of equipment for use in demonstrations

h) shortage of books and libraries

i) inadequate physical facilities

Parents

e) parents interested in their children's education

f) parents uninterested in their children's education

Independent

j) high student/teacher ration

m) safety

CHARACTERIZING GOOD SCIENCE TEACHING: QUESTION 17

Advocacy

a) involved in campaigns for social justice

d) fight for better conditions of service

Accountability

e) satisfy requirements of the syllabus

f) obtain a high percentage pass rate

Knowledge

j) know the subject matter

k) read professional journals about science education

l) read journal in the discipline of one's teaching

m) read local and national newspaper

n) register for further education

g) constantly try to improve one's teaching

Higher Order Teaching Skills (HOTS)

h) teach pupils to think critically

i) use lessons to discuss problems of wider society

Discipline

b) maintain student discipline

Extra-curricular

c) organize sporting events

SELF ASSESSMENT: QUESTION 19

as a good teacher, using grouping in Question 17

BELIEFS ABOUT SCIENCE: QUESTION 20

d) focusing on rules is bad idea

e) debates can harm learning

IMPORTANT KNOWLEDGE: QUESTION 23

Understanding science and everyday life

c) relationships between science and culture

f) relationships between science and socioeconomic development

STUDENTS USING HOTS: QUESTION 24

All the items on this question

QUESTIONING STYLE: QUESTION 25

Questioning for the correct answer

a) correct student's error in front of the class

c) call another student for correct answer

Questioning for understanding

b) ask student another question

d) call on students and discuss

TEACHING STYLE: QUESTION 26

All items on this question

APPENDIX A1

PHASE I and II OBSERVATION AND INTERVIEW INSTRUMENTS

Pre Observation Questions

1. Teacher Background
- educational background and opportunities to learn
- conditions of life and work (See Life History Interview Schedule)
- beliefs, understandings and personal philosophy on teaching

2. Lesson/Instruction
- What is/are the objective(s)?
- What is the context? Previous work? Future work? Standard curriculum? Other?
- Is there are a particular pedagogical style that you will be using? Why?

3. Configuration
- Who will be in the classroom?
- Who are the learners?
  -General description
  -Any learners requiring special attention? Why?

Science Lesson Observation Guide

Name of School:
Name of Teacher:
Grade:
Lesson(s):
Date:

Please write a short description of the surrounding neighborhood, school, classroom, and teacher(s).

Please draw a picture of the classroom here, noting major landmarks.

Please note how many children were present and provide counts by gender and ethnicity/race. How many were absent?

1. ***Narrative description.*** Describe the lesson(s) you observe. What are the teacher's objectives? What seem to be the topics and tasks? What is the order? How much time is devoted to each chunk? Note: This description is the major accounting of the lesson(s). Describe the (shifting) social organization of the learners and the classroom at different points and in relation to different activities.

2. ***Instructional materials.*** Please describe the materials in the room. Are any books present? If so, where are they? Of what type are they (trade books, reference books, textbooks, etc.). Note the publishers and names of any textbook and reference texts used as well as the dates.

Are there displays related to science learning or teaching? Describe or sketch these. Are they created by teacher, students, commercial publishing house?

2a. How are materials used across the day?

3. ***Science instruction.*** The following questions are specifically addressed to aspects of science instruction.

3a. Comment on what it seems that students are supposed to be learning. Does the teacher explain directly what students should be learning or are activities structured to provide experience with particular aspects of science? What goals are focal at given points or across the lesson(s)? Are all students expected to meet the same goals?

3b. Reflect on the conceptions of science represented across the lesson(s). What does it mean to be scientifically literate at different points across the lesson(s)? Does this differ across

the students in the class? [Use observations from across the lesson(s)--what is up in the room, different activities in which teacher and students engaged, etc. -- to lend concrete evidence and detail. Try looking for different kinds of 'scientific events'.

3c. Are there times during the lesson(s) when a significant number of students seem exceptionally engaged in the scientific work or activity at hand? What are they engaged in? Are there times during the lesson when a significant number of students seem to be disengaged or engaged in something else? What are they engaged in?

3d. Reflect on the discourse patterns that you observe during the day.

How do students participate? What kinds of things do students say, how much do they participate, what are they encouraged to do and not to do?

Who talks? To whom? Role of the teacher in the discussion?

How are students' ideas treated? Is there a press for convergence? Is there conversation in which no one right answer is guiding the discussion?

3e. Do you observe the teacher using any of the specific practices that are associated with the current reforms (e.g., co-operative learning, solving problems relevant to real life, engaged in experimental work, using science to construct explanations of reality, etc.)?

Is any special scientific terminology used? If so, what is it? What role does it play in the lesson(s)? How familiar do students and teacher seem to be with these terms? (e.g., scientific process, hypothesis, predicting, etc.). In what context were these terms used? What role did they play? How were they presented? Used? Discussed? By whom?

3f. How would you describe the relationship between traditional rote and new constructivist teaching/learning in the lesson(s)?

3g. Any other issues of interest about the lesson not covered in the earlier questions?

4. *Assessment-related activities.* Does the teacher use any test-preparation or test-related drills or activities?

What are these like? What is their content and focus? How are they used by students?

How much time is spent on these and when?

Why are these used?

Post Observation Questions

1. How do you feel about the session? Why? Did you accomplish what you hoped to? Did anything go differently than what you expected?

2. Was today a typical day/session? If so in what ways? If not, in what ways? Why?

3. Follow up on interesting aspects of the lesson. Ask questions to help clarify the teacher's understanding and purpose for using the particular instructional goal, pedagogical tool etc. e.g. I am interested in focusing on some events from the class I observed.

Observation 1: I notice that [plug in the relevant descriptor] e.g. a lesson that was taught from a textbook or a segment that looks like it was structured to pursue a certain reform agenda.

Could you tell me a little bit about [relevant descriptor]?
Where did you get that idea?
What were you hoping the learners would get from the lesson?
How did you think the students did?
Is there anything they had trouble with?
How could you tell?
Why was this a problem?
Is there anything they found easy or interesting?
Why do you think they found this easy/interesting?
How could you tell?
Is there anything you want to follow up on in future classes?
If so, what?
Why is that important to follow up?
Are there differences in the ways that students react to this material?
If so, what? Could you give examples?
Did you teach this material in the same way last year?
If so, can you recall any differences in the way you taught it this year and the way you taught it last year?
If so, what were those changes?
Why did you make them?
Is there anything that you might do differently next time?

4. If appropriate, inquire where the teacher learned about each particular reform related activity in the lesson. On their own? At their school site? District mandate? etc.

5. Ask a broad question relating to if and how their teaching has changed in the last 5-10 years. Follow up again with the influences that shaped these changes.

6. Opportunity for the teacher to raise issues that have not been covered.

APPENDIX B

SIMPLIFIED SCHEME FOR DESCRIBING TYPES OF SCHOOLS IN SOUTH AFRICA

APPENDIX B

SIMPLIFIED SCHEME FOR DESCRIBING TYPES OF SCHOOLS FOUND IN SOUTH AFRICA[1]

	TYPE OF SCHOOL	DESCRIPTION/STUDENT POPULATION
1a)	Boarding schools	(Serving White students). Found mostly in provinces with large rural areas. White boarding schools serve mostly the richest end of the spectrum. A number of these schools have always admitted African students from affluent backgrounds (irrespective of their race). Mostly single-sex and single medium schools (either Afrikaans or English medium).
1b)	Boarding schools	(Serving African students). Mostly located in rural provinces also. Vary in SES of students, with some serving high end and others the middle class end of the spectrum. Serve students of both sexes and also cater for non-borders. A sizeable number of them are religious schools that cater for specific denominations although they are open to all.
2.	Colored schools	formerly restricted to students of mixed race. Some high SES others low SES depending on location. Some serve Specific religious communities depending on their location.

[1] Under the new SASA of 1996, there are only two types of schools, the private and the public and all the public schools are open to children from all racial groups. Accordingly, there will now be variations to the

3.	Farm schools	mostly African and elementary, built on private land owned by the farmers for children of farm-workers. Low SES.
4.	Finishing schools	mostly African and caters only for repeating 12th graders. Visible in poor achieving areas e.g. some African locale.
5.	Indian schools	formerly restricted to Indian students. Mostly very high SES, but with sizeable low SES ones depending on location Some predominantly serve specific religious communities, although they are open to all. Religious rites and holidays are observed.
6.	Inner-city schools	mostly private and African. Located in dense areas of town and attract students fleeing from township schools. Most are in the business for profit and charge very high fees.
7.	Rural schools	Located in rural areas. White schools comparable to urban counterparts. Black schools are poorer and built from community contributions with matching funds from the government. Most offer regular curriculum program (all subjects excluding technical subjects). Very few are comprehensive schools (curriculum includes technicals)
8.	Suburban schools	All white and serve the high end of SES spectrum. Most offer a much broader curriculum with a lot of enrichment courses for students. At secondary level, most are single sex and single medium schools.

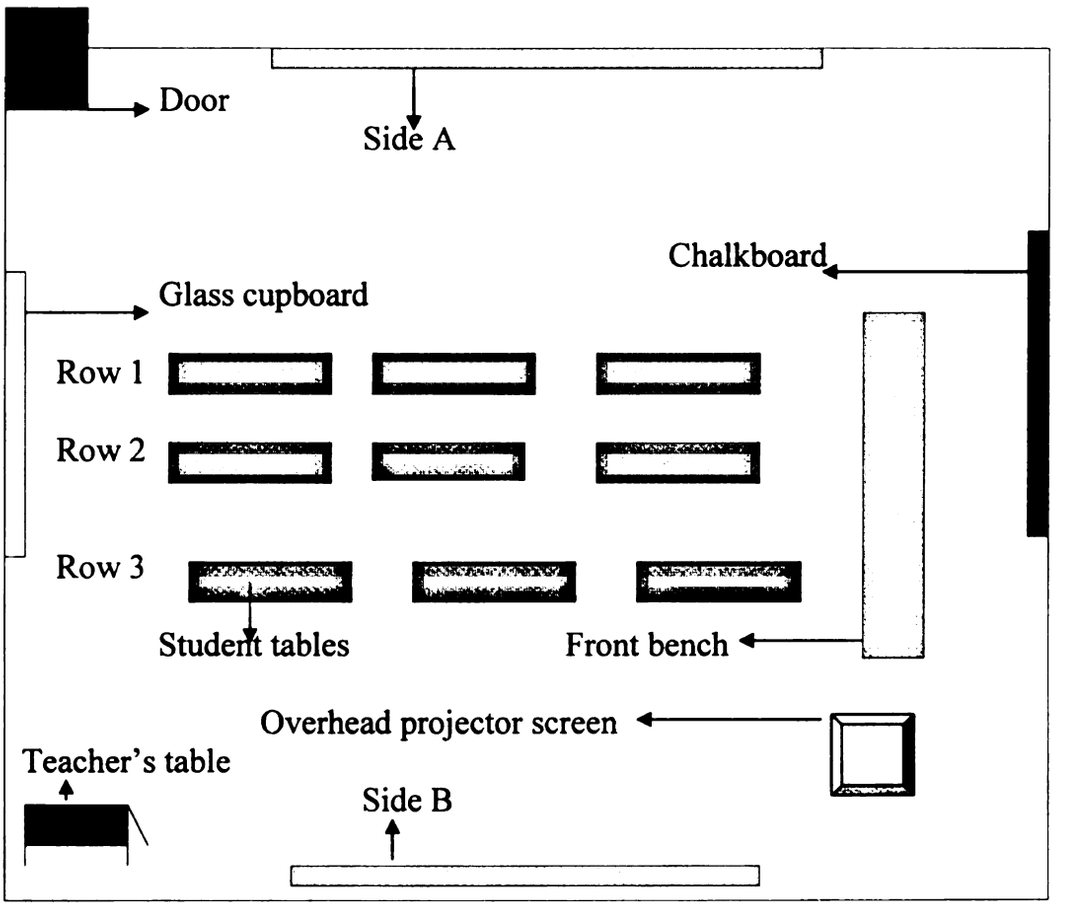
---

descriptions offered here. Many of the features, however, remain because of the residential segregation in South Africa.

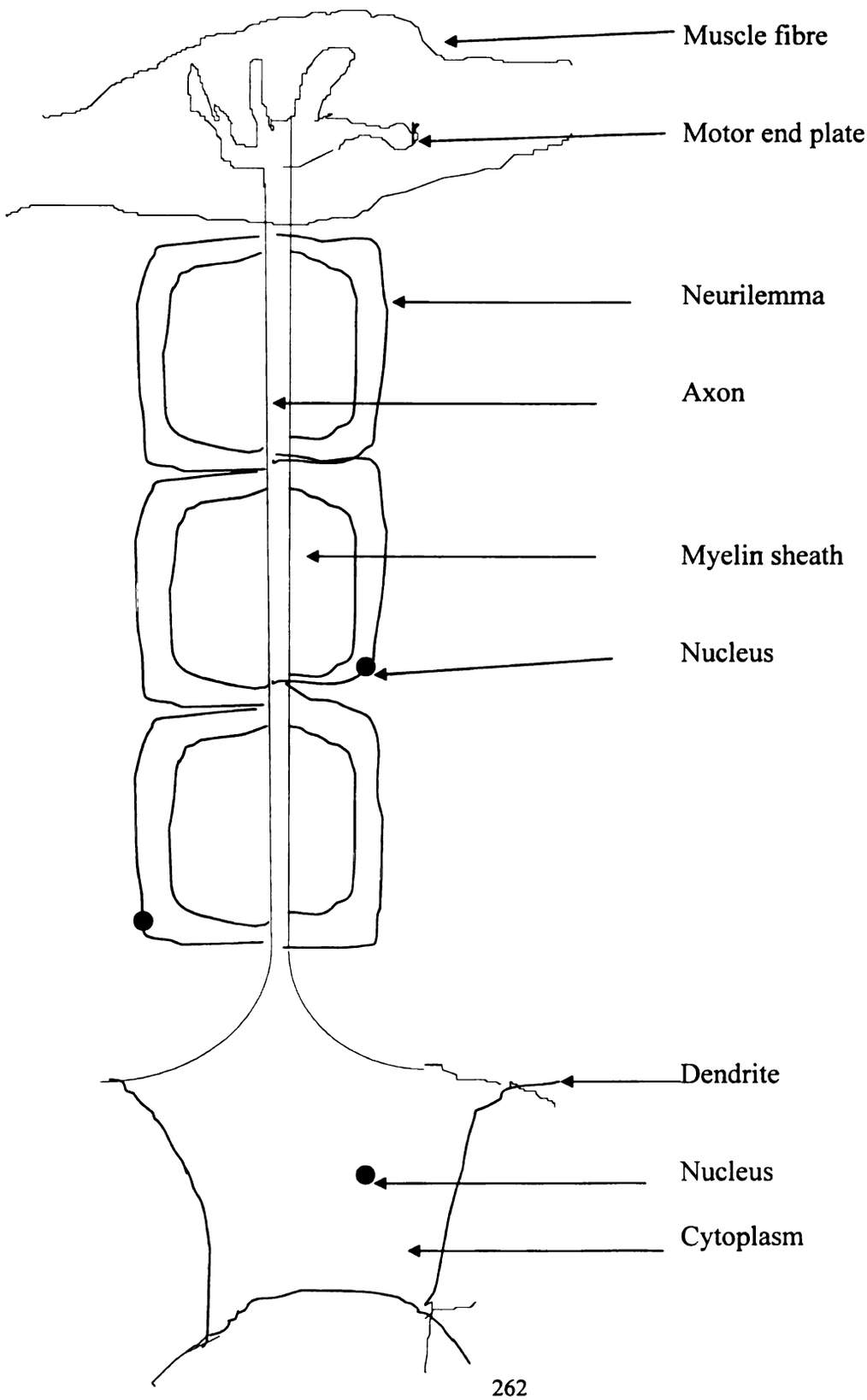
9a)	Township schools	(Regular). Most are working class schools on the lower end of the SES spectrum. Few would qualify as lower middle class (given the open admission policies that ensure a rather undefined mixing of students from different backgrounds). Township schools serve Africans only.
9b)	Township schools	(Comprehensive schools). A recent creation in the aimed at providing broader curriculum, including technical subjects. Most are similar to the regular schools but slightly better equipped and with newer facilities. When they began in the mid-1980s, most of them were characterized by white principals and senior teachers assigned by the DoE.
9c)	Township schools	(special programs schools). Very few in number. They offer only selected programs only e.g. science school.
10.	Technical/Vocational	Offer a strictly technical or vocational stream. Very few serve African communities. In white areas, these schools are uncharacteristically large and well equipped with a broad set of curricula offerings.
11.	Special schools	These are schools for the handicapped. They are very few across the different provinces and/or racial groups. Most offer a very restricted curriculum program geared towards basic literacy.

* Most African schools are single medium schools with exceptions in the townships with multilingual communities.

APPENDIX C: Mr. Sithole's laboratory setting



APPENDIX D: (FIGURE 1) A MULTIPOLAR NEURON



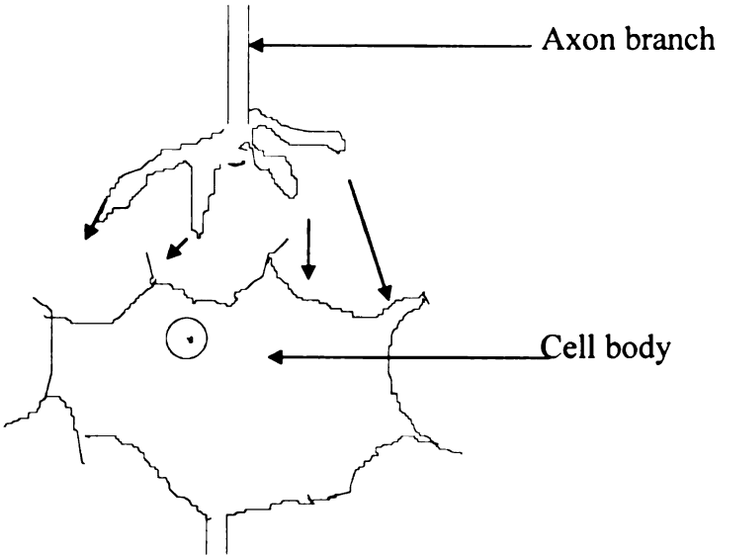


Figure 2: Scheme of a synapse

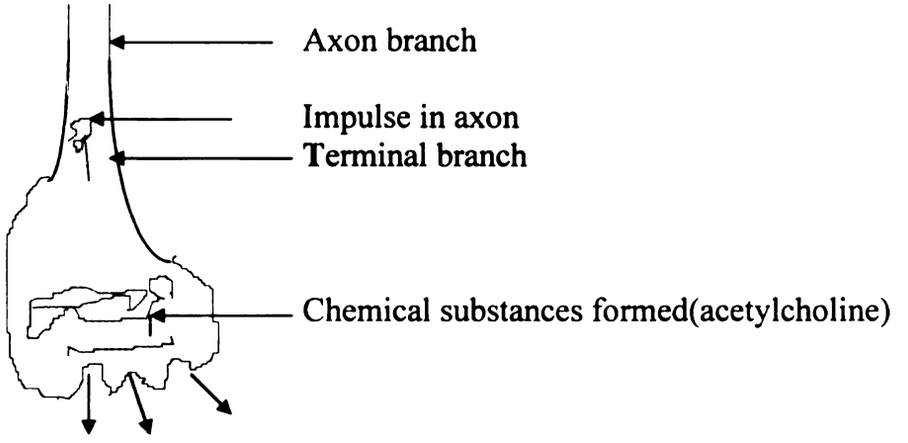


Figure 3: Schematic of a synapse transfer across a synapse

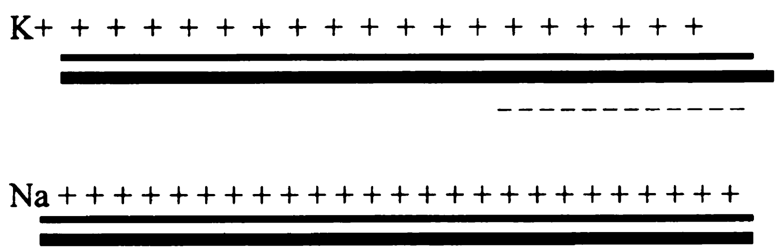
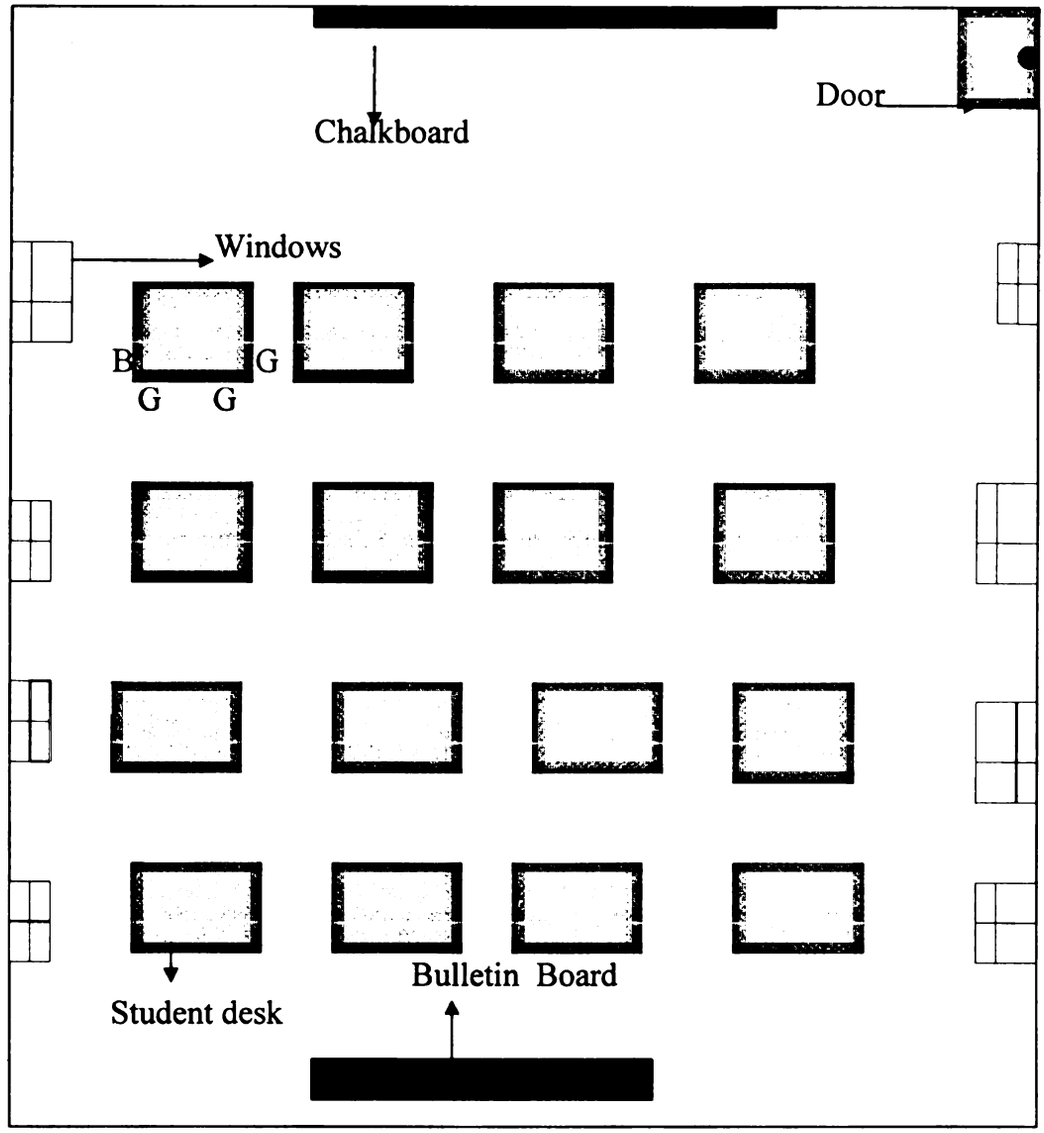


Figure 4: Nerve Impulse

APPENDIX E:

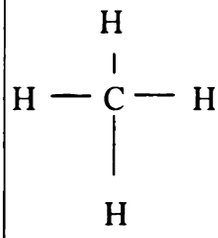
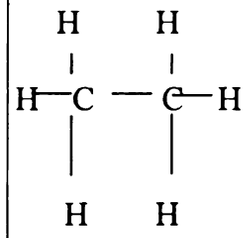
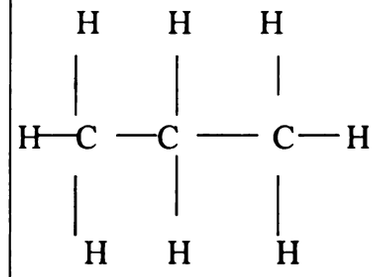
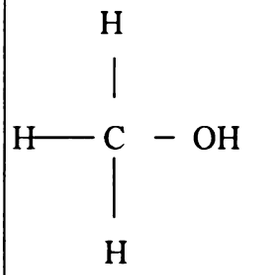
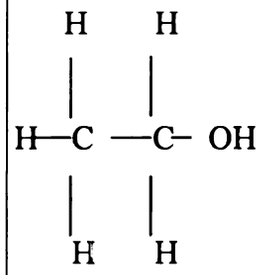
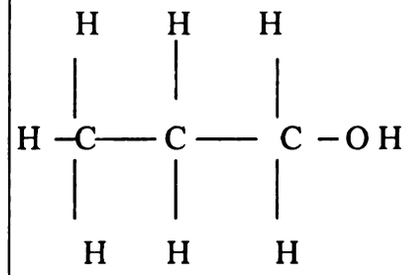
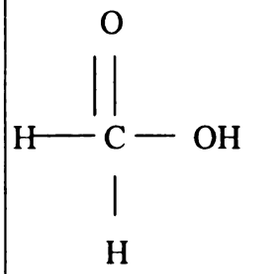
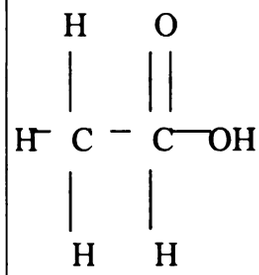
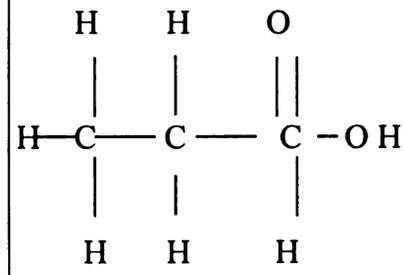
APPENDIX E: MR. TSHABALALA'S CLASSROOM SETTING



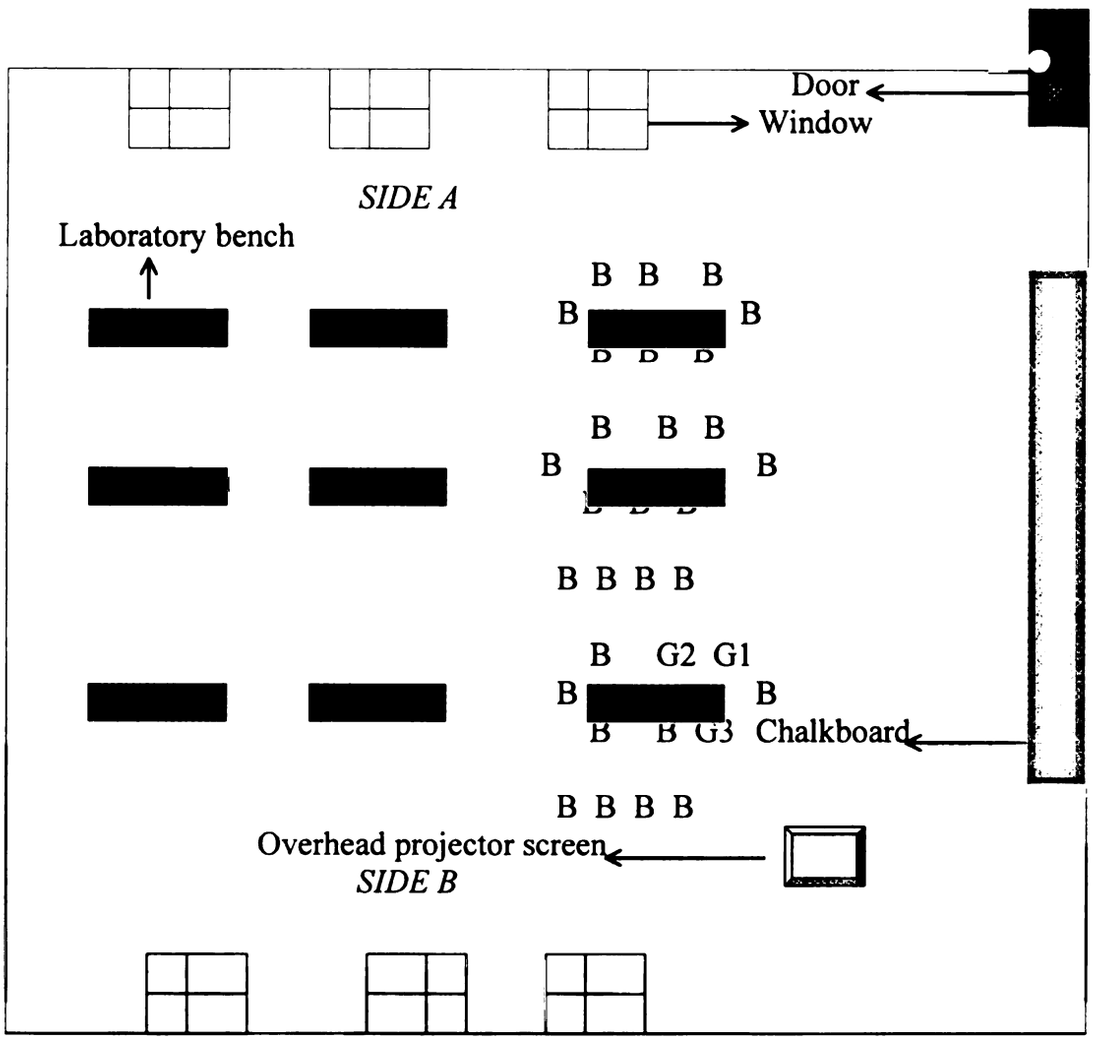
B: BOY
G: GIRL

Seating: 4 students/ desk
2 or 3 on desk and
1or2 on a chair placed next to the desk

APPENDIX F: THE ALCOHOLS & MONOCARBOXYLIC (FATTY) ACIDS

	1 CARBON	2 CARBON	3 CARBON
PARENT ALKANE			
ALCOHOL			
MONO CARBO-XYLIC ACID			
	METHANE TO METHANOL TO METHANOIC ACID	ETHANE TO ETHANOL TO ETHANOIC ACID	PROPANE TO PROPANOL TO PROPANOIC ACID

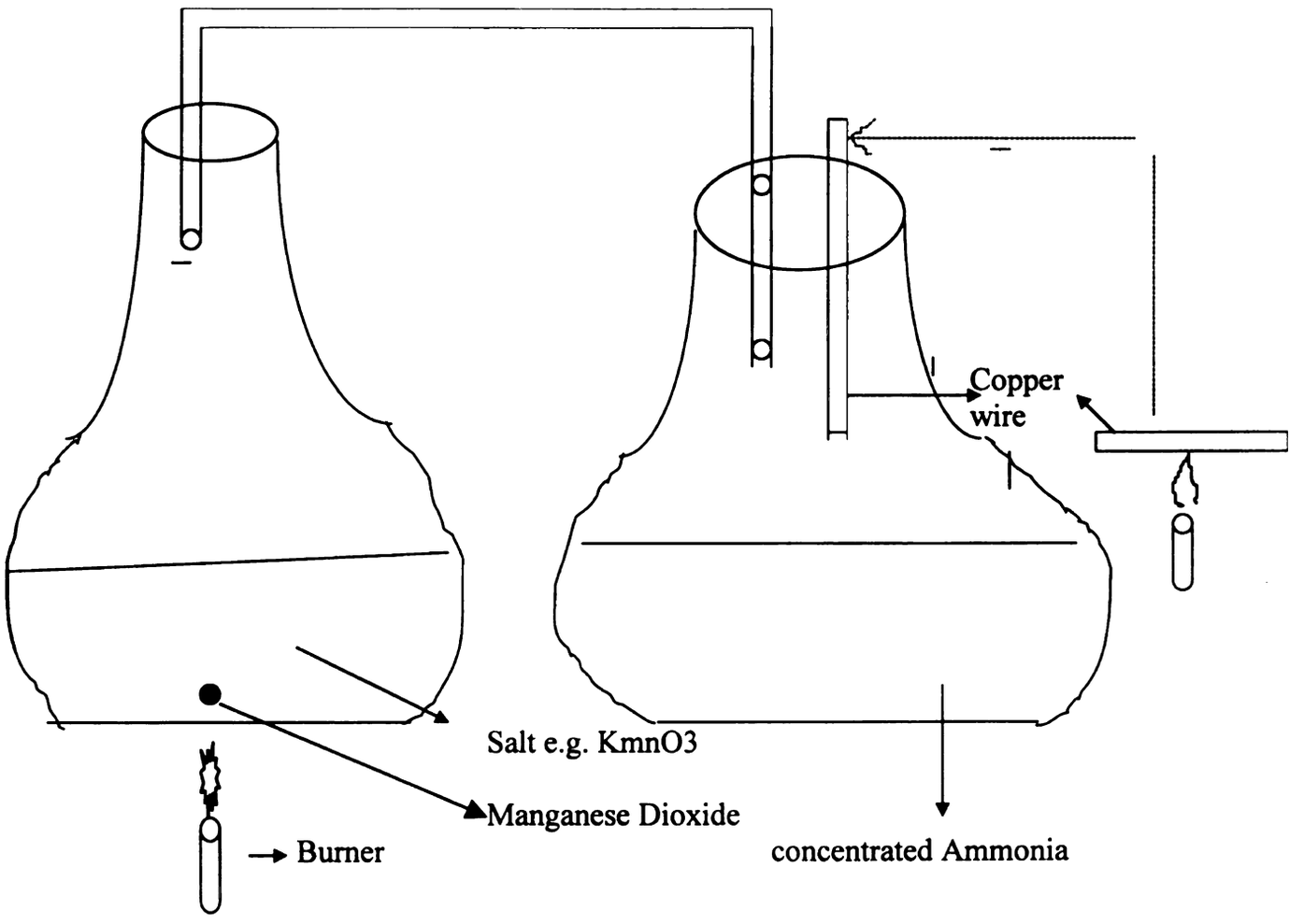
APPENDIX G: Mrs. Hlophe's laboratory setting



B= BOY
G= GIRL

APPENDIX H

Preparation of oxygen and the catalytic oxidation of ammonia



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