

**EXPLORING SCIENCE TEACHERS' EXPERIENCES OF
DIVERSITY IN THE MULTICULTURAL SCIENCE
CLASSROOM**

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**EXPLORING SCIENCE TEACHERS' EXPERIENCES OF DIVERSITY IN
THE MULTICULTURAL SCIENCE CLASSROOM**

By

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ABSTRACT

I have found that as a rule of thumb, when the majority of our learners in our science classrooms respond to expectation under examination conditions, the teacher's focus is on the minority who did not succeed. However, when only a minority of learners respond expectedly, then I feel teaching approaches have to be seriously questioned. My personal studies and readings in the education field, revealed a myriad of explanations and approaches surrounding the above problem. Literature has revealed that our greatest benefits can be achieved by successfully coping with the diversity of learners found in our science classrooms.

There is no doubt that the problem is large, and thus a proper understanding of the problem is paramount to its resolution. This is where my study focuses, a case study that checks for gaps in science teachers' understanding of *multicultural diversity* in their classrooms and the impact of such understanding on classroom practice. Approaching the problem from an interpretive viewpoint within a social-constructive paradigm, the issue of multicultural diversity, especially in the field of science, is a "relatively" new concept in the South African context. Europeans and especially the Americans have at least forty years of experience in this field, their economy, low unemployment and advanced technology being a measure of their successes in multicultural science classrooms. At a theoretical level much of the American experiences do have direct relevance in our South African setting and is thus used throughout my study as a point of reference.

The study used as its tools semi-structured interviews of 5 science teachers, (respondents), observations of a single lesson of each of the respondents and analysis of documents used in the observed lesson. The study was conducted in a middle to low socio-economic suburban secondary school of Kwazulu-Natal where science teachers' understandings of multicultural diversity was found to be somewhat traditional, simplistic and parochial. The study further revealed how a poor understanding of the issues of diversity amongst learners impacted on the teachers' abilities to successfully adapt the

science curriculum and their teaching approaches to meet the needs of their diverse learners, and thus create equitable learning opportunities for all learners.

Recommendations proposed in this study stem from the fact that though the respondents have some knowledge of the diversity in their science classrooms, their attempts to cope with the diversity based on currently available guidelines, viz. OBE, C2005 and the RNCS, still falls short of achieving equitable learning opportunities for all learners. Thus the study recommends serious attention to issues of multicultural science education with respect to language barriers and practice of appropriate teaching and learning methods. It also recommends appropriately designed training for both pre and in-service teachers and *teacher educators*. The study further recommends making science more meaningful by localising the Eurocentric curriculum and lastly, diversifying our teaching force to better reflect the increasingly diverse learner bodies.

DEDICATION

This work is dedicated to my parents, Mr & Mrs Padiachy:
Mum and dad, I appreciate the unstinting love, support, encouragement and sacrifices that you have bestowed upon me, that have brought me to this achievement. The example you have set and the values you have instilled in me, has imbued me with the desire to soar and strive for excellence in all that I do. I humbly thank you for all that you are to me.

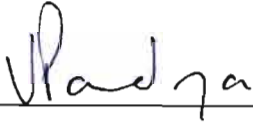
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I wish to extend my sincere gratitude to the following people:

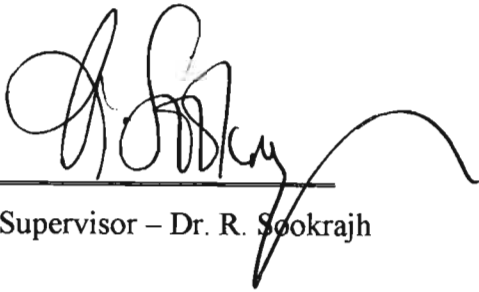
- ◆ To my loving husband Mervin, this would have been an impossible dream without your unconditional love and support. You kept me buoyant with your words of encouragement, advice and ever willing help when it counted the most. Thank you for nurturing me yet, giving me the space to grow. All my love, always.
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- ◆ To the five teachers and the Principal of my school for being kind and co-operative in sharing their knowledge and time with me.

DECLARATION

I, Vinodhani Paideya, declare that the research involved in my dissertation submitted in partial fulfilment of the Masters in Education Degree, entitled: 'Exploring science teachers' experiences of diversity in the multicultural science classroom' represents my own and original work. This work has not been submitted previously for any degree in any university.



V. Paideya



Supervisor – Dr. R. Sookrajh

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LIST OF ACRONYMS

| | |
|--|----------|
| Curriculum 2005 | C2005 |
| Ex-Department of education and training | ex-DET |
| Ex-House of Representatives | ex-HOR |
| Human Immuno-Virus/Acquired Immune Deficiency Syndrome | HIV/AIDS |
| Outcomes Based Education | OBE |
| Revised National Curriculum Statement | RNCS |
| Specific Outcomes | SO |

CHAPTER ONE

1.1 Introduction

This year (2004) South Africa celebrated its ten years of democracy. The new era of democracy in South Africa since 1994 has tasked the Education Department to change apartheid education. Post apartheid South Africa resulted in the classroom becoming the microcosm of the 'rainbow nation' with teachers having to deal with racial, cultural and other differences at varying levels within the classroom. The scenario since then has been one of classrooms becoming increasingly diversified with regard to, amongst others, race and culture of learners and teachers. This is reflected in the current constitution which recognises the rights of all people regardless of race, colour, religion or sex.

Le Roux (2000) makes reference to South Africa as a cultural kaleidoscope or ethnic mosaic of people and therefore can be characterised as being multicultural. South Africa being a multicultural society therefore requires an education system that recognises the value of diversity. The challenge of multicultural education across the curriculum has to be acknowledged and acted on if education is to become accessible to all learners in South Africa. In the context of this study, multicultural education aims to meet the needs of learners from diverse socio-cultural backgrounds. If meaningful educational reform is to be implemented, it is essential that socio-cultural factors are taken into account. Issues such as poverty, inequality, race, gender, age, disability and challenges such as HIV/AIDS all influence the degree and way in which learners can participate in schooling.

The Revised National Curriculum Statement (RNCS, 2003) claims to adopt an inclusive approach by specifying minimum requirements for all learners, thus all the learning area statements try to create an awareness of the relationship between social justices, human rights a healthy environment and inclusivity. [Equally important says Squelch (1993), is the need for teachers to create suitable learning environments within their multicultural classrooms, that will encourage learners to acquire the necessary skills, knowledge, and attitudes needed for meaningful participation in a multicultural society such as South Africa.]

Multiculturalism is now a critical issue in South Africa (Le Roux, 2000); – we all need to learn to live with diversity. Schools can play an important role in bringing people together and teaching children the need for tolerance because schools are transmitters of culture. Learners will have to develop the skills, knowledge, competence and attitudes to function effectively in a culturally plural society.

1.2 Aim of the Study

The purpose of this study is to investigate science teachers' awareness and understanding of the diversity in the classroom and its impact on classroom practice. This study is motivated by the need for more effective instructions in the multicultural science classroom. It will attempt to expose the different teaching methods used by teachers in catering for the diverse needs of the learners.

An inclusive approach adopted in the RNCS (2003) focuses the teacher's attention on understanding the multicultural diversities amongst his/her learners, so that teachers can effectively instruct learners from a variety of backgrounds such as urban, rural and suburban settings. Effective instruction can occur through appropriate teaching and motivational strategies for different groups of learners. For example, real-life contexts, gender sensitivity, examples of science in a variety of cultures and societal practices in our country, are taken into account when teaching learners from diverse backgrounds. According to Malcolm et.al. (2003) and the RNCS (2003), flexibility allowed by the curriculum promotes the incorporation of local practices to suit the differences amongst learners. Further, pedagogy for science will involve a change in the power relationships in the classroom and will favour a social structure where learners are empowered.

The western world of science had valued logical, scientific and specific linguistic abilities, and only rated people as "intelligent" if they were adept in these ways. However, through research,

people now recognise the wide diversity of knowledge systems that exist to attach meaning to and make sense of the world in which they live. The (RNCS, 2003) has infused Indigenous Knowledge Systems into the natural science subject statements to recognise the rich history and heritage of South Africa. Our constitution is one of many sources of change to help transform the values of learners and to ensure relevant science education occurs. Teaching for the diverse needs of the learner in my opinion allows learners to become involved in understanding issues related directly to their lives, thus equipping them to solve real-life problems. According to the RNCS (2003), it is through engaging learners in situations of natural scientific experiences (relevant in learners' lives) that the educator will bring home to learners the usefulness and importance of scientific thought in solving real-life problems.

This research is relevant, as it is needed to inform the goals and practices of science teachers' professional development programs. The findings could also be useful to:

- ◆ Science teachers with an interest in creating equitable learning opportunities for their learners, in an attempt to improve pass rates and learning experiences of learners.
- ◆ Curriculum development specialists and textbook writers, who prepare science material for multicultural classrooms.

1.3 Rationale

Firstly, my interest in this area of study arises from my knowledge and experience of alarming failure rates in the multicultural science classroom. Over the years, it has been my belief that if I was engaging learners' in a 'hands on' experience in the science classroom through experimentation, discussion and observation, then learners would successfully learn and understand the lesson content. However, to my frustration in most instances learners are unable to explain phenomena that they already learnt and therefore perform poorly in tests and examinations. I quote below an incident to illustrate the point; I had asked learners to explain 'Why the sky is blue?' after teaching a section on light. I grappled with the learners experiences of understanding this section because I received answers like '*God made it that*

way, *'It is the reflection of the ocean,'* and *'The sky is made up of water'*. These responses confirmed that learners come to the class with their own belief systems, values and experiences that influence their attitudes, perceptions, behaviour and how they learn science. Secondly, I am interested in understanding whether teachers are knowledgeable about their learners' backgrounds, aware of how different factors such as culture, social class, and personal circumstances influence learning, and whether teachers are able to design learning experiences (programmes) around relevant scientific issues to achieve meaningful learning? I believe that teachers need to go beyond the level of awareness of diversity in order to successfully deal with the issues of diversity in the science classroom. I am a science teacher and I am therefore keen to understand issues of diversity in the multicultural science classroom through the perspective of science education. Hence, establishing an in-depth understanding of how teachers cater for the diverse needs of their learners in the science classroom is of paramount importance for me in my study, in an attempt to improve classroom practice.

Thirdly, considering the multicultural make-up of most schools in South Africa today, I feel that a gap exists in teachers' understanding of multicultural education, thus affecting their ability to address meaningful learning in the science classroom. The RNCS (2003), document states that all teachers are seen as the key contributors to the transformation of education in South Africa. It is therefore interesting to note to what extent teaching is influenced by the learner diversity in the classroom.

The constitution of the Republic of South Africa (Act 108 of 1996) Curriculum 2005 and the RNCS (2003), all refer to creating equitable opportunities for all learners to learn quality science. However, the curriculum and the education system as a whole have generally failed to respond to the diverse needs of the learner population, resulting in alarming dropouts and failures. Therefore, this study will look at the influence of teacher conceptions of diversity on the different teaching methods employed by teachers in catering for the different needs of the learners, and such information can be used to influence effective instructions in the multicultural science classroom.

1.4 Critical Questions

Arising from the above discussions, the following two critical questions have been formulated for this study.

1. What are science teachers' understanding of diversity amongst learners?
2. What are the effects of their understanding of diversity in the way they teach?

1.5 Definition of Terms

It is necessary at this point to begin to clarify the meaning of specific terms that are used in this research study. This would help elucidate various concepts and ideas used in the study.

1.5.1 Diversity

Diversity in this study refers to the intersection of race, class, language, gender learning ability and disability, and other differences in the learner population.

1.5.2 Inclusion and Exclusion

This relates to the nature of the curriculum and the teaching methods, school ethos, and overall expectations for all learners, e.g. if there is an emphasis on valuing individual differences rather than competition, this can help less academically inclined learners feel that they can contribute. Education White Paper 6: Building an Inclusive Education and Training System (Department of Education, 2001), defines inclusion as the process of increasing the participation of students in, and reducing their exclusion from, cultures, curricula, communities and local centres of learning. Further, inclusion involves addressing barriers to learning and development experienced by all learners.

1.5.3 Anti-racism in education

Acknowledges the role of the education system in producing and reproducing inequalities based on differences in race, ethnicity, gender, sexual preference, religion or class and aims to do something about it. It further deals with white male power and privilege and marginalization and discounting of knowledge, beliefs and experiences of minority groups (Hodson, 1999).

1.5.4 Multicultural Education

According to Atwater (1995) multicultural education is an understanding of the diversity amongst students and using this diversity to teach. For the purposes of this study I will use Atwater's definition of multicultural education. Several definitions of multicultural education have been discussed which will follow through in chapter two (literature review).

1.5.5 Teachers' beliefs

Beliefs are part of a group of constructs that describe the structure and content of a teacher's thinking that are presumed to drive his/her actions (Bryan & Atwater, 2002).

1.6 Conducting a Literature Review

Existing research has been conducted on issues of diversity in multicultural schools in terms of management of diversity (Mthembu, 2001) as well as experiences of teachers (Singh, 2004). However, a study exploring teachers' awareness of issues of diversity in terms of the way they teach has not been explored adequately. There seems to be minimal research in expressing teachers' experiences of diversity in the multicultural classroom. This research study therefore will explore to what extent teachers are engaging in activities in the classroom that cater for the learner diversity.

What became evident from the literature I reviewed was that we cannot deny that students and teachers of non-western origin come to the science class with a background that is different from the world of western science. It therefore stands to reason that multicultural education for a new South Africa has become a logical outcomes-based necessity. However, according to Le Roux (2000:19) "The extent to which multicultural education will succeed depends largely on the knowledge, attitudes, views and conduct of the teacher as initiator, facilitator and manager of the educational and learning practice." If teachers are steering this change in the education system, it is of paramount importance to determine to what extent teaching is currently being influenced by the multicultural diversity of the class.

After reviewing literature on OBE and multicultural diversity, I have found that most research in the South African multicultural science classroom is learner-based, e.g. Kowlas et.al. (2003) dealt with relevant science in 'use of everyday knowledge' and Ogunniyi (2000) and Manzini (2000) looked at "*Teachers' and Learners' attitudes towards Indigenous Knowledge*" respectively. Research on purely teachers' experiences of teaching in a multicultural science classroom is minimal in the literature I surveyed. I believe that in order to improve classroom practice there has to be understanding of teachers experiences when attempting to serve the diverse needs of the South African learner population.

The following features of existing literature summarises the literature significant to my study:

- ◆ It has been found that in attempting to define multicultural education, it could mean many things to many people. Despite the difficulties to define multicultural education, many researchers have put forth their ideas of what multicultural education could be, since the term was first introduced in the 1960s. According to Atwater (1995), multicultural education is an understanding of the diversity amongst students and using this diversity to teach. For the purposes of this study I will use Atwater's definition of multicultural education because it highlights concepts surrounding my critical questions.
- ◆ It has been evident that there is increasing interest amongst science educators on how culture influences science education, however, very few have offered any explanation of how they understand culture. Several theories have evolved in trying to improve science education so as to include issues of culture.
- ◆ It has been found that socio-economic and political structures are found to be major diversities facing many countries. These differences are perpetuated at schools which ultimately result in adult inequalities.
- ◆ Various conceptual frameworks are presented for working with culturally diverse learners, however, research on curriculum formats within culturally diverse classrooms, and ways in which teachers understand and respect cultural diversities, is minimal.
- ◆ Learning theories are discussed with an emphasis on social constructivism on which Outcomes Based Education is modelled. Social constructivism and co-operative

learning assist us in understanding the ways in which learners make sense of the world.

- ◆ Literature on learners' personal circumstances is yet another diversity which is most often overlooked by teachers and yet is crucial in the development of the individual.
- ◆ Teacher beliefs are discussed as per Bryan and Atwater's assertion that beliefs are far more influential than knowledge in discerning how individuals frame problems and organize tasks, and are thus stronger predictors of behaviour. Hence, learning to provide high-quality and varied opportunities to learn science must take into account the beliefs that teachers hold about issues of culture, race, ethnicity, class, gender, etc.

1.7 Research Programme

The following is a brief outline on the course of study for this research undertaking:

Chapter One includes an introduction to the topic, where I provide a brief background to this research, aim of the study, rationale, critical questions and definitions of key concepts or terms and a summary of the literature review follows which indicates gaps in previous research.

Chapter Two is the literature review of the five different key concepts, viz. Diversity, Inclusion/Exclusion, Anti-Racism, Multicultural Education and Teacher Beliefs. Then a discussion of teaching and learning styles follows in respect of the five key concepts, and lastly, symbolic interactionism is discussed as a theoretical framework for this study.

In Chapter Three I attempt to describe the methodology used in capturing the relevant data. The chapter begins with a brief description of the research context, which is followed by a discussion on the different research instruments used. The chapter is concluded by an analysis of the data and the issues of Validity and Reliability are also examined. The limitations of the methodology used are then finally discussed.

Chapter Four focuses on presentation of the data collected and is set out in terms of the two research instruments used viz. Interview schedule and Observation schedule. Categories that

emerged from the Interview schedule were biographical data, teacher perceptions of diversity, language issues at school, teaching methods and learning experiences, diversity in the curriculum and teacher moments of diversity. The observation schedule reflects the following categories viz. classroom observation, lesson structure, language, learner participation and involvement, teaching & learning and curriculum.

Chapter Five serves as a concluding chapter, where I summarise my findings. This takes the form of a description of the significant issues. The results of this study reveal that science teachers in the school under investigation hold traditional, limited and generalised views of the *complex* issue of multicultural diversity. The study also shows that a poor understanding of the issues of diversity impacts negatively on teachers' abilities to adequately meet the needs of their diverse learners. I also offer recommendations on future research as well as how the results of my findings can be utilised.

In the next chapter I will present the literature reviewed on multicultural diversity with respect to science education, both in South Africa and internationally.

CHAPTER TWO

A REVIEW OF LITERATURE

2.1 Introduction

This chapter presents the literature reviewed in respect of the key issues of my study, followed by a discussion of the theoretical framework pertinent to my study. I begin with a discussion of the history of multicultural education, which is followed by some definitional issues of multicultural education. I then go on to discuss different perspectives of multicultural education in South Africa and abroad. This is followed by classroom practice in terms of multicultural education. The multicultural class is looked at in terms of the learning theory - Social Constructivism, as research has shown that teachers need to be aware of learners' alternative ways of 'knowing' in order to assist learners in developing scientific concepts. The chapter is concluded by looking at Symbolic Interactionism as a theoretical framework for this study.

2.2 Background History of Multicultural Education

Initially the idea of multicultural education was handled simplistically as the assimilationist approach that prevailed in education. The assimilationist view was the perpetuation, transmission and promotion of the cultural beliefs and norms of the dominant society, e.g., Americanizing minorities as part of the early American education strategies. The inequities such as the loss of the minority groups' languages and cultural beliefs were soon noted and therefore the assimilationist approach was superseded by the 'Integrationist approach'. This approach respected all learners as equal and thus aimed for equal opportunity within a culturally diverse and mutually tolerant society (Mullard, 1982) cited in (Hodson, 1993). However, the Integrationist view was also found wanting and was regarded by many radicals and activists as a rhetorical smokescreen masking underlying assimilationist goals (Hodson, 1993). This resulted in a shift towards the perspective of ethnic and cultural pluralism. Cultural pluralism accepts and actively promotes diversity, whereby, "members of the

dominant community learn to appreciate, understand and value the different conventions and cultural norms of other groups and members of racial and ethnic minority communities that are enabled to re-enforce and perpetuate their own cultural identities, thereby developing a more positive self-image,” (Hodson, 1999:776). Cultural pluralism is now the dominant interpretation of multicultural education in Europe, Australia and North America. It is however, still subject to a wide variety of interpretations. In the next section an attempt is made to analyse this term, viz; multicultural education.

2.3 Multicultural Education:

In this section an attempt is made to define the term multicultural education.

2.3.1 Towards a Definition

By its very definition multicultural education would mean different things to different people. Relative emphasis on issues of diversity will need to vary from country to country, region to region, and even from school to school and class to class. Thus every learning institution will have different priorities within the framework of multicultural education.

2.3.2 Current Trends

The assimilationist approach led to a shift in thinking regarding multiculturalism and multicultural education. Multicultural education tries to be further encompassing of diversity than the other limited approaches. Hodson, (1993), identified different perspectives on multicultural education that spanned the twentieth century: “For some, multicultural education is concerned with coping with the learning problems created by cultural diversity within the classroom and dealing with the educational challenges posed by children from ethnic, cultural, or religious minorities” (Hodson, 1993:687). This reinforces the fact that the priorities in these schools will be different from those schools in which the student population is drawn largely from the dominant culture.

Although Hodson, (1993), identified the many perspectives on multicultural education it is clear that multicultural education as a concept is difficult to define as expressed in different articles by Hodson (1993), Atwater and Riley (1993), and Pomeroy (1994). Paulo Freire (1995, cited in Hodson 1993) provided an insight into multiculturalism when he stated that:

A very first step is to understand the nature of multicultural coexistence so as to minimize the glaring ignorance of the cultural other. Part of this understanding implies a thorough understanding of the history that engenders these cultural differences. We need to understand that:

- (a) there are intercultural differences that exist due to the presence of such factors as class, race and gender and, as an extension of these, you have national differences.*
- (b) these differences generate ideologies that, on the one hand, support discriminatory practices and, on the other hand, create resistance.*

2.3.3 Some workable definitions of Multicultural education

Despite the difficulties to define multicultural education, many researchers have put forth their ideas of what multicultural education could be, since the term was first introduced in the 1960s. Banks and Banks (1989, cited by Atwater and Riley, 1993) defined multicultural education as:

an idea, an educational reform movement, and a process whose goal is to change the structure of educational institutions so that male and female students, exceptional students, and students who are members of diverse ethnic and cultural groups will have an equal chance to achieve academically at school.

The College of Education has also defined multicultural education at the University of Georgia (1993, cited in Atwater 1998), as a field of inquiry devoted to research and development of educational policies and practices that,

- ◆ recognise, accept, and affirm differences and similarities and
- ◆ challenge oppression and structural inequities that exist in society, generally,

and in local educational settings, specifically. These inequities that arise from social, economic and political structures are often determined by culture, race, ethnicity, age, gender, educational and socio-economic status, physical and mental attributes worldviews, lifestyles, and community.

According to Atwater, M (1995), *multicultural education is an understanding of the diversity amongst students and using this diversity to teach*. For the purposes of this study I will use Atwater's definition of multiculturalism.

2.3.4 Problems arising with the Multicultural Concept.

It is clear from above that a precise definition of multicultural education is lacking and this is supported by Atwater (1998:4) who states that "a lack of definition for multicultural science education allows critics to either disregard multicultural science education or deem it as an idea without meaning and structure." Rakow and Bermudez (1993) offer a far broader definition of multicultural science education that includes the broad context of culture as one encompassing the values and beliefs, the learning styles, the influence of the home environment, and the cultural influence of language.

According to Hodson (1999) multicultural education in essence is to help the educationally disadvantaged to assimilate into mainstream society, i.e., the dominant culture. He adds that disadvantage and discrimination remain hidden because superficially there is equality of opportunity and recognition of cultural differences. Sleeter & Montecinos (1999, cited in Singh, 2004) claimed that multicultural education is merely making cosmetic changes to the curriculum. These changes are often not part of the formal curriculum, but simplistic attempts on the part of the school to show inclusion of other cultures. Thus one of the major criticisms of multicultural education is its failure to recognise the wider patterns of racial discrimination and disadvantage faced by minority learners, and it is seen to be lacking in creating an inclusive education system as it ignores issues of socio-economic status, power, social class and political influence.

Considerations such as these have prompted a move in some parts of the world toward an anti-racist approach. According to Hodson (1999:696), "anti-racism is concerned about revealing, confronting and combating racist attitudes and practices which disadvantage and discriminate against some minority groups and result in an unequal distribution of opportunity, wealth and power." Moletsane et.al (2003) state that while anti-racism goes a step further and locates itself in opposition to more forms of inequalities, (race, class and gender), it still falls short of acknowledging all sources of unequal power relations and forms of discrimination they perpetuate. Currently in South Africa, class, social and economic status, continue to perpetuate great differences in the resources available at different schools.

2.3.5 The General Perception regarding Multicultural Education in the World and in South Africa

Multicultural education has become a highly politicised issue in Western society. Several science educators deal with aspects of the politicised concept of multiculturalism, particularly within American society, and its effects on pedagogy (Slay, 2002). Stanley and Brickhouse (1994) argue that multicultural education is an issue that is central to modern educators, and one that is challenging the basic underpinning concepts on which science educators build their modern curricula. They state that "Multiculturalists are raising questions that pose a fundamental challenge to those traditional forms of knowledge that have assumed western canonical thought that ought to compose the core of school curricula" (Stanley & Brickhouse, 1994:387).

In South Africa as in other parts of the world, there are those who argue in favour of a multicultural education as well as those who are critical of multicultural education. Moore (1994 cited in Patel, 1996) on multicultural education in South Africa, identified two groups of educationists: those that he called cultural realists and those that he identified as cultural constructivists. For the cultural realists multicultural education was viewed as education for

valuing cultural differences and for cultural transformation. In their approach to multicultural education cultural constructivists viewed multicultural education as the political analysis of culture and as empowering students in their specific contestations.

Moletsane et. al. (2003), however state that “for the South African context, multicultural education, is limited in its capacity to address issues of diversity, issues such as gender violence, child abuse, HIV/AIDS stigma, ability/disability and the different ways all these factors may interact to exclude certain individuals and groups from social institutions, including schools are not automatically addressed in an antiracist framework.” They suggest a human rights framework, which examines the relationship/intersections between race, class, gender, HIV/AIDS status and other forms of differences and inequity in school, their communities and society in the context of equalizing power relations.

According to Malcolm (2002:3),

multiculturalism is different in South Africa from countries such as Australia and the Netherlands. First, it stretches across a wide range of beliefs, traditions, socio-economic conditions, physical environment and lifestyles. Second, the major cultural groups still tend to live in their own areas, often with a strong sense of 'place'. While the nation has many cultures, most individual schools do not. Third, many ethnic groups (11 official South African languages) properly claim South Africa as their land – they are not recent immigrants expecting to 'integrate' into a dominant culture. They bring their traditions and hopes to the science curriculum.

2.3.6 Presenting a case for Multicultural Education in South Africa

Squelch (1991) states that multicultural education is one of the critical issues facing educationists in culturally diverse societies like the South African society. It is believed that multicultural education can improve the level of equality in education. She argues that

multicultural education is an option or an approach which is firmly committed to the principle of educational equality, especially for pupils who have been denied equal opportunity to learn and receive an education appropriate to their experiences, needs and circumstances, i.e. education relevant to their context. She states that despite multicultural education being surrounded by a great deal of controversy and as a result sharp criticism and scepticism, it has become popular in a sense that it is based on pedagogical consideration rather than on political concerns.

In a country where the apartheid legacy disadvantaged the masses, and excluded them from the world of science, multicultural education provides a means of setting right the injustices. Malcolm (2002) defines multicultural education in terms of learner-centred science, with its emphasis on inclusion and its implicitness in conceptions of 'Science for All'. Where 'Learner-centred science' is seen to be more overtly multicultural and avoids the notion of 'one science'. Learner-centred education is central to the South African policy:

Educational and management processes must therefore put the learners first, recognising and building on their knowledge and experiences, and responding to their needs. (Department of Education, 1995:21).

Malcolm (2002) further explained learner-centeredness for teachers and curriculum designers in South Africa as caring for students; learner-centred pedagogy, and learner-centred outcomes.

From the above literature on multicultural education, most definitions view multicultural education as an approach that is ongoing which involves:

- ◆ challenging traditional forms of knowledge
- ◆ coping with learning problems created by cultural diversity
- ◆ understanding the history that engenders cultural differences
- ◆ educational reform movement

- ◆ encompassing the values and beliefs, learning styles, influence of home environment and the cultural influence of language
- ◆ learner-centred science education

In analysing the different definitions of multicultural education, it is evident that while they are varied, they are common in that they all stem from reform issues; all have culture as a central issue, including gender and social class issues.

2.3.7 An approach to Multicultural Education.

Most definitions emphasise that multicultural education is about self-awareness and recognition of different cultural languages, race, gender and cultures. Squelch (2003), and Rakow and Bermudez (1993) further argue that it is clear that multicultural education is not a simple concept, but rather incorporates a wide variety of complex issues. In other words multicultural education must be viewed from a broader perspective. It is for these reasons that my study looks at the wider concept of multicultural education in the science classroom rather than the issues of anti-racism and social justice.

Hodson (1993) claims that sufficient breadth in determining a multicultural science perspective in the American context can only be achieved by regarding multicultural science education as comprising three basic elements:

- ◆ education of diverse cultural groups
- ◆ education through a wide range of culturally impregnated experiences
- ◆ education for life in a multi-racial and multi-ethnic society at both local and global levels ✓

The above perspectives are currently being engaged in ongoing debate/dialogue on multicultural science education. If multicultural science education as envisaged by Atwater (1993) amongst others, is one where all students can learn science, every student in the science

class is worthwhile, and that cultural diversity is appreciated in classrooms because it enhances rather than detracts from the richness and effectiveness of science learning then science educators should engage in developing a transformative multicultural science perspective.

2.4 Multicultural Education in the Science Classroom

Using an eclectic definition (i.e. combining the elements of multicultural education discussed), I will attempt to define the present set-up in the science classroom and I will also outline the acceptable parameters in which such classrooms should function.

2.4.1 Role of Culture, Ethnicity and Worldviews:

Science involves a way of knowing that is different from other ways of knowing (NRC, 1996 cited in Patel, 1996). “The scientific worldview is based on Western tradition of seeking to understand how the world works, which differs from other ways of knowing based on personal beliefs, myths, religious values and supernatural forces” (Lee, 1997:116).

According to Pomeroy (1994) science education world wide has begun to explore what it means to prepare our students through their education in science for life in a culturally diverse world. “Should the approach be one that merely develops appreciation of others cultures or one that goes further into exploring the activist implications of antiracism, including deconstructing old prejudices, attitudes, materials and institutional structures?” (Hickling – Hudson & McMeniman, 1993:58 cited in Pomeroy, 1994). The choice is whether to perpetuate the tokenism and hegemony characterised in the institution of western science or, as Giroux (1992) suggests, to move towards a model in which dominance and marginalism are replaced by the mutual respect and understanding necessary for teachers and learners to become cultural border crossers.

The South African view of culture has been shaped by its political past on an apartheid ideology. Therefore in trying to establish how South Africans, in particular those involved in education, understand culture, the role of the subversive and infiltrative dominance of the previous political regime on using culture as a successful divisive mechanism will have to be remembered and taken into account. In scanning the literature it has been evident that there is increasing interest amongst science educators in how culture influences science education but very few have offered any explanation of how they understand culture.

Ogawa (1999) sees western science as a foreign culture for non-westerners, and refers to Aikenhead's (1996, 1997) metaphor of the "cultural border crossing" in picturing the student from an indigenous background taking part in the process of learning modern science. He explains that each culture has its own "personal" science and that it is difficult for some students to "cross" to the closed culture of modern science (Slay, 2002).

Jegede and Aikenhead (1999) also looked at the implications of "crossing cultural borders" in science teaching. They agree that "multi-perspective" (Ogawa, 1999) or "collateral learning" (Jegede, 1995) is necessary in the acquisition of the culture of modern science as an indigenous student moves from his or her everyday world to that of the science classroom. Collateral learning is defined as the ability to hold in long-term memory the unresolved conflict of everyday phenomena. They suggest that this conflict might be moved towards resolution, with the learning made more "secure" for the student, by the following means:

- ◆ science curriculum being contextualised within the students' daily lives;
- ◆ culturally sensitive instructional strategy;
- ◆ native language science teaching;
- ◆ contribution of non-western scientists being acknowledged; and
- ◆ bridges being built between indigenous world view and that of modern science with the use of indigenous science knowledge and the comparison of the

relative epistemologies of the indigenous culture and modern science.

Thus the science teacher needs to take cognisance of the above pertinent aspects in order to meet the special demands of the science classroom.

2.5 Exploring Teaching and Learning in the Multicultural Classroom

Several research articles and summaries of research were helpful in developing a conception of beliefs.

2.5.1 An Examination of Teacher Education and Teaching Styles

Research conducted by Zahorik & Novak (1996) revealed that teaching is being influenced by the multicultural nature of the learners, but the influence is far from uniform. Some of the teachers have made only instructional changes while others have changed both their instruction and their curriculum. According to Hodson (1993:692) “in recent years, teachers have been encouraged to adopt a style of teaching that not only puts value on children’s own ideas but also gives a significant measure of responsibility to the learner and uses student-controlled discussion methods as a way of developing ideas. It should be recognized that children from certain cultural groups may find it more difficult than others to meet the new expectations that teachers have of them. In addition some parents may fail to support, or may actively oppose, the introduction of learning styles that encourage children to adopt a critical and questioning stance.” In this respect, teachers need to pay attention to language (tone), gesture and body language, question type and distribution, allocation of tasks, and responses to children’s work and contributions in class.

According to Delpit (1992), there are many ways that schools may place culturally diverse learners at risk, some of which are:

- ◆ failure to recognise and address problems that arise when there is a marked cultural difference between learners and the school, in which case two problems may evolve:
 - (a) misreading of students' aptitude, intent or abilities as a result of differences in cultural styles of language.
 - (b) utilizing styles of instruction that are at odds with community norms.
- ◆ stereotyping
- ◆ assuming that the failure of a child to thrive intellectually is due to a deficit in the child rather than a deficit in teaching and subsequently teaching less when one should be teaching more.
- ◆ maintaining ignorance about community norms of parenting and child-rearing.
- ◆ making invisible the histories and realities of children and communities of colour in the curriculum and in educator's minds.

Ladson-Billings (1995) and Cochran-Smith (1995 cited in Luft et.al, 1999), have suggested frameworks that foster deeper and richer understandings about working with culturally diverse youth. Ladson – Billing's (1995) theory of culturally relevant pedagogy entails utilizing a practice that supports learners' academic development, learners' acceptance and affirmation of their cultural identity and learners' development of a social consciousness. Ultimately, culturally relevant teaching results in constructive concepts about a teacher working with diverse youth, equitable social relationships in the classroom and an informed and interactive view of knowledge in the classroom. Cochran- Smith (1995) on the other hand suggested that teachers should have experiences that allow them to develop various perspectives that can serve their instruction. Through a programme of teacher inquiry, teachers should:

- ◆ reconsider personal knowledge and experience;
- ◆ locate teaching within the culture of the school and community;
- ◆ analyse children's learning opportunities;
- ◆ understand children's understandings and
- ◆ construct re-constructionist pedagogy

Other studies involving teacher education or teaching style and multicultural diversity are for example, represented by the work of Mathews (1994) who stated that children's ideas about science should be appreciated by their teachers, but children should know western science as there are not multiple or equally valid sciences. Brickhouse and Stanley (1994) have called for science instruction that is embedded within a historical and social context. While these authors describe varied conceptual frameworks that can be utilized when working with culturally diverse students, they also challenge the traditional view of science. Few researchers have examined the effectiveness of various curricular formats within culturally diverse classrooms. An example is represented by Rosenbery, Warren and Conant (1992) who successfully utilized a collaborative issue-based instructional approach with minority language learners. However, what I have noted is that research in the ways in which teachers understand and respect the cultural diversities in their classrooms is minimal, although it is of importance in understanding the diversities in the science classroom.

2.5.2 Teacher Beliefs and its impact on teaching styles:

Bryan and Atwater (2002) in their study in USA established three categories of teacher beliefs that influence teacher programme designs, viz:

- ◆ Beliefs about students characteristics
- ◆ Beliefs about external influences on learning
- ◆ Beliefs about appropriate teacher responses to diversity

(a) Their findings on beliefs about student ability and motivation revealed the following: Research on teachers beliefs about culturally diverse learners suggests that one of the most commonly held beliefs by both practicing and prospective teachers is the belief that “students from culturally diverse backgrounds are less capable than other students” (Bryan & Atwater, 2002:827). These negative beliefs have been found to serve as a barrier to effective instruction, where teachers attributed “less capable” to factors such as learner motivation and learners' lack of control. Hence teachers believed that by establishing rules and being

consistent about implementing rules were ways of getting students to learn. They also found that an extreme but common belief is that failure is simply inevitable for some learners, especially those of colour from low socio-economic backgrounds. Teacher beliefs about culturally diverse learners were based on hearsay yet influenced teachers' pedagogical decisions and performance expectations. As in most multicultural schools of S. Africa today, there exists little, if any "match" between the culture, language and attitudes of teachers and their learners. This mismatch, called "absence of synchronisation," results in teachers perceiving learners as "lacking" and thus do not recognise learner competencies. Teachers therefore behaved differently toward these learners and have lower expectations of them and provide instruction that is minimal.

- (b) In terms of teachers' beliefs about external influences on learning the following was established:

Several studies indicated that teachers locate problems associated with children's learning as a consequence of the children's lives outside of school rather than an outcome of teachers' beliefs and actions towards children in the classroom. It was found that prospective teachers hold the view that inner city children have so many problems at home and in the community, that it is virtually impossible to teach or motivate them. Further, it was found that teachers who were not familiar with the language and culture of English Second Language learners, perpetuated the stereotype of parents being non-interested by rarely communicating with parents and families, yet the findings also state that contrary to what teachers assume, culturally diverse parents genuinely want to help their children get the best education. A major repercussion of this deficit model is that teachers project their beliefs about uninvolved parents onto the learners in a self-fulfilling prophecy about the learner's abilities and limited expectations.

- (c) Responses to teachers' beliefs about appropriate teacher responses to diversity were as follows:

It was found that teachers respond to classroom events based on their beliefs about acceptable behaviour patterns, classroom - interaction and academic performance. Ladson-Billings (1994) cited in Bryan & Atwater (2002), refers to “dysconscious racism” which involves purposefully overlooking racial differences and accepting inequities as a given condition i.e., being fully aware of how some learners are privileged and others disadvantaged.

A further finding was some teachers’ belief that to be fair a teacher must be colour blind, “I do not see colour, I see only children,” (Olmedo, 1997 cited in Bryan & Atwater, 2002). With so much emphasis on striving for equality, equality is confused with sameness, and thus rather than learning to respond equitably to differences, teachers believe that fair means *not* to be aware. Ultimately, teachers’ dysconscious racism hurts those whose colour they are trying to ignore.

Teachers also attributed white learner achievements to internal factors such as effort and motivation and to external factors such as parental encouragement and heredity for black learners. The findings also show that teachers who believe that culturally diverse students are less capable, also believe that authority and control were imperative for learning, and subsequently learners from high poverty schools, were afforded less autonomy, less interactive opportunities, and less stimulating, positive classroom environments.

Nespor, (1987), as cited in Bryan and Atwater, (2002:825), concluded that “beliefs are far more influential than knowledge in discerning how individuals frame problems and organize tasks and are stronger predictors of behaviour.” Thus attention to the beliefs of teachers and pre-service teachers are sources of information about teacher practices in classrooms that current research has not yet revealed. Teachers’ beliefs about multicultural science education, therefore informs their classroom practice. The relationship between beliefs and classroom practice is an important issue for teacher professional development. The conventional wisdom

has been that changing teachers beliefs should be the focus of professional development because the assumption is that when a teacher believes differently, appropriate practice will follow. Hungwe (2001) believes that, the success or failure of any teaching and learning programme will always finally depend on the teachers. This is because teachers are the people who must accept and believe in a programme, in order to execute it as intended.

Implications for Science Teacher Programs:

Research on teacher thinking has demonstrated that teachers' beliefs about the teaching-learning process, directly affect lesson planning, assessment and evaluation and ultimately the quality of science learning. Therefore, given the increasing growth in multicultural classrooms globally, the opportunity must be seized to use teacher beliefs to tailor instructions to address the conceptions of teachers who are expected to serve the needs of diverse learners. "If teacher education programs do not assist science teachers in uncovering and critiquing their beliefs about students and teaching, we will continue to have teachers who rely on their cultural models that contain negative stereotypes (beliefs) and prejudices (attitudes) about culturally diverse students, their parents, and communities" Bryan and Atwater (2002:826). Despite their experiences in the teacher preparation programs, some newly graduated teachers still have worldviews grounded in their *own* socio-cultural background. Thus the teacher preparation programs in the USA need more attention in view of Bryan and Atwater's (2001) findings;

- ◆ Despite instruction, some teachers remain oblivious to the lives and communities they serve.
- ◆ The programs do little to cognize teachers of their own beliefs, stereotypes, and prejudices.
- ◆ Teachers leave the programs lacking the skills needed to instruct effectively on classrooms.

For changes to occur both pre-service science teachers and science *teacher educators* must gain experiences related to teaching and learning in multicultural settings or experiences, that

challenge them to confront, examine, refine and sometimes change their beliefs and attitudes. Specifically recognising tensions in one's thinking about science learning and teaching is the first step in learning from field experiences. Cultural bumps and tensions are productive when they highlight inconsistencies between teachers' beliefs and their actual or desired practices. In order to meaningfully design a teaching program that meets the demands of multicultural teaching, research needs to identify those beliefs and practices that under-gird desirable equitable science instructions.

2.5.3 A Review of Learning Theories and Learning Styles and how it applies in a Multicultural Classroom

Learners differ in the way they approach learning. Each individual learner has his/her preference when it comes to learning e.g. some grasp oral instruction quickly; others need to see the instructions in writing etc. Psychologists have been researching the nature of learning styles for a number of decades.

Learners experience the OBE science curriculum in various ways. I will discuss certain learning theories which will throw some light onto human understanding. This will be done by defining what learning means to different educational psychologists and a brief discussion on different learning theories. Scientific understanding requires learners to construct knowledge by integrating new information with prior knowledge and to make meaning of the newly constructed knowledge (Driver et al., 1994). Lee (1997) therefore emphasises the importance of incorporating culturally relevant and familiar examples, analogies, and contexts. He also stresses the importance of helping learners develop scientific conceptions; teachers need to be aware of learners' alternative ways of making sense of the world.

Social-constructivism states that individuals create their own new understandings through interaction between what they already know and believe and their encounter with new ideas



and experiences. Watts and Bentley (1989) envisage the classroom under constructivism as an area where learners are asked to consider the ideas and theories they hold for a particular topic. They explore these ideas by examining their consequences. They also listen and consider the ideas of others and begin to reshape their own ideas. Social, political, historical and environmental factors are to be taken into consideration. This ideology is pertinent to a multicultural education classroom. “When learners bring to the classroom a diversity of cultural backgrounds, this diversity may provide a cultural tool for teaching and learning to be modelled on social-constructivist lines” Cleghorn and Kakkar (2001:274). According to Vygotskian thought, the teacher is seen as a guide or co-explorer, so that the learning process is both intra-individual (within the learner’s mind) and inter-personal (stemming from interaction with teacher or knowledgeable peers). When we move from the intra-individual to the inter-personal or interactive, the construction of knowledge becomes a social enterprise (Cobern, 1996).

Social constructivism in science education focuses on the content of the curriculum, how we teach and to whom we teach, which are all matters outside of science, hence these are referred to as socio-cultural aspects. Adams (2002) states that “Science education research or curriculum that is based on a constructivist paradigm, tends to be guided by a view that knowledge is sensitive to both culture and science. Therefore, a learner’s way of knowing may or may not coincide with the manner in which science is generally taught in the science classroom that emphasises western science in an African context. If the quest is to achieve science that is relevant to all learners’ coming from socially and culturally diverse backgrounds, then there is a need to take cognisance not only of the learners’ ways of knowing and communicating in science, but also how they come to know what they know.” Hodson (1993) further supports the idea that learners learn in different ways and claims that “although it is naive to assume that children learn best by the same methods, many teachers seem to act as though they believe it.” He attributes this assumption by teachers to their use of power to enforce learning styles that may not be appropriate for some learners.

The study undertaken by Cleghorn and Kakkar (2001), indicated that by using a social constructivist teaching and learning approach – which involved critical discussion of readings, (reflecting in-depth knowledge about the range of western and non-western views on science), learners were able to scrutinise and deconstruct their own world-views of science that they had been assimilated into. Learners acquired a consciousness of their own cultural community's world-view and moved from that through reflection on their own personal experience, to an understanding of the culture of science education.

Atwater (1998) on the other hand claims that research findings indicate that co-operative learning (involves recognition of group efforts and achievements which replaces rewarding individual accomplishment), enhances science learning for all students, more especially in Southern African countries and the United States, as the demographics in these countries influence both the educational and political systems. It is felt that contact situations need to be structured in such a way that the different groups have equal status and work together in a co-operative manner to succeed.

2.5.3. Personal Circumstances of Learners

According to Banks & Banks (1989) “Students who lack confidence, or who experience severe problems outside the classroom, may be unable to learn under even the best classroom conditions.” Research has revealed that these learners' experiences at home include a range of factors such as love and emotional support, sibling relationships, parents' occupations, family illness (AIDS), economic resources, ethnicity, etc.

Teachers may unconsciously form different learning expectations about learners whose social-class is different from theirs (Bank & Banks, 1996). Children from poor homes may have few role models who illustrate the value of schooling or encourage them to work hard at their studies. It has been found that when teachers hold higher expectations for learners, through increased interaction, praise and offer them a more socially valued curriculum, they increase student learning. This view of multicultural science learning is similar to Malcolm's (2002) view of learner-centeredness and caring for the learners.

2.6 How Social, Economic & Political change in South Africa has impacted on Multicultural Education:

No education system functions in isolation from social, economic and political milieu. Against the backdrop of democracy, the educational system in post apartheid South Africa, must redress past inequities – Multicultural Education – also considers these aspects. My literature review regarding this aspect reveals the following: “Socio-economic differences among and between racial and ethnic groups, remains a major issue facing most countries. These differences are usually associated with differential levels of school achievement, discriminatory barriers barring access to decision-making positions in the political structure and participation in the job market beyond the entry level amongst others” (La Belle & Ward, 1994:139). While in some nations you may expect to find only one or at most a few of these differences across races or cultures present, the South African apartheid system had perpetuated all of these differences between Blacks and Whites, with lesser differences experienced amongst Whites and Coloureds and Indians.

Learners from the lower, middle and upper classes usually attend different kinds of schools and have teachers who have different beliefs and expectations about their academic achievement. Generally the structure of educational institutions also favours middle- and upper-class learners. Structures such as IQ tests, tracking, (used in US) and programmes for gifted and mentally retarded students are highly biased in favour of middle- and upper- class learners. According to Banks & Banks (1996), when children end their schooling, they differ more than when they entered, and these differences may be used by society in an effort to legitimate adult inequalities. They suggest that if we understand better how schools may help construct inequalities, we may be in a better position to try to change them.

2.7 Summary of Key issues:

The multicultural diversity in classrooms today presents tremendous and demanding challenges to teachers. The provision of equal educational opportunities to all learners by a teacher, who regards differences as useful learning resources and who views differences as cultural strengths

rather than as deficiencies, could be qualified as the ultimate goal or aim of multicultural education (Golnick & Chinn, 1986:29). Le Roux (2002) states effective education for the 21st century will introduce students to the reality of a diverse human race and will emphasise similarities between and the interdependence of all humans globally. Diversity will be viewed as a valuable learning source for all learners involved in multicultural classrooms and not as a handicap to effective education for all.

Cultural competence does not imply knowing everything about all different cultures. It is rather an active demonstration of respect for differences, an enthusiastic eagerness to learn about other cultures, an acceptance of different viewpoints on reality and a flexibility and willingness to adjust, change and re-orientate where required (Lynch & Hanson, 1999:493 cited in Le Roux, 2002). Good (1996:632) cited in Paccione (2000) concluded, ". . . some of the strongest messages teachers communicate to students are expressed through classroom behaviour. Teachers may have the best intentions in the world, but if they behave inequitably, real damage occurs." However, individual teachers can also make a positive difference in the lives of learners (Good & Brophy, 1994). Teachers who are able to build rapport with learners have the opportunity to make a significant difference. The rapport established between teacher and learner is one of the most important factors affecting learner achievement.

It has been noted from the literature that learners often achieve and behave according to how they perceive themselves to be through the eyes of others. The teacher is thus seen as a significant person in the lives of the learners. ~~It then follows that learners need to be~~ appreciated for their individual differences. This links with Malcolm's (2002) definition of multicultural education having emphasis on learner-centred education and science for all.

Teachers who continue to operate as if all learners are the same continue to perpetuate inequities in the educational system. Squelch (1991:47) states that "multicultural education in essence recognises and accepts differences and similarities and endeavours to accommodate both dimensions, without emphasizing one or the other.

In the next section I will present the symbolic interactionism theory which is closely related to this research. I will be focussing on the subjective interpretations of teachers' understanding of diversity in the classroom.

2.8 The Symbolic Interactionism Theory

My study is about teachers' understanding of diversity in the multicultural classroom. This understanding comes from teachers' perceptions of how different learners react to teachers, fellow learners' and the subject content in the classroom. The interactionist theorists see humans as active, creative participants who construct their social world, not as passive conforming objects of socialisation (McClelland, 2000). Symbolic interactionism focuses on individuals in interaction with each other and is therefore a suitable framework for my study. Interactionists place emphasis on the subjective aspects of social life. Symbolic interactionism attempts to 'interpret the meaning of symbols (actions, words and signs). The symbolic interactionist theory is concerned with explaining social interactions on the basis of meanings that individuals give them. However, they put emphasis on small scale interaction situations rather than large scale social change. Garcia (1991) as cited in Mthembu (2001) further argues that everything that occurs within the school environment, (i.e. all classroom activities), and factors, (e.g. classroom management techniques, instructional strategies and self – concepts), operate on assumptions one makes i.e. they are based on one's cultural perspectives. What is taught and what students learn argues Garcia (1991), are ultimately filtered and strained through their cultural sieves.

The interactionists' perspective begins from an assumption that action is meaningful to those involved. It therefore follows that an understanding of action requires an interpretation of the meanings people give to their activities. Thus, in the context of this study I will interpret the teachers' actions as their understanding of the diversity in the classroom. Interactionist theory thus argues that in a situation of people of diverse cultural backgrounds, e.g. in a multicultural school, interaction should prevail whereby both teachers and learners must be encouraged to be tolerant, thus understanding each others cultures and/or behaviour. Interaction implies human

beings acting in relation to each other, taking each other into account, perceiving and interpreting. According to Cohen and Manion, (1986), people to people interaction constantly changes, thus society changes due to changing interactions.

Blumer (1969) cited in Singh (2004), suggests that there are premises which underlie a theory of Symbolic Interactionism:

- ◆ Humans act towards things on the basis of the meaning that the things have for them. Symbolic Interactionism holds the principle of **meaning** as central to human behaviour.
- ◆ The meaning of such things arise out of social interaction that one has with others, that is the self is constructed through communication; and hence, **language**.
Language gives humans a means by which to negotiate meaning through symbols.
- ◆ A third core principle is that of **thought**. Thought modifies each individual's interpretation of symbols. Thought is based on language, or dialogues that require role-taking. Social activity becomes possible through the role-taking process.

Giddens (1993) also argues that when we interact with others we constantly look for 'clues' about what type of behaviour is appropriate in that particular context and about how to interpret what others say and do. If we don't interact with people, we are likely to criticize what others say and do, because of ignorance and wrong perceptions. Thus, in my research I focussed on the interactions between learners and teachers to establish science teachers' understanding of diversity in the classroom.

In my study following a Symbolic Interactionism framework and situated within a social-constructivist paradigm, I pursue this 'framework' in an attempt to understand if science teachers' knowledge of the diversity in their multicultural classroom impacts on their approaches to teaching.

In the next chapter, I discuss and present the research methods I used in order to facilitate the purpose of the study. My study, following a qualitative research methodology, examines the context of the study, sample selection, data collection instruments, data analysis, validity and limitations of the methodology.

CHAPTER THREE

RESEARCH METHODOLOGY AND DESIGN

3.1 Introduction

In the last chapter an attempt was made to examine the concept of diversity within a multicultural education system. The different forms of diversity were reviewed from a national as well as international perspective with emphasis placed on the role of the teacher.

This chapter describes the research process, the context of the study and the instruments that were employed to achieve the research aims. It includes an analysis of the various research instruments that I used during the data capturing phase, and serves as a framework for further interpretation and evaluation of the study. The chapter commences with a description of the methodology that was used and concludes with the probable limitations of the study.

This research is a case study using only qualitative methods of data collection and analysis.

3.1.1 Why Qualitative research?

This research is focused on teachers' awareness of diversity in the classroom and the impact of this awareness in the way they teach. Therefore it is only fitting that I choose a methodology that involves direct observation of human activity and social interaction in a natural setting. This study thus favours a qualitative research methodology, which would generate an in-depth understanding of the diversities in the multicultural science classroom in an attempt to provide answers to my critical questions.

According to Guba and Lincoln (1998) this type of research is also referred to as ethnography. Ethnographic or qualitative research aims to create hypotheses and theories from the data that emerge. In the absence of a pre-conceived hypothesis, the researcher is allowed greater flexibility concerning research design, data collection and analysis. The main aim of ethnography is to discover and describe the culture in an educational setting. Ethnographic research involves participant observation, description, a concern with process (what is the

pattern of interaction between learners and the teacher?), meaning and inductive analysis, (analysis by logical reasoning). The participant observers' participation is secondary to the main purpose which is research. He /she collects systematic observations about the situation and periodically withdraws from the setting to analyze the data.

A case study focuses on what happens in an individual classroom or single school setting. According to Guba & Lincoln (1998:112), "case study methodologies are typically eclectic and combine some of the elements of ethnographic research, program evaluation and descriptive methods." According to Cohen & Manion (1986), the purpose of such a study is to probe deeply and analyse intensively the multifarious phenomena that constitute the life cycle of the unit, (single classroom or single school), with a view to establishing generalisations about the wider population to which that unit belongs. Thus, I selected one high school in KwaZulu Natal that is made up of a culturally diverse learner population and teaching staff, in an attempt to answer my research questions.

The concern in ethnographic research is the context. It is based on the notion of context sensitivity, that is, the belief that the particular physical, historical, material and social environment in which people find themselves have a great bearing on what they think and how they act. Informants are used in social research. In this case the informants were the five teachers as they were the participants in the situation who could shed some light on the meaning of events or reactions. Informants give the researcher an insider view of the situation and clarify value patterns, concepts and beliefs which cannot be directly observed. An added bonus to me was the fact that I am a physical science teacher at the school under study. I therefore felt that these teachers knew and trusted me and would thus be sincere about their responses.

Two types of observations are recorded using ethnography viz. descriptive and reflective. It includes reflections on the analysis, including themes and lessons learned, reflections on method or procedures used in the study and ethical dilemmas and conflicts. Whatever the problem or the approach, every case study involves a method of observation. The method of

observation that I have chosen for this research is non-participant observation. Non-participant observation involves the researcher standing aloof from the group activities being investigated. I chose to be a non-participant observer because I am a teacher at the school under study, and felt that I would inevitably influence the results of my research if I were a participant observer.

3.2 Context of the Study

The school under study is situated in the Newlands area, just North of Durban, between Kwa Mashu and Westville see Fig 3.1, (a more detailed map in appendix 1, gives a precise location of the location). This school was a House of Representatives school during the apartheid era (before 1994). Blockland & Salvage (2001) cited in Barton (2002) emphasise that a sense of place is crucial to understanding how individuals relate to one another and to the structures that govern their lives. A 'sense of place' refers to the physical geography of the urban setting. Thus a sense of place is important because it influences both identity formation and a context for doing science (Barton, 2002).

The school was originally intended to cater for Coloured learners from the Newlands area. The school is made up of approximately 1100 learners. Presently, the racial composition of the learner population of the school is largely African, approximately 80% with the coloured learners making up approximately 15%, and the other 5% comprising of Indian (Malay) learners. Malay is hybrid of Coloured and Muslim people who are classified as Indian.

The large number of African learners that attend this school can be attributed to the desegregation of schools after 1994. African learners come from the townships of KwaMashu, Lindaleni, Interzuma, the neighbouring squatter area of Siyanda and many Black learners live in the Newland East area. These learners come from 'far and wide' to seek 'a better quality' of education in a historically Coloured school. These learners travel to school by bus or taxi and are often late for school, owing to the distance they have to travel. During times of strike action by the bus or taxi association and political unrest in the townships, a large number of Black learners are absent from school.

The staff of the school is made up of 30 teachers including the principal. Of these the majority are coloured, there are 6 Indian teachers and 5 Black teachers. There are 9 males and 21 females on the staff. The management team was previously Coloured males and females until a recent appointment of an Indian male as a head of department. There are five heads of department, two of whom are female. The principal is male and there are two deputy Principals, one of whom is female. Although there are three females in management positions, management is still being dominated by males.

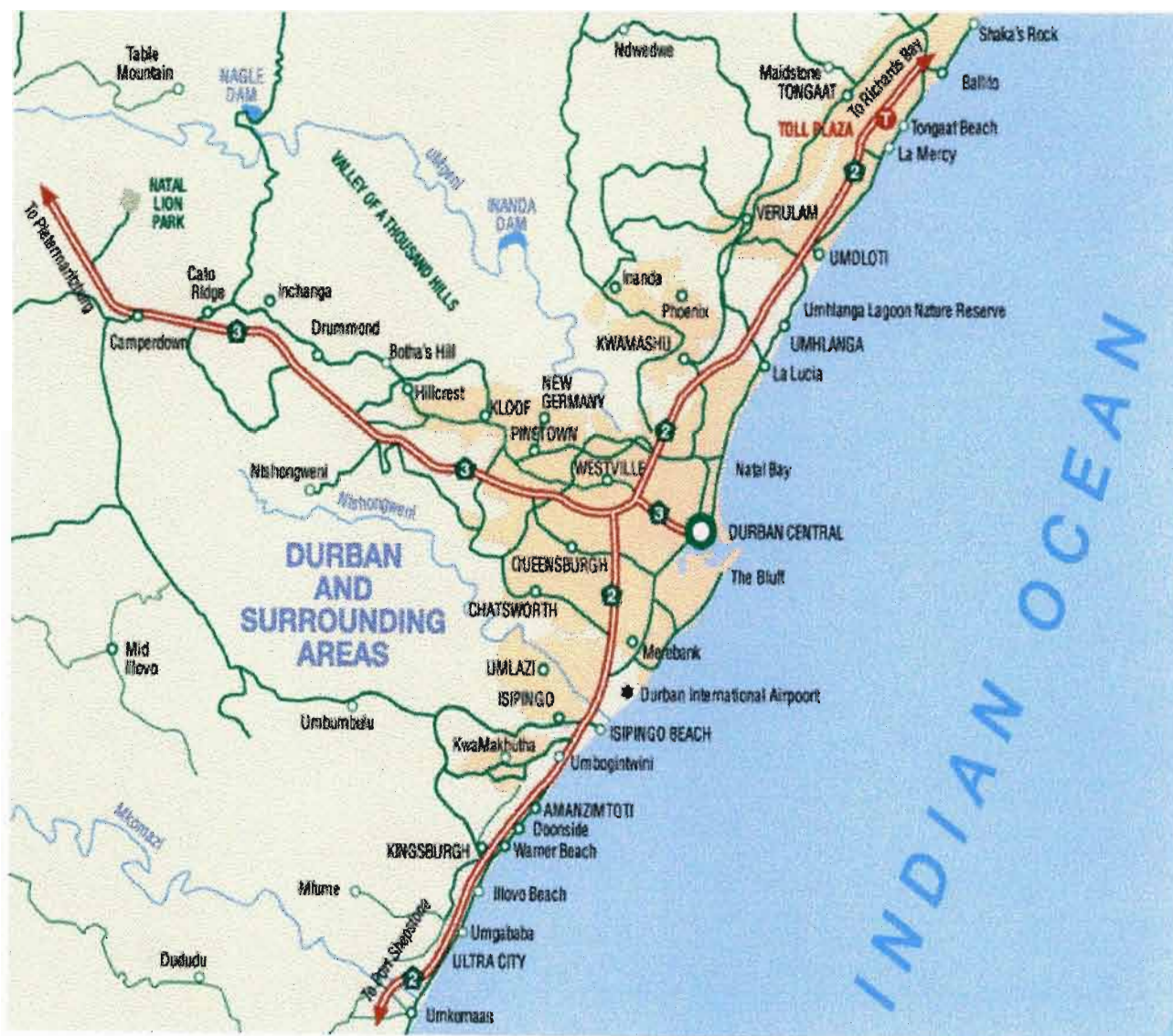


Fig 3.1: Map representing the Newlands area in the province of KwaZulu Natal
 (<http://www.mapstudio.co.za>)

3.3 Selection of Sample

My sample was made up of a cohort of science teachers from the school. Being a member of the school's staff, it was opportunistic for me to use the entire science department as these are people with whom I work very closely and are more likely to be supportive of my research.

I met with the members of the science department and briefly outlined the study. I explained that I needed five educators to participate in the study and it was entirely on a voluntary basis. Without much convincing all five members agreed to participate in the study. I assured them of confidentiality and of their anonymity in all respects of the research. The teachers' responses are therefore represented in chapter four as Teacher A, B, C, D and E. I also reassured them that they could look at my transcripts at any point during the research as well as the final research study to ensure that I had correctly quoted their responses and actions in the classroom. Refer to Table 4.1 for biographical details on participants in the study.

3.4 Methods of Data collection

The qualitative research methods employed in the study were semi-structured interviews, observations and document analysis. According to Hughes (2000) analysis of interview transcripts and syllabus documents, as well as observation of lessons, address different levels of curriculum discourse to build a picture of the science curriculum in operation.

3.4.1 Semi-Structured Interviews

Semi-structured interviews were used in this study as I was also able to probe for further information and it ensured that I got answers to all questions. According to, Cohen & Manion (1994), the interviewer in a semi-structured interview is allowed to use prompts to clarify topics and questions, whilst probes enable the interviewer to ask respondents to extend, elaborate, add to, provide detail to clarify or qualify their responses, thereby addressing richness, depth of response, comprehensiveness and honesty that are some of the hallmarks of successful interviewing. However, I was aware of the limitations of interviews as well, such as getting socially desirable answers from participants, the effects of my presence and the way

that I phrased a question, could alter the response of my participants.

Five science teachers were interviewed about their understanding of diversity in the multicultural classroom and how they used this awareness or understanding in their approaches to teaching. Although I went into the interview with a set of questions, this was not 'cast in stone' and I was able to appreciate the unique experiences and the special stories each respondent had to tell. All interviews were taped with the permission from the participants and transcribed myself. They were later analysed according to the categories on the Interview schedule that I had selected and discussed with my supervisor.

Reference: Appendix 2 for the Interview Schedule.

3.4.2 Observations

Cohen & Manion (1994), state that observational data are attractive as they afford the researcher the opportunity to gather 'live' data from 'live' situations. The researcher can play one of two roles while gathering field observation data, viz. non-participant observer or participant observer. The non-participant observer can collect data in the role of a pure researcher without being an integral part of the sample under observation, and as such, is unable to influence or guide the observed process toward any desired end or direction. In this study I played the part of non-participant observer, so as not to influence my findings. The participant observer enters the research setting and becomes part of the study. This type of observation involves a dual role, that of participant and observer. Observations have their advantages as it allows you to collect original data at the time they occur and need not depend upon reports and filtering information. Subjects seem to accept an observational intrusion better than questioning.

In the context of this study, the classroom observations of the five sample lessons were used as a means of making sense of the responses of teachers' understandings of diversity as well as to observe how their understanding of diversity impacted on the way they taught a lesson. A single classroom lesson of each of the five sample teachers was videotaped. The video-taping assisted me in recording the behaviour and experiences of the five teachers and the responses

of the learners. It also helped me in reviewing events after the lessons.

Reference: Appendix 3 for the Observation Schedule.

3.4.3 Document Analysis

The following documents were analysed to determine the extent to which teachers were accommodating for diversity and whether lesson outcomes were being achieved:

- ◆ Worksheets
- ◆ Lesson Preparation books
- ◆ Department Policy documents

The worksheets were analysed for appropriate content and language level, covering diverse human involvement in scientific practice, i.e. investigation and experimentation, user friendly, i.e. the right mixture of worded explanations and diagrams. The preparation books were analysed to establish the appropriateness of content level, with respect to relevance to the learner audience and objectives to be achieved for each lesson. In other words the above documents served to analyse the teacher's competence in dealing with issues of diversity in the classroom.

3.5 Data Analysis

The data analysis was an ongoing process where I searched for similarities, patterns and themes that emerged from the data that I collected. In preparation of the Interview and Observation schedules, questions were placed into categories and these served as the main themes for the emerging data. Categories were based on the issues that emerged from the literature review. The following categories were established for the interview schedule, around which the emerging themes were built from the data gathered:

- ◆ Teacher perceptions of diversity
- ◆ Language issues
- ◆ Teaching and learning
- ◆ Curriculum
- ◆ Teacher moments

Reference: Appendix 2 for the Interview Schedule.

The above categories were selected because:

- ◆ Equity issues in science education usually revolve around one or more of these categories.
- ◆ I believe that these categories broadly define the dilemmas in multicultural science teacher education.

I also used narrative analysis in analysing teacher moments to determine emerging themes. Barton (2002) justifies the use of contextual stories in an interpretive approach, to make sense of the research questions. Observation schedules were analysed to determine frequency counts in terms of the different categories, viz.

- ◆ Classroom Organisation
- ◆ Lesson Structure
- ◆ Language
- ◆ Learner Participation & Involvement
- ◆ Teaching and learning
- ◆ Curriculum

Reference: Appendix 3 for the Observation Schedule.

3.6 Validity

In this study, multiple methods of data collection were used in order to increase the validity of my findings. An integrated approach called triangulation was used in this study which involved combining different methods of data collection in order to unravel the various layers that the data yielded and to double check findings from a variety of vantage points. In my study the three instruments triangulated were the Interview schedule, Observation schedule and the Document Analysis. This allowed me to compare the findings generated by one instrument to the findings from another instrument. I was thus able to get a variety of responses using multiple methods to a single issue, for example science teachers' perceptions of diversity, as

triangulated and discussed as such in chapter five.

3.7 Limitations of the study

A cohort of five science teachers' interviews and observations were used for the study. Thus the study is limited in its generalizability, which is typical of case study type research. Case studies have their limitations as a result of a limited number of units of analysis. Descriptive

studies using qualitative methods of data collection have their limitations in the training and experience of the researcher who records and reports the data. Further, limitations of descriptive studies includes, limitation of reporting, due to the tendency of some researchers to talk about their observations in ways which suggest that they apply in general rather than to a specific sample or set of circumstances.

In terms of methodological limitations, interviews have their limitations because participants are not always honest in their responses and may give socially desirable responses. My own bias as a researcher, my tone of voice or emphasis could have had an influence in participants' responses. Further, observations have their limitations in that information is subjective, i.e. information is altered through the eyes and mind of the observer.

3.8 Conclusion:

This chapter has described in detail the methodology used in this study. A brief description of the context of the school as well as the teachers in this study was given. Data collection instruments used in this study are described. The chapter was concluded by looking at the validity and the limitations of this study.

In the next chapter the accumulated findings or data of the study is presented and analysed to facilitate a response to the two critical questions of this study, viz.

- ◆ What are science teachers understanding of multicultural diversity? and
- ◆ What are the effects of their understanding in the way they teach?

CHAPTER FOUR

Data Presentation and Discussion

4.1 Introduction

This chapter gives a detailed analysis of data received from the five respondents with an attempt to answer the research questions as laid down in Chapter one. In this chapter I will present data which will help answer the following critical questions:

- ◆ What are science teacher's understanding of *multicultural* diversity amongst learners?
- ◆ What are the effects of their understanding of *multicultural* diversity on the way they teach?

The data is presented in the sequence that it was collected, namely, interview schedule, observation schedule including document analysis.

The response to the first critical question was gathered through a Teacher - Interview schedule, and was divided into five sections:

- ◆ Biographical data
- ◆ Teacher perceptions of diversity
- ◆ Language issues at school
- ◆ Teaching methods and learning experiences
- ◆ Diversity in the curriculum
- ◆ Teacher moments of diversity

Data is presented sequentially as the questions appear on the Interview schedule.

The responses to the second critical question were gathered through an Observation Schedule.

The following categories emerged and were then developed for discussion:

- ◆ Classroom Organisation
- ◆ Lesson structure
- ◆ Language

- ◆ Learner participation and involvement
- ◆ Teaching and Learning
- ◆ Curriculum

The findings of the data collection plan as described in Chapter three are as follows:

4.2 Interview Schedule

4.2.1 Biographical Data

The sample consisted of five teachers who were interviewed to establish teacher biographical data:

Race, Gender, Qualification, Subject Specialization, RSQV, Language Proficiency, Religious beliefs and Personal Schooling experience, (refer to Table 4.1).

It is evident from Table 4.1. that the school has a fairly multi-racial staff, despite the majority of teachers being Coloured. One of the respondents classifies herself as Malay, which is a hybrid race of Coloured and Indian (Muslim). This school has teachers and learners that belong to the Malay community and follow the Muslim religion. Three of the five respondents follow the Christian faith whereas the other two respondents follow the Muslim religion.

Three of the five respondents were female, which is representative of the fact that females are the majority on the schools staff, (9 males and 21 females).

Teacher Qualifications indicate that all the respondents have a teaching qualification and hence would be regarded as competent teachers. Two of the five respondents have a Bachelor of Education (B.Ed) honours degree which is evident of the fact that teachers are working towards up-grading their teaching qualifications and staying abreast with current developments in education. Further, four of the five teachers are regarded as level one (non management position) whereas Teacher C is a level two teacher (Head of Science Department – management position). In terms of teaching experience, Teachers A and C can be considered as veterans in the education field having taught for 20 and 22 years respectively, whereas Teacher D and E can be considered as middle stage veterans (7 years experience) and Teacher B as a novice teacher having taught science for the past two years.

Four respondents indicate specializations in science education with the exception of Teacher B who teaches Grade 8 and 9 natural sciences and has not specialized in the subject. It is interesting to note that Teacher B has been placed in the science department due to a shortage of a science teacher in the department and her willingness to teach the subject.

It is evident that all respondents are proficient in the English language. In addition, Teachers C and A are also proficient in Afrikaans at an advanced level, whereas, Teacher A and D are proficient in isiZulu. Teacher A is proficient at conversing in both isiZulu and isiXhosa at an intermediate level. Teacher D is first language isiZulu and is therefore competent at conversing in the language at an advanced level.

Teachers A and B show competencies in teaching Grades 8 and 9, whereas Teachers C, D and E show competencies in the senior grades. Teacher C indicates that she is capable of teaching science from grades 8 to 12.

Teachers' personal schooling indicates that all the respondents attended schools that were either predominantly Coloured, (ex House of Representatives) or predominantly Black (ex Department of Education and Training). This is evidence that these teachers' schooling and teacher training was influenced by the apartheid type education. It would thus be interesting to note how these teachers, who have been socialized into accepting racial divisions, perceive diversity.

Table 4.1 Biographical details of Study Sample

| Teacher | Race | Gender | Qualification | Specialisation | RSQV | Language Proficiency | Number of Years | Grades Taught | Religious Beliefs | Personal Schooling |
|----------------|-------------|---------------|----------------------|------------------------------------|-------------|---------------------------------------|------------------------|----------------------|--------------------------|---------------------------|
| A | Coloured | Male | B.Ed (Hons) | Science Ed. | 15 | English, Afrikaans, Isizulu, Isixhosa | 20 | Grades 8 & 9 | Christian | Ex HOR |
| B | Indian | Female | H.D.E | Afrikaans, History, Speech & Drama | 14 | English | 2 | Grades 8 & 9 | Muslim | ExHOR |
| C | Coloured | Female | B.Sc / B.Ed (Hons) | Mathematics & Physical Science | 15 | English & Afrikaans | 22 | Grades 8, 11 & 12 | Christian | ExHOR |
| D | African | Male | M + 3 | Biology & English | 13 | English & Isizulu | 7 | Grades 10 & 12 | Christian | ExDET |
| E | Malay | Female | M + 4 | English, Biology & Geography | 14 | English | 7 | Grade 10, 11 & 12 | Muslim | ExHOR |
| Principal | Coloured | Male | B. Ed (Hons) | Geography | 15 | English | 24 | Grades 8-12 | Christian | Ex HOR |

4.2.2 Teachers' Perceptions of Diversity

In the semi-structured interview, section two Q1, 2 and 3, teachers' were asked to define diversity in their own words. Generally all teachers agreed that the obvious diversity was in terms of culture, race and language background:

I would say it's learners that come from different cultural backgrounds and different race groups. (T_C)

It is not just a race issue, diversity is dealing with culture, language, customs and traditions. (T_E)

When asked to describe the characteristics of a diverse group of learners, some of the responses were:

They think in their own language. (T_A)

Not all of them look the same in terms of dress, those from a 'good home' want to look neat and more presentable than those learners who come from a broken home or poor family. (T_B)

Differences in behaviour could be linked to intellectual ability. (T_C)

Amongst the African culture women are not really held in high esteem, sometimes learners disrespect the girls in the class because they are used to doing things like that. (T_C)

I think that for me I look at them all the same because I think there is adoption that has come into play. ...you do find coloured learners adopting more of a township type of life and then find some of the African learners adopting more of a coloured lifestyle. (T_D)

It is apparent from the above responses that the teachers do recognise diversities amongst

learners however teacher D sees all learners as being the same which is emphasised by Jansen (1991) and Moletsane (1999) cited in Mthembu (2001) who argue that when most teachers are asked as to how they deal with learners of different race groups in their classrooms, they usually say, 'they see learners and not colour.' It can also be noted that cultural diversity is not clear cut – as pupils tend to assimilate one another's culture. Diversity is also seen in classroom behaviour, when expected behaviour amongst learners differs from norm then it is attributed to cultural differences. The issues of women's rights though is not unique to the South African classroom context, but what is highlighted in the above example, is that gender issues exist at different levels in the different cultures.

Cultural backgrounds are closely tied to language diversity. Students from an African cultural background tended to think in their mother tongue (isiZulu etc.) – which leads to miscommunication in some instances:

They think in their own language which is isiZulu and they would write in English. (T_A)

As an example, during literal translation into English (use of pronouns such as he and she are confused) hence the essence of subject is lost. Language differences are linked to differences in religion and customs. Within one race group, e.g. the Coloured Community, there are further Cultural divisions – e.g. some pupils are from an English background and others from Afrikaans background – thus they have different customs and traditions.

Class differences came next, (regardless of race / cultural background), pupils who came from a more affluent class, were presented as the better pupils – more willing to learn, better disciplined and more presentable in terms of dress, e.g.

Learners that come from 'good homes' where there is a lot of parent involvement, then that child would probably be more well behaved, unlike some child that comes from a broken home where nobody is interested in his work or whatever he does. He would look for attention in the class because he is not getting it at home. (T_B)

Students from poorer backgrounds were presented as difficult to control, having an apathetic attitude to school work and learning. They are also seen as showing inability to concentrate and being generally disrespectful. Although teacher C mentioned that some learners tended to

value education and saw learning more as a kind of salvation.

Learners come from different social backgrounds; some learners from poor communities don't see education as of any value in uplifting themselves whereas other learners from the same communities look to education as being a place of virtue to themselves. (T_C)

Teacher E felt that socio-economic status did not play as vital a role as customs and traditions (background). She says that all learners are the same whether they come from Sandton (affluent) or Kwa Mashu (not so affluent) – but she does not qualify the “sameness”, i.e. are they all good learners (who value learning) or the apathetic learners, yet maintains that differences are attributable to background differences.

The characteristics (character traits) of learners themselves are still the same; it's just their backgrounds that are different. (T_E)

The danger of grouping learners into a homogeneous group, could lead to learners' individual differences and talents being ignored.

It was mentioned that disruptive behaviour was caused not only due to social (class) factors but also to language. A pupil presenting problems with understanding of language (English) also tended to be disruptive – due to boredom.

Most behaviour problems are caused by learners that do not really understand what is going on and rather than show their own ignorance, they rather misbehave and disrupt the class. (T_C)

The above responses suggest that the respondents are aware of the diversities in their classroom, the most common being cultural or racial diversity. This emphasises the point that these respondents construct diversity in terms of race and socio-economic standards predominantly. The respondents describe the characteristics of diverse learners in terms of: language differences, differences in dress and neatness, differences in classroom behaviour, differences in intellectual ability, cultural differences, socio-economic differences as well as differences in customs and traditions. However, one respondent still maintains that he sees all

his learners being the same, which in essence shows that he does not give any particular attention to the diversity that exists in his classroom or merely wishes to be politically correct in maintaining an antiracist stance. In such an instance, his actions are achieved at the expense of the learners who are not being appreciated for their uniqueness. Teachers don't seem to recognise this as being a problem in their classrooms.

4.2.3 Teachers Perceptions on Language issues

In response to section three, questions four to seven, of the interview schedule, with respect to medium of instruction in the science classroom, numbers of English second language learners and the use of code-switching in the classroom, the following were ascertained.

The problem faced by all the respondents was the fact that though English is the language medium of instruction, the classes actually consisted of 80-100 % English second language learners. All respondents resorted to some form of code-switching, i.e. if they were fluent in isiZulu, they used isiZulu, if not, then they resorted to using selected learners as interpreters. These were some of their responses in terms of whether they used code-switching or not:

If it is a homogenous class, I normally infuse a little bit of isiZulu, so as to drive a point. (T_D)

I don't speak fluent Zulu but I do know a few words for reprimanding learners. (T_E)

You've got to use that very strong isiZulu within you that says hey don't do this, do you understand. That they understand but if you use English they tend not to take it very seriously. (T_D)

I don't use code switching in my class because I don't speak isiZulu, however if there is something really difficult then I will get a learner who can speak, to relate it to the class. (T_B)

From the responses above, it is evident that all teachers agreed that they use some form of code-switching in their classroom. Teacher D still maintains the notion that learners can be classified as homogeneous if they belong to the same race.

Teachers have stated that it is not essential that a teacher be fluent in isiZulu (etc) in order to do code-switching. Some teachers have found that learning just a few basic terms (greetings, instructions and reprimands) are helpful enough especially to maintain discipline:

What I've done is gone to find out the basic reprimanding instructions like sit down, keep quite and follow in the book. (T_E)

The respondents have noted certain inherent difficulties that go with the use of an interpreter. It is essential that the interpreter be very fluent in both languages, and has a very good grasp of the concept being taught – so that he himself does not re-teach the wrong thing. The “interpreter” must also be trust-worthy. These sentiments are echoed by one of the respondents who say:

If it's all possible to code-switch and I know that it's someone that I can trust but I certainly wouldn't encourage taking a learner that is very weak and ask them to explain something in mother tongue. (T_C)

Literal translation into mother- tongue does not however solve all communication problems. According to the teacher's isiZulu, for example, have no words for many science concepts e.g. “deforestation,” “mitochondria”, “vacuole,” etc.

Some of the typical responses were:

Defining concepts is a bit difficult because for some of the science terminology words there are no Zulu alternatives. (T_A)

Learners themselves told me that sometimes they lack the terminology that is used in science to be able to explain in their mother tongue what the fellow pupils can't understand. (T_C)

However, Teacher D felt that the vehicle of learning (language) goes hand in hand with the mother-tongue despite there not being any ‘technical terms’ in isiZulu for many scientific concepts.

Even though there are no technical terms but we always go around a concept up until

you arrive at a point where learners are able to understand without using a technical term parse. (T_D)

There are many new terms (English terms – “Zulu wised” as teacher D refers to it) brought into mother tongue. These tend to confuse the pupils as they have no ‘origin’ or background schemata for it, by which to make meaning of it. Teacher D has found that code-switching is essential in such instances, to explain where the word or concept comes from. He concludes that a teacher cannot just use only English as medium of instruction, as there are different levels of understanding, which only mother-tongue can bridge. This is apparent in the following response:

There are concepts that I start of explaining in English then I infuse a little bit of Zulu within them whereby they say, oh! Okay so that is what you mean. When an English word has been Zulu-wised ... it has been taken from English directly into Zulu.

Teacher D explains the term ‘zulu-wised’, by learners making meaning of a new concept and relating it to a cultural practice that they are familiar with, for example the scientific term ‘commensalism’ can be related to the isiZulu cultural practice ‘Ukunana’. Both the terms refer to mutual dependence in nature.

From the responses above, it is evident that all teachers agreed that code-switching has a definite place in the learning environment. Teachers found code-switching helpful when their pupils were confused and thus resorted to mother tongue instruction for clarification. It is found that learners make meaning much more easily in mother tongue. However, the implications in using code switching in the science classroom could result in misconceptions in science, which have been noted by the respondents. Code-switching was used by the respondents largely for the purposes of reprimanding learners to maintain discipline in the classroom.

4.2.4 Teachers’ perceptions on Gender issues

In response to section three questions eight and nine, on how gender stereotypes get represented and the notion of gender gets managed in the classroom the following responses were received:

This school is co-educational and gender is certainly not seen as an issue. As teacher D puts it “*liberation is more of liberating ones mind, more than a gender issue.*” All teachers seem very careful not to make sweeping generalizations regarding what subjects to choose, or roles males and females should fill. This is evident by the following comments:

They respond in equal terms. (T_A)

I don't see it as girls and boys, you are just teaching learners. (T_B)

Whether they are a girl or boy it doesn't really matter in the classroom. (T_A)

I try to just believe that every learner is the same. (T_C)

I always try to infuse the sciences to make them understand we are all made equal. (T_D)

The responses suggest that both males and females are encouraged to pursue science education holistically, though Teacher C and E admit to working harder at encouraging the girls. They are doing this in order to empower the African females, to help them re-define the stereotype that an African female belongs at home and should be subservient to a husband. Perhaps this is actually good in a sense that teachers are not mindlessly perpetuating and promoting gender stereotypes. I do believe after all, that science should present a world of equal opportunity.

From the above responses it would appear that the five respondents adopt a very liberating approach to issues of gender. Freedom of speech for all learners is encouraged. A pupil's leadership ability is tapped regardless of whether it is a boy or a girl. Respect for both genders is encouraged. Contrary to the view that being seen and treated the same results in equality is the belief that learners individual differences are not being recognised and as such are less empowering to the learners.

4.2.5 Teacher's perceptions of Teaching and Learning in the multicultural classroom.

In response to section four questions eleven to eighteen of the Interview schedule which looked

at the different teaching approaches used, types of resources being used, and the inclusion of learners' prior knowledge, as well as methods of assessment used to cater for the diversity in the classroom the following was determined:

When asked whether teachers felt the need to change their teaching approach to cater for the diverse needs of learners, respondents felt that generally most teachers have moved away from the traditional 'chalk and talk' where the learners were passive listeners. Teachers now want active participation from learners due to the shift towards the Outcomes Based Approach (OBE) to teaching and learning.

Some of the typical responses were:

My teaching methods have changed from passive listening on the learners' side to active engagement by learners. (T_A)

Now I don't read the text book at all 'cause I found, they can not read. So I try to simplify everything, say it in simpler terms and do a lot of repetition to help them to understand what is going on. (T_C)

Previously, I found that my teaching methods were more audio learning where they would just listen, it was more rote learning. Now I find that I am using a lot more practical work. (T_E)

The following responses are included to illustrate the teaching strategies teachers use in their classes to cater for diversity:

Through group work and co-operative learning that I have initiated all the learners interact and talk. I would say that each one in the group has a chance or opportunity to express their needs. (T_A)

When speaking to them, you have to speak to them on that very low level and even when you making worksheets or explaining. You've got to make it as simple as possible so that they can understand. (T_B)

What I do is some demonstrations, a lot of short quizzes and asks them to give definitions. (T_C)

I have this theory of first sight, where theory of first sight basically is a glorified spider web. Whenever you see a certain concept whatever you know about the concept write it down. (T_D)

I use more pictures, more practical work and a 'hands on' approach. (T_E)

The above responses suggest that teachers are aware of the socio-cultural teaching strategies that encourage active participation of learners in the science classroom.

Two of the five respondents indicated that they often use group-work in the classroom, whereas the other three teachers indicated 'sometimes'. Group-work was found to have the following benefits to learners:

- ◆ learners felt more confident as they were not answering by themselves (*they did not feel threatened* – (T_A)).
- ◆ slow learners benefited from the assistance of more competent learners.
- ◆ the language barrier could be bridged.

However, the concept of spider-webs was not observed in practice during the classroom observations.

The responses below reveal that most respondents felt comfortable, under their current conditions, with their efforts in dealing with diversity through the use of different teaching strategies:

I would say there is better communication and also improved understanding because the responses from learners are much more improved and the learners feel confident in actually doing the task. (T_A)

The responses you get in class are much better. (T_B)

I've seen that results have improved because learners tend to use their senses more than before. In this case they are able to conceptualise or create pictures within their minds and come up with a more or less an idea what is being asked. (T_D)

I find that if there is no picture or diagram they don't perform well but where there is more data interpretation and graphs, this is more visual questions; you find that they answer much better. (T_E)

Generally, most of the respondents indicated that they had been successful in using different teaching strategies to cope with diversity. One of the respondents however indicated that she did not believe that there was an improvement in learners' performance with the new strategies that she used. She felt that she was lowering the content level for better understanding and as soon as things got a bit difficult or said in a different way, learners found the work difficult. This she felt was due to the language problem and the lack of scientific background knowledge by learners. She further commented that higher order questioning that took place in the past is now 'lacking'.

Teacher E felt that the use of pictures or diagrams in her lessons improved learner understanding, for example, in the study of the microscope, she provided the learners with fully labelled diagram of the microscope as well as diagrammatic instructions on proper use and handling of the microscope.

All five teachers have suggested that they attempt to move from the known to the unknown in their lessons. They first try to access the learners' prior knowledge through questions, (probing), and general discussions. Teachers try to eke out the learners personal experience with the topic before they try to introduce new material.

I would actually see what they know about a topic and they would use that in their discussions. (T_A)

When questioned about the different types of resources used during a science lesson, the following responses were received:

We don't have much resources, the only resource we depend on is the different children's experiences on a topic. (T_A)

We use lots of worksheets and if we have the apparatus then we do an experiment. (T_B)

I make use of the chalkboard, the overhead projector, worksheets and actual material for example the fern or earthworm and we construct models for example DNA. (T_E)

From the responses above it is evident that the most common resource amongst all respondents were worksheets. These worksheets will be analysed later in section 4.3.6 where more insight would be given regarding their usefulness in terms of catering for the diverse groups of learners in the class. One of the respondents indicated that she tries to bring in the practical aspect in science but found that physics practical work far too theoretical and if you tell learners that the situation exists in ideal conditions that can not be created in the laboratory, this creates mis-conceptions and thus she does not perform such practical work. One such example mentioned by the teacher was the Boyles Law practical (pressure and volume relationships), the results obtained do not verify the laws. Learners are then not convinced that the laws are true.

When questioned about assessment strategies used in the classroom, all teachers responded that teacher assessment was frequently used and occasionally peer assessment was used. However, most teachers agreed that they have not engaged with self-assessment yet, as the learners do not have the skills to manage that aspect yet.

In summary, respondents have indicated that most of them have moved away from tradition methods of teaching to a more interactive method where learners are active participants in the lesson. Some of the interactive teaching strategies that emerged during the interviews were:

- ◆ Group-work

- ◆ Co-operative learning
- ◆ Demonstration
- ◆ Practical work
- ◆ Spider-webs
- ◆ Quizzes

It is also evident that learners enjoy visual and creative type of learning and find themselves performing well. In terms of the use of learners' everyday experiences in the classroom, all five teachers ascribe to the use of learners prior knowledge before dealing with the topic at hand. The most common form of assessment is teacher assessment whereas peer assessment is used to a limited extent.

4.2.6 Teacher Perceptions on Multicultural Curriculum

In response to section six, questions 19 to 21, all five respondents agreed that the curriculum does not adequately cater for cultural differences and most of them suggested that it is up to the schools management to ensure that all subjects reflect the cultural differences of learners. They have also made mention of the fact that OBE has allowed teachers the opportunity to deal with issues of diversity affecting that community.

They have suggested the following in order to change the present curriculum to cater for diversity:

- ◆ Decrease class sizes
- ◆ Introduce topics that would relate to different cultures
- ◆ Invite stakeholders from the community so that teachers are aware of the community issues.

When the five teachers were questioned about their awareness of issues of diversity in Curriculum 2005 or the Revised National Curriculum Statement (RNCS) policy document the following responses were noted:

I understand that all diverse issues have to be catered for and all things should be treated equally. (T_D)

I have no idea what the Revised National Curriculum statement policy documents are saying but I do know with regards to OBE issues of diversity are covered. (T_E)

In planning the lesson we must take into account the needs of the learners, from that basis the learner will then find use for what they are learning. (T_A)

The above responses suggest that most teachers are aware of what Curriculum 2005 policy document is saying about diversity however they are not certain about the contents of the RNCS policy document for Natural Science, on issues of diversity. The RNCS policy document for natural science does incorporate issues of diversity into the science learning area programmes as mentioned earlier, however, the teachers seemed uncertain with regards to how issues of diversity feature in this document. This is probably due to the fact that the Revised Curriculum statement policy document has not been sufficiently work-shopped to establish a common understanding of what the document prescribes in terms of diversity.

All five respondents have indicated that the present school curriculum does not cater for individual differences. They have come up with a few suggestions to change the present curriculum to cater for the diverse needs of learners. Their knowledge of the policy documents suggests that teachers need workshops and guidance in terms of policy relating to issues of diversity.

4.2.6 Compelling events (episodes) experienced by respondents

Nespor, as cited in Bryan and Atwater (2001) contend that “beliefs reside in episodic memory the content of which is derived from personal experience or as critical episodes or experiences influence and frame how one learns and how one uses what is learned. A critical experience produces a richly-detailed episodic memory which later serves the student as an

inspiration and a template for his or her own teaching practice.”

“Other researchers have also noted the episodic nature of beliefs. Their studies have shown that the educational beliefs that students of teaching hold, significantly influence their perceptions and judgements that they make about their own and others’ teaching, as well as their interpretation and development of professional knowledge,” Bryan and Atwater, (2001), summarizing Calderhead, 1988; Calderhead and Robson, 1991; Clark, 1988; Feiman-Nemser and Remillard, 1996; Goodman, 1988.

In response to question 21 of the interview schedule the following stories (episodes) were categories for deliberation purposes. The stories were rated and ranked according to:

- ◆ Texture – how well told and presented
- ◆ Cultural bias
- ◆ Integration with other learning areas
- ◆ Link between teachers’ perceptions and any of the incidences

The rationale in rating the stories was also based on the fact that themes manifested in particular ways (choice based on common themes).

Reference: Appendix 4 A to E, for complete transcripts of all 5 compelling stories.

4.2.7.1 Teacher Moments one: Cultural and Traditional Belief Systems

Teacher E found that in teaching Biology, (Human physiology), and trying to empower her pupils with this knowledge, she was at the same time contradicting the African cultural beliefs that they held. She learnt from her pupils that upon adolescence a girl’s hymen was torn away with a thorn. This was done in order to associate pain with sexual intercourse as a deterrent from early sexual activity. In trying to empower her pupils with the knowledge that it was wrong to let anyone violate them in this way, she was actually asking them to move away from their cultural practices. A barrier to her teaching was created as science conflicted with African Philosophy and she battles to link science with some African beliefs / practices. Ironically this is completely contradictory to Teacher D’s experiences, where he displays great respect and appreciation for cultural and traditional practices. I guess different examples give rise to different possibilities.

According to Westra, (2000), “Virginity testing is condemned by members of the Gender and Human Rights Commission as a form of gender inequality because it is only girls who are tested. Some virginity testers have started to test boys as well.” However, a virginity tester from Kwa Mashu feels that it is unnecessary to test the virginity of young boys because “the girls are the ones spreading the AIDS virus, sleeping with one boy one day and another boy the next. Boys are also changing partners too, but not if the girls won’t let them”. These mind sets are another obstacle faced by teachers in their attempt to empower learners.

Westra comments that many rural women see virginity testing as the only means they have to re-instil lost cultural values such as chastity before marriage, modesty and self-respect. Regular virginity testing is also seen as a traditional African solution to the contemporary problems of HIV/AIDS, STD’s and teenage pregnancy. This raises the obvious clash between the constitutional rights where the central question is the girl’s right to privacy and dignity and traditional practices.

I however believe that the debate on virginity testing remains ongoing as long as the following questions remain unanswered;

Is there consent by the girls to the test or is it done through persuasion and coercion?

When a girl fails the test, is it fair to mark her with a different coloured dot on the forehead and ostracise her?

Aside from these questions,

What exactly are they looking for during the inspections?

How much anatomical knowledge do the testers have?

How do they know that a broken hymen is not the result of sport or even child abuse?

How hygienic are the inspections?

The above questions could serve as questions for future research. This story demonstrates that these human right issues must be debated by learners in the multicultural science classroom as it is in conflict with their traditions and cultural practices. Also, teachers need to be aware of the different cultural practices in their attempts to empower learners according to their constitutional rights.

4.2.7.2 Teacher Moments two: Cultural beliefs

Teacher A encountered a major problem in the learners understanding and expressing of sexuality and sexual practices. Learners were reluctant to freely talk about human reproduction. One of the chief barriers in this regard was the fact that the topic of sex is taboo in their culture. Learners were extremely uncomfortable in even naming the sexual organs, and would rather resort to using other names (euphemistically) associated with that part.

The teacher was extremely concerned about this occurrence as it is so important that a teenager, (“High School child”), have a deep understanding of sex and sexuality and thus be able to handle their own sexual nature sensibly, with sensitivity and maturity. Some cultural beliefs imbibed by the pupils were extremely damaging to them. He wanted to empower his pupils.

In order to overcome the barrier to learning created by cultural taboos, the teacher adopted an “indirect” method of approaching the topic. He decided to lead the pupils from the known to the unknown, and found that discussing animal sexuality (e.g. Dogs mating) would enable the learners to freely respond. The learners were comfortable discussing this as it is something they have all observed and were even prepared to use the proper names for the sexual organs. He would then gently shift into the topic at hand, i.e. Human sexuality and Reproduction. The teacher has even learnt some expressions used by learners themselves (*ucake and ucigarette*) to describe the different sexual organs and uses these expressions – to reach his second language learners.

The above incident suggests that issues of sexuality are still a ‘cupboard’ issue with certain cultures and therefore schools need to play a vital role in bringing about awareness around issues of sexuality. One such organisation working towards empowerment of youth is the Youth Foundation Council (YFC) in Kwa Zulu Natal (KZN), which has found that KZN is the South African Province most affected by the HIV/AIDS pandemic. YFC/KZN claims to have been working for over a decade with young people in high schools and local communities, specifically around the issues of women’s empowerment and gender relations. ChildHope a

UK funded project in Africa has been working in partnership with YFC/KZN since June 2000, ChildHope, (2004).

It has been reported that vulnerable young people in poor communities are most at risk from the virus due to poor sexual and reproductive health awareness. This group experiences a high incidence of unplanned pregnancies, HIV infection, AIDS – related deaths, unprotected sex, unsafe abortions, rape, sexual abuse and traditional virginity testing. It has been found that there is little local capacity, in either the education or community structure to address these critical issues. This is evident also in Teacher A's struggle to empower his learners on issues of sexuality.

This story re-enforces the importance that school curricula reflect issues that are empowering to the learner's everyday experiences.

4.2.7.3 Teacher Moments three: Curriculum and its link to culture and traditions.

Teacher D has found that the nature of his subject (science) and the curriculum have actually affected him on a very intrinsically personal level. It has made him go back to his roots and has imbued him with a deep respect for the Zulu traditional and cultural practices. His teaching has changed to reflect this respect and understanding. For example in teaching symbiotic relationships, he doesn't just use organisms as examples, but he would make reference to the spirit of ubuntu (sharing). He used the example of a man lending his bull to his neighbour to mate with the neighbour's cow. After the mating the bull is returned to its owner. The owner has lost nothing and in the mating the neighbour gains as his cow will give birth. Not only will he have another cow, but milk too. It's a win-win situation – the neighbour gains and the owner has maintained the virility of the bull.

The fact that he has been able to link biology with sociology has made an impact on him, and keeps enabling him to make new links. Another interesting example he gives to his pupils is of an old granny making Zulu beer. Without say knowledge of physics and chemistry she was still applying the basic principles of science. For example in the simple act of boiling the water

used, she was removing the oxygen. The examples enable the teacher to emphasize the need to live in harmony with nature and the need to conserve nature- as nature and our lives are linked.

This story emphasizes the importance of understanding our learner's cultural backgrounds, for it serves as prior knowledge that can be tapped into for improving learner's understanding of scientific concepts.

4.2.7.4 Teacher Moments four: Teaching & learning and Language

Teacher C found that her efforts to give detailed explanations and to show real life links to the aspects / concepts she was teaching were not appreciated by her pupils. Instead of clarifying the subject at hand, her pupils felt that they were getting confused. One pupil forcefully brought this home to her when he asked her whether while she was driving in a one way lane, did she suddenly turn on that same lane and move in the opposite direction. She realized that most of her pupils did not want detailed explanations or real-life links – so she keeps her lessons simple and focused only on the topic. For her high flyers, however, she does “digress” from the topic – as she would like to – in order to offer them some enrichment.

Another problem she encountered was the fact that the pupils could not apply their existing knowledge to other situations. They were stuck in rote-learning for example, when she taught them group one elements in the periodic table and used sodium as an example, and then questioned them on the properties of potassium, they were unable to answer. They were unable to make the link that the same properties applied to all group one elements. Questioning her pupils has revealed that their mother-tongue does not have vocabulary that allows for science and mathematics learning. The maths and science register when literally translated into mother tongue (isiZulu) actually ends up meaning something else. The educator feels that this country should actually develop the other official languages in context of each subject i.e. a proper register of the different subjects be formulated which should be taught in mother-tongue at an early stage - thus enabling the pupils to develop a solid background schemata.

These events reflect that teachers need to be aware of learners' language problems in order to develop learning programmes that allow for multiple ways in which learners can access the knowledge being imparted.

4.2.7.5 Teacher Moments five: Language

Teacher B encountered two major barriers to her teaching, viz. the fact that the learners had no background knowledge to enable teacher to proceed to more involved concepts; and the fact that language was a problem. The learners were unable to understand question terminology and therefore could not answer the questions adequately. Her solution to the problem was to ensure that she took nothing for granted but taught a section from "scratch" and phrased her questions in a simple form. Understanding the difficulty language posed to her pupils, thus enabled the teacher to make a breakthrough in her teaching methodology and leading to more effective teaching.

The following themes have evolved from the five stories related:

- ◆ Culture / Traditional Belief systems
- ◆ Curriculum and its link to culture / tradition
- ◆ Teaching and Learning
- ◆ Language

The above compelling events in terms of issues of diversity in the lives of the five respondents have resulted in common themes that coincide with themes developed during the semi-structured interviews. These themes will be juxtaposed for further deliberation in chapter five. These events related by the respondents clearly indicate concrete examples of their perceptions of diversity in the classroom.

4.3 Observation Schedule

The purpose of the classroom observations was to determine how the five teachers design their teaching to accommodate diverse learners in their classrooms and also attempts to answer

critical question 2 (What are the effects of their understanding of diversity in the way they teach). Data is presented sequentially as they appear in the Observation schedule and is followed by discussions around the subsequent areas.

Table 4.2 indicates the Lesson Profile of the five teachers which were observed. From the table 4.2 it is evident that four out of the five lessons were conducted in science laboratories, which should be of an advantage to the learners in that resources and practical experiences should be ready available. However, only Teacher E made use of scientific apparatus i.e. the microscope in her lesson. This is so, because as all five teachers have indicated that the laboratories have not been resourced over the past five year due to financial and management problems.

Teacher A's lesson was in a grade 8 class where the focus of the lesson was on Electricity as was teacher B's lesson was with a grade 9 class instead. Teachers C and D conducted lessons with senior learners in Grades 12 whereas Teacher E's lesson was conducted with a grade 10 learners.

Table 4.2 – Lesson Profile of the Sample of teachers

| Teacher | Date | Venue | Duration of Lesson | Age of Learners | Phase Organiser | Programme Organiser | Learner Outcomes/ SO's |
|----------------|-------------|--------------------|---------------------------|------------------------|-------------------------|---|--|
| A | 14/05/04 | Science Lab | 25 minutes | 13 – 15 | Economy and Development | Industry and Marketing | Recognize things that use electricity and determine how different homes have access to electricity. |
| B | 29/04/04 | Science Laboratory | 40 minutes | 14 – 16 | Environment | Environmental Issues | Uses of Electricity – how different appliances use electricity. |
| C | 29/04/04 | Classroom | 40 minutes | 16 – 20 | Electricity | Electric Fields | Should know what are electric fields, Properties of electric field lines, be able to draw and interpret electric field patterns and use the equation $E = F/Q$ |
| D | 12/05/04 | Biology Laboratory | 30 minutes | 16 – 20 | Digestive System | Absorption of nutrients & deficiency diseases | Learners should know: structure of the villus, absorption of nutrients, fate of absorption and identify deficiency diseases. |
| E | 30/04/04 | Biology Laboratory | 30 minutes | 15 -19 | Plant and Animal cells | Use of the Microscope | Learners should be able to use the microscope and view the plant and animal cells. |

4.3.1 Classroom Organisation during Classroom Observation

The way in which the classroom was organised was taken note of in order to establish the classroom ethos and the environment created for learning.

Table 4.3 – Classroom Organisation of the Observed Lessons

| Classroom Organisation | Teacher A | Teacher B | Teacher C | Teacher D | Teacher E |
|--|-----------|-----------|-----------|-----------|-----------|
| 1. How are learners seated? | | | | | |
| (a) alone at individual desks | | | | | |
| (b) in pairs at two-seater desks | | X | X | | X |
| (c) in groups at desks | X | X | | X | X |
| 2. How are learners seated? | | | | | |
| (a) randomly | | X | X | X | |
| (b) according to gender | X | X | X | X | X |
| (c) according to race | X | | | | X |
| 3. During the course of the lesson, does the teacher | | | | | |
| (a) remain in one place | | | X | X | |
| (b) move around the class interacting with learners | X | X | | | X |

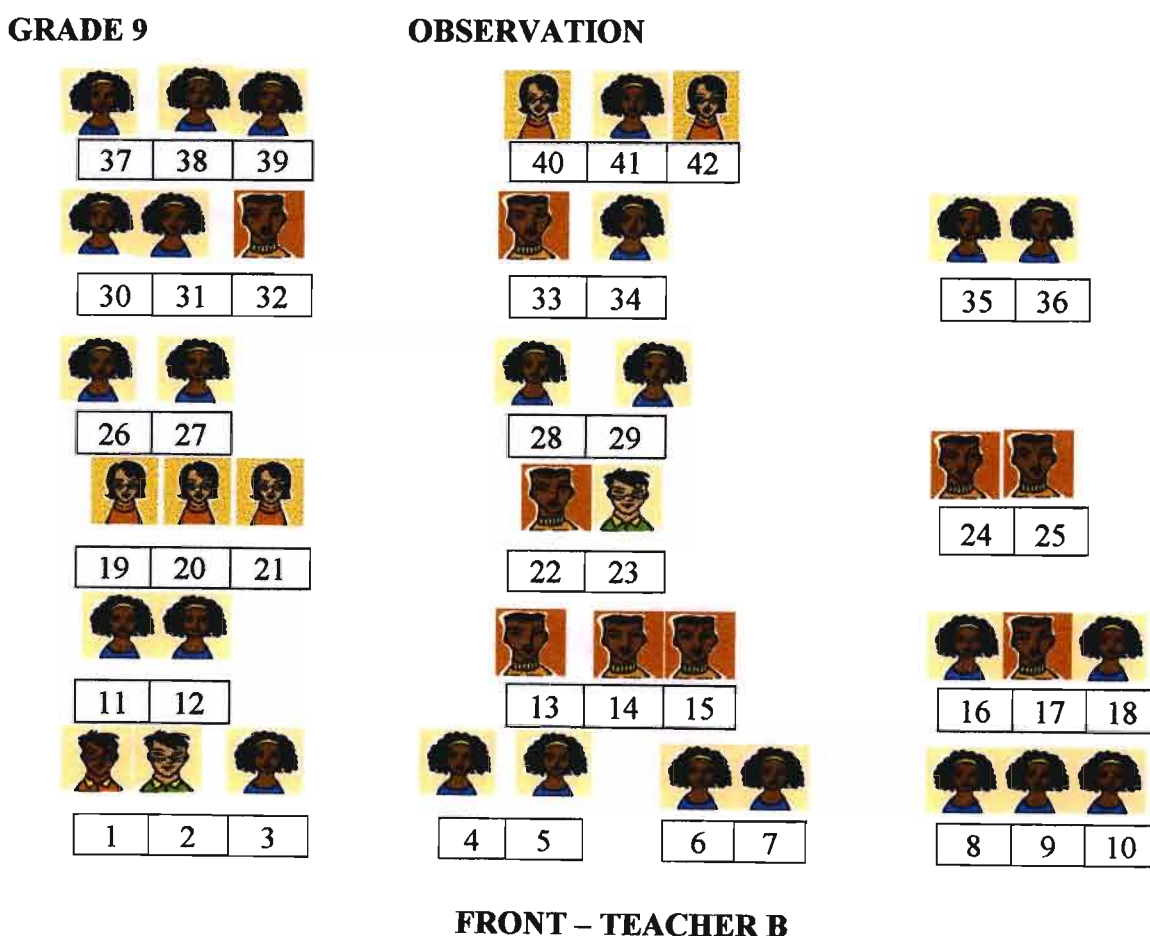
The table 4.3 reveals that a mixture of two-seater and group seating arrangements existed in the rooms of the sampled teachers. It is interesting to note that in four out of the five respondents' classes, learners are seated in groups, however, only Teacher B allowed for group interaction amongst learners. It is also evident that three of the five teachers moved around the class interacting with learners where as Teachers C and D remained in the front of the class during the lesson. Teacher C used the chalk board for the better part of the lesson, and thus remained close to the board for explanation purposes, while Teacher D used the overhead projector with prepared diagrams, and also illustrated explanations on blank transparencies.

4.3.1.1 Classroom Seating Arrangements:

In this section, the use of seating arrangements and sociograms are explored to trace patterns of classroom interaction. The following diagrammatic representation of the

This class constituted a total of 32 learners, made up of 7 black males, 7 coloured males, 8 black females, 9 coloured females and 1 Indian female. The class was thus made up of 44% males and 56% female learners, further broken as 47% black learners, 50% Coloured learners and 3% Indian learners. Black males were 22% of the class, and an equal percentage of coloured males, while, black females being 25% of the class, coloured females making up the majority of 28% of learners and Indian female making up the minority of 3% of the learners.

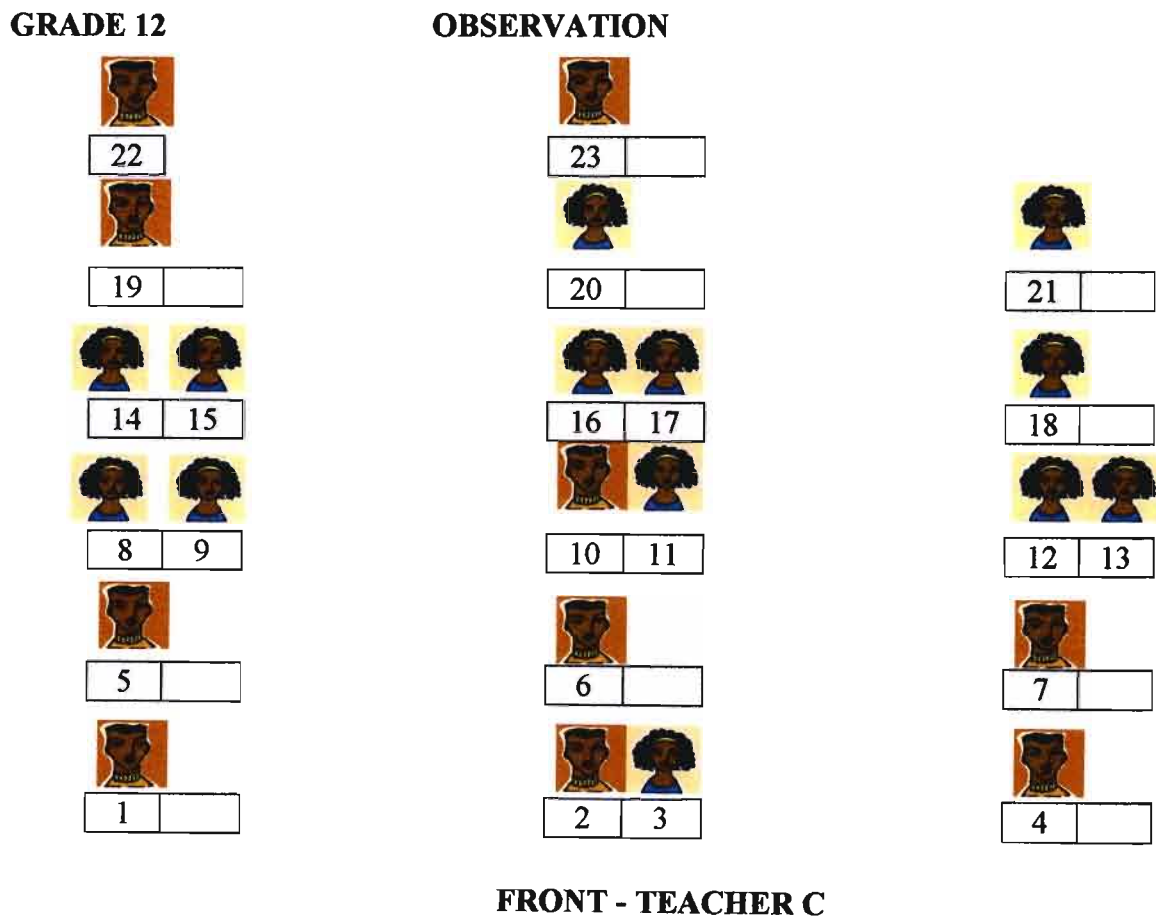
Figure 4.2: Observation of Teacher B classroom seating arrangements



This class constituted a total of 42 learners, made up of 9 black males, 2 coloured males, 1 Indian male, 25 black females and 5 coloured females. The class was thus made up of 29% males and 71% female learners, further broken as 81% black learners, 17%

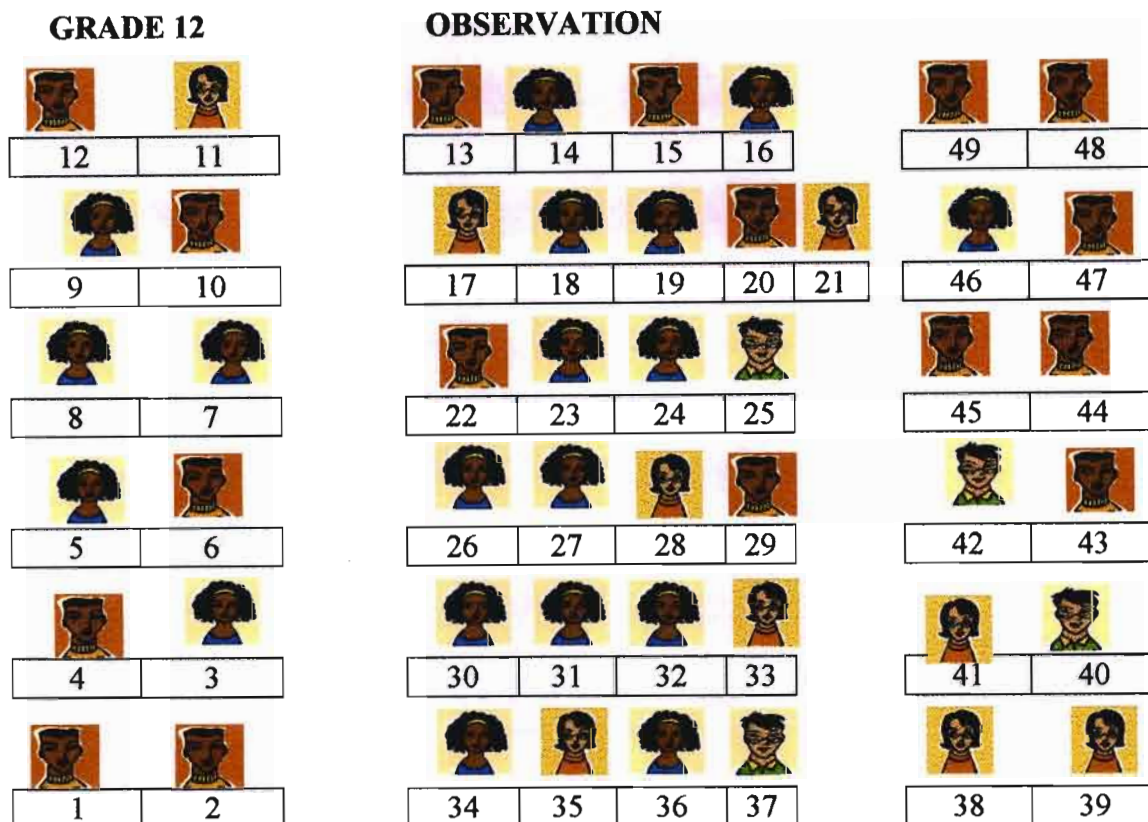
Coloured learners and 2% Indian learners. Black males were 21% of the class, 5% coloured males and Indian males being the minority at 2%, while, black females made up the majority being 60% of the class, and coloured females 12% of learners.

Figure 4.3: Observation of Teacher C classroom seating arrangement:



This class constituted a total of 23 learners, made up of all black learners' of which 10 were males and 13 females. The class was thus made up of 43% males and 57% female learners.

Figure 4.4: Observation of Teacher D classroom seating arrangement:

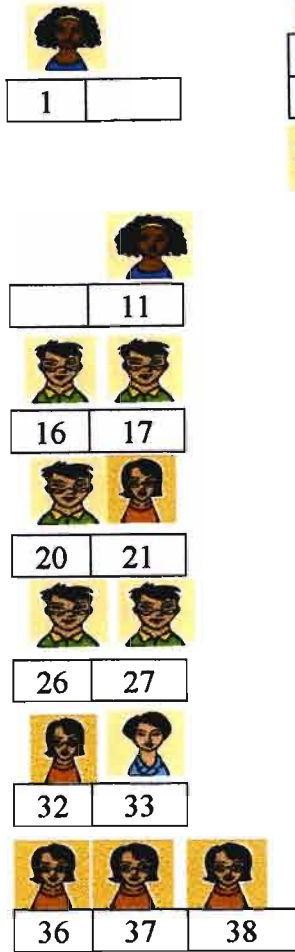


FRONT – TEACHER D

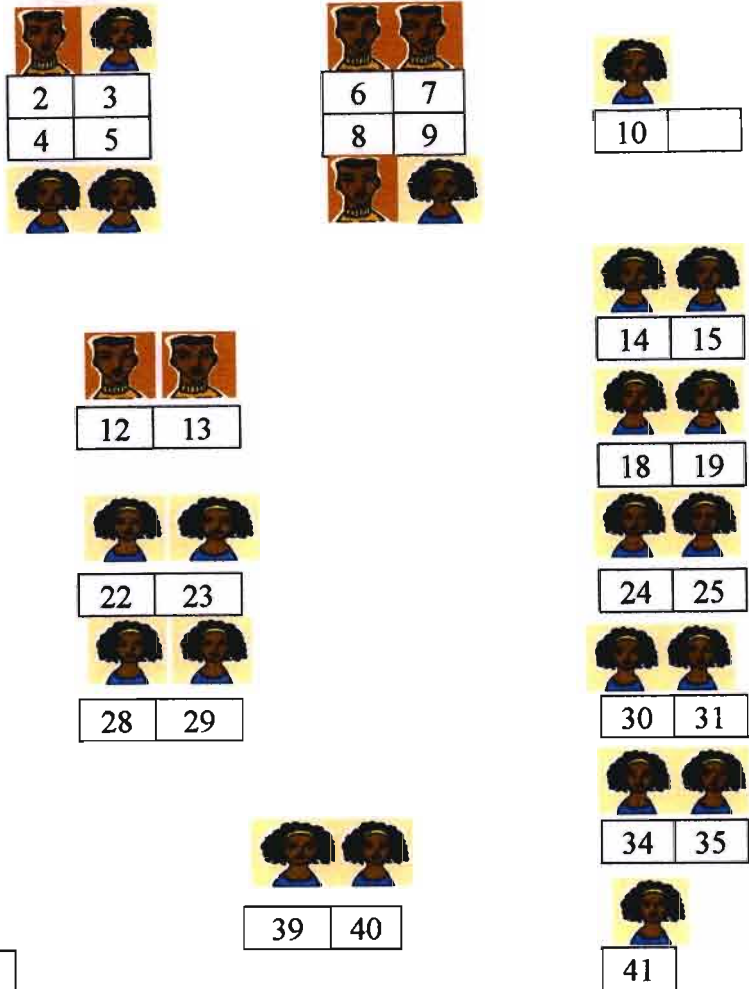
This class constituted a total of 49 learners, made up of 17 black males, 4 coloured males, 19 black females, 9 coloured females. The class was thus made up of 44% males and 56% female learners, further broken as 47% black learners, and 53% Coloured learners. Black males were 22% of the class, and an equal percentage of coloured males, while, black females being 25% of the class and coloured females making up the majority of 31% of learners.

Figure 4.5: Observation of Teacher E classroom arrangement:

GRADE 10



OBSERVATION



FRONT - TEACHER E

This class constituted a total of 40 learners, made up of 6 Black males, 5 Coloured males, 24 Black females, 4 Coloured females and 1 Indian female. The class was thus made up of 28% males and 73% female learners, further broken as 75% black learners, 23% Coloured learners and 3% Indian learners. Black males were 15% of the class, and 13 coloured males, while, black females making up the majority being 60% of the class, coloured females 10% and Indian females made up the minority at 3% of learners.

Seating arrangements of all five teachers show either clusters of female only grouping or in some instances racial groupings which suggests that teachers have not encouraged learner integration.

4.3.2 Lesson Structure

The structure of the lessons are analysed in terms of the different teaching methods and the resources used by the respondents. See table 4.4.

Table 4.4 – Lesson Structure of the Five Observed Lessons

| Lesson Structure | Teacher A | Teacher B | Teacher C | Teacher D | Teacher E |
|--|-----------|-----------|-----------|-----------|-----------|
| 1. What teaching method does the teacher adopt for the lesson? | | | | | |
| (a) whole class teaching | | | X | X | |
| (b) whole class discussion | X | X | X | X | X |
| (c) learners working in groups | | X | | | |
| (d) learners working alone. | | | | | X |
| 2. Does the nature of the environment created in the classroom include | | | | | |
| (a) visual aids | X | X | X | X | X |
| (b) resources | X | X | X | X | X |
| (c) scientific apparatus | | | | | X |
| 3. Is the lesson | | | | | |
| (a) teacher - centred | | | X | X | |
| (b) learner - centred | X | X | | | X |

Table 4.4 indicates that whole class *discussions* (these discussions were actually probing questions posed to learners, to determine their prior knowledge on the topic, to re-enforce certain concepts and for clarification of instructions) are more often used by the respondents however whole class *teaching*, which is more teacher- centred is favoured by Teachers C and D. Teacher C and D allow for learner participation by asking questions. Teachers A, B and E however, are involved in whole class *discussions*, which involve a lot more learner participation and involvement in the lessons. In Teacher B's class, learners worked in groups to determine the uses of electricity and Teacher E's learners worked alone when using the microscope.

All five teachers used some form of visual aid which served as resource during their lesson. Teacher A made use of a worksheet, a chart with pictures as well as a flip chart where he made note of learners' responses. The pictures and the worksheet served as resources. Teacher B made use of a worksheet with electrical appliances which served as a resource for the lesson. Teachers C made use of the chalk board where she drew diagrams representing field patterns, as well as a worksheet which constituted the notes on Electric field lines. Teacher D made use of the overhead projector where he placed diagrams of the digestive system and the villi in his explanation of the absorption process. Worksheet served as the notes on the section being taught,. Teacher E on the other hand made use of the chalk board with diagrams of the Plant and Animal cells, worksheets showing the correct use of the microscope as well as the microscope. Worksheets and the chalkboard served as the main form of resource for all five teachers. This is in keeping with responses teachers offered during the interviews.

4.3.3 Language use in the classroom

The use of language in the classroom is viewed in terms of the medium of instruction, the different methods used to allow learners to express themselves, the use of code-switching as well as the level of language content. Table 4.5 indicates the results of the observations.

From table 4.5 it is evident that all lessons are instructed in English. Learners in most instances expressed themselves verbally only, whereas, in the lessons of Teacher B and E, learners expressed themselves verbally and through written exercises and drawings respectively.

Code-switching was allowed in all five teachers' lessons, however the manner in which it was used differed from one teacher to another. Teacher D is first language isiZulu and is therefore capable of instruction in isiZulu. However, in the lesson observed he did not use isiZulu for instruction but merely to manage discipline, for example:

hey, gashle mpela – when I ask for questions you start talking.

Table 4.5 – Language Usage in the Observed Classroom Lessons

| Language | Teacher A | Teacher B | Teacher C | Teacher D | Teacher E |
|--|-----------|-----------|-----------|-----------|-----------|
| 1. What is the medium of instruction in the classroom? | | | | | |
| (a) English | X | X | X | X | X |
| (b) Zulu | | | | | |
| (c) Afrikaans | | | | | |
| 2. How are the learners allowed to express themselves? | | | | | |
| (a) language | | | | | |
| - verbal | X | X | X | X | X |
| - written | | X | | | |
| (b) drawings | | | | | X |
| (c) models | | | | | |
| 3. Is code-switching allowed during the lesson? | | | | | |
| (a) Yes | X | X | X | X | X |
| (b) No | | | | | |
| 4. When is code-switching used during the lesson? | | | | | |
| (a) instruction | | | | X | |
| (b) reprimand learners | | | | | |
| (c) manage discipline | X | | | X | |
| (d) define concepts | X | | | X | |
| (e) learner discussion | | X | X | X | X |
| 5. How often is code-switching used during the lesson? | | | | | |
| (a) occasionally | X | | X | | X |
| (b) frequently | | X | | X | |
| (c) not at all | | | | | |
| 6. What is the level of language content? | | | | | |
| (a) easy | X | X | | X | X |
| (b) average | | | X | | |
| (c) difficult | | | | | |

Teacher A is also capable of conversing in isiZulu and therefore uses code-switching to define concepts. The following IsiZulu words were used in Teacher A's class during the discussion, gogo (granny), dugga (mud), mkhuku, and ujonddolo (types of houses).

It is apparent from the table that code-switching is occasionally used in most lessons. However, it is most often used by learners in clarification of concepts and during discussions. Teacher A and E also mentioned the use of code-switching for the purpose of reprimanding learners during the interviews, which was evident in Teacher E's class. In terms of the level of language used, most teachers observed, displayed easy or 'accessible' levels of the English language which was consistent with the teachers responses during the interviews. They constantly defined terms being used, for example:

Number 2 says look at the appliances in the drawing below. Before we go on, does everyone know what an appliance is? (T_B)

The purpose of the microscope is to magnify objects. What does magnify mean? (T_E)

4.3.4 Learner Participation

Table 4.6 below indicates that Teachers A, B and E have active participation of learners in their classroom. Learners in these classes are actively involved in discussions with the teacher, other learners or in the case of Teacher E, learners were actively involved in discussions on how to use, and in actual use of the microscope.

When observing who answers the teachers' questions it became apparent that generally all learners, irrespective of gender or language competencies, attempted to answer the teachers' questions.

The three most common type of learner involvement evident in all classes, was *listening*, memorising and/or repeating words or scientific terms, and responding to teachers' questions.

Table 4.6 - Learner Participation and Involvement

| | Teacher A | Teacher B | Teacher C | Teacher D | Teacher E |
|---|-----------|-----------|-----------|-----------|-----------|
| 1. Do all learners participate actively in the lessons? | | | | | |
| (a) most (about three quarters) | X | X | | | X |
| (b) some (about half) | | | | X | |
| (c) few (less than half) | | | X | | |
| (d) none | | | | | |
| 2. Who are the learners who answer the teacher's questions? | | | | | |
| (a) English first language learners | X | X | | X | X |
| (b) English second language learners | X | X | X | X | X |
| (c) Male learners | X | X | X | X | X |
| (d) Female learners | X | X | X | X | X |
| 3. Indicate the type of learner involvement during the lesson | | | | | |
| (a) Listening to the teacher | X | X | X | X | X |
| (b) Observing demonstrations | | | | | X |
| (c) Copying teacher's notes | | | | | |
| (d) Memorising and or repeating words or scientific terms | X | X | X | X | X |
| (e) Responding to teacher's questions | X | X | X | X | X |
| (f) Asking questions | | X | X | X | X |
| (g) Completing tasks / activities in their exercise books | | X | | | X |
| (h) Discussing with peers | | X | | | |
| (i) Writing their own notes | | | | | |
| (j) Marking / reviewing of own/other Homework / class work | | | | | |

It can be noted that learners did ask the teacher questions in four of the five observed lessons. However, it was a rare occurrence for learners to ask the teacher a question in any of the observed lessons as indicated by the single green arrow in each of the Figs. 4.7 to 4.10.

In the case of Teacher C all her learners were English second language learners. Discussions with peers in terms of group-work was only evident with teacher B whereas observing

demonstrations or being involved in a practical exercise (use of the microscope) was observed with Teacher E only, indicating that group-work and practical work are not common practices amongst all the respondents.

4.3.4.1 Analysis of teaching content

The classroom observations of the five teachers were video recorded and transcribed in order to look at issues of diversity in terms of lesson content. The following sociograms which has been adapted from Sookrajh (1999) of classroom learner interaction was used to explain the lesson progression. Sociograms used in this section allowed for a great deal of information to be presented and enabled interactions between individual learners and the teacher to be documented and examined. These charts enabled me to record the extent to which a teacher addresses questions generally or to specific learners.

The sociogram Fig.4.6 represents learners in respondent A's classroom. This was a grade 8 natural science class and the lesson being observed was on the uses of electricity. Learners were involved in a whole class discussion, which involved Teacher A probing learners to determine their prior knowledge on the different types of electrical appliances:

Can you name one of these appliances that you have seen on your way to school this morning? Just to see how observant you are especially coming from different places and whether you walked to school or when riding on a bus or taxi and you saw these appliances.

This statement above also indicates that Teacher A is aware of the diversity of learners in his classroom in terms of where they live and how they commute to school. He also seems to be aware that each learner would have a different experience and tries to establish their understanding of electrical appliances. The uses of electricity, how people get access to electricity as well as the dangers of electricity were also discussed. Rural and urban homes were discussed to establish how people who lived in these homes had access to electricity. What was extremely interesting in Teacher A's lesson was the approach he used in getting learners to interpret pictures. This method allowed learners to draw on their experiences in answering the question and were not simply told what to see in the picture. This is illustrated

by the following excerpt where 'T' and 'L' refer to teacher and learner respectively.

T: *What is this house called?*

L: *Hut*

T: Do you think this house will be found in town or out of town?

L: *Far from town*

T: *What problems will the people experience as far as our topic is concerned?*

L: *No electricity*

T: *What do you think house number one is made of?*

L: *Sir, house one is made of dugga*

T: *Tell us what dugga means?*

L: *Mud*

The above example also indicates that learners were allowed to express themselves in language that they are accustomed to, thus making learning more accessible.

The different socio-economic communities were given due respect during the class discussions which illustrates the incorporation of attitudes and values in the lesson:

Let's try to be more serious, people live in these houses. They are not so well off or fortunate like us. We have to be respectable to such people because they are human beings. This government is looking after these people and is going to build houses for them and care for them so that they are like everybody else.

The dangers of electricity were touched on in terms of stealing electricity and learners were encouraged to explain why stealing electricity could be dangerous. Teacher A also ensured that the dangers associated with this practice were highlighted which is shown by the following example:

T: *You said house one is far from electricity. How do they get electricity?*

L: *They dig underground for the cord and they cut the cord and lead it to their house.*

T: *Are there dangers involved or is it not dangerous?*

L: *You can get shocked*

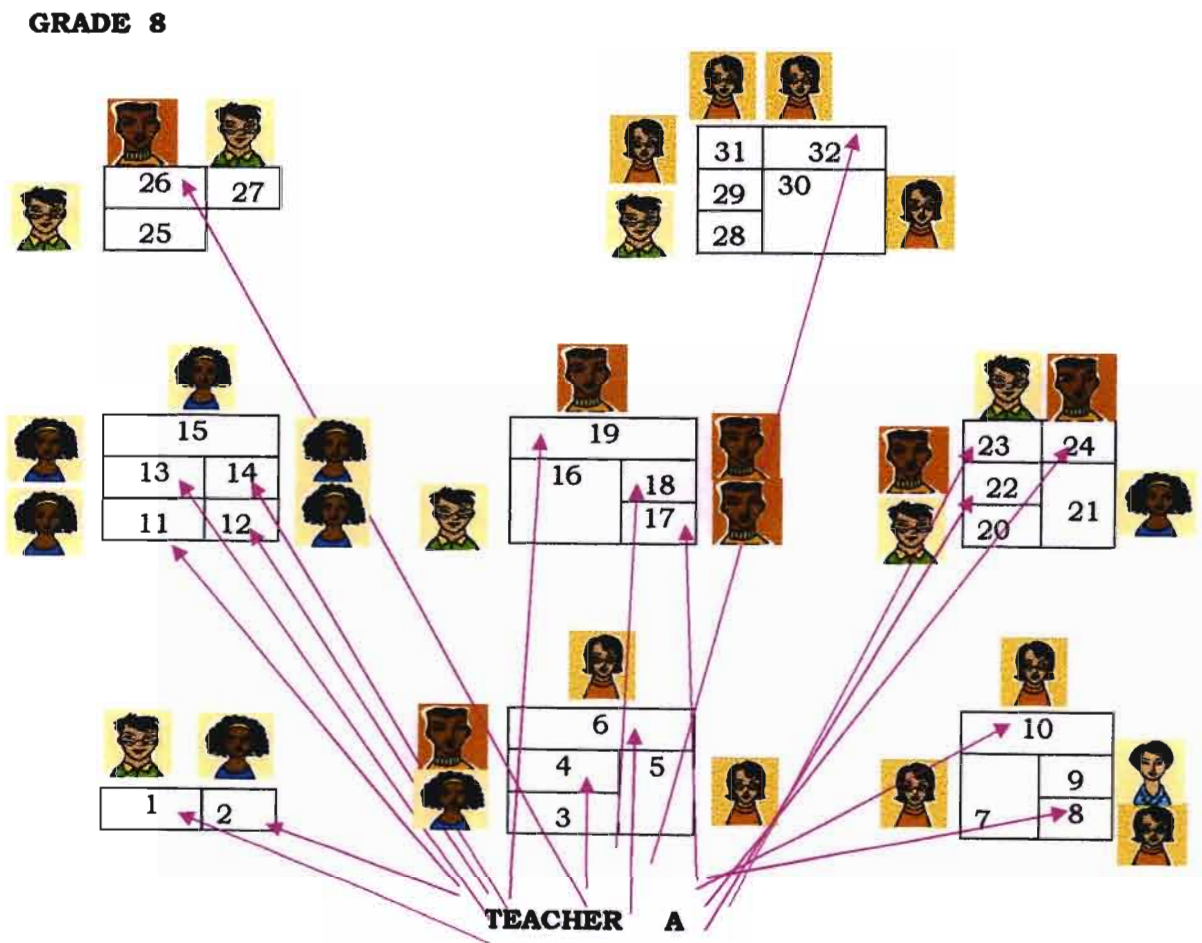
L: *If it's raining they get shocked*

T: *Why? If it is not raining then they don't get shocked?*

L: *No they also get shocked. Water conducts electricity.*

This example clearly illustrates how science teachers can empower their diverse learners regarding the usefulness as well as the dangers associated with the use of electricity. Teacher A was at the same time able to correct any misconceptions regarding electricity being dangerous only when exposed to water.

Figure 4.6: Socio-gram representing classroom learner interaction.



The above figure indicates that responses to teacher A's questions, came from throughout the class, covering both genders, and across racial groupings. There were a total of 41 responses

(responding to teacher's questions) from both English first language and English second language learners, indicating that the teacher took time to get as much learner participation as possible. However, the participation by learners was only as a result of teacher led questions, with no questions coming from learners to teacher, and no peer discussions were allowed by this teacher, as he felt it to be disruptive in the class. The details of the responses to teacher led questions are as follows:

The 41 total responses came from 20 different learners, thus only 65% of the class answered the teacher's questions. It was found that 44% of the total responses came from black males, learners 4,17,18,19, 22, 24 & 26, black females made up 29% of the responses, and these were learners 2, 3, 11, 12, 13, 14 & 15. Coloured males made up 7% of the responses, and these were learners 1 & 23 and 20% responses from coloured females, who were learners 6, 8, 10 & 32. Learners responded to the teacher's questions in short phrases, sometimes using scientific terminology.

It must be said about this teacher that he maintained discipline in his class, and selected learners to respond. Although the coloured learners made up the majority of learners, the teacher wished to get more responses from the English second language learners, to ensure more meaningful learner participation, and learner understanding of the content taught. To ensure learner participation and involvement in the lesson Teacher A insisted that all learners have a chance to answer questions in the class which is indicated by the following statements:

You must give me just one answer not all the answers. Let the other people give me the other answers.

You have already answered, you will have to just hold on unless you want to change your answer.

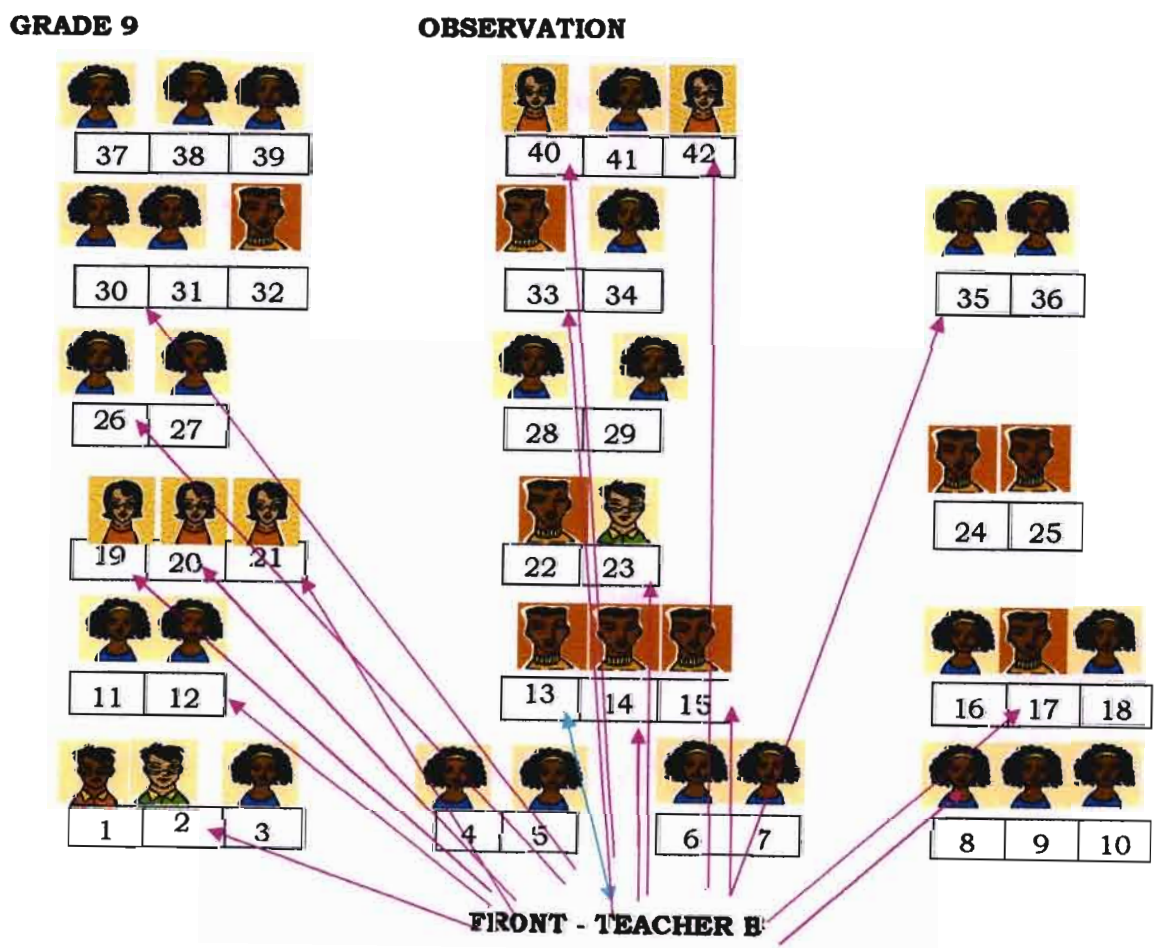
Although this method ensures learner participation, it seems restrictive in a sense that, this could lead to learners losing their enthusiasm for the lesson and merely residing in themselves.

Teacher A ensured that all learners were actively involved in the lesson by asking those learners' that did not answer to put up their hands and to repeat some of the answers that other

learners' had mentioned. This method ensured that all learners were attentive in class. However, this method relegates a lot of power to the teacher, giving the impression that learners would be attentive because of a fear of being pounced on. Personally I found that in Teacher A's plight to ensure all learners actively participate in the lesson, he was also able to discourage certain learners from answering by saying :

Why did you answer the question? I think I'm going to ask you to stand. Don't shout out the answer. I want everyone to get a chance to answer.

Figure 4.7: Socio-gram of classroom learner interaction



The above socio-gram of classroom learner interaction was observed in a grade 9 Natural science classroom, with a lesson delivered by respondent B. The lesson observed dealt with

the uses of electricity. Learners were asked to work in groups to determine the name of the appliance as well as to indicate how that appliance uses electricity. Before commencement of the task Teacher B used probing questions to ascertain if learners knew the different uses of electricity:

T: *How do we use electricity in our daily lives?*

L: *To cook*

T: *How do we cook?*

L: *Using a stove*

T: *What else?*

L: *We use an iron to iron clothes*

Teacher B gave the learners clear instructions regarding their task and defined concepts for example:

T: *What is an appliance? Something that uses electricity and you mentioned a few earlier on, am I right?*

L: *Yes*

T: *A fridge, a stove and kettle are those appliances?*

L: *Yes*

She ensured that learners were familiar with the different appliances in the worksheet by going over a few examples so that learners understood how to answer the questions.

T: *Look at the pictures so that you know exactly what they are. Number one is a cell- phone. What is the next one?*

L: *Till*

T: *Yes, till or cash register. The next one?*

L: *Calculator*

T: *What is the one on the left –hand side?*

L: *A petrol station*

T: *It is not a whole petrol station. It is a pump*

The above excerpt shows that teacher B does not assume that learners know all electrical appliances or how the appliances function. This indicates that the teacher is aware of the diversity in her classroom. Teacher B obtained feedback from the learners by going through a few examples, which indicated that learners were aware of the uses of electricity. The last question on energy changes were not covered during the lesson. In my opinion the lesson structure was good in that learners were interacting with each other in the development of skills, knowledge and attitudes and values, however too much time was spent on one concept which could have been covered in a shorter period of time.

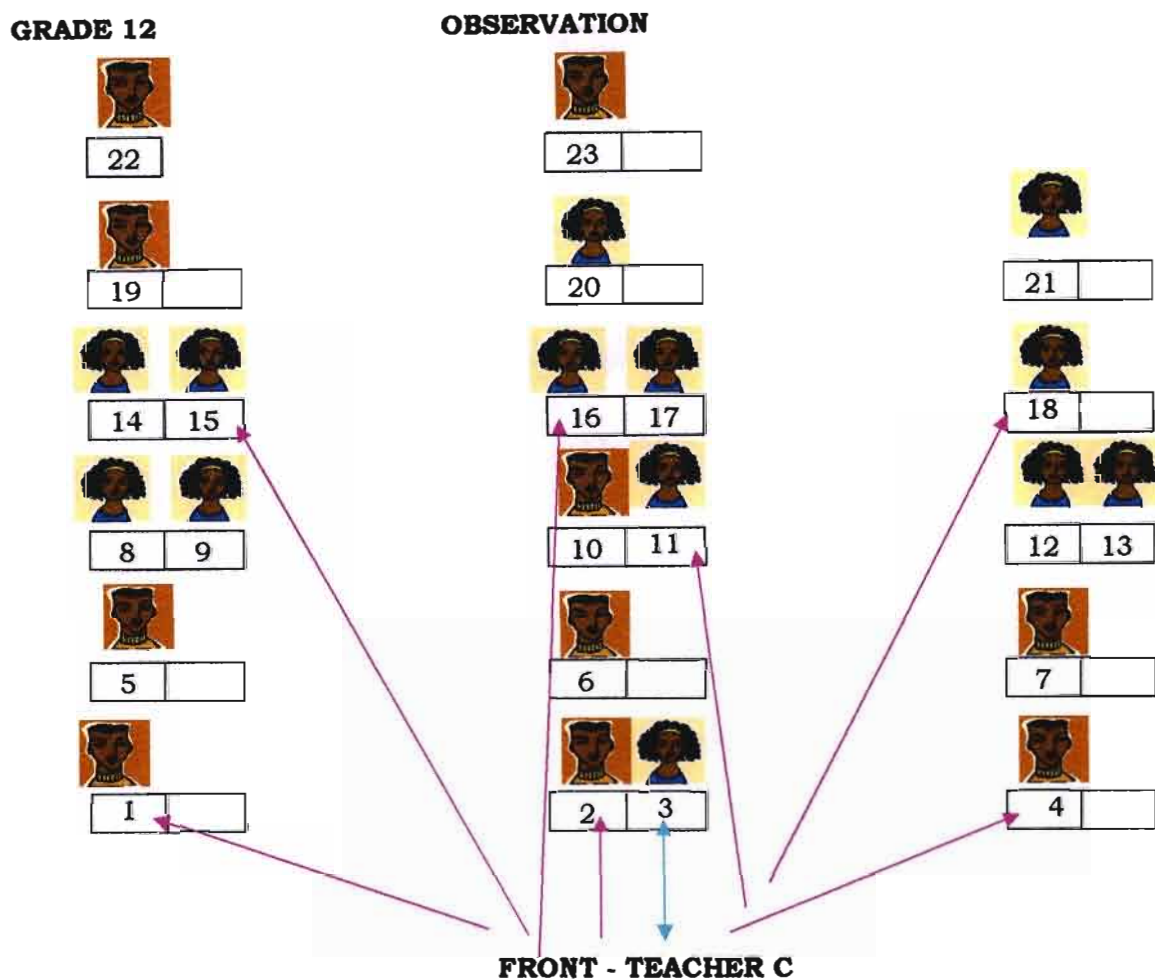
The above figure indicates that responses to teacher B's questions, came from both black and coloured learners in the class and covered both genders. The majority of the responses however came from female learners, viz. 25% of the responses from black female learners (learner no. 12,16,30& 35) and 31% of the responses were from coloured female learners (learner no. 19,20,21,40 & 42).

There were a total of 17 teacher initiated responses from both English first language and English second language learners, indicating that approximately 38% the class responded to the teacher's questions. The only learner that directed a question to the teacher was learner number 13, a black male learner. The remainder of the responses are as follows: 31% of the responses were from black male learners (learner no. 14,15,17,26 & 33) and 12% of the responses were from coloured male learners (learner no. 2 & 23). The above statistics reflect that the larger response to teacher's questions came from the black learners. This class has one Indian male learner who did not respond to the teacher's questions but contributed to the group discussions. Some of the learner responses to the teacher's questions were yes or no type responses however, most of the learners attempted to respond using the correct terminology.

Peer discussions dominated the better part of the lesson were learners interacted with each other in working out the different uses of electricity. During the course of the lesson Teacher B walked around the class interacting with learners, reading their responses and correcting

their answers. However, all learners were not given the opportunity to reach some conclusion regarding the different uses of electricity. I therefore felt that the lesson was open-ended.

Figure 4.8: Socio-gram of classroom learner interaction



The above sociogram of learner participation was observed in a grade 12 Physical science classroom, with a lesson delivered by respondent C. The above diagram indicates that only eight learners responded to the teachers' question which is equivalent to 35% of the class. There was a total of 14 responses, the details of the responses were: 41% of the learners responding are black males, learner numbers (1,2,4,11) and 59 % of the learners responding are black females, learner numbers (3,15,16,18). The above figure

indicates that responses to teacher C's questions, came from both male and female learners in the class. There were a total of 13 teacher initiated responses from the learners, indicating that there was limited amount of learner participation in the class. The above responses suggest that, the black female learners more frequently answer the teachers' questions or in many instances as observed, the teacher prompts female learners to answer the questions. Teacher C did mention during her interview that she encourages the female learners in her class to contribute to the lesson in her attempt to empower the female learners. Most of the responses from these learners were chorus type – responding to the teachers cues like change of pitch and pauses that learners have learnt to recognise and respond appropriately (Naidoo, 2000). This probably suggests that learners are not confident enough to answer the teacher's questions. It should also be noted that learners at the back of the class did not respond or were not prompted to respond to the teacher's questions.

There was only one learner who asked the teacher a question and this learner was female. The question asked by the learner was:

Miss, if you rub a ruler on your hair, why are you able to pick up paper?

This question was in response to Teacher C's explanation of the use of the equation $E = F/Q$, where she describes a positive test charge being attracted to a negative charge. The learner seems to draw a link between the two concepts and requests clarity from the teacher.

The lesson observed was on Electric fields. Teacher C has attempted to create a learning environment that does take into account diversity in terms of language. She has tried to make the lesson meaningful to all by using both a scientific register and ordinary simple everyday terminology for example:

T: *What I found interesting yesterday is that when you were given a pack from the foundation and quite a few of you were playing with the magnetic sets and someone said to me "come see Miss, they are running away from each other. What does running away from each other mean?*

L: *To repel*

Teacher C is obviously aware of the socio-economic background of her learners and that this has precluded most of them from having the advantage of a good general knowledge. So she tries to compensate for this by giving the learners some background knowledge before discussing the concept at hand.

How do you think scientist discovered these thing?

In the past before the advent of formalized education we had what we called philosophers and they did think about what happened. But not only did they think. Thinking is the start of scientific processes and they took their thinking a little further and they investigated it. So by experiments they came to their conclusions.

The properties of electric fields were then discussed and one of the learners was asked to indicate the direction of the field pattern on the chalk board. It would have been a useful exercise if all learners in the class were given an opportunity to work out for themselves different electric field patterns in order to develop the skills required to interpret the direction of the field lines.

Teacher C used concrete examples of the cat and ant to illustrate the abstract concept of a “test charge.”

Now a test charge we could explain in terms of say if an ant crawled on your shirt and you did not feel it against your skin. Would you know the ant was there? No

Only through the sensation of touch could you say no there is an ant and try and brush it off.

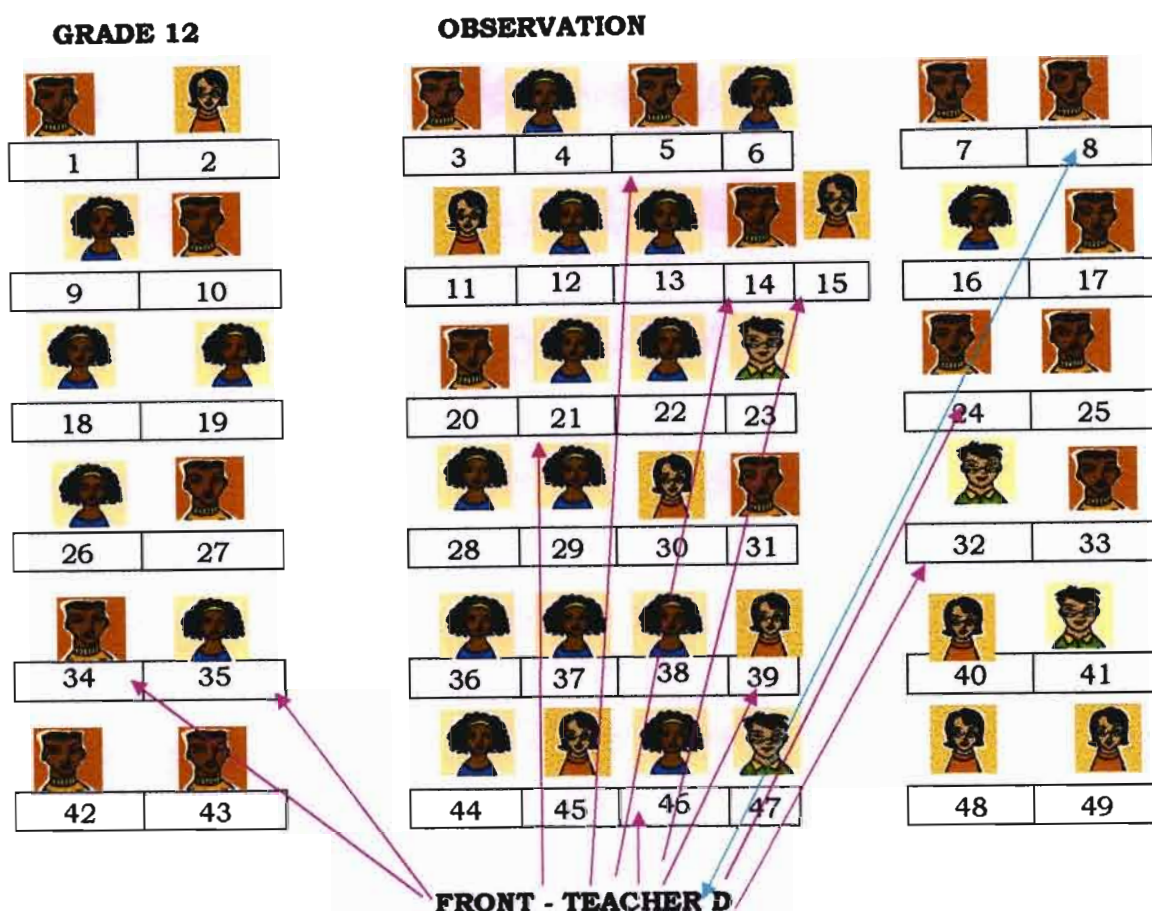
But if a cat was sitting on your back, would you feel the cat was there? Yes

The cat is not the test charge, what they used was something like the ant.

However, the above excerpt indicates that her explanation is not succinct with the concept at hand which could lead to mis-conceptions.

Electric fields are a difficult concept to understand. Therefore, as much as teacher C would like to make her explanations simpler and do a lot of repetition, she does not allow her learners to make meaning for themselves through active participation. In my opinion the lesson was far too orally inclined which does not cater for slow learners and the many different learning styles preferred by learners.

Figure 4.9: Sociogram of classroom learner interaction



The above sociogram represents learner interaction that was observed in a grade 12 Biology classroom, with a lesson delivered by respondent D. The above diagram indicates that only eleven learners responded to the teachers' question which is equivalent to 22% of the class. The details of the responses were: 27 % Black male responses (learner no. 5,8,14, 24 & 34), 33 % Black female responses (learner no. 21,35 & 46), 6 % Coloured male responses (learner no. 32) and 33 % Coloured female responses (learner no. 15, & 39). The responses suggest that more female learners respond to the Teachers' questions. Also Teacher D requested answers from a few female learners who he probably was aware, would know the answers or purposefully requested answers from female learners in an attempt to encourage and empower them to participate in the lesson. It was found that 60% of the responses were from Black learners. It was observed that learners used scientific terminology in answering the teachers' questions.

The aim of Teacher D's lesson was to ensure learners are able to understand the absorption of nutrients within the villi, the fate of absorbed nutrients and the identification of deficiency diseases. During the classroom observation the teacher used the overhead projector and prepared diagrams to explain the process of absorption in the villi and the fate of absorbed nutrients. He combined this process with a class discussion on the concepts being taught. He probed learners on previous concepts taught as well as prior learning experiences for example: *From yesterday we know that excess glucose is converted to glycogen by insulin. It is the function of the liver to store this glycogen. Glucose is converted into fats. That is why they say you should not eat too much sweets.*

Teacher D also used examples in his teaching that learners were familiar with:

When you drink a lot of your Brutal fruit, whisky, Spin and beer where does all those poisons go to?

In explaining deficiency diseases, respondent D used techniques to draw on learners' experiences by asking questions like:

T: *Can we look at these four words, Anorexia, Bulimia, Kwashiorkor and Marasmus and can you tell me what causes them?*

L: *Unbalanced diet*

T: *Precious*

L: *Malnutrition*

L: *If you have an eating disorder*

T: *Who has experienced either of these?*

L: *Ayanda*

T: *Maybe Ayanda is just small*

Teacher D in explaining the deficiency diseases Anorexia and Bulimia claims:

Normally these ones, I'm not being feministic but normally these ones are psychologically inclined diseases. Why I'm saying that they are psychological diseases is because Bulimia usually starts from low self-esteem. You always compare yourself to Naomi Cambell or Jay Lo.

Teacher D insinuates that Anorexia and Bulimia are female related diseases as they are psychologically inclined. This statement has a gender bias, in that not only do females suffer from low self esteem but also males and as such stereotypes the fact that only females can suffer from bulimia and anorexia.

In explaining the deficiency disease Kwashiorkor, he says to learners:

Now these two Kwashiorkor and Marasmus are related because without colonising your mind, look at the spelling here. This one is prevalent in mostly third world countries because when the United Nations and United States give us food, they give us food rich in carbohydrates. So when you eat carbohydrates you get the energy to move around and to move the flies away from your mouth. What is lacking in this food? Protein.

In bringing the problem associated with the above two diseases to the fore the teacher is in fact empowering learners about the international as well as national political implications associated with this disease.

“Look at the spelling of this word”

The teachers’ intentions in making this comment was not clear, however, the perception received was that he was insinuating that this disease occurs with black people only. If this is the case then this is an example of how teachers’ beliefs are influential in the class.

The teacher used verbal assessment strategies to determine if the learners understood the content taught, all learners did not respond to the teachers’ questions. For most of the lesson the teacher stood in front of the overhead projector and hence was teaching from a deficit position.

The above figure indicates that responses to teacher D’s questions, came from both black and coloured learners in the class and covering both genders. There were a total of 15 responses to teacher initiated questions from both English first language and English second language learners, indicating less than half the class being actively involved in the lesson. One of the learners, a black male (learner number 8) was the only one who asked the teacher a question, which was culturally relevant, viz:

L: *You said that when people throw up, they bring up stomach acids but those people who live in Newlands and Kwa Mashu drink 5l of water and throw up, it is a regular thing for them?*

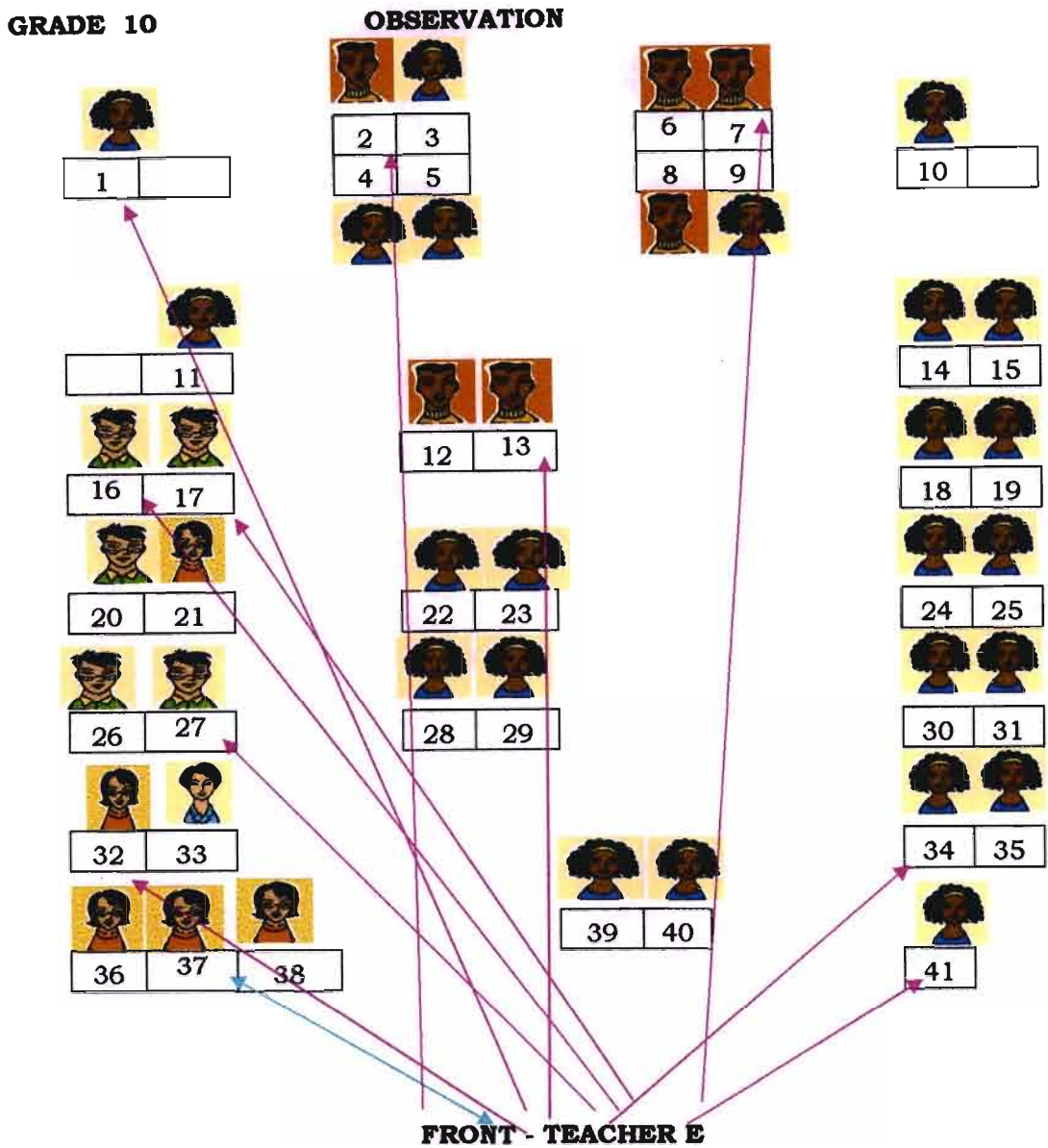
T: *You also do that, I also do that sometimes. The problem is after you do that when you try to grind your teeth like this then they are not as smooth as they are supposed to be. What are we doing? Let me just show you. The water goes down these and when anything hits the stomach, gastric juices are released. Then you decide that you want to bring up the water but what you are actually doing is destroying the lining of the oesophagus, your teeth and at the same time you are destroying the cardiac valve because it is only supposed to allow things to move down but what you are doing is forcing the valve up and the valve becomes flexible.*

The above question suggests that the learner is trying to formulate links between what he has learnt and different cultural practices that he is aware of.

The observed lesson for teacher E, showing learner participation is represented by the sociogram Fig. 4.10. This lesson was observed in a grade 10 Biology classroom. The diagram below indicates that only eleven learners responded to the teachers' question which is equivalent to 27% of the class. The details of the responses are as follows: 23% Black male responses (learner no. 2, 7 & 13), 23 % Black female responses (learner no. 1, 34 & 41), 23 % Coloured female responses (learner no. 32 & 37) and 23 % Coloured male responses (learner no. 16,17 & 27).

The sociogram reflects that an equal number of male and female learners answer the teacher's questions. However, responses to the teachers questions seem to be concentrated toward the left side of the classroom (coloured learners), whereas the black female learners are the majority in the class and seem non responsive. Learners respond to the teacher's questions using scientific terminology. Learner participation in this class is focussed on reading the worksheet on the use and proper handling of the microscope and thereafter working with the microscope in viewing different cells and tissues.

Figure 4.10: Sociogram of classroom learner interaction



The above figure indicates that responses to teacher E's questions, came from both black and coloured learners in the class and covering both genders. There were a total of 13 responses from both English first language and English second language learners, indicating that learners were participating in the lesson. The above data reveals an equal representation of male and

female learners as well black and coloured learners, in answering the teachers' questions. There was only one coloured learner who asked the teacher a question. The teacher was explaining unicellular (one cell) and multi-cellular organisms when the learner asked:

Do midgets have fewer cells than normal human beings?

The teacher responded by saying that yes they have few cells because they are smaller in size however their condition had to do with mitosis and meiosis which she was going to discuss at a later stage.

The black female learners are a majority in this class but, do not respond to Teacher E's questions. Teacher E had mentioned working harder to ensure female learners were responding during the lesson however this was not apparent in the lesson observed. Never the less, these learners have been observed to participate in the lesson in an alternate manner, through working with the microscope.

The above seating arrangement indicates that learners are seated according to race, to which the teacher responded was for the purposes of discipline as well as the language problem experienced by English second language learners. Teacher E felt that if she separated the coloured learner from the black learners, she could maintain better discipline, as she believed that the coloured learners frequently completed their tasks in a shorter period of time and caused discipline problems. In my opinion she should have rather used this opportunity to intermingle the coloured learners with the black learners as a means of using their energies more constructively in assisting the English second language learners.

Teacher E's focus for the lesson was on how to use the microscope and to ensure that all learners understood what they were seeing under the microscope. The learners were actually studying the Plant and Animal cell which lends itself to the use of the microscope to view the cells. The teacher made sure that all learners understood the purpose of using a microscope which is illustrated by the following:

If I wanted to show you a plant or animal cell, it is so tiny that you wouldn't be able to see it. That's what we are going to do today. If I wanted to show you the actual size of it and I said to

you here's it. Would you be able to see it? No.

Teacher E gave the learners clear instructions about the parts of the microscope as well as a demonstration on how to use the microscope. The proper handling and care of the microscope was also discussed for example:

The microscope is a sensitive and delicate instrument. Please use with care. Carry the microscope with one hand under the base and the other on the arm. If necessary, clean the lens with lens paper only.

Learners were given proper instructions as well as a worksheet on how each part of the microscope functioned as Teacher E was aware that the majority of learners in the class had perhaps never seen or used a microscope before. The worksheet served as a helpful tool for those learners who felt that the demonstration was inadequate could rely on the worksheet for guidance. Learners were asked to read their worksheets which had illustrations showing them how to use the microscope, before actually using the microscope to view the different cells and tissue. This teaching strategy was significant as it catered for the diverse needs of the learners.

During the classroom observation the teacher explained that cells are not actually one dimensional like in the drawings on the board:

This is a plant cell. Remember what I said, it looks flat but it actually has a front and a back to it. If I took a picture of me it would also be flat. Does this mean that the cell is one dimensional? No. It has a back to it and so on. The problem is that when we are looking at something under the microscope, we need to flatten it out.

Teacher E takes a known concept like a photograph to explain what is seen under the microscope.

The teacher caters for the diversity in her classroom by using different teaching styles for example: chalkboard, worksheets, discussions and the use of the microscope. These methods ensure that the curriculum content is accessible in different ways which favours the range of different learning styles learners have preferences for.

By using the sociogram to illustrate learner participation I was able to establish the effects of teachers' understanding of multicultural diversity in the way they teach (interact with the learners). Girls were found to be more enthusiastic in classroom participation than boys and teachers tended to encourage the female learners by directing questions to certain female learners. However, there are those learners who sit quietly and never participate unless specifically asked to do so and are systematically excluded from the lesson. From the classroom observations, coupled with the sociogram, it has become apparent that learner participation was concentrated on the side that the teacher spent more of his time on, i.e. left of class versus right of class.

The sociogram's of the five respondents' classrooms indicate that most learner participation in the lessons is in response to teachers questions. The different responses are either chorus responses, hand-raising responses, teacher initiated response or learner questioning response. Chorus allows learners an opportunity to verbalise science terms by repetition. The meaningless repetition of statements and words would limit the conceptual growth of learners (Collison, 1974 cited in Naidoo,2000).

According to Naidoo (2000), research has revealed that practitioners should engage in more interactive pedagogical styles in order to promote the development of learner's language skills as well as to improve their science conceptual understandings. A shift from the popular whole language question-answer evaluation sequence to the more interactive True Dialogue will result in more meaningful teaching and learning.

4.3.5 Teaching and Learning / Curriculum

The five teachers' lessons were observed to ascertain the different teaching approaches that they utilized in the classroom as well as to establish the curriculum content of the lesson.

It is evident from table 4.7 that teachers in most instances prefer to maintain one teaching strategy throughout the lesson, with the exception of Teacher B and E who use class discussions as well as group-work or practical work respectively. Reviewing and Reflecting

seems to be the most popular teaching method used by all teachers in their classrooms.

Table 4.7 - Teaching and Learning Curriculum

| | Teacher A | Teacher B | Teacher C | Teacher D | Teacher E |
|--|-----------|-----------|-----------|-----------|-----------|
| 1. Are different teaching methods / approaches used during the lesson? | | | | | |
| (a) Yes | | X | | | X |
| (b) No | X | | X | X | |
| 2. What are the different teaching methods used? | | | | | |
| (a) Group-work | | X | | | |
| (b) Story - Telling | | | | | |
| (c) Role-Play | | | | | |
| (d) Reviewing & Reflecting | X | X | X | X | X |
| 3. Does the curriculum content encourage learners to reflect on their prior knowledge? | | | | | |
| (a) Yes | X | X | X | X | X |
| (b) No | | | | | |
| 4. Do the worksheets / textbooks / discussions during the lesson reflect different cultures? | | | | | |
| (a) Yes | X | X | | X | X |
| (b) No | | | X | | |

During classroom observations with the respondents it became apparent that all five teachers introduced curriculum content that reflected on learners' prior knowledge base in varying degrees, for example:

Yesterday when you were playing with the magnetic sets and someone said to me, " come see Miss, they are running away from each other". What does running away from each other mean?

The above example indicates that the Teachers draw on learners' prior learning experiences whether they might be cultural experiences or not.

Worksheets produced by teachers A, B and E clearly reflect different cultures through the

people represented in the picture. The homes discussed during Teacher A's lesson also represented both rural and urban homes, re-enforcing cultural differences with respect to most common occupants of home type.

Teacher D's lesson reflected different cultures during the class discussion, with respect to eating disorders, i.e., different cultures like the Ethiopians, Hollywood actors, as well as people from Kwa Mashu can all have the same eating disorder, namely, anorexia and bulimia.

4.4 Document Analysis

In analysing the five teachers' worksheets and lesson preparation books, to determine if the teachers had achieved their outcomes, the following was revealed:

Teacher A had intended for the lesson to be an introductory lesson on electricity, where learners should be able to recognise things at home and in school that use electricity. How do people have access to electricity and the dangers of electricity.

The worksheet handed out to learners gave background information on the Programme Organiser – Industry and Marketing which was intended to help the learners realise the important of electricity in terms of technology in our lives, in South Africa and the global community. The language in the worksheet was made more accessible by defining certain words in brackets. This I believe is an excellent method of ensuring that all learners understand the curriculum content.

In Teacher A's lesson, learners were able to name things that used electricity, explain how different communities had access to electricity as well as explain why stealing electricity could be dangerous.

Teacher B had also intended for her lesson to be an introductory lesson on electricity, where learners should be able to recognise the various electrical appliances on the worksheet and indicate their use as well as how these appliances use electricity. The worksheet featured

different electrical appliances with three questions to be answered, viz. Name the appliance? How does this appliance use electricity? and state the different energy changes? The pictures of the appliances were familiar to all learners and the language level was accessible. The overall intention of the lesson was to explore the usefulness of electricity which was achieved.

Teacher C intended for her learners to know what are field lines, the properties of electric field lines, be able to draw and interpret electric field patterns and be able to understand and use the equation $E = F/Q$.

During the classroom observation the following was noted, the teacher explained what are electric fields and the properties of electric fields as well as the history behind the discovery of electric field lines or patterns. The history behind the development of scientific concepts in my opinion is important so that learners are able to realise that what is being taught has been developed over the last hundred years and are not scientific truths but rather built on peoples theories about a concept. The approach to this content could have been made more learner-centred, if learners had access to Physical science text books, where learners would explore for themselves how electric fields were discovered and the properties of these field lines.

Analysis of the worksheet indicated that all aspects of the content that Teacher C had intended to teach appeared on the worksheets in point form and in accessible language. Diagrams were clearly illustrated however the worksheet did not emphasise the processes of science, viz. investigation and experimentation. The worksheet also lacked pictures of people which do not reflect science as a human endeavour. The concept of Electric field patterns is a difficult one and I strongly believe that all scientific content should reflect the nature of science.

The aim of Teacher D's lesson was to ensure learners were able to understand the absorption of nutrients within the villi, the fate of absorption of nutrients and the identification of deficiency diseases. All aspects that featured in Teacher D's preparation book appeared on the worksheet presented to learners. The level of language used in the worksheet was accessible but again it did not reflect the true nature of science, which involves experimentation, problem-solving, experiences and so on.

Teacher E's focus for the lesson was on how to use the microscope and to ensure that all learners understood what they were seeing under the microscope. The learners were actually studying the Plant and Animal cell which lent itself to the use of the microscope to view the cells. During analysis of Teacher E's preparation book and the two worksheets handed to learners, I found that the two worksheets adequately reflected the aims of her lesson. The first worksheet was on the use of the microscope, which was clearly illustrated to reflect the processes of science (see Appendix 5). The people represented in both worksheets reflected different cultures as well as genders. The second worksheet illustrated the preparation of a sample which gave clear visual representation of how to prepare a sample of a plant or animal cell. These types of worksheets are well suited to English second language learners who would probably have difficulty with the English language.

Most of the worksheets used by the respondents were user friendly in that simple language was used, diagrams featured, as well as they seemed useful in providing a vicarious or simulated experience to the learner.

4.5 Conclusion

The data presented reveals that teachers are aware of the diversities in their classrooms mainly in terms of race and socio-economic standards. The most common form of diversity mentioned during the semi – structured interviews were race, language, culture and socio-economic differences. Although teachers are aware of issues of diversity amongst learners, more often very little is done to improve the situation. The classroom observations indicate that teachers are making efforts to accommodate for these diversities; however, there is a tokenistic approach to dealing with it. The data reveals that teachers are aware that they need more knowledge, information, (direction), and resources to better cope with diversity in their classrooms.

All teachers felt that there was a definite place for code-switching in the classroom in terms of clarification of ideas. The classroom observations have revealed that in most instances code – switching is practiced in all respondents classes, but the manner in which it is used varies, for

example in some classes code-switching is only used amongst the learners. What has been evident throughout the research is that language is a tool for thinking and therefore should be accessible to all learners.

It would appear from the interviews that there is a very liberating approach to gender. However, this position does not come through in the lessons except in the fact that, it has been noted that some teachers made concerted efforts to encourage female learners to answer the teachers' questions. The story on virginity testing is a typical example of the importance of liberating both male and female learners so that they are aware of their constitutional rights as an individual. If learners are not seen for their individual differences then their individual needs get neglected.

Gathering from the data it is evident that teachers claim to now want active participation from all learners however; it has been found that this statement is interpreted in different ways by the five different respondents. In some instances active participation means class discussion led by teacher, in other classrooms it means practical work and it could also mean group work.

In terms of Curriculum issues it has been noted that teachers are making effort to move towards a culturally more relevant curriculum however, a lot of insight and guidance is required by these teachers in attempting to make that change. The stories presented by the respondents clearly indicate that issues of sexuality should be part of the science curriculum to assist in educating the youth in terms of issues such as AIDS and in the general empowerment of learners in terms of issues of sexuality.

The above issues will be further deliberated in chapter five where more insight would be given regarding these issues.

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CHAPTER FIVE

SUMMARY AND CONCLUSIONS

5.1 Introduction

This study attempted to examine how science teachers' knowledge of multicultural diversity impacts on their approaches to teaching. In response to this question I have attempted to gather two critical pieces of data in a case study approach, i.e. what are science teachers' understandings of multicultural diversity amongst learners, and how do these understandings of multicultural diversity impact on the way they teach. In this chapter I will attempt to synthesize the differences and similarities between the respondents perceptions, (data gathered during the personal interviews), and actual classroom practice as recorded during the classroom observations. Both the differences and similarities will be re-enforced by the stories, (episodes), related by the respondents. In formulating a cohesive summary, specific segments of my literature review will lend support to the synthesis of the various strands of my study. I will then conclude this chapter with proposed recommendations in light of my position with regard to perception versus practice. These proposed recommendations will be for classroom practice and for research on issues of multicultural diversity in science education.

South Africa poses unique sets of dilemmas and challenges in its education systems. The context for the study is an ex-HOR school in Newlands East, Kwazulu Natal, serving a middle to lower socio-economic class community. The literature I reviewed specifically on S. Africa was very limiting with respect to putting forward supportive theories for classroom behaviour in a new S. African multicultural school after 1994. This is understandably so for the short period of our new democracy. Thus most of the theory found is based on American experiences which at specific technical levels are different from the S. African context and thus our uniqueness. However, at the theoretical level, the starkness of the global village theory in our similarities is very evident.

Science has its own formal language, and teaching it on 1st language basis, has its own unique set of problems, compounded to these issues, are the problems associated with teaching science to 2nd language learners. In this study, while language is viewed as a barrier to effective science learning, it is seen also as one of the many cultural barriers to learning science. For science to be understood with practical relevance, the knowledge needs to be internalised, and this is only achievable if the scientific concepts have personal context in the life of the learner. Multicultural science education is seen as a means of addressing this issue.

5.2 Findings of the Study

- ◆ An overview of the findings indicates that the sample respondents interviewed, understand multicultural diversity in a traditional manner, i.e. they see mainly race, language and socio-economic background as differences amongst their learners. This contrasts with the literature reviewed, that clearly indicates that a deeper or profound understanding of our science learners' backgrounds, including their culture, is necessary to successfully pass on scientific knowledge to our learners. This issue is discussed further, together with how and why a profound understanding of multicultural diversity has positive implications in the science classroom.
- ◆ The analysis of the data from the personal interviews has direct impact on classroom practice. Generally, based on their traditional understanding of multicultural diversity, and on analysis of curriculum, language, gender issues, teaching and learning methods used during the classroom observations, the respondents grappled to cross the cultural borders in order to effectively deliver meaningful science to their learners.
- ◆ The curriculum practiced in the classroom was found to be de-contextualised, i.e. the curriculum context lacks social and personal relevance in the world of the learner. In an attempt to overcome this, the problem of diminution of the science curriculum is also highlighted. This means that the curriculum is watered down for diverse learners instead of challenging them with more of what the school has to offer.

- ◆ Language was found to be a barrier to effective understanding of scientific concepts because certain scientific concepts lack literal translation in the IsiZulu language, and further, language is found to have a pivotal role in providing contexts for meaning.
- ◆ Gender issues were generally found to be handled fairly effectively, with female learners actively participating in science lessons, and boys although present in equal numbers in science classrooms, tending to “shy” from active participation.
- ◆ Related directly to the language barrier problems and difficulty in appropriately contextualising science curriculum for personal relevance, the teaching and learning methods were lacking in the scientific process, i.e. inquiry, discovery, investigation, experimentation, etc.

5.2.1 Teacher Perceptions and Practice of Diversity

The following emerged from the study, which indicates teachers’ awareness of diversity amongst their learners:

Data produced from the Interview schedule suggests that all five respondents used in the study are aware of learner diversity, which is evident in their definitions and description of the characteristics of diverse learners – race, culture, language, socio-economic background, customs and traditions, behaviour, dress, intellectual ability. However, based on literature that I have reviewed, I find issues of diversity as perceived by the respondents, somewhat too simplistic. The respondents’ perceptions of diversity are very parochial or based on traditional values and thus they construct diversity in terms of race, socio-economic standards and language barriers. This is also supported by the episodic moments as described by the respondents with the common themes again being limited to cultural and language diversity experiences.

As discussed in chapter two, the broader implications of multicultural diversity is lacking in the respondents understanding of the diversity that exists in their classrooms. Summarised, the

readings point out that classroom teachers' understandings of diversity must take cognisance of issues of oppression, structural inequalities including, (social, economic, political, educational), ethnicity, religion, gender, worldviews, lifestyles, communities, values and beliefs. Further considerations on multicultural diversity include Americanization, Eurocentrism, marginalisation, self-awareness and recognition, domination, assimilation, antiracism, prejudices, attitudes and tokenism amongst others. The reason for the respondent's limited understanding is twofold;

- ◆ Lack of appropriate training and knowledge in in-service teacher training programs, and
- ◆ where lack of appropriate knowledge and understanding prevails, people tend to fall back on their beliefs to support their understanding.

People's worldview, that is, the way they feel, think and act on/in particular issues/situation, portrays their *beliefs*. Bryan & Atwater (2002) state that significant research supports the fact that teachers hold beliefs about culturally diverse learners based on characteristics such as race, culture, ethnicity, language and social class differences. This however is only a superficial consideration of the issues of diversity, as the deeper dimensions arising from their perceptions of diversity tend to be ignored.

From the observed examples, although the teachers were aware that their pupils came from different socio-economic backgrounds they do not give due consideration to the issue of how poverty / low standard of living has created the unequal situation. Although the pupils have gained physical space in school, they cannot fit into the world of science, as a result of not being exposed to resources and opportunities necessary for a proper understanding of science and academic success in science. The data reveals that teachers view learners from a low socio-economic background as apathetic learners, difficult to control and showing inability to concentrate. Delpit (1992) considers this attitude a child-deficit assumption model, which she believes are indoctrinations from the negative models that teacher education focuses on. She strongly believes that teachers should have some knowledge of children's lives outside of school so as to recognize their strengths rather than their weaknesses. This could be achieved

by maintaining relations with parents, although this would be more successful for smaller classroom sizes compared to the current situation in the South African context.

In stories one and two (chapter four), cultural diversity is highlighted and the dilemma it poses in the multicultural science classroom. This re-enforces the respondents' perceptions that the most common form of diversity experienced in the classroom is one of culture especially when the culture of the teacher is different from the culture of the learner. This, from a teacher perception is viewed as a challenge or problem. Although the teachers are challenged by the Zulu cultural beliefs and its influence on the science curriculum, in story one the teacher decides to only empower the learners based on the human rights issues that are protected in the new South African constitution, leaving the decision with regards to the debate between traditional customs versus human rights to the learner. Further in story two, for Teacher A, the cultural challenge is also overcome by introducing the topic on animal sexual reproduction before dealing with Human sexual reproduction.

While one possible way around the controversy of virginity testing is given above, the debate to afford such a customary act due respect in the science curriculum, without denigrating the Zulu culture as a whole, still rages. "Sex education highlights another major problem for multicultural education: the incompatibility of contemporary feminist perspectives with traditional views of certain ethnic and cultural groups. Educationalists have to decide at what point the acculturation necessary for full participation in society becomes repressive assimilation; and at what point the celebration of diversity ceases to enrich and becomes potentially divisive" (Hodson, 1993:694).

Delpit (1992) also warns of stereotyping of learners or learner behaviour patterns. From the data presented in chapter four, teacher respondents have linked learner neatness to good homes and good behaviour. A further stereotype identified in the data is good behaviour being linked to better intellectual abilities. In her critical observation of teacher education programs, Delpit (1992:241) remarks, "It is in these programs that teachers learn that poor students and students of colour should be expected to achieve less than their *mainstream* counterparts."

In her talk on her paper *Education in a Multicultural Society*, Delpit (1992) speaks about some of the challenges faced in educating in a multicultural classroom. One of the issues she touches on is the school or its teachers viewing themselves as the “messiah,” existing for the purpose of saving the learner from the “ills” of its community. These ills, Delpit maintains, are mere perceptions or prejudiced beliefs held by teachers who do not have sufficient knowledge about parents and the community they teach in. The data in chapter four also points to such a perception being held by a respondent in the study. Often teachers believe that the notion of equality is synonymous with sameness, (Ladson-Billings, 1994). Delpit (1992) suggests that “...if one does not see colour, then one does not see children. Children made invisible in this manner become hard-pressed to see themselves worthy of notice.” This is evident also in two of the teacher responses as presented in the data in chapter four.

5.2.2 Teacher Perceptions and Practice of Curriculum

In terms of teachers’ awareness of how issues of diversity feature in the policy documents, Curriculum 2005 and the RNCS, all five teachers are aware that in the C2005 policy issues of diversity feature; although, their interpretations of the document varies in the way they deal with issues of diversity in the classroom. Furthermore, most of the respondents admit to not being entirely familiar with the content of the RNCS policy document. Some of the reasons given for their unawareness are the lack of work-shopping of the document and the many different policy changes during the course of the year that teachers are unable to keep abreast with all of these changes.

In the classrooms it was observed that the respondents do make efforts to incorporate examples of different cultures into their lessons. Even though they all agreed that the present school curriculum does not adequately cater for the diverse needs of learners, the respondents expectation is that management of the school should still drive curriculum change. All of the respondents focussed more on the inclusion of issues of diversity in pedagogy and classroom management, rather than in curriculum. It would seem that the school science that the learners are experiencing simply focuses on behavioural skills and static conceptions of knowledge. Real world problems would still need to be explored and incorporated. Some teachers have

tried to address this by linking their lessons to real life situations but others are teaching in a de-contextualised manner. According to Hodson (1999:787) “by grounding curriculum content in socially and personal relevant contexts, an issue-based approach can provide the motivation that is absent from current abstract, de-contextualised approaches”. In this manner learners are able to construct understanding that is personally relevant and meaningful. Lynch (2001) stresses the importance of managing a balance between issues of globalisation as well as adapting the curriculum to meet local needs of the community.

Several researchers have noted the turbulent conditions both leaders and teachers must work within to implement any new science education reform. “Turbulent conditions may take many forms, including distrust across decision-making and implementation levels, a lack of shared vision or understanding of urban education and the needs of urban learners, and sorely inadequate teaching conditions” (Kahle, Meece & Scantlebury, 2000 cited in Barton, 2002). Lack of proper resources for example intersects with how science gets constructed in the classroom. The fact that teachers may avoid practical lessons or simplify their lessons, (as suggested by the respondents of the study in chapter four), to bridge the language problem, and overcome the language barrier, but creates a new problem: the diminution of the science curriculum. Further “turbulence” is created when a watered down or diminished science curriculum is practiced which may allow students to participate in a “Science for all” approach, but, it will ultimately do little to empower the learners in the world of science. It also does not help in promoting language competency. School science as portrayed by respondents of the study, seems to regard low expectations as a ‘normal’ process of schooling. On a positive note, they do try to connect science to the lives of their learners. Although subjecting learners to diminished science content may be of benefit to the weak learner, it sidelines the exceptional one. Thus teachers may be failing to provide instruction that would support or enhance learning of all, which is the basic notion of the multicultural classroom. “It is important that teachers do not provide rationales for failure but visions of success,” (Delpit, 1992:246).

Story three as presented in chapter four indicates how understanding and knowledge of the learners’ community and culture can successfully help to incorporate the Zulu culture into the

science curriculum without any modern scientific explanation or understanding being lost. Similar to the problems in the United States the number of non white teachers in South Africa lags far behind the ratio of non white learners. According to Delpit (1992:237) “the question is not necessarily how to create the perfect culturally matched learning situation for each ethnic group” but to train teachers on diverse cultures so they can successfully adapt the science curriculum to be more relevant to the non white learners.

5.2.3 Teacher Perceptions and Practice of Language issues

According to Hodson (1999:785) “language usage is an important target for curriculum reform, especially in the context of multicultural and antiracist education.” It has been observed that language of school science plays a prominent role in creating barriers to universally accessing science, as “.... it differs from other ways of knowing, based on personal beliefs, myths, religious values and supernatural forces, (Lee, 1997:116). Some of the responses from the sample of teachers in the study illustrate the barriers posed to the Zulu learner in the science classroom:

- ◆ The data reveals that the second language English teacher is forced to infuse mother tongue IsiZulu to drive home a point in the science classroom.
- ◆ Teachers not fluent in IsiZulu, mindfully use translators selectively for some scientific explanations.
- ◆ Learners themselves have expressed that understanding generally happens through mother tongue, and when no word exists in the mother tongue for a scientific term, understanding becomes extremely difficult.
- ◆ A possible solution is to keep very close to words and their meanings that have been adopted into the language, so as to improve explanations and understandings. An example is “Zulu-wised,” when an IsiZulu word of similar meaning is used for a scientific term. In this manner the IsiZulu word is now given an additional meaning over and above its original meaning. This may however, lead to misconceptions regarding the true essence of the scientific term.

All respondents agreed that code-switching was an effective means of clarification of concepts to English second language learners. It has been found that in most classes code-switching is practiced however the manner in which it is used varies from teacher to teacher. Code switching or code mixing refers to switching between two languages where the speaker has some measure of competence (Rollnick, 2000). It has been observed in studies how the two languages were used to provide contexts for meaning and was used to explain difficult concepts in the classroom. Rollnick (2000) in her study noticed in biology lessons, that switches to IsiZulu, provide contextualisation cues which are semantically empty but alert learners to the fact that a key term is about to be introduced for the first time.

The data for my study, as presented in chapter four indicates that the respondents learn and then use first language greeting and reprimand terminology to maintain discipline in the classroom. Observations made by Delpit (1992) also re-enforces this finding, where White teachers who were perceived to be afraid of Black kids in urban American middle schools, were found to consistently have the most difficulty with teaching and whose learners have the most difficulty with learning. “These differences in discourse styles relate to certain ethnic and class groups. For instance, many African American teachers are likely to give directives to a group of unruly students in a direct and explicit fashion, e.g., I don’t want to hear it. Sit down, be quiet and finish your work NOW!” (Delpit, 1992:238). The teacher displays a high degree of personal power in the classroom compared to many middle-class European American teachers who use *indirect* commands and downplay the display of power. The explicit manner of instruction is what the learners hear at home, and in the second case, it sounds like someone who is fearful, less deserving of respect, and thus, learners will obey the explicit directive, and ignore the implied directive. This is evident in the data as determined from the respondents during the interview, indicating that learners respond more positively to IsiZulu reprimands, because the language brings across the command more explicitly or “seriously,” as used at home.

Story four and five in chapter four enforce teachers’ perceptions of the language barriers. As observed in practise in the classrooms, code-switching is used to partly overcome the language

barrier, but problems still exist. One of the teachers has suggested starting a proper language register of the different subjects which should be taught in mother-tongue at an early stage, thus enabling the learners to develop solid background schemata. The teacher believes that this is extremely important for understanding of scientific terminology and concepts. Again, increasing the number of IsiZulu speaking teachers in multicultural schools is necessary for the future, alternatively, training culturally different teachers to become proficient in IsiZulu.

5.2.4 Teacher Perceptions and Practice of Gender issues

Traditionally literature revealed world over that girls have been prevented access in science education through various means e.g. curriculum which reflects a masculine voice. However, there has been an interesting twist in this environment of study, where there seems to be no gender stereotyping in terms of excluding girls from the world of science i.e. science was not seen as the domain of boys. Science teachers seem to have taken into account feminine rights, and attempt to correct past handicaps in science learning. This is evident from the fact that the teachers specifically called upon girls to answer their questions.

There seems to be a subtle change in that boys rather seem to be ‘overlooked’ in the classroom. Possible reasons for this could be:-

- ◆ Girls seem to be more fluent in second language English than boys. They tend to display better understanding of content.
- ◆ Teachers are probably acutely conscious of the fact that girls must be given equal opportunity and empowerment.
- ◆ Girls in this environment seem to be more enthusiastic than boys, they do their homework etc., boys seem to be indifferent.

In trying to correct the injustices of the past – a negative image of boys is being induced. This is a typical example of a remedy to diversity issues, that tries to correct one injustice but inevitable creates another. This is evident in the sociograms, figures 4.6 to 4.10, in chapter 4.

5.2.5 Teacher Perceptions and Practices of Teaching and Learning

The five respondents in the study indicated that their teaching methods have changed over the past few years to accommodate for the diversity of learners in their class. They speak of the shift in teaching style where now, 'learners are actively involved' in the lesson. It has been found that this statement means different things to the respondents. In some instances active participation means teacher led class discussions, for others it could mean practical work or even group work. Active participation does not simply mean using different teaching methods but rather achieving the desired outcomes. The respondents do make an effort to fill in the background schemata of their learners via brainstorming, reviewing and reflecting, discussions, reflecting on prior knowledge, explanations, etc. The data also reveals that teachers are aware of the interesting and innovative ways of teaching diverse learners however on a practical level they do not create new opportunities for pupils to explore science on their own via research / interactive projects. In essence they have lost sight of the nature of science which involves inquiry and discovery, investigations, experimentation, problem solving which must be influenced by societal, cultural and personal beliefs of viewing the world.

"Teachers can, (and usually do), decide what will and will not be talked about who has the right to speak and for how long, what is the "correct" way to speak and to behave while speaking and listening, and what counts as legitimate knowledge, satisfactory evidence and proper argument" (Hodson, 1999:785). Moll (1992) in a review of recent trends that challenge a low level emphasis on learning for language minority students asserts that most schools fail to use the varied, rich family and community resources that students bring with them. This failure happens in part because both bilingual and non-bilingual programs make assumptions about the limited resources and consequently the perceived academic abilities of language minority students, (Nieto, 1995).

It would seem that nothing has been done to create a resource centre for example within the school environment. This shows that the issue of socio-economic background is merely noted but not acted upon. Also, as Tobin (2000) cited in Barton (2002) suggests that low expectations for high poverty youth are sustained in schools as part of the 'normal' process of

schooling through activities and mandates such as streaming learners, teaching to test, the unequal distribution of academic resources, curricula geared towards minimal attainment and with beliefs such as these learners will be difficult to teach. The nature of the learner's background (example the absence of the culture of homework, lack of intrinsic motivation, etc) simply has been accepted, without too much effort being made to change this in order to truly empower their learners in the world of science.

As much as there may be many shortcomings in the way the teachers handle diversity, it is most encouraging to note that the teachers are conscious of diversity. They have come a long way from Eurocentric and 'apartheid' type education and are aware that South Africa is *not* a homogeneous identity on the basis of culture and race. They do acknowledge the cultural diversity of the learners and try to incorporate this cultural diversity into their curricula. They may fall short in a holistic handling of diversity due to the many constraints and difficulties that they encounter such as lack of proper resources, large classes, limited finance, discipline problems, lack of support structures and limited teacher development programmes.

Teachers feel that they need to do a lot of talking and explaining which suggests that they haven't shifted the responsibility of the learning to the learner. Whole class discussions are the most favoured method of teaching. This method is probably most favoured because it enables the teacher to continue to be in control of the lesson despite learner involvement. This suggests that teachers still have not defused the power relationships that exist in the classroom, which could intimidate learners into silence during the lesson.

Although some teachers speak of group-work and co-operative learning their lessons were purely class discussions. This was probably due to the fact that the lesson was an introductory one or simply that there is a disjuncture between teacher talk and practice. The respondents mentioned that they use a lot of worksheets, which was evident in the classroom observations. The reason given for this was the lack of apparatus as well as text books. Teachers suggest that the use of more pictures and practical work improves science teaching and learning, which was evident in the classroom observations. This shows that some teachers are aware of how their

learners prefer to learn and are using these creative methods in their classrooms.

Teachers have it in mind that students will arrive at particular understanding, i.e. the scientific knowledge specified in the curriculum plan. Teachers are known to define and control classroom discourse in order to achieve these outcomes by asking specific questions; directing attention to some things rather than others; introducing easy ways of arriving at preferred solutions and acceptable views (Hodson, 1999). In this way teachers not only define the topic for discussion but establish the criteria of relevance and appropriateness by validating particular views and ignoring others.

Story 4 of the episodic teacher moments also brings up the issue of teaching and learning styles. When clarifying a concept after it was taught with current day examples, second language English learners, could not easily relate the examples to the concept taught/learnt, and accused the teacher of confusing them. As opposed to story 3, related by a Zulu teacher, in story 4, the learners failed to see the link between the example and the scientific concept, whereas, with appropriate background knowledge of the Zulu culture, in story 3 the respondent used a culturally relevant example to drive home the scientific concept. "Language and culture cannot be separated from learning content," (Lynch, 2001:623). This is an indication that respondent in story 4 has not contextualised science teaching and learning so that it is relevant to the learner. As previously quoted from Delpit (1992), the solution is not necessarily to have a Zulu teacher in every classroom, but to recognise the learner's problem, and seek its solution in the broadest way. Knowledge of culture is just one tool when devising solutions.

Also noted in story 4 was the inability of learners to link more than one example or situation to a concept taught, whereas the respondent relating story 5 has the challenge of learners having insufficient background knowledge to build on new concepts. Delpit's (1992) *child-deficit assumptions*, asserts that instructions that focus on isolated, de-contextualised examples, become boring and meaningless when not placed in any meaningful context. When instruction allows no opportunity for children to use their mind to create and interpret concepts, they will focus on low-level thinking and their school-based intellect will atrophy.

5.3.1 Recommendations

It is evident from the above summary based on data derived from five science teachers in KwaZulu-Natal, that the issues surrounding success in a multicultural science classroom are indeed complex. As my study is framed at an interpretive level within a social-constructivist paradigm, I have come to the conclusion that the sample teachers in this study are not ready for the cold, blatant, confrontational, radical, (anti-racist), type sweeping transformation in our everyday classroom endeavours. My findings strongly point me to the need for greater interpretation and better understanding of teacher behaviour in multicultural classrooms. Teachers clearly need to go through their own “truth and reconciliation” phase, which can only be achieved at our teacher training colleges, in-service training programs and workshops.

The literature reviewed clearly gives clues as to why the interpretive stance bears longer term fruits. In my literature review, I have come across a myriad of classroom cases across the United States clearly showing how ethnic minority learners have been disadvantaged as a result of teachers' failure to reconcile truths, myths and beliefs, (perceptions), when confronted with diverse multicultural classroom settings. These cases cut across the American geography, yet they have been grappling with multicultural education for decades before us. While our S. African setting or context might be unique, the American theory surrounding teacher behaviour certainly does apply. I would like to take my cue from Bryan and Atwater (2002:834), as it appropriately has a science education slant to it. “Of the studies we reviewed, almost all of them concerned elementary, reading, or language programs. Considering that the disciplines of mathematics and science are often viewed as unbiased, it seems incumbent upon our field to engage in studies that reveal the ways in which the teaching and learning of science are based on teachers’ cultural beliefs and assumptions.”

- ◆ Research has shown that knowing teachers’ beliefs and designing instruction to explicitly confront those beliefs facilitate refinement of and/or transformation of held beliefs and practices.

While most of Bryan and Atwater's study involved pre-service teachers, they have warned that changes in beliefs do not always translate into changes in practice. I however find implications for the S. African context with regard to emphasizing the relationship between beliefs and practice amongst pre-service teachers, for they are our future teachers, and thus breaking down the barriers of prejudices and stereotypes at that early stage is paramount to successfully achieve equitable science education in our multicultural classrooms.

- ◆ To overcome the above described failure of translating appropriate new beliefs into appropriate actions, Bryan and Atwater recommend further research to examine both beliefs and actions to develop the concept of praxis within science teaching and *science teacher education*, which leads to my next point.
- ◆ for successful changes to occur, both pre-service science teachers and *teacher educators* must challenge, confront, refine and sometimes change their beliefs and attitudes.
- ◆ This I believe can be achieved through in-service teacher training programs, and workshops based on latest developments in science education.
- ◆ This study also clearly shows that issues of language and curriculum are concerns for the respondents. Delpit (1992:247) sums up and I concur that “we should strive to make our teaching force more diverse, for teachers who share the ethnic and cultural backgrounds of our increasingly diverse student bodies, may serve with parents and other community members to provide insights that might otherwise remain hidden.” This does not mean that excellent teachers of diverse learners' *must* be of their learner's ethnicity. There are many excellent teachers who have already taken those bold steps of crossing the cultural border into the world of their learners so as to provide meaningful science experiences to their learners, and there are far too many excellent teacher educators and education administrators who have also crossed those borders, but in the grand scheme of things, they are still too few.

- ◆ We need to overcome the narrow Eurocentric curriculum that teachers need to teach. The new teacher training courses “must *not only* educate on what White Westerners have to say about diverse cultures, they must also share what writers and thinkers of diverse cultures have to say about themselves, their history, music, art literature, politics and so forth” (Delpit, 1992:247).
- ◆ Nieto best sums up my thoughts on the above recommendations, “Addressing the problems of inequitable and disempowering education means looking carefully at our own practice as teachers, and asking hard questions related to the curriculum and context for learning. Coming to terms with our own biases, including our unacknowledged racism, sexism, and classism and how they get played out in relations with students and their parents, is an especially necessary process” (Nieto, 1995:213).

All five respondents’ personal educational experiences have been mono-cultural and they have therefore been socialised into accepting racial divisions. There is need for professional development efforts to help educators broaden their perspectives and deepen their understanding of the diverse learners they are faced with and adapt their teaching methods and curriculum to achieve equity in science education:

5.3.2 A model for understanding and accommodating diversity in the classroom

(adapted from Pettigrew & Akhwrst, 1999)

- ◆ *Must be based on the premise that all learners are unique.*

Educators should be guarded against stereotyping and holding onto damaging assumptions. For example research indicates that teachers who stereotype can lead to the learner not receiving appropriate instruction. Delpit (1992) argues that there is a widespread belief that

Asian American children are the “perfect” students, that they will do well regardless of the academic setting in which they are placed. This stereotype has led to a negative backlash in which the academic needs of the majority of Asian American children are overlooked. This could be the case in the research school where Coloured and Indian learners are believed to better understand the work and are overlooked. The case of treating ‘all learners the same’ could also be a problem, as all learners do not have the same needs. I therefore suggest that teachers treat learners according to their individual needs.

- ◆ *All learners are special regardless of their physical, intellectual, social, emotional and language differences.*

Teaching methods should take cognisance of reading, writing and listening skills as they all play a part in the development of scientific understanding.

- ◆ *All learners should have the right to participate in and have access to the best possible education, irrespective of their race, class, disability, language, learning styles, gender, previous learning experiences and any other forms of diversity. This is any model must be based upon the values of social justice and equity.*

Teachers should not try to bridge understanding by diminution of content but should rather strive to promote excellence.

- ◆ *We therefore need to restructure schools and not learners to meet the diverse needs of all learners.*

Teachers in diverse classroom settings must use as many teaching strategies as possible in order to accommodate and cater for the range of learners in the classroom. More training in this regard should be provided.

- ◆ *Schools must communicate to their learners such that each and every one of them is a valued member of that learning community.*

Educators should not seek to create the perfect ‘culturally matched’ learning situation for each ethnic group but rather learn to recognise when there is a problem for a particular child they

should seek to use their knowledge about the child's culture as a tool to solve the problem. Teachers must have knowledge of learners' lives outside of school in order to be aware of the difficulties faced by their children in order to assess their academic problems and formulate adequate solutions

5.3.3 Implications for Curriculum Developers and Textbook Writers.

Jegade (1994) commented that the best way to improve science education in Africa involved the application of situated learning with sensitivity to local culture, to facilitate learning science as understood in western society included:

- ◆ Generating information about the African environment to explain natural phenomena.
- ◆ Identifying and using indigenous scientific and technological principles, theories and concepts within the African society; and
- ◆ Teaching typical African values of humane feelings in relation to and in the practice of technology as a human enterprise, (Jegade, 1994:130).

5.3.4 Recommendations for Further Research

One of the findings of my study is that due to a lack of understanding of our learners' backgrounds, teachers of science have great difficulty adapting the curriculum so as to make the content meaningful to the multicultural learners. A study which specifically looks at concepts in Biology or Physical Science in relation to the African culture would be able to establish how these subjects could more readily lend themselves to issues of multicultural science education, i.e. the process of localising science.

5.4 Conclusion

The task of the school as an institution is a multifaceted one, it is not just a place for the passive transfer of knowledge, a myriad other 'transactions' are occurring a number of them, unbeknown publicly. The school as an institution has a dramatic influence not only on the performance/competence of a learner, but also on shaping an individual and thus on determining the quality of our society. By its very definition/nature a major role-function of the school is to mould a functional, wise and competent individual. Thus the multifaceted nature of schooling / education cannot be ignored, or else the schooling system will be failing the very ones they are designed to help.

In an education system in transition, one that is trying valiantly to redress the injustices of the apartheid regime, our schooling institutions are facing a number of unique challenges. My study, along with the literature reviewed has attempted to highlight these. Amongst these are the preconceived ideas that science teachers hold about their learners, the background of the learners, their classroom abilities, the curriculum to be taught, and 'best' teaching and learning methods. What clearly emerges from my study is the fact that though the teachers may feel that they are coping adequately with the challenges of a multicultural classroom, they do in fact seriously need help and knowledge in further formulating their outlook on what are really the dynamics at work in a multicultural classroom. Teachers need to make changes in their perceptions on what (curriculum) constitutes successful science learning in a multicultural setting and furthermore how (methodology) to achieve success in a multicultural science classroom.

I thus conclude that this study which can be corroborated with and by more studies in other parts of the country, with calls for radical changes in training of pre-service teachers, and appropriately designed in-service programmes and workshops for in-service teachers, to address successful science learning in our multicultural classrooms. "In order to teach you, I must know you. I pray for all of us the strength to fight to teach our children what they must learn, and the humility and wisdom to learn from them so that we might better teach,"

(Delpit,1992:249). Schools are here to serve the needs of the learners and the nature of learners should therefore determine the teaching strategies employed to reach these learners – poignantly bringing home the above maxim.

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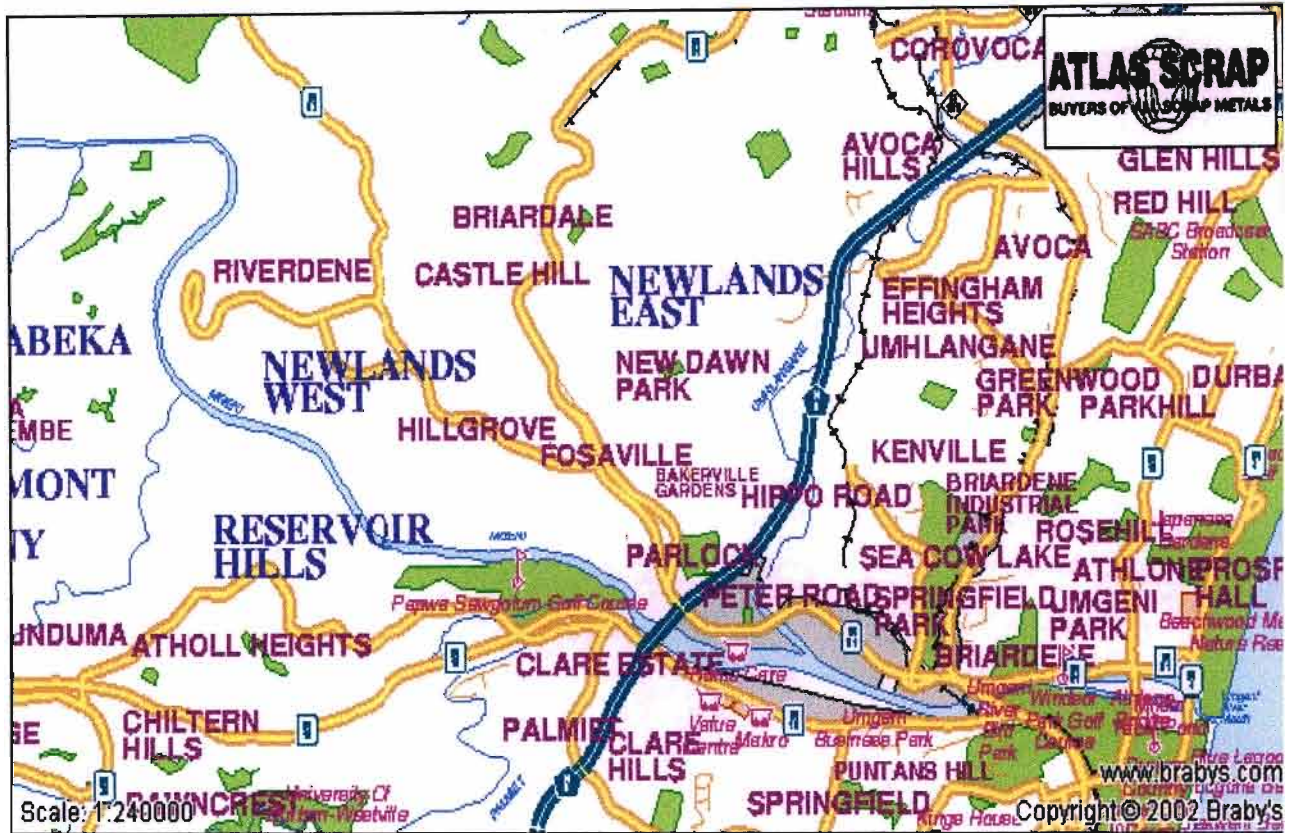
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APPENDIX 1



Detailed map representing the Newlands East area in the province of KwaZulu-Natal.

Reference : <http://www.brabys.com>

APPENDIX 2
INTERVIEW SCHEDULE
(Teacher)

This structured interview schedule is designed with the intention of determining the extent to which teachers recognise the multicultural diversity in the science classroom and how this knowledge informs classroom practice.

SECTION 1: BIOGRAPHIC DATA

Which grades do you teach: _____

Male / Female: _____

Qualifications: _____

No. of years teaching science: _____

Race: _____

Language Proficiency: _____

SECTION 2: DIVERSITY DEFINED

1. What is your definition/idea of diversity amongst learners?

2. Does your school have learners from diverse backgrounds?

| | |
|------------|-----------|
| YES | NO |
|------------|-----------|

3. Describe in your own words the characteristics of a diverse group of learners?
(eg. How they would behave/learn/look etc.)

4. How would you describe the demographic composition of the learner population at your school?

SECTION 3: LANGUAGE ISSUES

5. What is the medium of instruction in your science classroom?

6. What percentage of your class is made up of English second language learners?

| | | | | |
|------------|-----------|-----------|-----------|----------|
| 80 - 100 % | 60 - 79 % | 50 - 59 % | 40 - 49 % | 0 - 20 % |
|------------|-----------|-----------|-----------|----------|

7. Do you use code-switching during your lessons. If so, when does this happen? (eg. During instruction, when reprimanding, to manage discipline or to define concepts, etc.)

8.1. Do you believe that being conversant in Zulu is an advantage in your science classroom?

| | |
|-----|----|
| YES | NO |
|-----|----|

8.2. How is it an advantage and in what way?

9. Do you encourage gender stereotypes in your classroom e.g. “ Boys can only clean the chalk- board”.

| | |
|-----|----|
| YES | NO |
|-----|----|

10. How do you deal with gender sensitive issues in your classroom?

SECTION 4: LEARNER COMMUNITY PROFILE

11. What is the name of the suburb where most of your learners’ live?

12. How would you describe the socio-economic status of the above community?

| | | |
|--------------------|---------------------|--------------------|
| Upper income group | Middle income group | Lower income group |
|--------------------|---------------------|--------------------|

13. Do you also live in the same suburb?

| | |
|-----|----|
| YES | NO |
|-----|----|

SECTION 5: TEACHING & LEARNING

14.1. Did you feel the need to change your teaching approach to cater for the diverse needs of the learners?

| | |
|-----|----|
| YES | NO |
|-----|----|

14.2. If yes, what specific methods / means have you used to cater for the diversity in

your classroom ? Explain

15. How successful have you been in dealing with diversity through the use of these teaching methods ?

16. Have you ever asked your learners how they would like to learn ?

| | | | |
|-----------|-------|-------|--------|
| Sometimes | Never | Often | Always |
|-----------|-------|-------|--------|

17. Indicate if the following teaching methods are used in your science classroom?

| | Sometimes | Never | Often | Always |
|------------------------|-----------|-------|-------|--------|
| GROUP-WORK | | | | |
| STORY-TELLING | | | | |
| ROLE-PLAY | | | | |
| REVIEWING & REFLECTING | | | | |

18. What are the different types of resources used during a lesson in your science classroom?

19. How do you make use of learners' everyday experiences in your classroom?

SECTION 6: CURRICULUM

20. In what way has the curriculum catered for cultural differences in this school?

21. What suggestions can you offer for changing the present curriculum to cater for diversity in this school?

22. Are you aware of how issues of diversity feature in Curriculum 2005 or the Revised National Curriculum statement policy documents? Explain.

23. Describe a significant / compelling event experienced by you in your interaction with diverse learners.

THANK YOU FOR YOUR TIME & SUPPORT.

APPENDIX 3

OBSERVATION SCHEDULE

Teacher's Name: _____

Date: _____

Lesson No.: _____ Venue: _____

Approximate duration of Lesson: _____ minutes

This schedule is to be completed by the researcher while and after observing the lesson. The researcher will tick (√) or cross (x) relevant blocks and comment where necessary.

CLASSROOM ORGANISATION:

1. How are learners seated?
 - (a) Alone at individual desks.....
 - (b) In pairs at 2 seater desks.....
 - (c) In groups at desks.....
 - (d) Other, specify.....

2. How are learners seated?
 - (a) Randomly.....
 - (b) According to gender.....
 - (c) According to race.....
 - (d) Other, specify.....

3. During the course of the lesson, does the teacher?
 - (a) Remain in one place.....
 - (b) Move around the class interacting with learners.....
 - (c) Other, specify.....

Any other comments.

LESSON STRUCTURE:

4. What is the science topic addressed in the lesson?

5. What teaching method does the teacher adopt for the lesson?
 - (a) Whole class teaching.....
 - (b) Whole class discussion.....
 - (c) Learners working in groups.....
 - (d) Learners working alone.....
 - (e) Other, specify.....

6. Does the nature of the environment created in the classroom include?
 - (a) Visual aids.....
 - (b) Resources.....
 - (c) Scientific apparatus.....
 - (d) Other, specify.....

7. Is the lesson?
 - (a) Teacher-centred.....
 - (b) Learner-centred.....
 - (c) Other, specify.....

LANGUAGE:

8. What is the medium of instruction in the classroom?
 - (a) English.....
 - (b) Zulu.....
 - (c) Afrikaans.....
 - (d) Other, specify.....

9. How are the learners allowed to express themselves?
 - (a) Language.....
 - (b) Drawings.....
 - (c) Models.....

10. Is code-switching allowed during the lesson?
 - (a) Yes.....
 - (b) No.....

11. When is code-switching used during the lesson?
 - (a) Instruction.....
 - (b) Reprimand learners.....
 - (c) Manage discipline.....
 - (d) Define concepts.....
 - (e) Learner discussion.....

LEARNER PARTICIPATION AND INVOLVEMENT:

12. Do all learners participate actively in the lessons?
 (a) Most (about three quarters).....
 (b) Some (about half).....
 (c) Few (less than half).....
 (d) None.....
13. Who are the learners who answer the teacher's questions?
 (a) English first language learners.....
 (b) English second language learners.....
 (c) Male learners.....
 (d) Female learners.....
 (e) Other, specify.....
14. Indicate the type and extent of learner involvement during the lesson

| | | | | | | | |
|------------|---|--------------|---|------------|---|--------------|---|
| Not at all | 1 | Occasionally | 2 | Frequently | 3 | All the time | 4 |
|------------|---|--------------|---|------------|---|--------------|---|

- (a) Listening to the teacher.....
 (b) Observing demonstrations.....
 (c) Copying teacher's notes.....
 (d) Memorising and or repeating words or scientific terms.....
 (e) Responding to teacher's questions.....
 (f) Asking questions.....
 (g) Completing tasks/activities in their exercise books.....
 (h) Discussing with peers.....
 (i) Writing their own notes.....
 (j) Marking/reviewing of own/other homework/class work.....

TEACHING & LEARNING:

15. Are different teaching methods/approaches used during the lesson?
(a) Yes.....
(b) No.....
16. What are the different teaching methods used?
(a) Group-work.....
(b) Story-telling.....
(c) Role-play.....
(d) Reviewing and reflecting.....
(e) Other, specify.....

CURRICULUM:

17. Does the curriculum content encourage learners to reflect on their prior knowledge?
(a) Yes.....
(b) No.....
18. Do the worksheets / textbooks / discussions during the lesson reflect different cultures?
(a) Yes.....
(b) No

APPENDIX 4A

Question 23 - Interview Schedule

Describe a significant / compelling event experienced by you in your interaction with diverse learners.

Transcripts of the five teachers' responses.

Teacher A

Hmm what I actually deduced was a situation where animals were mating just to The concept more depended and consolidated an understanding and making some links to real life because one cannot assume that learners know exactly what adults do or not do especially during reproduction where the male sexual organs and the female sexual organs are coming to play and hence such a topic is also taboo in their own families. What I did is I compare ahh animals which they see in their daily lives like dogs. I mean in this case it would be a female dog and a male dog and I ask them to describe what parts sexual organs those animals have they would name them and they would say what is happening and they would understand fully what is happening at that point . Ja, and to ensure participation as well because one must acknowledge that in most cultures this topic is taboo even mentioning such parts is also taboo hence they would come up with other names associated with that part rather than naming it directly. So that was a way in which getting learners to participate more and feel free to discuss these issues and what I've observed is with animals, that most of the class have seen those animals they have indicated to me by show of hands and they seen what they do and they can possibly even name some of the parts sexual parts, on the animals and then we would shift gradually towards human beings who are more discreet than what animals are. Hmm what made it significant is the fact that the learners find it difficult to relate to it and could not express themselves freely to something so important in a High School child's life at this stage of their development where they need to know the body parts and they need to know exactly what they are and what and how they respond when you do certain things to them. The cultural practices and beliefs from the children, from their families is coming through in education, and I would really like to empower my learners to know themselves to know their body parts and how these affect their lives directly.

APPENDIX 4B

Teacher B:

Okay, it was a period where I had given a test and ahh the learners had written the test and the following day when I had finished mark the test, I was horrified 99% of the class had failed and I thought it was my fault because I didn't take into account that I was teaching children from different cultures and that the work was too difficult, the language was too difficult and they didn't understand. It's not so much that they didn't understand the work, they didn't understand the questions. That is why they couldn't answer it, so what I tried to do after that; it made me change in a way that I had to ahh always give background to every science lesson that I teach. I couldn't take it for granted that I am just teaching that topic I had to go and teach from scratch because you find that they don't have any background at all. So and I had to put everything into much simpler terms and simpler language because other than that they definitely didn't understand and then after a retest I found that they did much better where the questions were in simpler form in their own way of understanding. So that really opened my eyes and for me it really helped me and them.

Teacher C:

22. As a teacher I always felt a need and to digress in my teaching in a sense that if I was explaining something to them, I will try to show them the link in other subjects or other learning areas or even in real life what it meant and where it would fit into their real life. One day one of my African students he raised his hand and asked me do I drive, so I said yes I did. He said to me when you driving on the freeway and you know the traffic goes in one direction, do you drive in the opposite direction to the way the traffic is going. I said no I've got to drive in the correct way. He says but that's how you teach in the classroom, he says you try to tell me too much and all I wanted to do is I only want you to just teach me what I need to know and I found that so strange because I felt that it is my responsibility as an educator to make the learning significant and show them how they can experience it and over the year's I've tried to use that as my guide and I found that being second language learners and trying to learn science they want it to be phrased in a simple language as possible. They don't want you to digress off the topic; they don't want you to give them too much detail that actually confuses them. So they want you to say everything as simply as possible and I have refrained from doing that again but what I try to do is those that I know that are high order learning I now will call them aside and I will only digress or explain to them in great detail where this fits in real life and in higher order learning to those few. Because the rest of them are really not interested or maybe they just can't comprehend it. I've tried to simplify the science at the same time I'm not trying to trivialize it but put it in a simpler language as possible that makes or tries to make it accessible to them.

APPENDIX 4C

Teacher D:

It was one incident where we were talking about symbiotic relationships in biology What I brought to the floor for the learners was that one of this symbiotic relationship which isis actually an ancient African tradition which encompasses the spirit of Ubuntu, where in an instance, one partner gains while the other is not being affected in any way. So I made an example that if within the spirit of Ubuntu. Before ...you had your neighbour who maybe had only one cow and the next door neighbour had ample cattle so he will lend out one bull to mate with the cow, we called it “ubusisa” in Zulu meaning after that years after mating obviously the cow will give birth to a calf which means that family will be able to gain milk out of that to make maas and eat and at the same time being able to have two cows instead of one. Once the whole process is finished the bull will be taken back to it’s original owner which then translates into the owner of the bull doesn’t loose anything but still maintains the virility of his bull but at the same time he has helped the neighbour. So withit is the same thing that even it did not only apply to some of our learners, ahh coloured learners only. It was broad spectrum because we found that some of our Africans that didn’t know about this practice that took place ahh long time ago. And so after that you know they started asking me questions about “but then sir what if the cow dies or the bull dies you know” it’s more of a mutual agreement that takes place. Take into consideration that if you give out this help the person that is given help will look after the bull up until it is returned back, you see. So I thought that when the moment I introduced commensalisms in that way they are able to understand that relationships do not only apply to animals as such, but even with tradition and customs and goes way beyond biology and also the sociological aspect of it. People do actually practice ahh these things which are being practiced by other organisms in the particular ecosystem.

APPENDIX 4D

Teacher E:

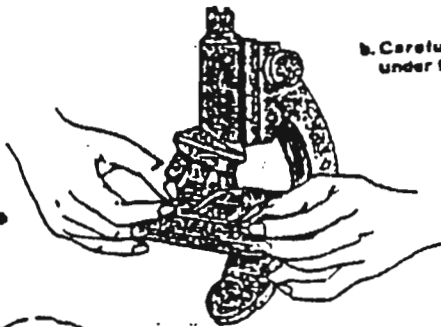
Ahh, yes it was a few years ago where we were dealing with Human Reproduction and I had the female reproductive system ahm and I showed them the diagram on the OHP and someone picked up their hand and asked me where the hymen was and I explained about the hymen and then I went on and explained that the hymen can not really be ahh you can't actually have a clear way of indicating whether someone has a hymen or not because sometimes if you are a very active, fit person, and if you play karate, riding a bike or whatever, you can lose your hymen, you can tear the hymen and you wouldn't know. So it doesn't necessarily mean that if you have intercourse for the first time, and you don't bleed, you were never a virgin. Children picked up their hands and they talked about the Zulu culture where they actually have virginity testing. They do virginity testing ahm and they take these girls and they take them to this river and they actually lie them down and they pull their legs apart and there is a lady that goes there and actually has a look and she looks whether you, whether there is a hymen there. Unfortunately not everyone has the hymen. So I said to them it is not fair, and they said to me, "no Miss, we won't have the hymen there," that they were actually using some kind of object to test. I was absolutely floored by that because, what they do is they take a thorn when they turn 12, and they take this thorn and they tear the hymen so that when they think of sex, about interacting with a boy, when they get older and start liking boys, they are going to think about the thorn and the pain and that should put them off intercourse. What that did to me was that it shocked me because I'm a person who is constantly dealing with trying to empower women. I could not believe that in this day and age that we are still,.. these girls are coming here learning all these topics, learning all of these things but they are still going home and they are still getting their hymen torn with a thorn. I could not believe that and they were allowing it to happen to them.

You see, the difficult part for me, the most compelling part for me was that this was a ahh custom, this was a practice. So ahh who am I by telling you that no one should tear your hymen am I telling them to go against their customs and traditions, their belief system. But at the same time you've got to look at it ahh in what society. This leads you to the question, Is science and culture actually linked? Because if you listen to, if you look at what we are teaching in science, what we believe in, and what is out there with regards to the African philosophy on how they view culture, it is not the same. They are not running parallel to each other, they are actually miles apart from each other. So that made me think that if we look at the evolution, the big bang theory that tells you if you going to go pro, if you going to believe in that, it means that you going to be some how saying that your religion doesn't believe in it, your religion believes that there was Adam and there was Eve. So what we are teaching and what we truly believe arethey contradict each other and that is what this event did to me, it made me realize that I need to think deeply about the concepts of science and the African traditional beliefs and we need to work more to try and link them but in reality they are absolutely diverse, they are not the same.

APPENDIX 5A

ADJUSTING THE MICROSCOPE

a. make a drawing of the letter "a" as it appears to the naked eye.

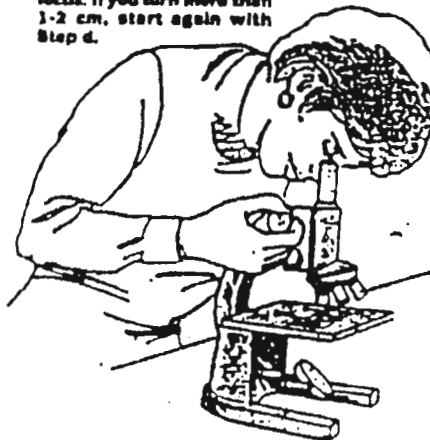


b. Carefully insert the slide under the clips.



c. Position the "a" over the hole in the tube. The "a" should still be side up.

d. Look into the eyepiece and slowly turn the coarse adjustment to raise the tube. The "a" should come into focus. If you turn more than 1-2 cm, start again with Step d.



d. Looking at the low power objective from the side, be sure the objective so that it almost touches the slide.

f. Finish focusing by turning the fine adjustment.

g. make a drawing of the "a" as it appears under the microscope. Indicate the magnification of the letter next to the drawing.

h. Turn the objective to the next higher power.

i. Do not touch the coarse adjustment. Focus with the fine adjustment only.

j. make a drawing of what you see. Indicate the magnification of the letter.

QUESTIONS

1. When you move the slide in one direction, which way does the image move?
2. What part of the low power image do you see when you change to a higher power objective?
3. Do you see more or less of the sample as the magnification is increased? Explain.

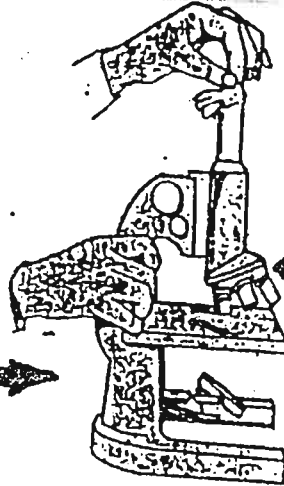
The purpose of the microscope is to magnify objects. The microscope is an expensive and delicate instrument. Treat it with care and it will enhance your sense of sight.



a. Carry the microscope with both hands, one hand under the base, and the other on the arm.



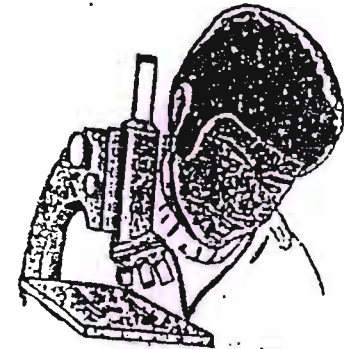
b. Set the microscope in front of you with the arm nearest you.



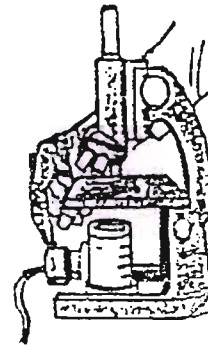
c. If necessary, clean the lenses with lens paper only. The lens paper will not scratch the lenses.



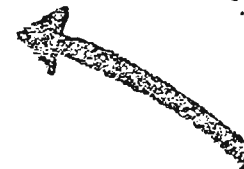
d. Look at the eyepiece and you will see a number with an "x" after it. The number is the magnification of the eyepiece. The "x" means "times." Record the magnification in Question 1.



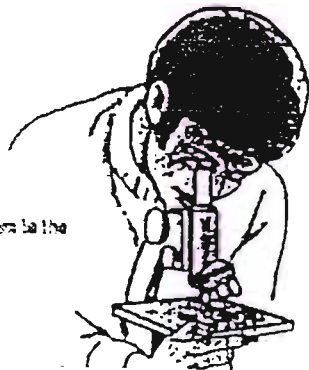
e. Look at each of the objectives. Record the magnification of each objective in Question 2.



f. If your microscope has a light, turn it on.



g. Turn the objectives with the coarsest magnification until it clicks into place under the body tube.



h. The slide goes in the opening.

