TALKING ABOUT SCIENCE:
A DISCOURSE ANALYSIS OF WOMEN'S VOICES

By

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DEDICATION

To my parents, husband and children
for enduring my absence from home.

University of Fort Hare
Together in Excellence

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I would like to express my gratitude to Professor Fihla (Dean of Faculty of Education) for patiently overcoming the many administrative problems I encountered throughout my study period.

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ABSTRACT

Gender differences, especially in science-related fields form the focus of much current research.

The purpose of this study was to investigate problems faced by black, female South African students as they pursue science subjects, as well as identifying possible solutions to these problems.

These problems which these students face and their possible solutions were identified through a study which sought answers to the following research questions:

(1) *What do black female students in high schools in South Africa perceive to be the possible causes of gender differences in perceptions and attitudes towards science subjects and what do they suggest as possible solutions to these problems?*

(2) *According to black female professional scientists, what are the causes of gender differences in perceptions and attitudes towards science subjects in South Africa and what do they suggest they do/did to overcome these problems?*

An interpretative cultural framework underpins this investigation. Within this perspective, a discourse analytic methodology was adopted.

A review of literature revealed that in most countries, more males than females participate and achieve better results in science-related subjects. Most of the theories given as explanations for these observed gender differences are centred around the nature versus nurture debate.

The sample consisted of eight standard nine and ten students and four professional women in science-related fields. Four of the students were from a rural day secondary

school, while the other four were from an urban day secondary school. These two schools are located in the Central Region of the Eastern Cape Province. Two of the four students from each school were taking Physical Science or Physics and Chemistry (science students), while the other two were from classes where the above mentioned subjects were not taken (non-science students).

Students participated in vignette discussions and in-depth interviews while professional women participated in indepth interviews only. The data collected were analyzed using discourse analysis.

The findings indicated that most of the perceived causes of gender differences in perceptions and attitudes towards science were identified as emanating from the socio-cultural environment as well as from the inborn traits some of these female students have that are different from males'. Solutions suggested included an attempt to reduce stereotypic behaviour tendencies both at home and school. It was also suggested that more female students be determined to take up science-related subjects and professions so as to provide more role models for the next generations.

The implications these findings have on science learning and teaching are that the school science curriculum needs to be reviewed in terms of its contents and pedagogy. This can be a positive move towards helping some female students develop positive attitudes towards science. Women's psychological being must be considered when these interventions are made.

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CHAPTER ONE

THE PROBLEM, CONTEXT AND RESEARCH STRATEGY

1.1 INTRODUCTION

1.1.1 The Roots of the Study

This research originated directly from my observations and personal experience. My interest in the social position of women dated from my undergraduate days. At the university where I did my undergraduate studies, I observed that there was only one woman out of a total of about ten lecturers who were taking us in various science courses. The woman was teaching biology courses. This under-representation of women in the physical sciences struck me as worth investigating.

I have been a high school science teacher for a number of years. As a female science teacher, I became particularly interested in the ways in which these differences in science participation arise. I was sceptical of the claim certain literature I read put across which assumes that males are naturally better than females in physical sciences (Felter, 1906 cited in Kelly 1981a). I then decided to use this issue as the starting point for my research.

1.2 THE PROBLEM

1.2.1 The Global Context

The under-representation of females in scientific fields is a well known phenomenon.

> *"It is not widely recognized that the 'technological imperative' carries with it a set of sex role prescriptions but numerous examples exist of the operation of these norms in conjunction with economic change. In particular, we have noted that women are considered incapable of handling or understanding complex machinery and thus denied access to useful tools"* (Chaney & Schmink, 1976, p. 175).

Though I took this quotation from a book that was written about two decades ago, what is striking is the embedded truth it carries which applies to most societies world wide.

The old view that one has to be strong to work with machines is fading due to the development of microelectronics and the decreasing importance of heavy industrial technology. However, even though this is the case, not only does society still hold stereotypes of what males and females are capable of doing and what behaviours they should display, but also defines what men and women should be like in order to perfectly fit in that particular society. This has proved to be a major drawback for women's participation and achievement in science and technology in most countries all over the world. However, while there is a broad agreement about the existence of the unequal representation of males and females in science, there is no concrete agreement about the deeper causes.

1.2.2 Women in Science and Development

All over the world there is a growing awareness that women must play a central role in all aspects of development processes. In Africa and other parts of the world, the formation of organizations like the South African Association of Women in Science and Engineering (SA WISE), the American Association of University Women (AAUW), the British Association for Women in Science and Engineering (BA WISE), American Women in Science (AWIS), the Canadian Association of Women in

Science (CAWIS) and the Third World Organization for Women in Science (TWOWS) is a response to the demands by women to better their prospects of entering the once male dominated fields of science. The inclusion of women in the science and engineering workforce is a goal most countries, including South Africa, are striving for (South African Science and Technology Indicators, 1996, p. 7).

According to Griffiths (1985), women in both developed and developing countries act in relation to technology largely as consumers. Men are the generators, constructors, assemblers of technology in addition to being consumers. This results in men dominating over the generation of new products while women have only negligible control over the development and character of technological change. Furthermore, their lack of technological knowledge means that they are forced to rely on male technical experts. Mastery of new technology bestows some power on these men:-

(a) in relation to women who lack this expertise;

(b) in terms of material rewards this skill brings, and even

(c) in terms of popular portrayal as heroes at the frontiers of technological progress.

Basow (1980) states that it is differential power that underlies all inequality. In most cultures, to be in command of the very latest technology signifies being involved in directing the future and so it is a highly valued and mythologised activity.

Arnold and Faulkner (1985) add that in general, new techniques tend to benefit men rather than women. As men in developing countries embark on their own institutionalization of science and engineering, there are signs that women will simply find themselves at the bottom of the new

hierarchy.

Other international organizations, for example, the UNESCO (1988) identified local customs and values as powerfully discouraging women from moving into what is perceived as a male province. These values are perceived as the norm so much that women themselves often subscribe to them and play a subservient role in society.

1.2.3 The South African Context

> "*The challenge that we face at the dawning of a democratic society is to create an education and training system that will ensure that the human resources and potential in our society are developed to the full. It is this challenge posed by the vision of The Freedom Charter to open the doors of learning and culture to all*" (ANC, 1995, p. 3).

This decision was arrived at after the government of National Unity realized that, historically, instead of promoting economic and other forms of equality (as do education aims in other countries), the role of education in South Africa was to achieve just the opposite. Kahn, Levy, Rollnick, Segall and Kotecha (1994) state that education provisions for various population groups were different. For example, the per capita expenditure on education for blacks was one fifth of that of whites. According to the South African Institute of Race Relations (SAIRR) (1995/1996) in 1994, the average amount spent on education for white pupils was 147% higher than the amount that was spent on African pupils. This clearly indicates that education was designed to work for the advancement of the white and other privileged sectors of the population.

As the South African Green Paper on Science and Technology (SAGPST) (1996, p. 10) puts it, "*Redressing the imbalances between the advantaged and disadvantaged institutions and groups is critical as is*

promoting increased participation by girls and women in science, engineering and technology". This report further states that women must have improved access to universities and technikons. This clearly indicates that presently in South Africa, there are gender differences in participation and achievement in educational institutions.

The above statement is supported by Kahn et al. (1994). They state that there is an observed gender bias away from science subjects by female students as they approach higher levels of learning. According to the Scientec '97 magazine of the Foundation for Research Development (FRD), engineering had only 8% female university graduates and only 4% technikon graduates in 1993. For a country that needs a bright technological future this is a major drawback.

As a one time science student and being female, I identified a number of factors as contributing in one way or another to the presence of less females than males in science related professions. These were : gender role ideology; perceived usefulness of the subjects by students; students' attitudes towards science; students' aptitude; teachers and parents' attitudes towards the students and classroom interactions between the teacher and students and among students themselves.

As a female science teacher, I have observed that failure in science subjects incurs a wide array of individual and social costs. For the individual, failure to have a pass in a science subject is linked with limited occupational and economic prospects and a rejection by society and some of its institutions. For girls aspiring for professions in the fields of science, failure to pass science subjects leads to disappointment since many of the well paying jobs are science oriented. In communities and societies where education and a well paying job are at the cutting edge of recognition of social status, these women end up with a lower status.

Against this background, the challenge of investigating possible ways of addressing the factors that may contribute to causing gender differences in science in high schools in South Africa is very important.

1.2.4 The Purpose

Given the controversy surrounding the reports about the facts, theories and evidence concerning gender differences in science education, the purpose of this study is to investigate problems faced by black, female, South African students as they pursue science subjects and how these problems can be overcome.

1.2.5 Rationale

The presence of very few [illegible] in the fields of engineering and related professions in South Africa is a source of serious concern for educators and society. *"If science is the engine for driving economic and social progress, then South Africa certainly cannot afford to marginalise women, 51% of its population, from science and technology any longer"* (Scientec '97 Magazine, 1997, p. 1). When female students elect not to take science classes, they are seriously limiting the nation's creative resources at a time when an expanding pool of workers is needed to compete in the international job market. Women's talents must be utilised to the full at all levels of scientific and technological education, training and employment since it is an economic investment in this country's future national development.

According to Burton (1990), economists are concerned with the economic welfare of society and fear the long term consequences of having only a small body of scientifically literate people in the workforce. There is reason for alarm because a recent report by the Task Force on Women,

Minorities and the Handicapped in Science and Technology, estimates a shortage of 560 000 scientists and engineers in America by the year 2010 if the present trends continue (Parsons : 1997). She reports that the statistics from Britain show the growing unpopularity of science among boys and girls. She states that even though there is a great expansion in the undergraduate population, only a steady 5% of the students choose physics related subjects. What this can imply is that beneath the gender problem relating to girls in science education, there could be something about science as a subject that students are not comfortable with. This is an avenue for the course of new research into science education.

Some educators believe that people should make choices in life for self development and self realisation. Unless there is equal access to educational goals, this ideal cannot be realised. Skrtic (1990) supports this by stating that public education cannot be democratic unless its practices are equitable.

Feminists are worried with female under-representation in the above mentioned areas of work and knowledge. It is because this results in technology developing in a male-oriented direction making females feel alienated from the whole developmental process. The SAGPST (1996, p. 72) states that in South Africa, there are gender imbalances in the physical sciences and engineering. According to this report, the 1993 statistics for undergraduate studies indicate that there were twelve males for every female in these subjects combined.

The decision to concentrate on black female students was made in view of the fact that among all the population groups (African, White, Coloured and Indian) Africans have the lowest pass rate in physical science even though they comprise the majority of the candidates enrolled in higher

grade physical science as depicted by figures in Figure 1.

Figure 1: Examination results for physical science higher grade by population group (1993)

	Candidates	Pass	% that passed per population group
African	36 618	5 955	16,3
Coloured	1 313	1 038	79,1
Indian	4 109	3 274	79,7
White	15 112	13 568	89,8
Total	**57 152**	**23 835**	**41,7**

Source : Edu-Source (1994 b). Edu-Source Data News, No. 7, December 1994.
As reported in the South African Science and Technology Indicators, 1996, p. 195.

Furthermore, for African [illegible] even though their total enrolment in standards 8, 9 and 10 is sometimes even higher than that of their male counterparts, the percentage of girls who finally enroll for physical science is always lower than that of boys. Figure 2 clearly shows this trend.

Figure 2: African enrolments for physical science, Standards 8 - 10 (1992 - 1994)

1992

	Std 8	Std 9	Std 10
Total Enrolment	**444 062**	**391 796**	**363 027**
Male	196 420	171 138	154 114
Female	247 642	220 658	208 913
Physical Science (higher grade)	84 169	63 124	43 572
Male	41 651	31 563	22 603
Female	42 518	31 561	20 969

Physical Science (standard grade)	10 527	7 726	13 948
Male	5 105	3 905	6 798
Female	5 422	3 821	7 150
Total Physical Science Enrolment	**94 696**	**70 850**	**57 520**
% of total enrolment	21,3	18,1	15,8
% of total male enrolments	23,8	20,7	19,1
% of total female enrolments	19,4	16,0	13,5

1993

	Std 8	Std 9	Std 10
Total Enrolment	**492 542**	**428 925**	**395 518**
Male	218 053	187 184	169 197
Female	274 490	241 741	226 321
Physical Science (higher grade)	97 020	75 480	48 828
Male	47 444	37 817	25 005
Female	49 576	37 663	23 823
Physical Science (standard grade)	8 526	6 854	14 131
Male	3 999	3 300	6 755
Female	4 527	3 554	7 376
Total Physical Science Enrolment	**105 546**	**82 334**	**62 959**
% of total enrolment	21,4	19,2	15,9
% of total male enrolments	23,6	22,0	18,8
% of total female enrolments	19,7	17,1	13,8

1994

	Std 8	Std 9	Std 10
Total Enrolment	**515 423**	**463 273**	**437 817**
Male	230 194	202 766	187 579
Female	285 229	260 507	250 238
Physical Science (higher grade)	109 316	89 137	60 661
Male	53 401	43 585	30 485
Female	55 915	45 552	30 176
Physical Science (standard grade)	9 4567	8 563	18 594
Male	4 378	4 143	8 694
Female	5 078	4 420	9 900

Total Physical Science Enrolment	**118 772**	**97 700**	**79 255**
% of total enrolment	23,0	21,1	18,1
% of total male enrolments	25,1	23,5	20,9
% of total female enrolments	21,4	19,2	16,0

Source : Statistics supplied by Research Institute for Education Planning (RIEP). As reported in the South African Science and Technology Indicators, 1996, p. 184 - 185.

In America, within the African American population group, in 1992 and 1993, the number of doctorates awarded in engineering, life sciences, physical sciences and science and technologies were 4 961, 2 620 and 3 429 respectively. According to Synder and Hoffman (1995), only six black females were awarded doctorates in engineering, 23 in life sciences and 8 in the physical sciences and science technologies. As depicted by these numbers, the black females who were awarded doctorates in the sciences was extremely low. The low representation of African American females in particular continues to be of interest to many researchers as it is also the case with black female South Africans. Exploring the reasons why this is the case is part of the present study.

From both the development and equality point of view, it is crucial that investigations into processes which prevent the full participation of women in scientific fields be done.

The findings from this research could be useful to:

(a) Teachers not only of science but also of related subjects who have interest in reducing gender stereotyping in schools.

(b) Other researchers. Existing knowledge concerning the underlying problems related to school performance of girls not only in South Africa but all over Africa is very limited.

(c) The study can contribute significantly to the formulations of policies and strategies aimed at improving the situation of girls in secondary schools hence contributing to the attainment of

education for all.

(d) Curriculum developers and textbook writers who prepare science teaching materials. They would know some of the activities that motivate female students so that they incorporate them in their writings.

1.3 RESEARCH STRATEGY

Some of the fast growing literature on gender and science education provides the underlying conceptual framework for the research strategy employed in this study. The following issues drawn from the debates on research strategies are central in this study: the meaning of research, the influence of research paradigms, as well as the choice of the theoretical framework. These are to guide me in the search for an answer to the question of gender differences in science.

1.3.1 Research

Lincoln and Guba (1986, p. 549) define research as "*a type of DISCIPLINED INQUIRY undertaken to resolve some PROBLEMS in order to ACHIEVE UNDERSTANDING or to FACILITATE ACTION*" (emphasis in the original). This definition they give is particularly useful since it brings out the fact that researches are done to solve problems. In this case, the problems faced by female black science students are long standing ones which need remedy.

As these authors clearly point out, "*decisions about how to label an activity are important, but the prior decision regarding the philosophical and epistemological stance that will guide the inquiry is equally crucial*" (Lincoln & Guba, 1986, p. 561). Because of this, it is important that I discuss the theoretical issues I considered so as to arrive at my choice of

the research paradigm.

1.3.2 The Choice of a Paradigm

The positivist paradigm used to be the dominant mode of inquiry in social sciences. However, other competing paradigms have risen to replace it. One such paradigm is interpretivisim (Green, 1990). According to Guba (1990), the critical dimensions that separate these paradigms or a system of basic belief systems that guide inquiry are ontology, epistemology and methodology.

Ontology has to do with the 'operation and fibre of the world', (Romm & Alant, 1990) while epistemological statements refer to matters of knowing. It is concerned with the criteria and processes used to validate claims of knowledge and truth. In other words, it is the philosophical bases for determining who to trust, what to believe and why something is true. It is important to note that these represent social or cultural rather than individual choices (Collins, 1990). By methodology I mean the study of techniques and practices used in the research process. In other words, it refers to the theoretical analysis of how the research process is or should be carried out.

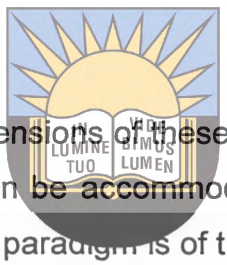
The positivist approach emphasises universal laws of causes and effect based on an explanatory framework which assumes a realist ontology. Positivists argue that reality consists of a world of objectively defined facts. The hypothetical deductive method is seen as the principal means by which causal relationships are established. Quantification is also a crucial aspect of this natural scientific approach (Henwood & Pidgeon, 1992).

Unlike positivists, interpretivists view the purpose of research as

understanding and interpreting occurrences and social structures as well as meanings people give to phenomena. The ontology of interpretivism is constructed through human interaction. Its epistemological stand is understood through the mental process of interpretation which is influenced by and interacts with the social context. Within this paradigm, quantification is not a crucial issue (Contrell, 1993).

In the following section, I describe details of the nature of interpretative knowledge. This is important if one is to understand the context of the research strategy I adopted.

1.3.2.1 Interpretivism



After the critical dimensions of these paradigms were analysed, I found that my research can be accommodated in the interpretive paradigm. This is because this paradigm is of the "subjective-order" and views the purpose of research as understanding and interpreting daily occurrences and social structures as well as the meanings people give to the phenomena. Researchers from this orientation strive to understand and to interpret meaning within the social and cultural context of the natural setting. Smith (1989) states that social objects and events unlike physical objects and events, are constructed by human minds. Because of this, they can only be understood by examining them within their contexts.

I have decided to use this approach because this paradigm views humans as rational beings who have reasons for their actions. It also views the motivations behind human behaviour as something that can be unearthed, described and explained (Kuiper, 1997). These reasons are what I aim at finding. The understanding of these reasons may enable human behaviour to be described.

According to Howe (1992), interpretivism is a view that may be identified with emphasising the so-called "insider's perspective". This is due to its ability to interpret meanings and implications of social events and arrangements. He proceeds by stating that this approach views humans as active and self-creating since they can internalise and construct their own views of knowledge. Interpretive methods share a focus of discovering, entering and sharing the universe of the actors. They make the assumption that contact can allow us to share the actors' definition of the situation explaining their behaviour in so far as the orientation is capable of doing so.

Unlike positivists who believe that reality exists apart from the researcher and is knowable, interpretivists hold that reality is constructed. In fact, "*inquiry is not a matter of offering interpretations of reality, but one of offering interpretations that become reality to the extent they are agreed upon*" (Smith, 1989, p. 171).

The other advantage of this approach is that it seeks the subjective perceptions of individuals. Carr and Kemmis (1983, p. 85) also emphasise the idea that "*to identify the actor's motives and intentions correctly is to grasp the subjective meaning the action has for the actor*". In support of this idea, Fetterman (1988, p. 18) asserts that researchers from this perspective argue that "*what people believe to be true is more important than any objective reality; people act on what they believe*". He goes on to state that in order to uncover what people believe and assign meaning about their actions and intentions, interpretive researchers interact dialogically with the participants. Within this interaction, values cannot be sidestepped. Unlike positivists, interpretivists accept the inseparable bond of values and facts.

Within interpretivism are also aspects of social constructivism.

"Our ability to respond and use our knowledge appears to depend strongly on the context in which the knowledge is required. Most of the reasoning we do apparently does not involve the application of general purpose reasoning skills. Rather it seems that most of our reasoning ability is tied to particular bodies of knowledge" (Rumelhart & Norman, 1981, p. 341).

Social constructivism emerged out of radical constructivism and is concerned with the contributions of social actions to the construction of self. According to them, the construction of self includes a construction of 'who am I'. In this particular research, this includes the self as a science learner and one's construction of science.

Much of a person's actions (including the knowledge and intentions of the person) can be understood only in terms of the norms of the society in which that person is a member. Students' cultural realities including concepts of self and s[illegible]oles are constructed through social interactions. These students are active participants in the process of constructing their social worlds.

1.3.2.2 Nature of Interpretative Knowledge

Greene (1990) proposes five views about the nature of interpretive knowledge. These are that:

(1) The knowledge obtained through interpretivism is grounded knowledge. This means that it is not developed from speculation or deductive reasoning. It is both discovered and justified from the field based, inductive methodology of interpretivist inquiry.

(2) Interpretivist knowledge represents inside understanding of the perspectives and meanings of the setting being studied. It includes both propositional and tacit information. This means that interpretivist knowledge communicates understanding which comes from both its words and the broadly shared contexts of

natural experience within which it is embedded.

(3) Interpretivist knowledge constitutes a holistic pattern of theories of mutual and plausible influence.

(4) Interpretivist understanding also aims for internal consistency and coherence.

(5) Interpretivist knowledge is value bound. This makes social inquiry done in this perspective meaningful.

As evidenced by the nature of interpretivist knowledge, it *"denies the possibility of universal social laws and empirical generalizations. This type of research generates working hypothesis that are connected not to a priori theory but to a context-specific, often emergent inquiry problem which may be or may not be informed by existing knowledge"* (Greene, 1990, p. 276).

According to Greene, within the interpretive paradigm, the challenge of knowledge accumulation has been primarily addressed by the general concept of transferability. The researcher's responsibility is shifted to one of providing sufficient descriptions of the context studied so that others may judge the applicability or fit of the inquiry findings to their own context. The locus of judgement is shifted from the inquirer to the potential users.

According to McCutcheon (1990, p. 277)), interpretivists seek to understand the nature of a phenomenon rather than looking for structures. The researcher just aims at capturing the essence of the matter. However, *"doing qualitative research and commenting on a chapter are somewhat akin to seeing shapes in clouds"* (McCutcheon, 1990, p. 277). Different individuals may see different patterns.

1.3.3 Theoretical Framework

Rein (1983, p. 96) points out that facts, theories and values intermingle to form perspectives or what he terms 'frames' in research. According to him, "*a frame is a way to understand the things we say, see and act on the world. It consists of a structure of thought, of evidence, of action and hence of interests and values. In brief, a frame integrates theory, facts, interests and action*".

In this study, the perspective followed is informed by early researchers like Arnot (1981) who proposed that gender differences in education fall under one of the two perspectives namely the cultural and the political economy perspectives.

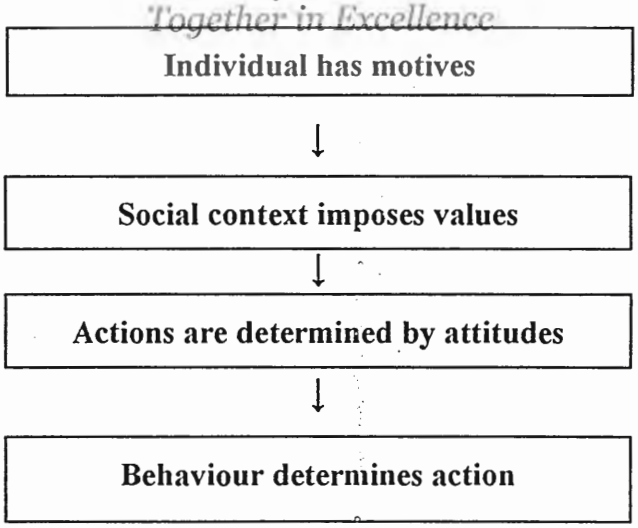
The political economy perspective aims at explaining the origins of sexual divisions of labour and reasons for their particular patterns of development. The cultural perspective, on the other hand, "*attempts to explain and describe how gender differences are created and maintained through schooling*" (Arnot, 1981, p. 4). This difference in focus is seen as a difference between internal and external accounts since cultural theorists focus on the school, while political economy theorists focus on the social and economic contexts of the wider society.

In the present study a cultural perspective approach was adopted. The advantage of the cultural approach is that, it is more directly oriented towards formulating policy measures designed to alleviate problems caused by stereotypes created by culture of which gender differences in educational participation and performance is an example. As Arnot (1981) argues, cultural theorists tend to view the problem of gender inequality in schools as an educational problem requiring an educational solution.

Although the political economy theorists see problems of gender inequality in broad terms, these researchers support the school based remedial measures arising from research conducted within the cultural perspective. It must not be assumed that researchers working within the cultural perspective oppose the views of the political economists, that gender divisions have their origins outside the school. Wolpe points out the clear aim of research conducted within the cultural perspective as :"*to demonstrate that these attitudes and behaviours arise from the social environment and are socially constructed*" (Wolpe, 1978, p. 292).

Wolpe's idea agrees well with social psychologists' views that individuals are not born with attitudes but develop them in relation to their experiences. As the individual grows, s/he orders his or her social environment in terms of the things s/he seeks and those s/he avoids. Figure 3 tries to show the sequence of events:

Figure 3 : Determinants of one's actions



An individual has certain inner drives or motives which initiate and direct his/her action towards certain goals. These goals are formulated in relation to societal expectations. These motives provide the individual with a set of values which give rise to attitudes and finally results in

action. In his work on developmental psychology, Valsner (1989) stated that culture should be regarded as an inseparable component of a child's development. According to Konold (1975), researches must focus on both the psychological and the socio-cultural aspects of knowledge and learning.

As the individual grows, s/he develops a particular gender role ideology. A gender role is defined by Block (1983) as a constellation of qualities an individual understands to characterise males and females in his/her culture. These roles include social positions, personality characteristics and a lot of other abilities and behaviours. Cross-cultural research by Mead (1939), showed that physical attributes account for only a small proportion of the constellation while social or culturally determined attributes account for the major part. For this reason, the term gender role is used in preference to sex role in this study.

Gender stereotypes are created and maintained by society and as such, cannot be divorced from their particular social and cultural contexts. This research therefore explores where black female students in South African high schools locate the role of their society (culture) in the structuring of their interests and attitudes towards science.

The following research questions drawn from the relevant issues identified earlier and methodological debates in gender equity issues guided this study.

1.3.4 Critical Questions

The study focusses on the following questions:

1. What do black female students in high schools in South Africa

perceive to be the possible causes of gender differences in perceptions and attitudes towards science subjects?

2. What do black female students in high schools in South Africa suggest as possible solutions to overcome problems of gender differences in perceptions and attitudes towards science subjects?
3. According to black female professional scientists, what are the causes of gender differences in perceptions and attitudes towards science subjects in South Africa?
4. What do black female professional scientists in South Africa suggest they did/do to overcome problems associated with gender differences in perceptions and attitudes towards science subjects?

1.3.5 Limitations of the Study

I do not claim that the results from this study can be generalized to every part of South Africa. This is because even within South Africa there exist some cultural differences within the black population itself. Nevertheless, there are other grounds for believing that these findings may be generalizable to a certain extent.

Guba (1990) argues that the interpretivist case study can provide a basis for such generalizations because it communicates natural experiences as well as tacit knowledge. The education system in South Africa is centrally controlled and for this reason, it is likely that any of the processes underlying gender disparities in science education in schools in this part of the country resemble those in different parts of the country. The tendencies to gender type is universal. What may differ from place to place and from culture to culture is the content of subject gender types.

From a positivist paradigm, what may sound as another limitation is that it is carried out with a very small sample size. However, according to

Potter and Wetherell (1987), when taking a qualitative paradigm, in such cases, the generalizability of these results depends on the reader assessing the importance and interest of the effects described. Even though the findings are relevant for these participants and cannot be generalized to other populations, according to Stake (1988), these findings can be used to generate theories to be tested in future studies.

A discourse analytic methodology was used in this research. It depends mainly on interview data. Since the respondents were not using their first language and neither could I speak theirs, this could have acted as a hindrance to the data collection process. There could have been some misinterpretation of my interview questions and the respondent's responses.

1.3.6 **Organization of the Study**

The study is organised into five chapters. Chapter one provides the general setting for the investigation by describing the research problem and outlining the research strategy. The significance, limitations and organization of the study are also outlined together with the clarification of certain terms.

In Chapter Two I review the relevant literature by analytically describing the facts surrounding gender differences in science education. This is followed by some comments on the existing literature including methodologies used in the results outlined. The explanatory models of how gender differences are created follows. A brief overview of alternative methodology follows.

Chapter Three covers the methodology aspect. I start by describing discourse analysis and the stages followed when carrying out such an

analysis. I also explain how this methodology fits in with principles of feminist methodology.

Chapter Four is devoted to the analysis and discussion of the results. This is done by identifying relevant themes from the transcriptions of the interviews conducted.

In Chapter Five, I summarise the study and draw conclusions. I organised this by responding to the research questions of the study. I finally conclude with a few recommendations.

1.3.7 A Note on Terminology

Before proceeding any further, it is important to define the following terms that were be used in this study. The importance of explaining terms is that it makes us gain proper understanding of the context within which the study is undertaken. People may attach different meanings to certain terms and hence the clarity of the arguments raised in the study might be distorted. The following terms will be explained : attitudes, gender, perceptions, respondent, sex, science, science student and non-science student.

Attitudes: According to Morgan and King (1971) an attitude can be defined as the tendency to respond either positively or negatively to certain persons, objects or situations. It has emotional, intellectual and motivational components. Attitudes are expressed through what people feel about the different features of their immediate environment. They also provide indications of how these individuals are likely to act towards different aspects. (Emphasis is my own).

Gender: It is a psychological and cultural term referring to one's subjective feelings of maleness or femaleness. It is quite possible to be

genetically of one sex with a gender identity of the other.

Perception: This refers to how an individual understands his or her environment. Perceptions are derived from experience. The roles of the environment and learning are important. Past experience affects how an individual perceives his or her environment.

Respondent: The terms respondent and interviewee are used interchangeably throughout the text. It refers to a person from whom I obtained data through interviewing.

Sex: It is a biological term. People are either male or female depending on the genes they have. In this study the terms gender and sex will be used interchangeably throughout.

***Science*:** In this study the term science will be used in preference to Physical Science or Physics with Chemistry or Physics and Chemistry taken as separate subjects. In the context of this research, Biology is not taken as a 'science' subject though it is normally classified as one.

Science students: In this research, this term refers to students taking Physical Science or Physics with Chemistry or Physics and Chemistry taken as separate subjects. These subjects are considered by most students as the most difficult in the natural sciences. This means that students taking these subjects show that they have a great interest in natural science related subjects.

Non-Science students: These are students not taking Physical Science or Physics with Chemistry or Physics and Chemistry taken as separate subjects. Most of these students take Biology as one of their subjects. They could have opted for Biology since it is a requirement that every student must take at least one subject from the natural sciences.

The next chapter discusses empirical research findings on the subject of gender differences in science, explanatory models and feminists' views on science and technology.

CHAPTER TWO

'FACTS' ABOUT DIFFERENCES IN SCIENCE, EXPLANATORY MODELS AND FEMINISTS' CRITICS OF SCIENCE AND TECHNOLOGY

In the previous chapter I tried to put the study in perspective. I now review the relevant literature on the subject. An exposition of the explanatory models which theorize the perceived causes of gender differences follows. A discussion of feminists' views on the nature of science and technology is also done. Finally, I analyze research methodologies used in empirical findings discussed and I then suggest an alternative methodology.

2.1 THE 'FACTS' OF GENDER DIFFERENCES

Over the past decade, a number of studies documented the fact that boys and girls often experience qualitatively different educational situations especially in science. Those differences can have long term impacts that extend through college into the professional years. Most of this research is centred on the following issues: differences in achievement, participation, attitude, perceptions, as well as what happens in the classroom.

2.1.1 Participation

There is evidence in literature that from middle junior high school upwards, when students choose the subjects they want to pursue, the number of girls who choose science subjects drops (Kahn, 1991 cited in Kahn et al. 1994). Compared to boys, girls take fewer advanced science and mathematics courses in high school and college. More of them major in art subjects more often compared to boys (American Association of University Women (AAUW), 1991; Holmes, 1991).

According to the South African Science and Technology Indicators of the FRD (1996) report, in South Africa, the total number of females enrolling at technikons increased from 25% in 1989 to 38% in 1993. Even though this was the case, female students' enrolment in natural sciences (including biology) and engineering remained fairly constant at 30%.

Several studies have found gender differences in attitudes towards science with boys liking it more than girls. In addition to this, it was also found that liking science is positively related to achievement (Woolnough, 1994; Weiburgh, 1995). In South Africa, the directorate for science and technology policy of the FRD, in conjunction with the Centre for Science Development (CSD) of the Human Science Resource Centre (1996), carried out a survey on scientific literacy and attitudes towards science. They found that more males than females have positive attitudes towards science and that males achieve better results than females (S.A. Science and Technology Indicators of the FRD, 1996).

2.1.2 **Achievement**

Data on differential performance in science seem to indicate that students in elementary institutions do not show any gender differences in achievement (Shaw & Doan, 1990) and that gender differences begin to appear at junior or middle high school (Shepardson, 1994; Catsambis, 1995). The same pattern is observed in mathematics performance (Leder, 1986). More boys than girls are seen to do well in problems involving spatial visualization while more girls have good verbal skills (Maccoby & Jacklin, 1974). Boys' achievement scores are more variable than girls' (Feingold, 1992).

Since problem solving and mathematical skills are needed more in science subjects at higher levels than simply explaining concepts and

their relationships, for example in physics and chemistry, this is said possibly to explain the above observations. Kahn (1991) cited in Kahn et al. (1994) explains that the "fall off" in girls' performance could be influenced by the increasing social pressures which affect girls as they become young women. This observation clearly indicates that the environment rather than genetics explains for such differences. Therefore, this casts doubts on Kimura's (1992) assertion that evidence suggest that sex hormones affect brain organization at a very early age in life. Because of this, environmental factors act on different brains in boys and girls hence it is almost impossible to evaluate the effects of experience independent of physiological predispositions.

2.1.3 School Type

Brien and Porter (1994) report that students in co-educational schools tend to have more negative attitudes towards science compared to boys and girls in single sex schools. Furthermore, girls in single sex schools perform better than their counterparts in co-educational schools. Contrary to previous findings, Opare (1996) found that girls in mixed schools in Ghana are more likely to choose physical science subjects than their counterparts in single sex schools. His explanation for this observation is that girls' schools appear to concentrate on non-science subjects unlike in boys' schools. However, mixed schools appear to lie in between. This means that those girls who wish to pursue science tend to choose co-educational schools.

2.2 EXPLANATORY MODELS

Different views have been brought forward by various theorists in an attempt to explain the origins of gender differences and all these views are centred around

the nature versus the nurture debate. The dispute is over the extent to which the gender differences are natural and the extent to which they are produced by nurture, that is by the ways children are brought up in societies. These theories include the biological determinism theories, socialization theories, cognitive theories, the psychoanalytic theories and feminist theories. Other explanatory models described emanated from these major ones. I now go on to look at each of these together with the emanating ones in turn.

2.2.1 Biological Determinism Theories

Some biological determinism theorists claim that gender differences between males and females in attitudes, aptitudes and temperaments are due to biological factors such as chromosomes and hormones (Kimura, 1992). They also argue that chromosomal inheritance is also responsible for the development of gender identity and for sex differences in cognitive skills and personality. Gray (1981), who is a sociobiologist, regards differences between the genders as inbuilt, unchangeable, desirable and determined by the biology of the two sexes and should not be tampered with.

Anthropologists, namely Tiger and Fox, (cited in Haralambos, 1985), also support this view by stating that there are what are called human "biogrammas" which predispose mankind to behave in certain ways. However, according to them, these biogrammas can be modified by culture. They also argue that male and female biogrammas are slightly different. Maccoby and Jacklin (1974) also propose that differential patterns in brain lateralization partly contributes to this difference. According to them, males are more highly lateralized than females and this makes them superior in spatial skills and it is this superiority that accounts for the tendency of males to perform better. These theorists propose that there are hormonal influences on brain differentiation that

dispose males in general to be superior to females in reasoning ability. However, the data on which this hypothesis is based is controversial.

Criticisms leveled against these theories are that it is very difficult to establish categorically the extent to which differences are biological or social in origin. The problem lies partly in that biological theories draw heavily on experimental findings from work done on animals. There are always questions about how far we can extrapolate to humans findings based on animal behaviour.

2.2.2 Locus of Control

Some students blame someone or something else for their poor performance. It could be a difficult test, a confusing book or an incoherent teacher (Dembo. 1991). These students believe that the environment controls their failure or success. They see themselves as powerless to counteract this trend. Psychologists classify such personality dispositions under the construct: locus of control.

Weiner adopted Atkinson's theory of causes of failure and success. His classification of causal attributions has been adapted to conceptualize students' attributions of success and failure along the dimensions of stability and locus of control (Fennema and Peterson, 1985; Fontana, 1988; Koehler, 1990; Dembo, 1991). Fennema (1985), identified four major causes of success and failure in achievement situations. These are ability, effort, task difficulty and luck. Their interactions in determining achievement has been summarised in Figure 4.

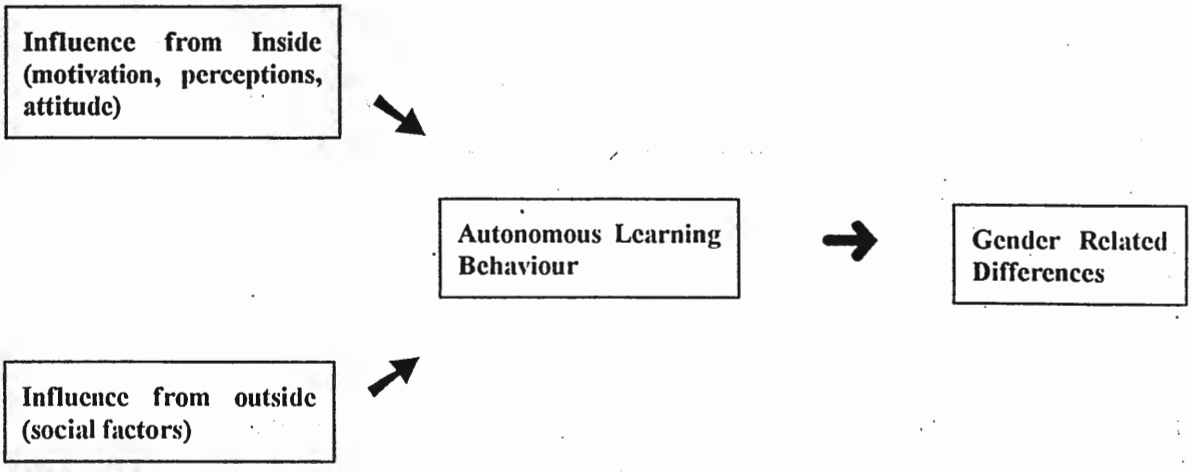
Figure 4: Determinants of achievement behaviour

	Success Or Failure Attributed To Stability Factors	
Locus of control	Stable	Unstable
Internal	Ability	Effort
External	Task difficulty	Luck

Source : Fennema (1985, p. 150)

In various studies it was found that males were more likely than females to attribute their success to ability (internal and stable) and their failure or lack of effort (internal and unstable). Females, on the other hand, attribute their success to effort, luck or help from others (external or internal and unstable) and their failures to inability (internal and stable). Fennema and Peterson (1985) believe that girls do not develop autonomous learning behaviours (ALB) necessary for performance on high cognitive tasks. ALBs can be expressed through freely choosing to engage in high level cognitive tasks (for example in physics), working independently and persistently. Boys are more likely than girls to seek difficult rather than easy tasks and persist until the task is completed. In contrast, girls are more likely than boys to avoid the possibility of failure (Dembo, 1991). The development of ALBs is attributed to internal factors (for example, confidence, ability and perceived usefulness of the subject) as well as external factors. ALBs mediate between the external and internal influence and performance in science as illustrated in Figure 5.

Figure 5: Development of gender related differences



2.2.3 The Neuroticism-Stability Dimension

Eysenck's anxiety (or neuroticism-stability dimension) tests indicate the existence of three major personality traits, namely extroversion, neuroticism and psychotisism. According to Lynn (1971), more females than males tend to have high neuronism scores throughout the years of formal education. High scores indicate that the individual is orientated primarily towards the external world of people and experiences. Such individuals are prone to anxiety and to reactions and fears associated with it (unstable) while low scores show good psychological balance (stability). This may be one of the reasons why girls tend to shy from science subjects and concentrate upon the arts where higher neuronism may be less of a handicap. Critics of the trait theory and those who want to offer an alternative description of the self, noted the limitation that it is asocial in its approach. It ignores the inconsistency in human behaviour (Mischel, 1968). Another point is that trait theorists can comment on personality test data, but in real life situations, these traits bear little relation to how people perform in non-test situations. The majority of people, for example, may come out partly as extroverts and partly as introverts on personality tests. Whether introversion or extroversion

dominates, depends on their perception of the situation. They cease to be predictable and trait driven.

2.2.4 Self-esteem

Girls have generally lower levels of self-esteem than boys. This could be largely due to cultural factors and the general status of women in society. Evidence for lower self-esteem in girls is found when girls are paired with boys in problem-solving tasks. Girls sometimes artificially depress their performance levels so as not to outshine their partners (Fontana, 1988). According to him, this phenomenon does not work in reverse. Some girls do not feel comfortable in the superior role as if they are performing in a manner inconsistent with their true position in life. This agrees well with Hormer's model of fear of success.

In as much as they fear success, most girls fear failure. This 'fear of failure' syndrome may partly explain why most girls do not demand the time and attention they need during lesson times because they fear ridicule in cases where they may respond in an unacceptable manner. This may also contribute to explaining their low performance in science and reluctance in taking up more challenging science courses at higher levels. The fact that girls' scores are less variable than boys' can also be explained by this factor. Very few of them are found in the extreme cases that is very high and very low performance levels.

2.2.5 Cognitive Styles

These have also been identified as contributors to success or failure in science. Turkle (1984), in her observation of young children computer programming at school, found that boys and girls tended to use two different computing styles. Boys construct a structured linear plan while

girls use a more interactive and negotiating style. According to Wajcman (1991), boys' way of computing is related to the abstract sciences while that of girls is related to the concrete sciences since they prefer to work with a set of concrete elements. This view agrees with Scott-Hodgetts' (1986) observation that there are more girls than boys with a serialistic learning style while more boys prefer the holistic approach to solving problems. She argues that the serialistic approach disadvantages students when they are required to tackle unstructured higher level tasks especially in mathematics and science at higher levels of learning. (Alper, 1993; Brush, 1991) are of the opinion that the lack of a strong mathematics and science background can also limit women's subject choices.

2.2.6. **Socialization Theories**

These can be grouped under two major categories, namely social learning theories and cognitive development theories. The similarity between their views is that they see the environment as the major contributing factor in the creation of gender differences. This view is supported fully mainly by feminists who explicitly reject the notion of biological givens which determine the way men and women feel, think and act. Socialization theorists see socialization as a complex process that trains individuals to take their places as responsible members of society. However, it is not yet fully known how this process brings about gender differentiation.

2.2.6.1 **Social Learning Theories**

Children are in a dependent position and they want love and approval so they come to accept and repeat what they are taught. This theory also emphasizes the importance of imitation and modeling since children learn

new behaviour by imitating both adults and their peers. Another important aspect is that children imitate people whom they see as being like them (Sikes & Measor, 1992). Some form of reward is received for every good behaviour and punishment for unsuitable ones. According to these authors, the problem with these theories is that it is difficult to determine the extent to which this process of rewarding and punishing children work effectively in fostering desired behaviour. The picture of children portrayed is that of passive beings who agree with all that is said and done to them by adults. Kelly (1981b), also attacks these by stating that the link between adult behaviour and child stereotyping is often assumed.

2.2.6.2 **Cognitive Development Theorists**

Cognitive development theorists concentrate on learned behaviour which is seen as appropriate for one gender or the other in society. The theory suggest that children have a desire to learn. They are motivated primarily by the wish for competence. They are concerned with developing ways of understanding the world as a means of gaining competence. They develop categories into which they fit their world and form rules about these categories. Being male or female is one of the significant categories they use. Children put together attributes that they label as masculine or feminine and then copy the attributes that are displayed by people they identify themselves with (Sikes & Measor, 1992).

The main advantage of this theory is that the child is viewed as an active participant in constructing his or her experience and forming sex role concepts (self socialization). This theory moves away from the social learning theory which sees society as imposing sex role stereotypes upon the individual. In this theory, there is evidence that imitation, modeling, reenforcement and cognitive process all play a part in the child's sex role

reenforcement and cognitive process all play a part in the child's sex role socialization (Sikes & Measor, 1992).

Factors outside the home also affect children's growth in scientific reasoning and contribute more to the young boy's skills than girls'. Young boys respond more strongly to resources in the neighbourhood than girl because boys in middle childhood spent more time out of the home than girls. According to Block (1983), for females, the socialization process discourages exploration but emphasizes close supervision thus restricting their experiences. This explains why sex related differences in participation and performance in science appear from junior high school onwards. Mothers give boys more freedom and opportunity to explore than they give daughters. According to Bing (1963), the extent of boys' freedom is associated with the development of greater spatial ability. The close supervision imposed on girls makes them become docile, obedient, dependent and not aggressive or high spirited members of society. This behaviour is used for shaping the child towards appropriate sex typed responses. The assessment of such socialization is through direct measurement of sex typing in the child's behaviour pattern.

According to Askews and Ross (1988), stereotypical traits are value laden. Those which are assigned to people with power in society are generally those that are seen as desirable. The closer the match, the better. According to Shepardson (1994), the gender differences with lower female participation and achievement in science and technology have been said to be due to the relative lack of appropriate role models for young girls to emulate and parents' expectations that boys will do better in science and maths, even when their school performance is equal.

2.2.6.3 Gender Role Stereotyping

Leder (1986), follows Hormer's model of "fear of success" in trying to explain why at higher levels most females do not perform as good as boys. She states that because achievement in higher levels of science and mathematics is seen as more congruent with the male role than the female role, success in these fields has more negative consequences for females than for males. In actual fact, for males, it is one way of gaining a prestigious position in society while for females, it may lead to loss of popularity and other people in society may doubt their femininity. Thus, fear about the negative consequences that might follow the attainment of success might detract from the value of the goal and might lead to decrements in performance. This characteristic mainly affects high ability females than low ability ones.

Terry and Baird (1997) investigated students' attitudes towards women in science related studies and professions. It was found that students who have a high science ability have a positive attitude while males with low science ability have the least favourable attitude towards these women.

Occupational stereotyping in girls may result due to lack of role models to follow. There is empirical evidence (Collings & Smithers, 1984), which shows that girls are in general more interested in people than boys are. That could be an explanation why most of them prefer careers that deal with people.

2.2.7 Psychoanalytic (Psycho dynamics) Theories

These theorists also try to explain the origins of gender differences. Their theories are rooted in the works of Freud. They are centred on the

early years of life of a child. According to them, the role of the father in socialization is very critical. This view holds that boys in establishing their sex-role identity must solve the masculine role identification problem first by breaking down early cross sex identification with the mother and building up some sex identification with the father. In carrying out this task, the male presumably practices problem solving techniques that are applicable to problems in general. Masculine problem solving is postulated to include abstract principles which are not present in feminine problem solving since females identify themselves with the mother. Because girls do not undergo this problem solving process, they fail to mature fully cognitively (Sikes & Measor, 1992). This, according to these psychologists, is the major source of the differences between males and females in the way they solve problems that require critical thinking. This also explains why most females do not enjoy doing maths and science at school since these subjects involve a lot of problem solving.

According to these authors, psychoanalytic ideas have the advantage of focusing on the emotional as well as cognitive or learning and thinking aspects of the child. However, one major criticism leveled against them is that their theory can not be tested experimentally.

2.2.8 Attitudes and Perceived Usefulness of the Subject

This factor can be used as an explanation of gender differences in participation and achievement. A greater number of females than males see science as neither relevant nor compatible with their interests, needs and experiences. They see it as less useful to them in their future lives and careers (Fennema, 1985; Ndunda, 1990). According to Woolnough (1994), the uses of science, especially physics, are associated with activities which in our present society are stereotyped as male since it helps men with power to control this world by means of weapons and

machines.

2.2.9 Classroom Processes and the 'Hidden Curriculum'

Classroom processes have also been identified as the major contributing factors in perpetuating gender differences in attitudes towards science. Researches by (Fennema & Peterson, 1985; Koehler, (1990) and Leach, 1995) have shown that boys interact more with the teacher in the classroom than do girls. They receive more praise, encouragement, as well as discipline. Boys are called upon more frequently to answer questions, given more freedom to call out answers and receive more detailed feedback for their efforts (Jones & Wheatley, 1990; Sadker & Sadker, 1994; Tobin, Kahle & Fraser, 1990). Even with high achieving girls, the trend is the same.

Differences in students' participation occurs nearly in all activities including in group activities. Boys perform more hands-on-science activities compared to girls (Alper, 1993; Guzzetti & Williams, 1996; Tobin, et al., 1990; Alexopoulou & Driver, 1997). However, cooperative learning research by Webb (1989) showed that males as well as females performed better in majority-male and majority-female groups, respectively, rather than in groups of equal numbers of males and females. One other interesting aspect they observed was that, in majority-male groups, males tended to ignore females in the group and direct their explanations to other males, females tended to direct their explanations to males in both groups. However, Cohen (1994) observed that in the early elementary years, children's behaviour in small groups does not seem to be differentiated on gender basis.

In some schools, the option schemes help to steer girls into traditional areas by blocking science and technological studies against such choices

as home economics and commercial subjects that are enjoyed by many girls (Ward, 1986).

2.2.9.1 Teaching Materials and Media

Literature used in and out of school has been identified as one of the major tools used in perpetuating gender differences (Hood-Williams, 1997). Hood-Williams in his comparison of boys and girls' comic books saw that girls are portrayed as anxious, 'good girls' and submissive. On the other hand, boys are portrayed as people who are clever, who can make tricks, disrupters of social order, heroes and creators of brawls.

The teaching materials used in science classes such as textbooks and computer software also reflect and reinforce gender bias. They associated science activities and careers more with males than with females (Bazler & Simo[illegible]91; Bianchini, 1993).

There is also evidence that the media (these include television and newspaper) help to shape ideas and attitudes as well as reinforcing popular beliefs and stereotypes.

All these negative, gender related activities are partly used for explaining the attitudes female students have towards science. They work together through the school years to erode girls' confidence and even success with later science-related effort in high school, college or even beyond.

2.2.10 Feminist Theories

Feminist theorists, namely the liberals, radicals and the socialists, differ in their identification of the factors responsible for the inferior conditions

of women in society (Stromquist, 1990). This inferiority displayed by women stretches in most social aspects of life including science education. Though I am not a feminist and neither am I going to base my argument solely on a feminist framework, I find it important that I discuss the feminists perspectives on the causes of gender differences in society and in science in particular.

The liberal feminist perspective is dominated by the sex-role socialization paradigm. It considers that the social system is essentially just and that all deviations from 'desirable' conditions — educational equity included — are due to lack of information about the problems facing women (Stromquist, 1990). They believe that if all problems that women encounter in various spheres of social life are addressed, then automatically the problem of gender difference will be solved.

Radical feminists consider that the main cause of women's subordination originates from power relations based on sexual differences (mainly the women's ability to conceive and give birth). On the basis of this factor, an ideological system is constructed around the notion of sexuality and motherhood. This system, known as patriarchy, defines man as superior to women and is defended and maintained through an intricate web of values, norms, laws and institutions (Stromquist, 1990). Expanding the radical feminist perspective to education, the presence of few women in 'traditionally male' fields at higher levels of academic study would be explained in terms of the influence of the patriarchal system that inculcates upon women the value of domestic responsibility with the consequences that they choose careers that tend to be extensions of domestic roles or that will not conflict with their way of thinking.

The third feminist perspective, which is the socialist perspective, sees an interconnection between ideological and economic forces in which

patriarchy and capitalism reinforce each other. This perspective sees the family as a source of oppression — an oppression that is constantly reinforced by conditions in the labour market. Women are seen as subordinates and never as initiators of technological development. Socialist feminists' analysis of education holds the school as a cite for the reproduction of woman's oppression as workers and as women (Stromquist, 1990).

2.2.10.1 Feminist Critiques of Science and Technology

The idea that science education involves passing on a body of knowledge that is value free has been the overwhelming and prevailing ideology of science educationists (Whitelegg, 1992). However, currently, the philosophical arguments surrounding the nature of natural science is that it is not value free. This is shown mainly in the disciplines of physics and mathematics (Lakomski, 1989). She goes on to state that like social science, natural science is a historical practice which is socially created and thus value laden. Since society itself is based on sexist and other hierarchies, and since science is a social and historical practice, it too bears the "social finger prints" of the dominant groups and is thus sexist.

The social constructivist's viewpoint that argues from a Marxist epistemology proposes that knowledge is grounded in experiences made possible by historically specific social relations. In societies where power is organized hierarchically by class, race or gender, there is no possibility of a perspective that is impartial or value free or detached from a particular historical social relation.

Even if natural science research is technologically driven, and the scientists not necessarily motivated by visions of new technologies of control or profit making, the funders of scientific research are.

Scientific knowledge, like all other forms of knowledge is affected at the most profound level by the society in which it is conducted. Much research has examined circumstances under which scientists actually produce new scientific knowledge and have demonstrated how social interest shape this knowledge. Studies provide many instances of scientific theories, drawing models and examples from the wider society. It has also been demonstrated that social and political considerations enter into scientists' evaluations of the truth or falsity of different theories (Wajcman, 1991).

Other feminists view science and technology as constructed without including women-centred values and hence they feel alienated from most scientific activities. However, they attributed such values to a socially and historically constructed gender division of labour. Rose (1983), endorses the Marxist characterization of bourgeois science as a form of alienated and abstract knowledge. She argues that it is the mental and manual division of labour, integral to capitalist production which gives rise to this form of knowledge.

Explaining the under-representation of women in science education and related professions, most research criticize the construction and character of feminine identity and behaviour encouraged in most cultures. However, these authors mainly pose the solution in terms of getting more women to enter science itself. Such studies assume that science is a noble profession which is worthy to pursue and that girls, given the right opportunity and encouragement, would gladly become scientists in proportion to their numbers in the population. It also follows that remedying the current deficiency is seen as a problem which a combination of different socialization processes and equal opportunity policies would overcome. This approach, as Harding (1986) points out, locates the problem solely in women and not in science and its

institutions.

The equal opportunity recommendations ask women to change their gender identify for a masculine version, but without asking man for a similar degendering process. This approach appears to assume that women are somehow deficient and that female participation will increase only if women are made more like man. Even though the old view that one has to be strong to work with machines is fading out due to the development of microelectronics and the decreasing importance of heavy industrial technology, there is no corresponding increase in the number of females engaging in science. An explanation for this phenomenon could be that there is something about the culture of science that makes it less comfortable for women than for man. For example, according to Wajcman (1991), the current career structure for a professional scientist requires long, unbroken periods of intensive study without giving room for childcare and domestic responsibilities. In order to succeed in these professions, women must model themselves on men who do not engage themselves in such tasks. The equal opportunity strategy has had little success because it fails to challenge the division of labour by gender in society.

Technology like science is seen as deeply implicated in the masculine project of the domination and control of women and nature. Many feminists argue for a technology based on women's values. Other male authors, like Cooley also argue that

"technological change has male values built into it: the value of warrior admired for his strength, speed in eliminating the weak, conquering competitors and ruling over vast armies of men who obey his every instruction. Technological change is starved of the so-called female values such as intuition, subjectivity, tenacity and compassion" (Cooley, 1980, p. 43).

He goes on to state that it is imperative that more women became involved in science and technology to challenge and counteract the built-in male values: "*that we cease placing the objective above the subjective, the rational above the tacit and the digital above the analogical representation*" (Cooley, 1980, p. 44). If the science that is taught to them appears to be 'male' science, then girls who do not conform to this male view will still feel alienated and will not enjoy nor succeed in it.

The notion that women are closer to nature than men contains various elements such as that women are more emotional, less analytical and weaker than men. In the advanced industrial world, where scientific and technical rationality are highly valued, these associations play a powerful role in the ideological construction of women as inferior.

2.3 COMMENTS ON EMPIRICAL FINDINGS

Most of the existing research findings on the relationship between gender and science education are based on:

(a) **Schools in the Western countries**. The socialization process of the young differs from one society to another so much that it is dangerous to generalize some of the findings without carrying out further investigations. Empirical research must be done first in every society so as to come up with valid conclusions.

(b) **Standardized test results**. Meta-analysis and test norms analysis have both been used for determining gender differences. The findings addressed only gender differences in central tendency and variability in most cases. The critics on these methods are that, the populations and the prevailing conditions under which the tests were standardized, for example the intelligent quotient (IQ) and aptitudes tests would be different

from those under which the experimental groups would be experiencing. This creates problems in determining the validity of the results obtained in different settings. Furthermore, in most cases, after carrying out a statistical analysis, commentators fail to make a clear distinction between statistical and educational significance of the results obtained.

(c) **Traditional paradigms of which positivism is an example**. This line of research tries to answer the women in science question without focusing on women decision processes in the context of the psychology of women. According to Baker and Leary (1995), research embedded in feminist paradigms employs a different set of assumptions, research designs and psychological models from those normally found in the science education literature. This feminist perspective hold greater promise for understanding the relationship of girls and women to science than those frameworks employed in the past. Furthermore, Kruger (1988) is also of the opinion that approaches and methods which are considered appropriate for studying physical or biological realities are not at all applicable to the study of human experience.

The literature is therefore limited in that:

(a) it fails to fully explain gender differences in perceptions and attitudes in relation to science achievement in an African developing country like South Africa.

(b) it tells us very little about *why* girls choose or reject scientific subjects and careers. Little is known about the underlying causes of female students' attitudes towards science since, in most of these studies, attitudinal scales based on the Likert-scale questionnaire were used. Their major disadvantage is that some respondents fill in their responses without putting much thought into it.

(c) it fails to offer an in-depth study of gender and science performance by employing qualitative research methodologies so as to get comprehensive information from the female students and professionals themselves. Of the few studies that employ qualitative methodology, the analysis of data has been by content analysis which in itself does not throw much light on the issues under investigation.

Based upon the previously discussed underlying assumptions of the previous methods used, the shift in methodological approaches appears not only appropriate, but long overdue. According to Cantrell (1993), the complex nature of education entangled in inter-relationships with social, political and economic contexts and laden with values, demands that an alternative paradigm drive educational research.

2.3.1 **Alternative Methodology**

The research strategy outlined in Chapter One guided the choice of the methods I used in my research. It was particularly the nature of the problem that had much influence. Kruger (1988) suggests that it is the unique demands of the problem which indicate the method rather than the method which limit the problem.

My research was therefore a qualitative, in-depth, empirical study which aimed at studying causes of gender differences in perceptions and attitudes towards science subjects as well a s identifying possible ways to overcome the associated problems.

I collected data through in-depth interviews. I analyzed it using discourse analysis which offered a deeper insight into the problems under investigation. A shift in methods was justified since, according to

Solomon and Harrison (1991), there was inconsistency in the results obtained when gender differences in the knowledge of science and technology issues were investigated using a Likert-scale questionnaire and semi-structured interviews. The results that were obtained through the questionnaire method were not found in the transcripts of conversations with the same students. Conversations, unlike questionnaires, revealed that girls were confident about their technical competencies.

Interviews by Baker (1990) and Baker and Leary (1992) indicated that attitudinal differences toward science between boys and girls are small. They go on to say that women in certain studies chose 'not sure' on a questionnaire because they said that the answers depend on the situation and on what was meant by science and technology. If the same question was asked in an interview, they would have asked for clarifications.

A full discussion on the methodological orientation is discussed in the next chapter. In the same chapter, I dwell mostly on the selection of the sample, description of the actual data collection methods employed, data analysis, as well as methods used to enhance the trustworthiness of the findings.

CHAPTER THREE

DISCOURSE ANALYSIS AND ITS METHODOLOGICAL STAGES

In the previous chapter, I outlined 'facts' and 'explanatory models' on gender differences in science. Problems with most of the methodologies used in the reviewed empirical studies were also highlighted. In this chapter, I describe the advantages of qualitative research methods in general, then discourse analysis in particular. I describe its assumptions and the methodological stages I followed.

3.1 QUALITATIVE RESEARCH

Before qualitative research methodologies had been fully accepted in preference to quantitative methods in the fields of social sciences, it was necessary to defend these research approaches (Woulcott, 1990, p. 26). It is therefore unnecessary for me to devote a substantial portion of my account to justifying qualitative methods. In this chapter, I intend to provide a brief rationale for my approach and choice of using discourse analysis as a method for analysing my data. Within this methodology, I also provide detailed descriptions of my data gathering techniques and analysis procedures that I followed.

Firstly, as I mentioned in the second chapter, most of the researches done in the field of science education in order to investigate students' perceptions and attitudes towards science are quantitative. Most of these researchers used statistical analysis on data that had been collected through questionnaires. Because of this, there is need for more qualitative studies. This opinion is also shared by Harriette and Raabe (1993), who propose that traditionally, psychologists' concern with issues pertaining to perceptions and attitudes assumed that individuals hold consistent viewpoints which can be measured using attitude scales. According to them, these make way for the categorization of participants. Many of these psychological scales and surveys rely on detailed

statements expressing an opinion to which respondents register their level of agreement or disagreement (Likert-scales). The use of propositional scales has been criticised as being inadequate on the basis that the initial emotional response of the subject would be tempered by consideration of the qualifications and justifications posed in the statement. They go on to state that this influences the respondent's judgement. The assumption that these traditional, attitudinal studies share is that there is some enduring entity within individuals that can be measured. However, I reject this assumption and argue that when people fill in an attitude scale, this must be thought of as linguistic formulations which are dependent on specific contexts.

Secondly, most recent researchers advocate the use of qualitative research methods such as in-depth interviews and focus group interviews (Seidman, 1991). Different individuals have different world views that provide a frame of reference for their perceptions, beliefs and behaviour. Furthermore, these different individuals would have had different experiences and that results in them having different interests and personalities. A qualitative approach in such a situation is best since it facilitates the expression of these multiple perspectives.

3.2 DISCOURSE ANALYSIS

Discourse analysis is a relatively new approach in social psychology. It has its roots in more established perspectives in philosophy and sociology. Its major tenet is that people use their language to construct versions of the social world (Potter & Wetherell, 1987). Like social constructivism, discourse analysis is a movement which has been stimulated by dissatisfaction with the positivist model on which psychology has been traditionally based.

The term discourse analysis is a generic term for virtually all research concerned with language and its social and cognitive context (Brown & Yule, 1983). Stubbs

(1983) uses it to describe all studies which involve linguistic units only above a sentence.

Some continental discourse analysts and conversational analysts such as Foucault (1980) take discourse to refer to much broader, historically developed linguistic practices.

Some researchers make a distinction between discourse analysis and text analysis with the aim of separating the study of underlying theoretical and methodological strategies (Levison, 1983). Others also want to make a distinction between discourse analysis and text analysis with the aim of separating the study of underlying theoretical structures from actual linguistic performance (Halliday, 1978). Other researchers also distinguish discourse analysis from content analysis (Potter & Wetherell, 1987). They argue that even though it deals with language systems, content analysis works on a different philosophical model from discourse analysis. Language is used as a dependent variable which records causal processes revealed by the numerical assessment of occurrences within categories. Unlike discourse analysis when strictly applied, content analysis allows for a certain amount of statistical analysis.

The definition of discourse used in this research is informed by Potter and Wetherell (1987). They refer to it as all forms of spoken interaction that could be formal or informal and written texts of all kinds. According to them, discourse analysis means an analysis of any of these forms of discourse. However, for this particular study, I will take discourse analysis to refer to an analysis of transcribed material that was obtained from interview data.

The rationale for using discourse analysis is that this approach is intended to do justice to the complexity of lay explanations as they are deployed in natural contexts (Potter & Wetherell, 1987). They go on to state that although discourse analysis is sensitive to linguistic nuances and the kind of contextually sensitive

features of talk which are extremely difficult to recover using traditional content analysis, it is a systematic approach whose findings are open to evaluation. It also enables the unearthing of what they called 'practical ideologies' through which (in this particular case) gender inequalities in science can be understood. Finally, the results of analysis of this type are both interesting and potentially useful because they focus on both the specific linguistic content and the organization of lay explanations.

A number of researchers in the fields of psychology and sociology have used discourse analysis. Examples of them include Potter and Wetherell (1987) who analysed a section of an interview transcript concerning Polynesian immigrants to elucidate racist discourse. Hollway (1992) also used discourse analysis in analysing the construction of subjectivity in heterosexual relations. Burman and Parker (1993), also edited a number of researches done by various researchers who had used discourse analysis as the analytic strategy.

Attempts to provide guidance on how to analyse case study data was done by Glaser and Strauss (1967). Their approach to theory generation through grounded theories places heavy emphasis on induction. However, grounded theory is not seen as producing all, nor is it concerned with proof. It is seen as a stage prior to verification. Similarities and convergences with the literature may be established after the analytic core of the categories has emerged. Glaser and Strauss (1967) gave a model of the research process in terms of the progression from raw data to categories to their properties and then to hypothesis formulation. This contrasts the trend in traditional psychological research and other related fields whose aim is to verify theory which has been arrived at by logical deduction from prior assumptions.

Potter and Wetherell (1987), modifying Strauss and Glaser's propositions, suggest a number of methodological stages one can follow when carrying out discourse analysis. These are the stages I followed and I outline them in the

forthcoming section.

3.3 METHODOLOGICAL STAGES

3.3.1 Stage 1 : Research Questions

Questions asked by discourse analysts can be many and varied, but broadly related. These questions are designed with the problem in mind. By answering these questions, the possible solutions to the problem are found. I outlined the research questions for this particular study in the first chapter. I found that just like in traditional methods, research questions acted as crucial determinants of my methodology and other related aspects of my research.

3.3.2 Stage 2 : Sample Selection

> "*Discourse diverges most radically from the traditional view which involves the basic question of sample size. Since it is a labour intensive approach, a small sample size is recommended. Even after the demanding process of transcribing, and preliminary coding is complete, these texts must be reread several times and if there is too much of it, there is danger here of the researcher being bogged down in too much data and not being able to let the linguistic detail emerge from the mountains of texts*" (Potter & Wetherell, 1987, p. 161).

Their argument is that since the researcher is mainly interested in language use rather than the people producing it and that varied linguistic patterns can still emerge from a few people, small samples or a few interviews are generally quite adequate. According to them, the success of a discourse analysis study is least dependant on sample size.

Due to the nature of my research, I did purposeful sampling since I found it to be the most appropriate method. Seidman (1991) recommends

maximum variation sampling as the most effective strategy for interview studies. These sampling principles are also important components of the grounded theory approach.

In this research, four female black students from a rural day secondary school and four from an urban day secondary school in the Central Region of the Eastern Cape Province were used. Rural and urban students were selected so as to obtain interview data that was varied since it was coming from people from relatively varied backgrounds. The students were from standard nine and ten classes.

A pre-college sample was selected for the following reasons:

Firstly, according to Erickson (1968), adolescent years are described by many developmentalists as the time youth begin to define themselves by attempting to identify who they are. One important aspect related to this identification, though tentative in nature, is related to the adolescent's choice of a career.

The second reason pertains to the science workforce pool. Berryman (1983) states that examining populations at the pre-college level is imperative because as they engage themselves in science-related activities, the pool for the science workforce first emerges in the elementary school, grows and is generally completed by standard ten. Any migration occurring after this standard is usually from, rather than into sciences.

Due to the nature of my research, purposeful sampling of the schools was also done. The schools selected had good science facilities (adequate science equipment, a laboratory and [trained] qualified science teachers).

My sample of science students came from classes of students who had selected physical science as one of their subjects. I noticed that those classes of students who had not opted for physical science were doing biology as one of their subjects and hence my sample of "non-science" students come from these biology classes. (See Section 1.3.7 for further explanations).

After selecting out a few students who did not meet the conditions outlined above, the remaining students' participation was purely on a voluntary basis. Interviewing unwilling students would not have been fruitful in the sense that they would not have generated live debates.

I also interviewed a sample of four professional women in science. These again were chosen purposefully through snowball sampling. I was looking for women who had done physics and/or chemistry up to post-graduate level or had undergone some training in a physics or chemistry related job. I included professional women in science (that is those who had been successful throughout) since their reasons for success regardless of all problems have seldom been examined by academic researchers.

My sample consisted of females only. I chose to use such a sample because of the following reasons. Firstly, feminist scholars have long advocated for the abandonment of male-female comparisons in favour of looking at females alone. Secondly, such an approach avoids using a deficit model or the assumption that male behaviour is the norm. It also allows the data to be understood in light of women's socio-psychological validity as expressed in educational preferences (Campbell, 1988).

By involving a combination of students and professionals, I was assured of obtaining 'rich' data which helped me tremendously in understanding and explaining the phenomena under investigation. According to Yin (1984), phenomena are the starting point and cases are opportunities to

study the phenomena. Since I am interested in detailed information specific to black females' perceived causes of gender differences in perceptions and attitudes towards science subjects and possible solutions to the problems, I found case studies very appropriate. Case studies are also appropriate for most educational issues because of the human complexities of the education situation. Complexities are generally not susceptible to quantification by way of a survey, for example.

3.3.3 Stage 3 : Instrumentation

Two types of instruments were constructed so that they could be used for data collection. These were interview schedules and a vignette.

The interview schedules were constructed based on my research questions. The questions asked were purposefully designed to bring out from the respondents problems female science students encounter as they engage themselves in science related activities. Questions pertaining to what they felt could be possible solutions to the problems they encounter were also included. Since my investigation is guided by the interpretive paradigm (see Chapter Two for detailed information), the key questions I asked were very much influenced by its assumptions.

The first question on the student interview schedule was asked just to confirm that I was talking to the right person. The second and third questions were: *Why did you choose/not choose to do science?* and *what do other people think of your choice?* respectively. I viewed these as important questions basing my assumptions on the fact that humans possess self-consciousness.

This implies that:

(a) people can consider themselves through the eyes of other people and bring their behaviour in line with what they think others expect of them.

(b) people can step outside themselves to examine their own action or intended action and can decide whether they want to act in a given way or not. The ability of humans to choose between various options of courses of action implies that humans have an awareness of the world and they can participate in creating their world. This assumption of self-consciousness implies that human beings are fundamentally different from objects, plants and other animals since they can reason and think (Romm & Alant, 1990).

The fourth key question was *Which subject do you like best?* I found this question to be very relevant in this research. After realising that humans have self-awareness and can visualise alternative ways of action, I also realised that they can choose between options. This implies that there is a unique relationship between them and their world. Romm and Alant (1990), are also of the opinion that "*the world in which humans live is structured by acts of consciousness as a world of meaning. Human consciousness actually reshapes the world into a life world*" (p. 44). This means that the human world is rooted in the human beings' ability to construct a meaningful reality. People construct the world in terms of their experience thereof. Students like certain subjects and dislike others depending on the stance that they take towards them. Certain subjects do not have any relevance to them. Some students feel that the content of certain subjects does not have any relevance for them independently of the way they attribute meaning to them. Certain knowledge would not exist for them unless they were meaningful to them. According to Romm and Alant (1990), the world which exists for an individual is the world s/he makes sense of or gives meaning to.

Although I knew the nature of questions I wanted to ask, I did not develop specific follow up questions in advance. The course of the interview was determined by the respondent since I was building my new questions on what she felt was important.

To generate interpretive contexts in such a way that the connections between the interviewee's accounting practices and variations in functional contexts become clear, I adopted the follow-up questioning technique to responses which posed alternative or problematic views or facts. (See Appendices B, C & D for the interview schedules) These questions guided me. I made sure that I asked all the interviewees the same key questions. What differed were the intermediate ones which depended on the respondents' response.

The vignette was constructed based on a fictitious story (see Appendix A). It was intended for finding out what girls thought about science-related subjects and careers in relation to gender. Stereotypic behaviour in science related activities was to be revealed through the discussions that followed if it was there among black South African students.

3.3.4 Stage 4 : Data Collection

I used the following procedures for gathering data.

3.3.4.1 Biographical Questionnaire

Van der Mescht (1996) regards the use of biographic questionnaires as a crucial step in the data gathering process. It can be used as the initial step in selecting the range of people from whom to choose a sample to interview. I used if for selecting students who could participate in my study. I wanted to make sure that I would interview the right people I

wanted, that is female, black South African students who grew up and were staying either in an urban or rural area. Valdo (1992) expounded upon some of the advantages and disadvantages of written questionnaires so I was reluctant to ask for more than biographical information through questionnaires since they are impersonal.

3.3.4.2. Pilot Interviews

Potter and Wetherell (1987) suggest that pilot interviews must be done before the proper research so that the adequacy of the schedule can be assessed and any necessary modifications made to question wording and general organization. I carried out the pilot interviews and I realised that I had to improve on a number of aspects.

Firstly, as a novice researcher the first thing I realised needed rectification was the way I was to prepare for the interviews. The interviewees needed to know a lot about me. After my first interview, I realised that I was supposed to be prepared to answer all the questions they asked me so that they could also willingly cooperate during the interview sessions. Most of them got much interested when they realised that I could not speak Xhosa. I learnt that I was supposed to explain everything they wanted to know so that they might not fear me or be shy to explain their views to me.

In some cases I realised that when I asked a question, I got different responses from what I expected. This made me restructure some of my questions since they were ambiguous.

During the probing process, I realised that sometimes I asked leading questions. I tried to avoid it in the actual interviews but I would confess again that it was rather difficult for me.

I also realised that most of the students were not well conversant with English. I later realised that I was to give each respondent an option to speak in English, Xhosa or a mixture of the two. However, all the students in this study opted to speak in English even though some of them could not speak good English. Nevertheless, it was understandable.

3.3.4.3 Actual Interviews

The goal of traditional interviews is to obtain or measure consistency in participants' responses (Potter & Wetherell, 1987). Consistency is valued because it is taken as evidence of a corresponding set of actions or beliefs; consistent discourses demonstrate that the interviewer has found some genuine phenomena and not biased. However, in discourse analysis, "*consistency is less useful and desirable for analysis than variations in interviews*" (Potter & Wetherell, 1987, p. 163). Consistent responses are uninformative since they tell us little about the full range of accounting responses people use when constructing the meaning of their social world.

I visited the schools on different days after making appointments through the principals. Everytime I went to conduct these interviews, I went with someone who could understand both Xhosa and English. This provision was made for those who might have decided to be interviewed in Xhosa. Nevertheless, none of the respondents preferred to be interviewed in Xhosa. In all occasions the vignette and interview discussions were tape-recorded and later transcribed.

Initially, four girls from each school were presented with a vignette

describing a high school student who intended to pursue a career in engineering (see Appendix A). This was followed by an open-ended question which was open to debate. The discussion of this question was done in my absence because I felt that as an adult, my presence could have influenced the course of the discussion. Students chose a facilitator from among themselves.

Soon afterwards, I carried out individual in-depth interviews with each of the four students (two science and two non-science students). This activity was designed to elucidate discourses related to problems black female students encounter and the possible solutions to those problems. It was through the identification of these problems that I also managed to cite causes of gender differences in perceptions and attitudes towards science subjects and related areas. From these tasks, I was able to deduce societal expectations on boys and girls' attitudes towards science and career choices.

In-depth interviews were also conducted with four black female professional scientists. This task was designed to provide information on what the people who went through the system see as the causes of gender differences in perceptions and attitudes towards science subjects and how problems associated with these differences can be overcome.

Each interview was about twenty minutes long for students and about thirty to forty minutes with each professional woman.

It is of paramount importance for me to explain why I chose in-depth interviews as the only method for collecting data. Seidman (1991) argues that "*at the root of in-depth interviewing is an interest*

in understanding the experience of other people and the meaning they make of that experience" (p. 3). He also states among other issues that access to the context of people's behaviour is provided through interviewing. The participants' words provide an inside view of their reality. I adopted an interview/case study approach because I wanted to hear what the women had to say in their own terms rather than test my own preconceived hypothesis. Feminist researchers emphasise the importance of giving a voice to those who have not been visible, that is women and other oppressed groups. Greater emphasis is placed on the value of personal experiences of people - the mind and everyday experiences of women, normally hidden and deemed unimportant (Baker & Leary, 1995).

I decided to interview women only because, according to Wetherell (1986) interviewing women when you too are a women is an advantage since the women are much more likely to talk about personal aspects of their lives than they would do with a male researcher.

The interviews and vignette discussions were tape recorded and transcribed resulting in a number of texts that were later analysed.

3.3.5 Stage 5 : Tape Recording and Transcribing

Each word that is spoken by a participant reflects one's consciousness. The advantage of tape recording is that it preserves the words of the participants such that if something is not clear on the transcript, the researcher can return to the source and check for accuracy. According to Briggs (1986), in working with the material it is important that the researcher start with the whole. Tape recording also benefits the

participants since they feel assured that there is a record of what they have said to which they have access. I played back the interviews to the respondents who were willing to listen before transcribing them. Even after the transcribing process, I gave the interviewees scripts of their interview data for them to verify whether what I had on paper was exactly what they wanted to say.

Seidman (1991) argues that to work most reliably, with the words of participants, the researcher must transcribe tape recorded material since this is the primary method of creating text from interviews. I transcribed the whole interviews rather than just the respondents' parts because, unlike in traditional interviews, the researcher's questions are seen as active and constructive not passive and neutral.

There are many transcription varieties one can adopt (Alkinson & Heritage, 1984). The choice depends on what one wants to use the texts for. The more detailed it is (that is including timed pauses and overlaps) the longer it takes to transcribe a piece of work. However, for this particular case, the timing and annotations were not important so I did not include them. The very simple method was used (see Appendix E for details).

The following transcription conversions were used: Words with particular emphasis are in italics. The respondents' words are bolded. Three dots in brackets are used to indicate that the respondent's talk trailed off in mid sentence. It is also important for me at this stage to state that I made no attempt of correcting grammatical and other errors related to English language in the transcribed information. It is also important to note that all the respondents are second language speakers with respect to English. It is only that they insisted that they wanted to respond in English during the interviews.

3.3.6 **Stage 5 : Coding**

There are different methods used for creating codes, but the one I used is the empirically "*grounded approach*" advocated by Glaser and Strauss as explained by Miles and Huberman (1985).

The goal of coding transcribed information (texts) is to "*squeeze unwieldily body of discourse into manageable chunks*" (Potter & Wetherell, 1987, p. 167). The categories I used during coding are related to my critical questions. These categories acted as retrieval and organizing devices that allowed me to spot quickly, pull out then cluster all the segments relating to a particular concept or theme.

It is important that I distinguish between content analysis and coding at this stage. Content analysis involves coding data into categories as well as looking at the frequency of occurrence and is simply equivalent to analysis (Berelson, 1971). In discourse analysis, analysis follows.

The following codes were used to denote words spoken by various individuals during the interview sessions. I also changed the names of the respondents since some of them did not wish their names to be published.

A	:	Annie
B	:	Babalwa
C	:	Cathrine
D	:	Diana
F	:	Felly
I	:	Interviewer
Nom	:	Nompilo
Non	:	Nonhlanhla

P	:	Pamela
R	:	Roselyn
S	:	Sizeka
T	:	Tulisile
R1 - R8	:	Focus group respondents

3.3.7 **Stage 6 : Analysis**

The analytic process followed was basically that set out by Potter and Wetherell (1987). Discourse analysis as used in this thesis is based on the following assumptions regarding the nature of discourse:

(a) It is language realized in speech or writing.

(b) It is a social production and hence is open to a multiplicity of interpretations.

(c) Besides being used for communication, it is also imbued with power; and

(d) It is action orientated.

In addition to the above assumptions, Potter and Wetherell (1987) suggest the use of the notation of interpretative repertoires by looking at some crucial aspects of language. These are that:

(1) There is always variation in the accounts that people give which is more important than the consistency that traditional psychologists look for. Since variation is a result of function, it can be used as an analytic clue to what function is being performed in a particular stretch of discourse.

(2) Talk has a variety of functions other than that of simply transmitting information. It is action-oriented and hence people do things like accusing, blaming, justifying, requesting and so on with their

discourse. However, the elucidation of function is one of the end products of discourse analysis. Functions are the findings rather that the raw data. These functions are revealed through a study of variation.

(3) Talk and writing are constructed out of existing resources. According to Burman and Parker (1993, p. 4), "*these resources are the repertoires, repertoires we do not create anew when we speak, but which we have to borrow and refashion for our own purposes*". This means that people are familiar with a range of repertoires for a given topic and according to the function of their discourse in a particular context, will draw on these repertoires in a flexible and variable way.

The analytic practices involved in this approach are that:

(1) Close attention is paid to the detail of language use, working from transcripts rather than from (in the social psychological tradition) some numerical transformation of these things or the remembered gist of interaction.

(2) Discourse itself becomes the primary research focus.

(3) Discourse depends on the study of variation, working from the way discourse is constructed to some conclusions about the functions discourse might be serving (Wetherell & Potter, 1988).

The identification of recurrent patterns in the linguistic construction referred to here as repertoires was tackled by reading and rereading the transcripts and taking out instances where there appeared to be terms, phrases and metaphors linked to the concept of causes of gender differences and solutions to the problems. They were selected either in terms of:

(i) similarity in structure or content ; or

(ii) differences or variability in what was said.

Extracts were initially taken out even if they seemed loosely associated with each concept. This process was repeated a number of times. Secondly, attention was given to how the selected constructions were being used and whether they seemed to save the same functions.

I started sort of 'proper' data analysis as soon as I finished interviewing my first case. From my experience, I noticed that it was rather impossible to separate the process of gathering data and analysing it. Once the interview had commenced, I could not help but work with the material I was getting during the interview to ask more informative questions in order to keep the interview going forward. Other researchers (Lincoln & Guba, 1985) also argue that these two stages, namely data collection and analysis must be integrated so that each informs the other. As a result of every previous interview, I received insight into how to frame new possible probing questions to use in forthcoming interviews.

According to Miles and Huberman (1984), the analysis of data at the end of the data collection episode rules out the possibility of collecting new data to fill in gaps or to test new hypothesis that emerge during analysis. In their words : "*Analysis during data collection lets the field worker cycle back and forth between thinking about the existing data and generating strategies for collecting new - often better quality - data*" (p. 19). This practice made my analysis an ongoing, lively exercise.

I paused for a week to give myself time to review the main themes, issues and problems that I encountered during this first contact. Some of the issues I come up with are those explained in section 3.3.4.2.

Although the pure separation of data collection and analysis is impossible. I avoided in-depth analysis of the interview data until I had completed all interviews as suggested by Seidman (1991). According to him, this is important because it assists the researcher in identifying the most appropriate way of coding the data and finally analysing it.

3.3.8 Stage 7 : Validation

With regards to the question of content validity and the validity of data interpretation, this approach I adopted emphasizes that the information obtained from any participant is valid since that account is a product, although complex of the social domain. This view is also supported by feminist researchers who state that unlike positivist researchers who search for patterns of causation and universally applicable theories, discourse analysts insist on the validity of every individual's view and experience (Hollway, 1989).

Stake (1988) is also of the opinion that validity depends on the use to which the findings are put and the researcher and reader's point of view. A case study is valid to a reader to whom it gives an accurate and useful picture or representation of the bound system. The basic demand of feminist research ethics is that the work should not be simply on women but also for women. This means that the product of such research should be directly used by women in the formulation of policies and provisions necessary for the betterment of their lives in various spheres of life.

In this particular research, in order to make sure that my research is valid, I did the following:

(a) I offered an in-depth description of each of the stages I followed explaining the rationale for including that particular aspect.

(b) I tried to give a coherent account of the analytic process demonstrating how the identified discourses fit together to give a comprehensive account. The discussion include original statements made by the respondents. I believe that the inclusion of these quotations gives the reader an insight into the actual views and feelings of female students and professionals as reported by themselves. Further, insight can be obtained from reading the actual interview transcripts (see Appendix E).

(c) To ensure credibility of my transcribed information, I asked respondents who were willing to read through the transcripts to assess whether I was to analyse texts of what each one of them said.

(d) During the data collection and analysis processes, I tried to 'bracket' my own assumptions and ideas as an attempt not to falsify the respondents' intentions.

Traditional researchers employ various forms of triangulation to overcome the problem of deciding which of the available accounts should be considered as the real findings of one's research.

However, in discourse analysis, discourses from different sources compound rather than reduce variability between participants' accounts. This variation is made a way into analysis (Potter & Wetherell, 1987).

In this chapter I described the methodology I followed in this research. I also made an attempt of explaining the rationale for including each of the outlined procedures. The details of the analytic process are discussed in the next chapter.

CHAPTER FOUR

ANALYSIS AND REFLECTIONS ON DISCOURSE ANALYSIS

In the previous chapter I described in detail the methodology I used in carrying out this study. Reasons why I carried out each of the outlined procedures were also discussed. I also discussed advantages of using discourse analysis as an analytic tool. In this chapter I analyse the interview data using discourse analysis. An evaluation of discourse analysis as a method of analysing data is done at the end.

4.1 THE ANALYTIC PROCESS

The analytic process was approached using a system of discourse analysis formulated by Potter and Wetherell (1987, 1988). The details of the procedures followed were discussed in the previous chapter. I made an attempt at quantification only in instances where a larger group or too few people seemed to agree on a certain aspect. I endeavoured to identify interpretative repertoires and explore their functions in relation to my research questions (see Chapter One for details).

It is important for me at this stage to state that since discourse analysis is a subjective process, I continually imposed my own meanings onto the text. This means that I viewed the text through my own 'eyes' and my positioning as a female who is also influenced by theoretical or ideological paradigms (such as feminism). These influenced the meanings I attributed to some of the respondents' discourse.

I identified two interpretative repertoires which I used for accounting for the gender differences in perceptions and attitudes towards Science. These are an essentialist account (Kaminer & Dixon, 1995) and a normative feminine account. I also feel that it is important for me to explain that these interpretive repertoires

were not necessarily distinct from each other. In some cases they presented some degree of overlap across categories.

However, for the purpose of this analysis, classification was determined in terms of whether the cause was portrayed as due to something inbuilt - that could not be changed or as originating from the social environment and was viewed as appropriate, normal and expected. Those accounts that portrayed the notion that females lacked certain inner attributes which males possess that contribute to their positive attitude towards Science subjects were classified under the essentialist account. Those causes that were said to be due to the environment were classified under the normative feminine account.

Within these repertoire categories, data were further sub-divided into smaller categories (thematic chunks). I did this as an attempt to separate each given text into coherent themes. This approach is informed by the idea that discourse does not simply express or reflect meanings, rather, meanings are constructed through discourse (Potter & Wetherell, 1987). For the purpose of clarity, the format for presenting the findings is organised so that problems are dealt with under respective explanatory categories which fall under respective repertoires. Suggestions on what can be done about the problems were also discussed separately. Some of the solutions suggested could be solutions to a number of problems so it was difficult to discuss specific solutions under specific problems.

The purpose of doing all this was to try to ease the analytic process.

4.2 ACCOUNTING FOR DIFFERENCES IN ATTITUDE TO SCIENCE

4.2.1 The Essentialist Account

This repertoire was constructed upon the essentialist notions of gender (Bohan, 1993; Kaminer & Dixon, 1995). However, in the context of this

study, essentialism should be equated to biological determinism as well as being seen as a product of social, cultural and historical processes. It utilizes and perpetuates the notion that men and women possess essentially different characteristics and qualities which contribute to their differences in behaviour. These differences are viewed as innate, natural and universal. Using this repertoire, respondents constructed the causes of females' perceptions and attitudes towards Science as due to their possession of unsuitable characteristics and hence accept them as natural feminine features. They also used what males say about them concerning their femininity for consolidating what they though about themselves. They contrasted it with males' perceptions and attitudes towards the same subjects. For females not in Science, this justified their behaviour of not taking up Science as one of their subjects.

4.2.1.1 **"I really don't known why they are so *lazy*"**

This type of explanation focused on women's laziness and was brought up by almost half of the respondents. However, it contradicts some of the research findings like, for example, that of Macleod (1993). Using a post-structuralist discourse analytic approach, she found that women lack the 'natural flair' in Mathematics and hence work harder in it compared to males. Maybe, this contradiction arose due to the different methodological approaches used.

Pamela, a professional women, challenges females to work hard like what males do.

P: *I want to challenge more females. Work hard just the way males work.*

Tulisile, who is also a professional women in science, comments on this

aspect:

T: *We also fail maybe because we are sometimes lazy, even to push ourselves, putting more extra time in our work. At times it might be a different case with males.*

In one of the focus groups, someone gives a clarification on why she thinks women are lazy. Her narrative is constructed around the duration of scientific courses.

R3: *Women are lazy. They wouldn't be able to do that. They are so lazy that you find them, most of them are nurses. Nursing only takes three years. Women wouldn't bear a seven year degree.*

This account constructs the duration of courses in Science related careers as one of the relevant factors that make most females shun Science subjects and related courses. It is evident, however, that the specific manner in which this factor affects female students' participation is understood in dissimilar ways by different individuals.

Sizeka, a Science student, had this to say when I asked her what reasons non-Science students give for not liking Science.

S : *I really don't known why they are so lazy. I mean they believe that laziness is the nature of women but I really don't believe that. I mean, I really don't believe it. I mean the way they look at me, the way they see how much I love Science, they sort of think maybe you were supposed to be a boy.*

I: *Uhm. Because normally Science is associated with boys?*

S: *Yes.*

I: *Why do people associate being a scientist with boys?*

S: *Science is adventurous and people who like adventures are boys so girls should sit their passive. I mean I don't believe in that. I mean they believe that boys are adventurous so then are good for Science not girls. But I happen to be a very adventurous person throughout and I associate myself with Science.*

In contrast to Sizeka's explanation in which she portrays laziness as the nature of women, R3 describes women as lazy because they do not want to spend long periods training for a job. They rather opt for jobs with shorter training periods. The reason why most females opt for nursing described here further contradicts that explained in section 4.2.1.2 in which respondents gave reasons that they prefer to work with people rather than with machinery.

Two aspects of this later extract are immediately striking. Firstly, Sizeka appears to be not answering the question she was asked. Instead of explaining why she thinks women are put off from joining scientific fields, she appears to be providing a justification for why they are not in Science, "*I don't known why they are so lazy*". She does not give women's reasons for not taking up Science but goes on to say that she thinks of them as "*lazy people*". To be lazy is to intentionally avoid work, not necessarily due to incapability. She sees the source of the problem as the women themselves.

Secondly, she seems to push the problem to something beyond the control of these women when she states that this laziness is their nature. The use of the word 'nature' may imply that this laziness aspect is an

inborn characteristic which is very difficult to eradicate. She seems to generalize this aspect to all women who are not in Science. However, she sees herself as different from all other women since her beliefs about the nature of other women are different from what she thinks about herself. She sees this unique difference between herself and other women as a major contributing factor to her greater liking for Science.

Sizeka outlines some personality traits she sees as necessary for a scientist to possess. It is worth at this point to look at the nature of the personality trait which she formulates as necessary for a scientist. She uses herself as an example. She classifies herself as someone who is hard working and adventurous and hence associates herself with Science.

What is striking about these qualities of a scientist she is describing is that they seem to be tied to stereotypes about gender. Scientists have got to be 'adventurous', 'love Science' and 'hard working'. These qualities seem to fit more readily with stereotypes of masculinity than femininity (see Chapter Two for details). Indeed, if anything, the qualities appear to match more closely stereotypes of men: It is man who, according to stereotypic behaviour, are hard working, adventurous and love Science. The significance of this is that she sees other people as if they regard her as having male characteristics: "*they sort of think maybe you were supposed to be a boy*". According to her, these male characteristics are what makes her to be suited for Science. This extract supports the impression that Sizeka is accounting for why women are not acceptable into Science rather than why women do not opt to enter Science.

Babalwa, a professional scientist, also attributes her success in Science to the 'strange background' from which she comes from.

B: *Maybe it's because I also come from a strange background because my father in a sense never let me feel that I am a woman really. He actually made me feel like I was a man.*

Her use of the phrase 'strange background' could imply that what her father did, of not treating her like how other women were treated made her upbringing unusual in her eyes as an individual and in the eyes of society. Just like Sizeka, Babalwa attributes her achievements in Science to the manly characteristics she possesses from the way she was socialized. Sizeka and Babalwa seem to convey the message that any female who wants to succeed in Science must abandon her womanly characteristics and be more like a man, like what they did.

However, on closer examination of this aspect, the problem appears to originate from gender role prescriptions - an aspect that is discussed in section 4.2.2.2.

It is clear that the so-called male characteristics are being used as the norm against which other characteristics are judged for their appropriateness for Science. This extract can also be a good example of what has been called the male norm phenomenon (Spender, 1985). It is against the background of this norm that becoming a scientist in male dominated areas can be hard for women.

4.2.1.2 **"Its just that most of us females *we don't like to do jobs like that*."**

The other reason why females do not participate in Science was identified as the lack of interest in the nature of physical Science related jobs.

All the students engaged in the vignette discussions agreed that student

X is male since he enjoyed Science related activities (See Appendix A). The extracts below bring out this aspect.

R7: Its just that most of us as females we don't like to do jobs like that.

Z: Females don't like engineering.

R1: We [females] don't like something like we have to be dirty, to wear those overalls or the dirty clothes.

Female students themselves see boys as the ones who are more suited to engineering and related careers since they are the ones who do not mind being dirty as evidenced by responses on the vignette. Females associate femininity with attractiveness. They associate their physical appearance with success and power within their feminine roles. As Matthews (1984, p. 75) puts it, *"they are anxious about their bodies, hyper conscious of their physical appearance and insecure about their attractiveness"*. This finding was also obtained by Kelly (1987a). Females like neither dirty jobs nor wearing clothes that are not consistent with their society's expectations. They could have been brought up being told that there is dressing that is suitable for males and another type that is suitable for females. These extracts also normalizes female's non-participation in this field.

The statement by R1 further reveals that this student has a very limited knowledge about engineering. There are lots of engineering professions in which one does not get dirty and even wear overalls. This agrees well with R7's observation that females lack guidance on career choices which is actually a prerequisite if more females were to enter into Science.

Diana, one of the Science students sees engineering and other related

jobs as not suitable for women in the sense that when these women are pregnant or are now mothers, it is not proper for them to continue with the job.

D: *And to find a mother, you know, a mother, somebody who is supposed to be respectable doing mechanical engineering does not look right. In our culture, I don't think its such a respectable job for a women. It's more like a man's job. I mean, can you imagine a pregnant woman?*

I: *Yes.*

D: *She can work in a hospital as a medical doctor or as a nurse, but in engineering, she has to go under cars...*

The idea Diana is putting across is that, on sheer pragmatic grounds, there is little women can do in certain scientific fields. Due to biological reasons, it is impractical sometimes. This view is also shared by radical feminists who believe that women's ability to conceive and give birth acts as a major constraint to their incorporation of other roles besides their domestic ones (Stromquist, 1990). This is a very different and contradictory discourse from that other respondents were putting across. Pragmatic realism is a particularly flexible repertoire. Its effects in this particular context is to present constraints which are beyond females' control. Diana portrays the image that this aspect causes women to regret but at the same time constructs them as people who are at least realistic and practical.

Diana's use of the phrase 'somebody who is supposed to be respectable' in her account, is quite interesting. Behaviour that is respectable is that which is socially acceptable and hence, even though a woman may not

mind engaging in certain scientific jobs which society does not approve of, it views her as a social misfit.

R2: I also think X is a male because from, from the time like if you are a girl or a boy like girls like to play with dolls and like dolls and those things. Guys like to eh to do engineering and like to break up things and put them together again.

R2 traces X's choice back to an interest in construction kits, 'breaking up things and putting them together again'. This appears to indicate a natural preference for 'realistic' activities (Holland, 1985). According to these girls' perceptions, they are mostly boys who display such behaviour towards Science.

All Science students and even Tulisile, one of the professionals, indicate that their main occupational interests lie in medicine. It is interesting to note that even Sizeka who in section 4.2.1.1 indicates that she behaves like a boy when it comes to liking Science also opts for medicine.

When I asked these students why they chose to do Science, they responded in the following manner:

S: Because my main goal was to become a doctor and still want to become a doctor. So I have heard that you need a good Science.

Nom: The reason why I chose to do Science is, from a little girl, I wanted to be a doctor. So and then, I just grew up with it.

D: I want to be a doctor.

F: I want to be a nurse.

According to the 'Occupation Finder' in Holland (1985), subjects like Physical Science and Maths are classified as investigative subjects and are normally preferred by individuals interested in realistic occupations. Engineering comes under the category of 'realistic' occupations. It attracts people with practical abilities, who prefer to work with objects and machines rather than people. Since Sizeka, Nompilo and Felly were doing Physical Science which is a subject associated with realistic occupations, it might be expected that they have preferences for realistic activities. However, they prefer medicine and nursing.

Professions like medicine and nursing in which one deals with people, helping them, etc., are referred to as the 'social' occupations. They attract people who primarily perceive themselves as having interpersonal skills and aversion for systematic, ordered work involving objects or machines (Holland, 1985). Although it is possible to select responses which seem to offer support for Holland's personality types for these occupations of which Sizeka's descriptions of herself can be an example, it is evident that this can only be achieved by ignoring the complex conversational context of such responses. When this is examined, there are mismatches between responses and the occupational typology. An example is of Sizeka who has a lot of interest in helping other people, yet again she is very much interested in physical Sciences which are categorised as 'realistic' and 'investigative' subjects that are normally done by people who do not enjoy working with people.

The analytic results above are in agreement with Gilligan's (1982) findings that there are differences in the ways in which men and women develop their values and their sense of identity. She propounded the existence of a 'woman's nature' or 'female psychology' rooted in relationality and communion. While men define their identity in terms of autonomy and separation, that of women is defined in a context of

relationships and judged by a standard of responsibility and care. Wetherell, (1986, p. 78) also argues that in psychology, feminine and masculine have usually been understood in terms of "*a communion/agency, or alternatively, expressivity/instrumentality distinction*".

Even though Sizeka is very active in Science just like boys, she still has this element of femininity in her - the need to help both people and other animals. Collings and Smithers' (1984) empirical quantitative data also show that girls are in general more interested in people than are boys. When I asked Sizeka what influenced her to become a medical doctor, she narrated a story:

S: *Eh! Something outside inspired me. I mean like ... ehm ... it may sound a little stupid but it really affected me. Once a chicken died in front of me and I was very fond of this chicken. It was very sick and I was very helpless. I couldn't do anything to help it and it just passed out. And sometimes you see a person in pain and you feel like maybe, if maybe there would be a way to help that somebody but you are now just helpless. And I felt maybe this inspiration can get me somewhere. I mean there would be more things happening in my life that I'll feel helpless. And so, I really don't like feeling helpless and so that is why I just want to serve the nation.*

She even has high hopes of finding solutions to some world problems related to people's health like finding a cure for AIDS.

S: *In the true sense, there could be hope for the treatment of many diseases such as AIDS which has really become a dreadful disease. That is maybe through Science, maybe you could see my face through TV saying, eh, I actually found the medicine to*

treat this disease.

Tulisile also does not value working in an industry compared to doing medicine. She does not see it as directly helping people in need as happens in medicine.

T: And being a doctor you know you are somehow part of the people. You know you are helping unlike in industry.

In this essentialist account, other jobs detached from direct involvement with helping people are presented as natural and exclusive for men and as unnatural for women to enter. Women construct themselves as lacking the necessary skills for entering this male domain successfully. Statements such as, "*We women we don't like jobs like that ...*" signify engineering as an activity which does not come readily to women and which does not form a normal part of their social activities. Males are portrayed as having superior skills - 'they break things and put them together again' - from a very early age. Their superiority in this domain derives from the fact that working with objects comes more naturally to them compared with girls who enjoy playing with dolls from a very early age and hence need careers related to caring. This may even explain why women choose to enter the biological Sciences and medically related fields. This is also in agreement with Baker and Leary's (1995) qualitative research in which they found that those females who chose Science subjects were drawn to them because of strong affective experiences with a loved one and a desire to help.

4.2.1.3 **"It is the *fear*"**

A different explanation for women's non-participation in Science is put forward by Nonhlanhla.

Non: It is the fear. The idea that it is a male job. So even those that were capable, I want to believe were not able to join because they though that they were not able to do it.

It is clear that the phrase, "*it is a male job*" is being used to refer to much more than the simple numerical superiority of males in Science subjects and related careers. What this signifies is that there could be something that these males do that is not pleasant to the females. This is what Nonhlanhla and Diana go on to explain.

D: If you are the only woman at work, you get just males around. All of them may be busy harassing you when you get to work, degrading you and that kind of thing.

Non: If you are going to be found in a male dominated area, they don't see any feminine characteristics in a person like that. They would want you to be elsewhere than in the area where they dominate. When you are in their place, they always find you to be a queer person.

They seem to provide ways males use for intimidating and chasing away females from those areas they dominate. Nonhlanhla herself is somebody who has been in Science for quite a long time and she relates how males used to treat her when she excelled in Science subjects when she was still at school.

Non: They would always remark about me being abnormal.

There is evidence from these extracts that females are discouraged by males from excelling in Science subjects. Being remarked at as 'being abnormal' is to be subjected to nasty and unjust behaviour. This could

be the source of the fear of those females who do not want to enter into Science. Someone who is sensitive to such remarks will never dare try to enter into such areas. In accordance with the essentialist perspective, according to these males who are said to make such remarks, women are not naturally suited for Science. They (males) are more suited to it.

Nonhlanhla explains that the 'stigma' attached to Science subjects make some females not prepared to take them up.

Non: There are lots of them who pass but it is only that they wouldn't want to venture into those areas because of the stigma attached to the courses.

The choice of this construction (the use of the word 'stigma) serves to show that the problem is not with women who do not want to join scientific fields nor with Science itself but rather it is due to society which discourages females. Females who venture into these fields may be viewed with discontent and dishonour by other members of society since it is seen as a field that is most appropriate for males.

Cathrine, a non-Science student openly admits that she could have done and passed physical Science, but she just underestimated her performance.

C: ... It's not something that I am not capable of doing... I am beginning to question why I had underrated myself and think that I could not do such a thing.

Another explanation under this same category is focused on problems a female may encounter if she is promoted to a higher post in a male dominated area. There is apparently 'proven' negative reaction to them

from males.

Non: *In cases where now you might be given a responsibility, you will always find a situation where they think that you have been given responsibility just because you are a woman not that you deserve it.*

P: *They underrate us. Its natural. Just like that.*

C: *Males do not want females in leadership positions. They say our society does not allow us to be led by a lady.*

C: *We don't get encouraged in any way because we know when we get the highest position there, nobody would like us. Life at work would not be as interesting as it should.*

The first thing to note about these extracts is that they all carry the message that most males do not enjoy seeing women in leadership positions. The lack of female scientists is put on men who make the lives of aspiring scientists and those already in the field unbearable. In the black traditional culture women must never lead men. They must always be in subordinate positions.

This fear could also be the 'fear of failure'. The phrase "*they thought they were not able to do it"* brings out this aspect. This agrees well with the idea of the fear of failure which most female students suffer from when confronted with difficult tasks (see Chapter Two).

Students prefer taking up subjects they feel they are good at. Most students in this study felt that they are better at biology than physical Science.

R: *I am good at this subject (biology).*

Most of the non-Science students felt that they were not good at Maths.

R: *I feel I am not good at maths.*

Since Physics also has a lot of calculations in it which these females said they are not good at, this was identified as another cause of gender differences in perceptions and attitudes towards Science.

Another reason given by R2 which though it belongs to this category, means something different is as follows:

R2: *And they are scared like they always like to protect themselves. Like they don't want to be hurt so they are scared that the electricity will harm them.*

It is interesting to note that she talks about her fear of being physically hurt indicating a sense of herself as fragile and vulnerable. According to Davis and Banks (1992), this also is normal for females since it is a feminine characteristic. As discussed in section 4.2.1.1., scientific activities need someone who is adventurous and loves Science. If one is so afraid of harming herself, then it acts as a limitation in the learning of Science. This again appears to support the notion that females have characteristics that are not suited for Science.

Felly tells that males are more suited for scientific jobs since they are physically stronger than females.

F: *The types of jobs need somebody who has strength. Some females are afraid to do such jobs.*

Due to this fact, she sees Science subjects as more important for males than for females. When I asked her to which group of people, females or males is scientific knowledge more important, she had this to say:

F: More important for boys.

Felly, just like Diana in section 4.2.1.2 uses an explanation related to biological differences between males and females to explain the cause of their differences in perceptions and attitudes towards Science.

4.2.1.4 "I managed with the *help* of other honours students"

The cognitive demands of Science were also cited as possible causes of gender differences in perceptions and attitudes towards Science subjects. Most of the females felt that it was difficult for them compared to males from whom they actually received assistance. Responding to the question related to what made her succeed in her Science courses even though most females regard them as difficult, Tulisile responded in the following manner:

T: I managed with the help of some honours' students who were already there during that time.

When asked whether the people who helped her were males or females, she had this to say:

T: They were male.

Pamela, a professional scientist also explained this issue in the same manner.

P: Most of the boys did not find as much difficulty as we females.

P: Sometimes we had to go to these boys and ask for explanations to some concepts.

When I asked her why she could not go to other female students, she said:

P: They (girls) usually will have similar problems. You then find yourself going to the boys instead of to the girls in Science.

She went on to explain that males did not face as many difficulties as females.

P: Most of the boys did not find as much difficulty as we females.

In this discourse, girls are positioned as people who need help from other students especially males in order to succeed in Science.

Within the essentialist repertoire, women are constructed as not only different from males, but also inferior. Tulisile and Pamela's experiences portray women as lacking very important characteristics necessary for doing Science. These are intelligence and ability. They need a more knowledgeable person to assist them in explaining difficult concepts they would not have understood during the lesson times. Weinreich-Haste (1981) in her correlational study with British university students also found that girls saw Science as difficult. They also saw complicated and difficult things as masculine. More boys than girls found difficult things interesting. This lack of confidence in their ability acts as a major drawback in their participation in Science.

Besides intelligence and ability, Pamela sees women as lacking courage, a characteristic which males have which make them enter and persist in scientific subjects even though they are rated as difficult.

P: I am sure men have been created like that, with that courage more than women. Otherwise, women have the same degree of intelligence but then they don't have the courage to join.

This position of females is relatively powerless compared to the provider of assistance. The female situated in this discourse seems to experience negative emotions, confused, desperate, insecure and very inferior. Studies indicate that students' feelings of self-esteem and personal competence are related to their feelings of interpersonal influence. To be powerless is to be out of competent contact with others. A student's perceptions of holding low status, more than having such status, is related to incomplete use of intellectual ability and to negative attitudes towards self and the subject. For students, these feelings of powerlessness can diminish further their concentration on their academic work.

Research on 'learned helplessness' indicates that powerless students gradually assume less personal responsibility for their work (Au & Watkinson, 1997). Other students (see Chapter Two) similarly indicate that students who think of themselves as possessing less "fate control" perform less well than their peers who feel more vital.

When the female student finally passes her Science courses, she attributes her success to the assistance she got from other people. This agrees well with the research findings on locus of control discussed in Chapter Two.

Though this appears to be the case, that some females need assistance in order to pass, Pamela and Diana strongly believe that males and females are equally intelligent. Pamela had this to say:

P: Otherwise, women have the same degree of intelligence (as men)...

Even Diana, a Science student, also had this to say:

D: I personally think that basically man and women are just the same. They are equally intelligent...

Diana used this biological explanation in trying to justify her claim that when put under similar conditions, for example in boarding school, there must not be any excuses from females for not taking up nor doing well in Science.

According to Cathrine, a non-Science student, females' reliance on males for assistance can be due to stereotypic thinking in society that males can do challenging things better than females.

C: I think that goes back to the community that we live in. It emphasises that it's man who can do challenging things...

Since there is a general agreement that among the respondents that Science is a challenging subject, this could be one of the reasons why females students view it as a male subject.

In addition to this, Pamela views the capabilities of most males in Science as something natural which most females must agree with.

P: *I am sure in this field, to a certain extent, we just have to agree with this. Boys find it easier than girls. Naturally, they are more creative than girls.*

P: *I am sure that is natural. Don't we have to agree that that is natural? They are just created like that.*

P: *I'm sure they are more gifted in the scientific field. We have to agree with that.*

She uses biological determinism theory to account for gender differences in perceptions and attitudes towards Science.

Cathrine sees boy's everyday experiences as preparing them for Science, unlike those for girls.

C: *They are saying most of the things they are involved in at school are things which most guys are usually or they have got an idea of what it is all about.*

Cathrine cites the home as the source of these male students' experiences.

C: *I think it's basically because of fathers at home who usually take guys with them when they are going out.*

In the essentialist account, then, the major cause of gender differences is that Science is presented as a natural and exclusive domain for men and as an unnatural domain for women. Women construct themselves as lacking the necessary skills or rather inbuilt characteristics for negotiating this male domain successfully.

4.2.2 **Normative Feminine Account**

Within this repertoire, respondents framed their reasons for not entering into the scientific field as normative. It is normative in the sense that it reflects on what is seen as appropriate and accepted feminine behaviour of females living in that particular society. The normative feminine account can also be referred to as the social norm discourse and is characterised by its construction of gender as socially derived.

In most of these examples, this normative feminine repertoire serves a defensive function. The use of "*we females we ...*" which implies the "everybody is doing it" discursive act is common.

4.2.2.1 **"Some mathematical aspects are difficult *especially to a girl*"**

The influence of significant others was also identified as one of the causes of gender differences in perceptions and attitudes towards Science.

In this particular context, the term significant others refers to those people who are important or who have significance to an individual by reason of their ability to reduce insecurity or to intensify it, to increase or decrease his/her helplessness, to promote or to diminish one's sense of worth. Some individuals are more significant to an individual than others in the development of one's self. Parents, peers and teachers were identified in this repertoire as major contributors.

Even though her parents (Nonhlanhla) were not quite knowledgeable about maths, they were aware that mathematical concepts are mostly difficult for girls. Whyte (1981) also observed that lots of people including parents do not expect girls to do well in subjects that involve a lot of

mathematics.

Non: In my case, they (parents) had very little information about it but you could hear them saying for example, "Some mathematical aspects are very difficult especially to a girl".

Annie also pointed out that it was actually her father who suggested that she drop Science. He saw her as someone who was not capable of doing it. When I asked her who influenced her to drop Science and concentrate on the arts subjects she was doing, she responded in the following way:

A: Most of it is my father. He taught me when I was in primary school. He told me that I won't be able to take Sciences. He said I must take the arts.

Diana, a Science student also received discouragement from her mother. She did not want her to take up Science subjects because she was afraid that she was not going to do well in them.

D: My mother was actually against the idea (of her taking Science subjects). I have some cousins of mine who did Science and they didn't do well.

In the extracts above, these parents see nothing unusual when females face difficulties in understanding some mathematical and scientific concepts. This unquestioning attitude to parental authority of some students (like what Annie did) shows that their desire is to be just what they imagine their parents want them to be. Such students may not want to escape from parental authority in order to try something new. A person needs to be strong and determined to disapprove someone who is

significant in one's life.

Peers also view scientific fields as meant for males and any female who ventures into these areas is seen as acting against the norm.

Non: The peers as well .... they always find you to be a queer person.

To be a 'queer person' is to be strange in some way. This means that some males see females in Science as different in some way from those not in it whom they regard as normal females. According to her explanations, they are the male counterparts who discourage females from taking up Sciences.

Diana and Pamela also cited friends as influential in the subject choice of one of their members.

D: ... it can also be influenced from your friends, you know. Usually if your friends are going to be doing Biology, Physical Science and Maths, you will be inclined to do that as well.

Pamela also had this to say:

P: Friends, mob psychology. They tell you, "You want to do Maths, Physics and Chemistry? You won't get anything. They are difficult.

Babalwa initially went into the arts stream due to peer pressure but she later changed into the Science stream.

B: It was peer pressure in the sense that they told me that, "If you go into Science, you are going to fail. Science is difficult, so don't go into it."

Roselyn also had this to say:

R: *Some friends of mine sort of encouraged me to do Biology because they knew that I am good at it.*

Each peer group has its own norms. They are these shared expectations or attitudes about appropriate or inappropriate behavioural procedures that strongly influence the behaviours of its members. If a female student belongs to a social group which is not interested in Science, even if she happens to be interested, due to fear of being rejected by other members, may end up not taking it up. Students have been shown to feel anxious when their personal response is in opposition to a group norm. Indeed, studies indicate that students fear being rejected by their peers and tend to go along with peers' perceptions of group norms.

However, those students who manage to behave in opposition would have realized that group pressures need not always be restrictive to individuals. Because there are so many individual differences it is important that norms remain flexible.

Even teachers were also cited as contributing to discouraging female students from taking up Science subjects.

P: *People are told ... I'm sure it is the teachers. They tell you that these subjects are difficult. They actually tell you that "Please make sure you have enough confidence to join these subjects. They have got a high failure rate in these subjects at this school."*

B: *... teachers in South Africa in particular may be ready to discourage not only girls but children in general from doing Science in higher grade. Some are only interested in getting one*

hundred percent pass rate.

B: *... they (teachers) discourage children from doing higher grade Science especially those they think are a little bit weak.*

Since most females perceive themselves as weak in Science, they become the immediate victims.

Cathrine is of the opinion that the fact that more males than females normally get prizes in these subjects at school, portray the image that Sciences are for males.

C: *... they see their seniors getting prizes and they realize that most of these people are only boys who are getting the prizes. That means that this thing is for guys. It's not meant for females.*

Some teachers also believe that easy stuff is meant for girls while that which is classified as difficult is for males. Tulisile cited her analytical chemistry lecturer as one of the people who influenced her to pursue chemistry up to third year level. However, the reason he gave for encouraging her to take it up was that it is simple and straightforward - the norm attached to subjects/courses females are expected to take up.

When I asked her who influenced her to take up chemistry courses up to third year level, she said:

T: *My lecturer of analytical chemistry.*

I: *Is he male or female?*

T: *He is male.*

I: *What did he say?*

T: *You should do analytical chemistry. It is simple and straightforward.*

This agrees well with what Tulisile went on to say about those males who fail Science courses but keep on trying while most females normally quit Science when they fail and look for alternative easier courses to do. These males do not want to switch to other subject choices since they view them as easy and hence meant for females.

I: *Why don't males go and do BA?*

T: *They regard those as easy. They are meant for women.*

I: *Is it so? So you mean they prefer the hard options?* (Laughter).

T: *They always believe that that is always meant for males. I mean Mathematics is meant for males. If a female can take Mathematics as a major, they will just wonder whether she is going to make it anyway.*

The use of the word 'anyway' in this context may signify males' anticipation of women's failure in such subjects.

Asking Nonhlanhla why she thought males regard females as not good at Science, she said this:

Non: *In some cases they think that women are not intelligent enough and others believe that they don't have courage to tackle problems in Science situations.*

These last statements by Tulisile and Nonhlanhla reveal the presence of some sexist remarks coming from males as part of the problem. They underrate females' performance in areas where they dominate. Zodwa brings this aspect out when she states that throughout history women were looked down upon by males.

Z: They (males) were looking down upon us.

Significant others act as evaluators and can give both positive and negative comments that can later have a profound effect (depending on the individual) on an individual. What other people think about someone really affects the way one sees oneself. What one thinks about oneself is a vital part of internal consistency. One will always act in a way which one thinks is consistent with how one sees oneself. Annie said that she could not do Science because she had been told that she was not capable. She also later categorised herself with people who are not intelligent enough to do Science.

A: I was considered one who is very dull so I just thought I could not do it.

It is interesting to note that she does not want to change her view of herself and hence acts in a way consistent with what she was told. It is her view that she is not intelligent enough that determines her behaviour (not doing well in Science). This agrees with the notion of the self fulfilment prophesy.

Students enter school with a predisposition towards achievement and failure already fertilized by the qualities of the significant others in their lives. Each student is invisibly tagged, some by a diet of nourishing interest and affection while others are crippled by a steady downpour of

psychic blows from significant others, denting, weakening and distorting their self-concept.

4.2.2.2 "Like *maybe* this X *is a girl*"

The way society views females who go into Science also acts as a barrier to females' participation. It sees such individuals as acting in a manner which is not consistent with their nature. They will be aiming at being different from other 'normal females'. One of the respondents had this to say on the vignette discussions:

R3: *I also feel X can be a female. Like if she, if she, if this X eh like wants to make a difference in this world. Like maybe this X is a girl and she wants to show the other women around that we can do it. Women can do what so ever they want, even if people are not encouraging us.*

The use of the phrase "*wants to make a difference in this world*" signifies that it is quite unusual for a female to like scientific activities and careers like what X in the vignette is doing. It also shows that it is something that is not expected of a woman. Any female who behaves like that is actually regarded as acting in a manner inconsistent with the normal feminine behaviour. She is regarded as different from the rest.

If a woman wants to be or is married to a man who is not in Science, she has to think twice about entering the scientific field since it might create problems in the home.

Non: *It does especially if you are going to be married by a man who is not in your area. It's like there is that label that Science is difficult, so if you can do well in it, so it means you are better off. It might*

create problems.

It is always viewed by society as normal for males to be better than females in aspects that are regarded as challenging. Since males are regarded as more intelligent and knowledgeable, women who enter this 'male territory' are viewed with suspicion since they act as a threat to male domination in this field.

4.2.2.3 **"Most of the time, you know, there are *male* Science teachers ..."**

The lack of black female role models in Science fields was also cited as a contributing factor to the masculine image of the physical Sciences. Along these lines, Tulisile had this to say:

T: I would rather say firstly you would find that maybe, the whole chemistry department, there isn't any female person who is in position. All lecturers are male. Everyone else, technicians are male you know. So you just feel insecure working under that environment. So, even if you are at times an honours student, if you want this you have to go to Mr. So and So. If you want this again you have to go to Mr. So and So. You might not know, they might not be as approachable as they should. So, as a woman you might feel somehow frightened.

The point that Tulisile brought up that working in a male dominated place is frightening agrees well with Nonhlanhla and R2's observations discussed in section 4.2.1.3.

Tulisile went on to say that:

T: Even at Matric level it's the same thing. The Maths teacher is

male, the biology teacher is male. I just don't know. It might happen that at times the biology teacher might be a female. Most of the time you know there are male Science teachers.

This was supported by other respondents.

B: *... also many girls don't have many role models. Maybe, they don't have any role models to follow so they easily give up.*

D: *I think they need to see other people who have made it ... You know, there are so few women you can look up to who have done engineering.*

B: *If you have more males in a certain area, and they mystify the subject, it's very easy to mystify the subject. They will be the people who will have [illegible]ach you. They can mystify the subject such that you see people feel that it is very difficult and it's a male domain.*

C: *... people who are in professions that involve Sciences, most of them are males.*

These extracts show that there is a general agreement that there are fewer females in scientific fields. Cathrine continues to state that it is the society in which we live that makes the Science professions appear as if they are reserved for males only.

Since most Science teachers are male, this further contributes to this stereotype that Science is for males. For females not in Science, this lack of role models acts as an excuse or justification as to why they are not entering into Science.

4.2.2.4 **"We do have *many things, many interests*, like marriage ..."**

The lack of concentration on school work has also been cited as a contributory factor to the under-representation of females in scientific fields. The following extract best illustrates this attitude of females.

R7: It's just because we as females we don't like to concentrate on one thing. We like to do many things at the same time, so I think he is a guy and is the one who can manage to stand for those seven years to do engineering ... We do have many things, many interests like marriage...

Consistent with many other findings conducted elsewhere, (see Duncan, 1989), women are uncomfortable with committing themselves to careers with relatively long training durations. For many, attention ends up divided between having a family and proceeding with training. For males, it is not much of a problem since they can have a family and still proceed with their studies with minimal interruptions. In the African culture, marriage is highly regarded such that at a certain age, one can even be coerced into getting married by certain members of the family.

The persistent or continual use of the phrase "*we females we ...*" by R7 shows that the respondent is providing an effective warrant or justification to why females do not behave otherwise but in the specific manner in which they are behaving towards Science. The possession of a negative attitude towards Science by most female students was depicted not as a notable or unwelcome activity, but as normative, something shared by all females. Another feature this extract also highlights is its persuasive orientation. It makes the message more convincing. According to Potter and Wetherell (1987), when people decide to act in a certain way, their decision is only partially influenced by their relevant attitudes; it is also

influenced by judgements of the normative desirability of the action.

Two of the professionals, Babalwa and Pamela also cited the childbearing years as the time when most females who want to pursue Science courses or degrees face limitations. They all agreed that the major problem comes when one is now doing practical work that requires one to spend long hours each day in the lab. It is hard to combine a career in Science with domestic responsibilities especially child care.

B: The limitations, I think, that come to one are during the childbearing years.

B: To actually do research which I had to do during my Masters and Ph.D and have children because of its long hours, it's not something you can do at home like in the arts. It's something you have to do in the lab. This is when women really begin to fall off.

D: In some job adverts, in newspapers they want women who have passed a certain age probably passed childbearing years.

Babalwa has a strong feeling that this 'falling off' of women from Science results in a few of them managing to get to the top and hence less role models for the young generations to follow.

B: ... as one looks at what happens at high school, maybe because they (female students) mainly think about when they get married and have children anyway. They feel they will not be able to pursue Science.

4.2.2.5 **"Females *were allowed* only to be at home cooking and all that..."**

This statement legitimises the 'stereotypic behaviour' discourse as a historically grounded aspect. Consider for example the statement: "*In the olden days ... but nowadays ...*" Statements of this nature feature quite frequently throughout the analysed text. However, it also allows for the change in attitude towards Science by female students.

S: Females were allowed only to be at home cooking and all that, but now I wanna become a doctor.

The phrase "*were allowed*" signifies that this discourse has a historical aspect to it. According to her, it is something that used to happen in the past. The use of the word "*allowed*" signifies that there was/were some people in authority who actually determined who did what or whose opinions were to be followed since they were quite influential. According to Sebakwane (1994) people who were in control of mission, apartheid and Bantu education systems contributed in various ways in imparting the black population especially women with the type of education that would not develop them technologically. (See Section 4.2.2.6).

Sizeka clearly locates the behavioural act of not taking up Science within the context of social norms. The statement simply means that males 'do' Science and females 'do not' as a result of socialization. However, she highlights that females who are not yet in Science must not cling to old fashioned ways of thinking since this is today and that was then. She herself wants to be a doctor, something that females could not do in the past.

Sizeka externalizes the root of female students' behaviour or attitude towards Science.

The same applies to Nonhlanhla when she responded to the question which demanded a clarification on what she meant by the statement "*men have been benefiting for too long*".

Non: They were just more exposed. So now that the females are getting exposed they can as well get the chances.

The following comment by Zodwa also reveals that there used to be some discrepancies before independence in the way males and females chose the courses and subjects they wanted to pursue.

Z: Nowadays, now, since we are in new South Africa, I think females and males are equal. They are free to do whatever they want to as long as it is right, as long as it's their choice to do so.

This statement is questionable. Babalwa in the next section, 4.2.2.6 contradicts this view.

4.2.2.6 **"Why should they (girls' schools) *only have* home economics?"**

Though Zodwa, a non-Science student argues that in the new South Africa, people are equal (see Section 4.2.2.5) and free to do what they want, Babalwa, a professional scientist feels that more is desired especially in girls' schools in imparting them with technical skills that make them technically minded since that is part of what Physics is all about.

B: Also you know there are girls' schools like (names the school) here where my daughter went to school. Why should they only have home economics and no woodwork and other technical subjects? Those things are not there. They are not on offer.

She goes on to state the consequences of such a set up.

B: *That is a limitation. Girls are not technical minded. I also think that women are encouraged not to have technological minds right from the beginning...*

She goes on to state that boys who are already subjected to technical skills in the home are further presented with technical subjects at school, while girls are presented with non-technical subjects like home economics. This helps in boosting the boys' technical skills which are important in mastering some Science concepts. For Babalwa, the fact that single-sex schools are deprived of certain subjects on the bases of their gender composition is unjust.

4.2.2.7 **"... so you would rather go to a technikon *to get the practical experience*"**

Some of the Science curricula in schools and universities are viewed by Tulisile as of less relevance to solving problems in the outer world. This is of major concern to Tulisile. She prefers a Science curriculum which involves solving practical problems like what is done in technikons. This agrees well with what was discussed in section 4.2.1.2

T: *I think maybe; although I'm not sure, it's always that when you have done a degree, there isn't that much of solving practical problems. You would rather go to a technikon to get the practical experience.*

Considering the time factor discussed in section 4.2.2.4, doing Science subjects at university appears to be a waste of time since one has to go

to university then to a technikon to train for the job. For women, most of whom have other social commitments like marriage, this could also be one of the reasons why most of them do not want to participate in Science even at high school level since they would not love to continue with it up to university level. It is important to note that this is just an implied cause.

Kelly (1981a) in her investigation also observed that girls are interested in the practical applications of Science.

4.2.2.8 **"*They encourage a male more* than a female to do engineering"**

Females' causes for not participating in Science subjects and related fields are also partly due to other members of society who encourage males into Science more than females. This theme emerges relatively strongly from the transcripts studied. It is very strikingly illustrated by the following selection of quotes:

R7: They encourage a male more than a female to do engineering.

Z: Females don't like engineering or maybe it's because they don't get someone who can encourage... Someone who can guide and encourage them and give them more encouragement.

R7 and Zodwa agree that society encourages males more than females into Science. Zodwa offers an explanation of the consequence of this practice - 'females don't like engineering'. In making this psycho logistic claim, Zodwa, a non-Science student, does two things. Firstly, she conveys the message that there seems to be no real or genuine motivation on the females' part to become scientists. Secondly, this assertion serves to foster criticism or charges of sexism on society.

Encouraging a male more than a female gives the impression that more women would love to get into Science if it were not of lack of encouragement. Lack of encouragement also removes interest and confidence in the subject from these female students.

Babalwa, a professional scientist, also feels that the lack of encouragement that faces most females causes gender differences in perceptions towards Science.

B: ... lack of encouragement ... not special treatment but probably its more of discouragement from the male staff. You know, if people have something that they have owned for a long time as a male field, to encourage females and make them equals is difficult. The tendency could be to discourage.

Confidence has been reported by many researchers (Fennema, 1985; Steen, 1987) to be one of the most important variables related to learning. Since it reflects one's ability to learn a particular subject, it acts as a strong predictor of the course election. Four out of the twelve respondents portrayed lack of confidence as one of the reasons why women do not participate in Science.

Lack of confidence may also lead to failing the subject. According to the self-worth theory, if a person fails at a task, the feedback evokes the possibility of a lack of ability. In addition, failure at a task creates feelings of unworthiness and self-rejection (Covington, 1984). This follows that if one is faced with a task where there is a possibility of failure, one will avoid the situation. This can also account for the lack of females in Science since according to previous research findings and even this one, females have this fear of failure syndrome and will always try to avoid situations in which they are most likely going to fail.

Responding to a question that demanded an explanation on why more females than males did Science subjects, Zodwa had this to say:

Z: I think they lose confidence.

I: What makes them lose confidence?

Z: It's because ... there is no one to encourage them.

The extract above clearly shows that there is a closer link between encouragement and confidence building. Zodwa depicts women as having less confidence in their abilities in Science fields. The use of the term 'lose confidence' indicates that initially, these students may have confidence in doing Science but due to lack of encouragement, their confidence is eroded. Males are portrayed as having confidence in their abilities because of the encouragement they get. This lack of confidence by females is what makes most of the female students seek assistance in their work from their male counterparts (see Section 4.2.1.4).

4.3 SOLUTIONS TO NON-PARTICIPATION

Even though professional women provided more explicit data than students, not much was found on solutions to the causes of gender differences in perceptions and attitudes towards Science. Solutions suggested included the following:

- females need to be encouraged to take up Science,
- the need for the curriculum to be changed to meet the training needs of people,
- females to be determined to work hard to overcome all barriers to their participation,
- the need for teachers to pay more attention to the weak students when

teaching them,

- the need for females to ignore all unwelcome comments they may be showered with from other people, and
- also increasing the enrolment of females in training institutions so as to have more role models available.

I now look at each of these solutions in more detail.

4.3.1 "I think they (female students) *need to be encouraged*"

All respondents agreed that female students need to be encouraged to join these scientific fields. The family was targeted as the immediate provider of the encouragement. Responding to the question on what could be done about these problems that face women, the following responses were received from Sizeka:

S: *That is from their families, I mean, I think they need to be encouraged, "See, if you don't wanna do Science, you will end up being a disaster and your family will drown because you won't have a job..."*

Socialization starts in the family. If family members could learn to show no partiality in the way they bring up children then this can help in narrowing the gender gap in society. Proper education on the merits of doing Science must be done.

In the extract above, there is the metaphorical use of the following phrases: 'being a disaster' and 'your family will drown'. In this context, it may refer to disappearance from recognition.

Sizeka even went on to suggest how the encouragement could be done.

S: *I can say that I think women have to stand up. I mean we can not be ruled by man in this world. I mean you find engineers whether it's right or wrong, they do it their way. I mean we are actually trying to show that we don't appreciate the fact that the doors have been opened for us to do Science. If we, if we get stubborn and say "No, I am not going to be involved in Science. I was never allowed to, It will not help." But now I think women should do Science because really now is the survival of the fittest.*

Instead of simply stating that females must be encouraged into Science, she actually went on to give the advice. The advice is based on what female students not in Science must realize so that they may revise their way of thinking towards Science. She started off by stating that women must stand up. Her use of this phrase signifies action. It is high time women realize that the fact that man dominate in these scientific fields means that scientific developments take a course that suits men. Females' interests may not necessarily be catered for since there is no-one to represent their interests. If technological development follows men's interests, then females are forced to dance to their tune and hence will be ruled by men technologically. This agrees well with the suggestion of Wajcman (1991).

Sizeka goes on to state that things are now different from what they used to be in the past. (see Section 4.2.2.5). The fact that 'the doors have been opened', implies that chances are there for women to take up Science. The past must not affect one's current decisions. Things are different now from what they used to be. She uses the phrase "*now is the survival of the fittest*" to describe the tough competition that exists now, maybe in the job market. Those better qualified for the available jobs are the ones who survive.

Here, it can perhaps be added that this suggestion of encouraging females to join in scientific activities right from a very early age is not unique to this corpus of text analysed. Various other researchers in the field of gender studies have in the past reported similar findings (see Becker, 1990). Myeong and Crawley (1993) also identified support received from parents, teachers, and peers as one factor that acted as a predictor of the intention to choose Science subjects by female students.

Another form in which females can be encouraged into Science is through the introduction of career guidance sessions in schools. Pamela, a professional scientist, relates how career guidance sessions influenced her in taking up a Science related career. She owes her source of inspiration of interest in the job to the information she received on a career day.

P: *... that day (career day) really made a difference in my life.*

The use of the phrase "*made a difference*" signifies a situation where her way of thinking and her way of perceiving the world around her in terms of scientific jobs changed. This illustrates that if career guidance could be taken seriously in schools,, it could make a difference in many more female students' lives. It could really assist in changing students' perceptions and attitudes towards Science. Eurrard's (1992) investigation on guidance and counselling needs of students in the Eastern Cape Province in South Africa showed that more females than males need guidance on career choices. This agrees well with the findings in this research.

4.3.2 "It *(curriculum) needs to be changed"*

Tulisile, a professional scientist, suggest the following to be done:

T: *It (curriculum) needs to be changed. Because when you try to go out of universities, you are not prepared to be part of the field. You cannot say when you are from university you have trained for the job. You have to undergo some training of some sort.*

For female students, the relevance of the Science curriculum is an important issue. Tulisile recognized that Science is part of people's everyday lives (see Section 4.2.2.1). She wants to see that connection made in school rather than learn Science out of context.

The extract in the above section has a suggestion for this problem. The curriculum must be changed so that it might be more relevant to the needs of these female students. This is in agreement with the government's suggestion explained in the South Africa Survey 1996/1997. It states that there ought to be a paradigm shift from the former emphasis on 'curriculum input' or 'subject input' to 'curriculum output' (meaning students' ability to use what they have learnt in different ways and apply it to different situations) (South African Institute of Race Relations, 1997, p. 224).

Roselyn, a non-Science student suggested that calculations must be removed from Science subjects so that more females may feel comfortable in them. She cited them as one of the contributing factors that made her not take up Science subjects.

R: *I think they have to remove those calculations.*

Since she is just a student who might not be well versed with how important those calculations are, she could have been trying to suggest that the mathematical concepts taught be illustrated with familiar examples so that it could be easier for them to understand.

Diana, a Science student, also suggested that more simple Science, especially Physics topics be introduced at junior school so that students get to understand that there is nothing complicated about Science.

D: *... maybe in junior school, they must start including more Physics. I think by so doing they will understand gradually.*

4.3.3 **"(If) *teachers were to pay more attention* to those who were not very good"**

There is a whole lot of evidence in literature that classroom practices contribute to the liking or disliking of a subject by students (see Chapter Two for details). Annie highlighted this aspect when I asked her what she thought could have been done to make her like Science before she dropped it. She had this to say:

A: *Maybe teachers were to pay more attention to those who are not very good.*

Those who are normally weak in a particular subject are 'forgotten' while the pace of progress is determined by the faster learners.

A: *In a class there are always those who are good and it seems teachers pay more attention to those who can do better and pay least attention to those who are not very good, who are not quick to think.*

It is well known that in most cases, subject liking is very much related to the liking of the teacher. This finding was also confirmed by Babalwa and Roselyn in their narrations. They viewed the liking of the teacher as a factor that drew them to the subjects they rated as their best.

R: The other thing is I like my Biology teacher. So I ended up doing Biology.

B: I think my lecturer had a lot do to with it ... who made the subject, you know, come to life.

She explains that the teacher taught very well and that is why she entered into the Science stream.

From the previous sections, it was discussed that males are more intelligent and more interested in Science than females. This means that even under normal classroom situations, these are the people to whom teachers pay more attention. Females who normally have much less interest and ability are the ones who are neglected and hence their interest in the subject continues to deteriorate. So, teachers are also to blame when female students perceive Science as boring, difficult or irrelevant. Teachers are encouraged to be cautious about how they carry out their daily duties in the classrooms since that can act as a demotivating aspect to the learning of Science.

4.3.4 **"If we can just stand ... and just say, "I am going to *do* this, you can *do* it"**

Most of the respondents agreed on the aspect that females are just as capable as males in doing Science. They also view the liking or the doing well in Science as dependent on the individual and not on one's inbuilt characteristics.

Nom: If we could just stand up for ourselves and then you can just put your fist on the table and just say, "I am going to do this", you can do it.

S: I mean, we have the ability to do it.

D: They (women) have to fight very hard.

There is need for females to fight hard as they take up Science subjects and courses since there are so many constraints that can hinder their progress.

These extracts depict determination. The use of the pronoun 'we' signifies jointed effort in dealing with the matter. Females must support and encourage each other so as to be determined to counteract all the discouragements from other people.

4.3.5 **"...I *ignored them* (discouragements)"**

Nonhlanhla said it twice during the interview that she used the strategy of disregarding what the people who were discouraging her said. Responding to what she did when discouraged in her Science activities, she gave the following response:

Non: In the majority of cases I ignored them.

Even when her parents told her that mathematical aspects are normally difficult, she did not take them seriously.

Non: I did not take them seriously.

Unlike Annie, she did not readily accept adult's views without questioning.

Babalwa, a professional scientist, also states that the most important

thing is for females to aim at being more in number in top positions so as to gain acceptability from males and other members who may look down upon them.

B: The more we are at the top the better ... If there are more, there could be more acceptability.

However, she goes on to warn that it is not easy to get to the top.

B: It's hard work to get to the top ... You know, women also have to work harder and be stronger I'm afraid. To be accepted into the club that has been there for a long time as a male club, it's not easy.

4.3.6 **"They (teachers) *need to be talked to*"**

Cathrine, a non-Science student, felt that since some teachers and parents contribute in discouraging females from taking up Science subjects, they (teachers and parents) need to be educated with regards to this issue.

C: They (teachers) need to be talked to about this issue and need to be told that they must not scare away students that come to their classes.

Nonhlanhla also suggested that parents must be educated on the importance of Science in today's world and that they must provide equal opportunities for boys and girls to take up Science. Campbell and Connolly (1987) are of the opinion that parents maybe the single strongest negative influence on girls' participation in Science when they hold expectations for daughters which are different from the expectations

they have for their sons, since they can treat their children in ways that reinforce gender stereotypes.

Non: I think parents must be informed for them to realise that opportunities should be equally distributed to all children irrespective of whether they are males or females.

The responsibility of educating parents was entrusted to a variety of groups of people namely the students themselves and other knowledgeable people who might have an opportunity of addressing parents on educational issues. As for educating teachers, the task was given to people who are in the ministry of education and training institutions.

Non: I mean the children themselves. When they realise that they can tackle the subject easily, they can come back and inform their parents. When there are public addresses or when people address parents publicly, either at school or at any other gathering, they can always be informed about those things.

4.3.7 **"They can *increase the numbers* in intakes"**

Increasing the numbers of females in intakes was also cited as one possible solution to the problem of non-participation of women. The increase in intakes both at school and tertiary level will, in the long run, make available role models for the young ones to follow.

Non: I think where possible, since they have not been exposed enough ... they can increase the numbers in intakes. Let's say they were taking ten females, they can try to increase the numbers and encourage more women to join in.

Various methods of increasing females' participation in scientific fields were suggested.

Diana suggests the introduction of scholarship specifically for women in Science as a way of helping in increasing women's participation.

D: *Maybe scholarships for women in particular. Promoting women in Science subjects and engineering.*

However, there is a contradiction in this view from Babalwa who feels that such a move can be a disadvantage rather than being an advantage.

B: *Well, the more help you give people, the more they become disabled.*

The reason why their numbers must be increased is that , "*they have not been exposed enough*" in the past so this increase in enrolment acts as some form of compensation to the deprivation of chances they experienced in the past. The use of the passive voice in this phrase indicates that they (females) were denied exposure to scientific activities, it was not according to their will not to get exposed to these activities.

There is also ample evidence from the analysed text that role models can have profound influence on young females to take up Science. When I asked Diana what made her decide to take up Science, she gave the following response:

D: *... my sister also did Science so I just thought, well, I have to do Science you know.*

Besides getting to know about the job she later entered into through

career day, Pamela was also inspired by her aunt who was also working as an engineer.

P: I was inspired that I could do it.

Responding to my question on whether she could have joined that profession if it were not for her aunt, she said:

P: I don't think I could have got the guts. I don't think I could have got the guts. (Shaking her head).

Repeating the statement may indicate emphasis. She most likely would not have got the courage and determination to get into that profession even though she had the interest that had been generated on the career day exhibition she attended. This extract really shows the importance of role models in fostering courage into young aspiring female scientists.

Pamela also targets the media for providing role models.

P: Normally when they advertise a scientific thing, in most cases they make sure there are males there. Why not put females there and some may find themselves saying, "I can be like this lady if I really work for it".

Even some of those who encourage certain students to take up certain subjects and drop others base their arguments on role models. Roselyn's parents wanted her to be an accountant.

R: It's because they see some accountants prospering in life so they (parents) just wanted me to become an accountant.

Cathrine, a non-Science student, also suggests that more females be given the task of teaching Science subjects so that more female students could be encouraged into it.

C: *A lot of female teachers should be given the task of teaching Science subjects.*

4.3.8 **"... make sure that both boys and girls do the work at home *and share the responsibilities...*"**

From the previous section, we saw that Science is a subject which needs more concentration and hard work. To the problem that girls do more work at home and fail to get enough time to study, Nonhlanhla had this to say:

Non: *To try and balance. To make sure that both boys and girls do the work at home and share the responsibilities so that they finish the work a little bit earlier and have time to study.*

D: *But as a girl child, especially in our African culture, you get home and you have to do some work while your brothers are reading. So, by the time both of you are supposed to go to bed or start reading, you will already be tired and your brother will have had his supper and has been sitting the whole day, he can do his work.*

The purpose of sharing responsibilities would be to try and equalise the reading time of each student. Related to this issue is the solution of sending female students to boarding schools.

This was a solution suggested by Diana:

D: *If you are in boarding school, I don't think there are any problems or anything that can stop anyone from achieving what they want.*

Helping each other in carrying out domestic duties can be a major step forward in reducing these clear distinctions between masculine and feminine. This is important because once girls define themselves as feminine and Science as masculine, then they will tend to avoid it. Males on the other hand, don't do duties females are engaged in at home since they are perceived as feminine roles. However, these feminine roles seem to disadvantage girls from entering Science since they do not develop as technically-minded beings.

In trying to find out whether Cathrine's brothers also perform domestic duties, she had this to say:

C: *No, they don't.*

I: *Why?*

C: *They think things of the kitchen are supposed to be reserved for ladies.*

On asking her what they think their duties are, she had this to say:

C: *What they do in the home is to try to connect TVs and the like.*

The contrast she makes between her brothers' roles and hers is interesting. While girls' main duty is cooking, boys are responsible for fixing up things in the home - something that is technical.

Whyte (1981) is also of the opinion that most females' reduced interest

in Science may be directly related to insufficient experience of mechanical and constructional toys and a lack of early activities at home and school involving spacial awareness.

Still commenting on the ill effects of gender roles on women, Babalwa had this to say:

B: *... as an African (Black South African), there isn't that much of support for a female by a male partner to say, "Well, today I will take care of the children or I will cook while you go to the lab".*

The woman is expected to carry out the domestic duties as well as pursuing her career interests. This is really a difficult exercise. Babalwa suggested the introduction of day-care centres on university campuses. This move could help females with young children intending to do research in higher degrees in Science.

B: *Where I went to university, for example, the university had a day centre which catered for children there.*

There would be somewhere for mothers to leave their children while they pursue their academic work.

In this analysis, I identified two interpretive repertoires - the essentialist and normative feminine accounts under which the cited causes of gender differences fell. Females' inbuilt aspects, namely, laziness, fear, a dislike for jobs related to Science and inability, were identified as the major causes under the former repertoire. Societal expectations, lack of role models, gender roles, lack of much relevance of the Science curriculum to solving everyday problems, were causes identified under the latter account.

The solutions to the above problems stated included that the curriculum

needs to be changed to suit needs of females, teachers are to pay more attention to slow learners, more of which are females who have been disadvantaged through gender roles and historical times. Parents, teachers and significant others in these females students' lives are also to be educated so that they realize the importance of encouraging females into Science. Female students themselves are to be determined and willing to do Science subjects despite all barriers that confront them. Disregarding discouraging comments from male counterparts was also cited as a solution. Some also suggested increasing the numbers of scholarships and providing role models for them to emulate through media.

Reflecting on the interviews I conducted and the analysis I carried out, I perceive the real causes of gender differences in how males and females perceive Science as due to the nature of Science content that seem not to address these females' needs and socio-cultural expectations (gender roles) that seem to make females feel that naturally they are not suited for Science.

I also perceive educating members of society on the importance of Science to everyone, trying to make Science content more relevant to females' needs and providing more role models as major solutions to these problems.

4.4 REFLECTIONS ON DISCOURSE ANALYSIS

In this chapter I tried to identify the causes of gender differences in perceptions and attitudes towards Science and solutions thereof from the women's perspective. I have illustrated how some of the problems and solutions raised complement each other while others contradict.

Nevertheless, just like with any other research methodology, there were also a number of strengths, problems and limitations that have become clearer to me in using discourse analysis. Some of these aspects may be common to all researches analysed through the same way while others are specific to this study.

Firstly, the idea of 'letting discourses emerge' that is often emphasised by discourse analysis theorists (Potter & Wetherell, 1987) that discourages the imposing of a structure on the analysis is problematic. My initial attempt to follow what appeared to be patterns in the identification of themes that emerged proved fruitless. I was forced to impose a structure of analysis based on my theoretical framework I discussed in Chapter Two.

Secondly, I also observed that carrying out discourse analytic work is an extremely labour-intensive and time-consuming process. The time I spent conducting interviews and transcribing them was quite considerable. Added to this, I also spent time trying to learn and develop the skill of analysis as I previously explained. As Potter and Wetherell (1988) argue, discourse analysis is a craft skills which needs time to master.

Thirdly, the other potential disadvantage with this kind of analysis is that it does not produce the broad empirical generalizations which are developed in traditional social psychological researches. As a result, these findings cannot be understood as identifying universal processes underlying causes of gender differences in perceptions and attitudes towards Science subjects. What it simply did was to examine the explanations as put forward by a group of female students and professionals in a particular social and historical context. Thus, we might expect to find different accounts put forward to explain the same phenomenon if these respondents had been interviewed by a male or had been talking amongst themselves.

This lack of generalizability, it must be noted, does not invalidate the research. It merely serves to emphasise discourse analysis' point about the constructive action orientated nature of language I discussed in Chapter Three. According to Wetherell and Potter (1988), for discourse analysis, the failure to theorize universal processes is not a weakness, but an inevitable consequence of the fact that explanations are always constructed out of particular interpretive resources and designed for specific occasions.

Finally, although attempts to provide different ways of conducting discourse analysis were made by different discourse analysis theorists (Potter & Wetherell, 1987), just to mention a few, through the experience I gained in this study, I discovered that there is no simple and straight forward way of analysing discourses without borrowing from the styles of analysis of other analysts whose methods of analysis I was not strictly following. An example is of where I commented on the power relations between females and males - an aspect normally central in the post structuralist discourse analysis methodology.

To conclude, these limitations are seen not as unresolvable problems arising from this discourse analysis, but as issues brought to light via a discourse methodology.

Against all this, I discovered that discourse analysis has considerable value. Just as Parker and Burman (1993) observed, it offers both a practical and theoretically coherent way of analysing a whole variety of talk and texts, taking seriously in their own right and treating them in their own specificity.

This analytic method is elaborative and reflects on what is usually not thought of in traditional psychological research, that is giving the respondents room to air their views. In this case, respondents were given room to identify what they feel are the problems that confront them in pursuing Science as well as suggesting what they feel could be possible solutions to their problems. This in

a way is empowering them - people whose voices are normally not heard. In most cases, solutions to their problems are suggested from the 'knowers', implemented and they themselves just act as recipients of the innovations.

In the analytic process above, it is clear that I did not link individual participants with particular repertoires, neither did I go into the details of describing the participants' backgrounds and other personal details. This is because in a sense, the participants themselves are irrelevant because it is the language they speak that is being investigated. I feel that it is important to make it clear that the focus of discourse analytic research is in the construction and function of linguistic resources (Porter & Wetherell, 1987). According to these authors, discourse analysis moves away from the individual as the unit of analysis as what happens in traditional social psychological research methods.

Another strength of discourse analysis is that it allows for the identification of the functions of the various discourses that were discussed. In this study, though my major concern was not with identifying the functions of the various discourses, I identified the following: ***justifications, mitigations, blames and contradictions.***

Justifications: There were characterised by the reasons for the causal claims of non-participation of women in Science that the respondents made. The 'everyone is doing it' discourse was common. An example is of what R1 said, "*We females we don't like jobs, like uses hand, lie down and wear dirty clothes".* Further justifications they made were that they lack technical skills which males have due to the way they are socialized. What this reflects is that some female students' attitude towards Science stems largely from the way they are socialized.

Mitigations: These were characterized by instances where respondents tried to lessen the seriousness of the non-participation of some women in Science.

An example is of an instance where respondents seemed not to see the deeper causes of females' lack of interest in Science. Nompilo and Sizeka, who are both Science students, just viewed it as due to laziness. In a society where there is a strong ideological emphasis on meritocracy and individual success, one's failure to take up Science can easily be viewed as one's choice.

Contradictions: These were characterized by disagreeing or opposing accounts of the same phenomenon. Such accounts were given by the same individual while others were given by different respondents. An example of such an account is when Pamela and Tulisile agree in their accounts that females normally go to males for assistance in various Science concepts but at the same time, they argue that males and females are equally intelligent.

Blames: These were characterized by instances where the choice of getting into Science or not to, was seen as the individual's choice. Females who dropped out of Science were depicted as lazy - who could have improved their chances of succeeding in Science through working hard.

Discourse analysis has proved very useful in studying individuals' perceptions and attitudes towards Science subjects. It is only through analysing what comes out of an individual through language that one can try to study what goes on 'inside' an individual. Other researchers (Moir, 1993; Marshall & Raabe, 1993), just to mention a few, also used this method while studying personality profiles in different social settings.

Finally and most importantly, I saw that discourse analysis offers a way of understanding ideology. In the present analysis, even though the respondents declared their desire to see more female scientists, they produced discourse which was ideological. Some of the accounts they produced served to justify the notion that Science is a male domain and that males are naturally better at Science than females.

CHAPTER FIVE

SUMMARY OF FINDINGS, THEIR IMPLICATIONS AND CONCLUSION

In the first chapter, I tried to put this study into perspective by outlining the roots, purpose and rationale for the study. This was followed by a brief discussion of the research strategy. The interpretive paradigm and the cultural perspective were discussed since they are the one that guided this inquiry. In the second chapter, I reviewed the relevant literature. I discussed the methodology followed in the third chapter. In the fourth chapter I analysed interview data collected from female black South African high school students and professional women in science. In the present chapter, I discuss the summary of the findings and their implications to science learning and teaching. Concluding remarks finally follow.

5.1 SUMMARY OF FINDINGS

The purpose of this study was to investigate problems black female students in South Africa encounter as they pursue science subjects as well as possible solutions to these problems.

The research strategy I used, which is the interpretive cultural framework proved quite useful in carrying out this investigation. The purpose of research conducted within this framework is "*to demonstrate that these attitudes and behaviours arise from the social environment and are socially constructed*" (Wolpe, 1978, p. 292). This is partly what the results of my analysis showed. The other interesting aspect is that this research has also attempted to explain and describe how these gender differences created by society are maintained in schools. This is one of the aims of research conducted within the cultural perspective. (See Chapter One for details.)

The cultural perspective focuses on the school for remedial issues directed at

alleviating problems caused by stereotypes created by culture. Some of such solutions were identified by respondents. They explained how their implementation in schools could help in reducing gender stereotypes in science subjects and careers. Scholars who locate the problem in culture or schools, Delamont (1994) also argues, want more energetic and well designed schemes to change some aspects of the culture or school itself.

Just as a reminder to the reader, the purpose of the interviews were to seek answers to the following critical questions that were also outlined in Chapter One:

1. What do black female students in high schools in South Africa perceive to be the possible causes of gender differences in perceptions and attitudes towards science subjects?

2. What do black female students in high schools in South Africa suggest as possible solutions to overcome problems of gender differences in perceptions and attitudes towards science subjects?

3. According to black female professional scientists, what are the causes of gender differences in perceptions and attitudes towards science subjects in South Africa?

4. What do black female professional scientists in South Africa suggest they did/do to overcome problems associated with gender differences in perceptions and attitudes towards science subjects?

I asked these questions because I am concerned with the inner behaviours (i.e. individuals' feelings, perceptions beliefs and purposes) that make males and females behave differently towards science. Some humanist psychologists propose that:

> "*To understand human behaviour ... it is necessary to understand the behaver's perceptual world, how things seem from his (sic) point of view. This calls for a different understanding of what the 'facts' are that we need in order to deal with human behaviour; it is not the external facts that are important in understanding behaviour, but the meaning of the facts to the behaver. To change another person's behaviour it is necessary somehow to modify his (sic) beliefs or perception. When he (sic) sees things differently, he (sic) will behave differently.*" (Combs, Blume, Newman & Wass cited in Dembo, 1991, p. 324)

It is through understanding the motives behind an individual's actions that useful suggestions to changing that individual's behaviour can be made. By knowing what these students perceive as causes of gender differences towards science, ways of dealing with the problem can be suggested.

A number of these problems and possible solutions were brought to light through interviews I conducted with eight students and four professional women in science. The discourse analytic process informed by Potter and Wetherell (1987) I used, proved very useful as an analytic tool for this particular research (see Section 4.4). I categorised the problems highlighted under the essentialist and normative feminine accounting repertoires. Those accounts under the former repertoire suggested some characteristic traits within an individual as causes of these gender differences in perception and attitude towards science. Those in the later account portrayed the causes as originating from the society (see Chapter Four for details.)

The first two critical questions were answered through the analysis of students' accounts while the last two were answered through analysing professionals' accounts. However, due to the fluid nature of these accounts, I found it difficult to summarise these accounts under specific critical questions. An attempt to do that led to repetitions of certain accounts. What follows is a collective summary of the analytic process.

5.1.1 **The Accounts**

In this section, I give a brief summary of the respondents' narratives on what they perceived as causes of gender differences in perceptions and attitudes towards science subjects and possible solutions thereof.

Students and professional women's accounts showed more similarities than differences. However, professional women had more suggestions. Most probably, this is due to their exposure to more different social contexts. Furthermore, unlike students' accounts which were just briefly stated in most cases, those of professional women were more elaborate.

One other interesting observation I made was that some of the professional women appeared to have forgotten what they went through during their high school days. There were very few instances where they could cite examples from their own experiences. In relation to my last two research questions, this could mean that these women were highly intrinsically motivated in doing science during those days. This could have made them not see the problems even if they were there. Alternatively, they could have been unaware that some of the experiences whey went through were actually occurrences which were not supposed to take place that way. Responding to a question that required an answer to whether there were any problems they encountered as females doing Science at high school, Babalwa, a professional scientist said, "*I think during my high school days, as a female, I don't think so*".

However, analysis of these professionals and students' accounts on what they view as causes of gender differences in perceptions and attitudes towards science subjects and the possible solutions indicated the following:

5.1.1.1 **Members of Society:**

These include parents, teachers and peers. Their perceptions of Science as a difficult subject, especially for females, was cited as one of the causes of gender differences in the subject. As evidenced in the vignette discussions, society encourages males more than females into science. Due partially to this practice, some males feel that science is their field and develop a negative attitude towards females who enter it. One of the non-science students actually stated that females '*are looked down upon*' by such males. In other words, there are males who despise females and view them as people who are incapable of doing science. This is also what Nonhlanhla, one of the professionals reiterated: "*They (men) think that women are not intelligent enough*". These actions cause some females not to prefer science subjects.

To try to rectify this problem, it was suggested that all these members of society need to be 'educated' about the importance of eradicating gender stereotypes from society. The following methods of educating them were suggested:

- including gender issues in curricula in teacher training institutions and schools;

- having career guidance in schools. Females need most guidance or assistance in their subject and career choices. Since cultural stereotypes view science as a male domain, more must be done both at home and at school to deconstruct such perceptions; and

- knowledgeable people are to hold meetings with parents explaining these issues to them.

Details of what can be included in the proposed curricula are discussed in section 5.2.

5.1.1.2 **Lack of Role Models:**

Members in both groups gave the lack of role models in these female students' vicinity as also a major negative contributing factor. These female students normally see males in various scientific fields and hence tend to view science as a male domain.

As solutions to this problem, it was suggested that:

- ways must be found of making sure that more females get encouraged to take up Science related courses and careers so that there could be more role models for the future generations to emulate. Increasing the enrolment of females in higher institutions of learning in these fields can be done by providing scholarships for women entering science-related fields.

- an increase in the public visibility of black women in scientific jobs like engineering is required if the numbers of women in the field are to increase.

5.1.1.3 **Gender Roles:**

These were cited by most of the respondents as major causes of the problem of gender differences in science subjects. Most of the tasks males do in the home are technically orientated while those for females are not. Coupled with the different toys young boys and girls are given to play with that are related to their gender roles in the family, boys develop technical and creative skills that are useful for mastering some science

concepts at school while girls do not. This, according to the respondents, acts as a contributing factor to causing gender differences in Science.

These gender role prescriptions are reflected in schools again. Most girls' schools in South Africa do not offer technical subjects since these subjects are viewed as meant for males.

Babalwa, a professional woman in Science, also cited the problem she faced as a family woman doing research in Science as she tried to reconcile domestic duties and her studies. Unlike in arts subjects where one can do one's academic work at home, research work in science involves many hours of practical work in the laboratory. She highlighted that men do not seem to assist their wives by helping with domestic duties.

The solutions suggested for these problems are that:

- parents ought to desist from treating their sons and daughters differently by giving them different toys to play with when they are still young. They must not assign them different tasks to perform in the home. This may assist in reducing gender stereotypes towards scientific activities.

- men need to assist their partners by helping with domestic duties. Day care centres for young children could also be built in or near universities so that there could be somewhere nearby to leave children with someone looking after them while the mothers are doing their practical work.

5.1.1.4 **The Science Curriculum:**

Most of the students in Science who were taking biology as one of their subjects ranked it as one of their best subjects. The main reason they gave for this was that, this subject is related to solving people's everyday problems. Most of the students preferred to be medical doctors in future. Science did not seem to be related to people so some students preferred not to take it up. Furthermore, the mathematics involved in science subjects was also identified as one reason why females have a negative attitude towards it.

The solution suggested for this problem was that:

– the science curriculum must be reviewed so that it may be applicable to solving everyday problems. The problems females are mostly interested in are those related to helping people and other living organisms.

I discussed details of the nature of a science curriculum that may appeal to females in section 5.2.

5.1.1.5 **Characteristic Traits:**

Different characteristic traits males and females possess were also identified as contributing to causing gender differences in perceptions and attitudes towards science subjects. Most of the respondents seemed to agree on that males possess inner qualities or traits that make them more suited for Science. Two of the respondents, a science student and a professional woman in Science, portrayed the view that for females to be good at science, they must act like males. A summary of the characteristics they highlighted within their discourses are discussed in

. section 5.2.

5.2 IMPLICATIONS FOR SCIENCE LEARNING AND TEACHING

There are a number of implications some of the findings have on science learning and teaching. For my argument to be understood better, it is important for me to start by arguing from the females' psychological needs' (Baker & Leary, 1995) view point that have also been identified in this research. Belenky, Clinchy, Goldberger and Tarrule (1986) also suggest that females have different experiences from males and that these different experiences generate distinctive modes of thinking, judging and relating.

Explicit in the analysed accounts is the idea that males make good scientists and are somehow naturally suited to it while it is just the opposite with females. At this point, it would perhaps be appropriate to briefly discuss the differential constitution of representation of females and males as per dominant ideological discourses identified in this study. Indeed, this discussion would be essential if the functions of the discursive themes identified in this text are to be fully understood.

Females	Males
fearful	courageous
dependent	independent
passive	active
less intelligent	more intelligent
lazy	hard working
less confident	more confident
physically weak	strong
attractive	adventurous
less ambitious	ambitious
less determined	determined
failure-avoiding	success-orientated
less creative	creative

This summary shows that females in this study represented males very positively in relation to Science. These females see themselves as lacking in those essential inner qualities that make males more suited to Science. This differential representation of females and males is viewed as being integrally linked to the justificatory function of the ideology of gender differences. From a very early age, both boys and girls grow up with sex-role stereotypes due to being socialized into these essentialist views about differences between females and males.

The heart of the problem, according to Matthews (1984), lies in the male-female dualism. This is because:

> *"... all individuals and all societies tend to treat what they have created as woman and man as essential, and as necessary to their sense of rightness and order. Indeed, they build up the specific relevant differences and relationships between women and men into an order in its own right. This ordering according to gender is one of the main ideological and material grids within which social meaning is created; an ordering which encompasses the entire society, sub- or super-imposed on all other orderings"* (p. 13).

Like other dualities such as day and night, good and bad, male and female is perceived as an inevitable and natural duality, each opposite to its other and each relying on the other for an interpretation of itself. In the same way, we cannot understand good without bad and maleness without femaleness (Davis, 1989).

In a male dominated society like the one we are currently in, the male-female duality is seen as essential and functional. Science is seen as a male subject. Females who excel in it are viewed as possessing male characteristics which in the eyes of some males, especially those not in Science, see as undesirable. Females are constrained by images of femininity which do not value possessing male characteristics like being independent, adventurous and so on as

appropriate for them, but which are all aspects scientists must possess in order to be successful.

One professional's comment that the science curriculum seems not to be relevant to her seems to explain the current trend of events. This is evidenced by what I explained in the first chapter that although black female students enrolment in high schools in the country are more than black male students, only a small percentage takes physical science (see Figure 2). This could be explained by the fact that these female students do not enjoy it or may consider it to be irrelevant to them. Consequently, most of them do not intend to pursue a career in science. Kelly (1987b) and Rosser (1990) made similar observations in their studies they carried out in Western societies. As reflected in this study, all the females in science preferred medicine to careers related to engineering. Their suggestion that the science curriculum needs to be reviewed sounds logical.

5.2.1 The Science Curriculum

5.2.1.1 What to teach?

The image of science and related careers appears negative to many females. They see them as impersonal and divorced from the social context. Other subjects like biology, because of their concern for living things appear more personal and alive. In the previous chapter there was evidence that by nature, women prefer to learn about topics that have relevance to solving everyday problems of human kind. Kelly (1981b) in her analysis of work done on women and science education also observed that girls are interested in the practical applications of science. They prefer helping and caring for human kind and other living organisms hence most of the respondents in Science stated that they preferred to be medical doctors. A change in the science curriculum was suggested as

the solution to this problem.

Fausto-Sterling (1991), in his call for science education reform, called for a closer analysis of the subject matter as well. He suggested that "*if we are to address the crises in science personnel we ask not only about how we teach science but also about the subject matter itself*" (p.5). Significant or meaningful science learning occurs when it is perceived by students as relevant to their own needs and purposes. According to Combs, Avila and Purkey, (1971), humanists consider learning to be a two part process. It involves both the acquisition of new information and the personalization of it. Students enjoy learning a subject best when it is personally significant.

Girls need a science that addresses people's needs. This means that if Science were to include more of such topics and also giving more of such examples within the texts, it may appeal to more females.

I agree with Kelly's view that "*... to construe the problems as enticing girls into Science may not be the most promising way of progressing. Rather, reconstructing science and in particular science education both are more in keeping with the experiences and explanation of the world that are familiar to women might serve teachers better*" (Kelly, 1987b). There is need for careful examination of the (curriculum and instruction) textbooks used in science from primary school to higher institutions of learning. Science must not be depicted as a predominantly male domain by explaining it and giving examples more familiar to males than females. For example, instead of using examples familiar to males for illustrating certain theoretical concepts, like using industrial machinery, it would be easier for females to understand it if examples of simple machines from home economics are used. This may help in instilling interest in the subject.

Furthermore, to correct the current trend of events, the new Science curriculum may also be designed in such a way that it encourages confidence-building in the subject. This is because the majority of the interviewees gave *"lack of confidence"* and *"being afraid"* as reasons why most girls do not take up science. This shying from science signifies that there must be something wrong with their perceptions of Science, the world around them or themselves. Girls' misconceptions of themselves and Science itself must be corrected. Though Benley and Watts (1989) are of the opinion that treating girls as though they are the problem and designing 'girl-friendly' approaches to Science is not the most successful way to ensure that women have equal opportunities to impose their ideas on existing science frameworks, I feel that it could be a positive move towards encouraging females into Science as evidenced by this study.

However, since Science is both a social product and a social process, changing its subject matter to render it more attractive to girls is not easy. If the subject matter reflects the interests of the dominant groups in society, then it is those interests and needs which must be changed first (Saraga and Griffiths, 1981).

5.2.1.2 **How to teach?**

The current Science curriculum emphasises individualism and competition which are methods of learning preferred by males. Rosser (1990) investigated the culture of competition that characterizes many science classrooms. Her findings indicated that competitive classroom environments appeared to facilitate more individual achievement for males than for females. Such environments acted as significant deterrents to women's achievement. This means that methods of instruction employed must be reviewed to make them more suitable for females as well.

Designing a 'female friendly' science curriculum it must be noted, does not disadvantage either gender. As Bohan (1993, p. 7) correctly points out: "*none of us is feminine or is masculine or fails to be either of these. In particular contexts, people do feminine, in others they do masculine*". He goes on to state that according to the 'cultural feminism' perspective, the traits distinctively females' must be deemed as indeed different from but equal or even preferable to those that characterize males in general. Women's ways of being must be revered rather than demeaned. Such a move can bring forth transformation and can have a lot of implications for science teaching and learning.

By Tulisile going to ask for help from others (see Section 4.2.1.4), it may also signify the need for 'togetherness' and the need for cooperative work which some research documented as one of the learning techniques preferred by most females. Mayberry (1998) suggests the implementation of collaborative teaching strategies in which learning takes place as students work in small groups and collectively pose questions and define problems together sharing their conclusions. Since the aim of collaborative learning is for students to construct and share knowledge, the collaborative classroom is built around the strategy of interdependency which is one of the personality traits of females identified in this study.

Another interesting finding was the effect of the orientation of the students' attributions of success and failure. According to Tulisile's account, females tend to quit science courses if they fail unlike males who normally repeat. The willingness of an individual to repeat a course reveals the quality of being success-orientated. Such students believe that they can handle the challenges of that particular subject and as a result, their ability is not viewed as an important issue in learning and view success and failure as related to the quality of their efforts. They

also tend to attribute successes to ability and effort and failure to lack of proper effort. For such students, success inspires further confidence as a sign of one's ability to do well, whereas failure signifies the need to try harder. Instead of demotivating, failure acts as a motivating tool.

Using the same argument as above, females who quit science when they fail to do well reveal the quality of being failure-avoiding. They attribute their failures to lack of ability and their successes to external factors such as due to help got from someone else like what Tulisile, a professional scientist, revealed in her account. Such students feel that they have no or little control over their academic destiny (Dembo, 1991). It is only through confidence building that female students can change their orientation to attributions of success and failure. I believe that a large component of developing autonomous learning behaviours in science takes place in the classroom.

This difference in orientation could be due to differences in socialization these students were subjected to. Males could be socialized into having a success-oriented attitude while females are channelled towards having a failure-avoiding attitude orientation. This is the view other educational theorists share. According to Dembo (1991), the factor that determines whether children develop the need to achieve or avoid failure is the type of experience in the home. Certain child rearing practices are believed to contribute to greater achievement striving.

The ideas students bring to school as well as continually gather from peers and teachers influence their subject and career choices. Gender-role stereotyping in the classroom is part of the 'hidden curriculum'. Teachers must be more aware of how their own expectations and behaviours contribute to reinforcing sex-roles and the development of different academic abilities and behaviours between male and female

Learning is best acquired and retained in an environment free from threat. Teachers must help in the cultivation of such environments.

4. Teachers must also help students understand that there is a difference between gender-roles and gender identity. Employing the feminist pedagogy which invites students to criticise the unequal social relations embedded in contemporary society might be a useful implementation strategy. They must ask why these circumstances exist and what one can do about them. These strategies empower students to apply their learning to social action and transformation and become effective voices of change within the broader social world.

In order to achieve gender equity in science education, it is teacher education itself that must be reformed first. Secondly, the government's educational department must put in place curricular guidelines that must be adhered to. Such guidelines may assist commercial publishers and school administrations to adopt non-sexist guidelines to improve the quality and equity of instructional materials.

All these suggestions may help in making females not be afraid of venturing into fields that are normally perceived as for males. This in turn educates males who might want to treat unfairly females entering in fields they perceive as their domains.

5.2.2 Projections into the future

This interpretive research is not an end in itself. The findings I obtained can pave the way to more research into women and science education in South Africa and even elsewhere. The conclusions of one study, as Morgen (1993) puts it, merely provide a starting point in a continuing cycle

of inquiry which may (or may not) with time, serve to generate persuasive data from which further conclusions can be drawn.

My research findings provided some evidence that females see males as more suited to science than themselves. So, instead of asking what could be wrong with female students that make them not interested in Science, further investigations may be done into what it is about the nature of Science and related fields that make them not attract and retain the interest of females.

A number of reasons were also given by those already in Science as to why they decided to take it up. Since this was not the focus of this current research, I did not pursue it further. Further investigations into why prominent black female professionals decided to join science-related careers is important since such research may provide data which may inspire young students to join science. It may also provide data which help those involved in career guidance to really know the benefits women gain by taking up a science-related career. What most of these students know are disadvantages associated with it.

Investigations with knowledgeable female science educationists and professionals can also be conducted so as to get views on the science curriculum that might be more appealing to black South African female students.

The interpretive research methodology I used successfully managed to provide answers to my critical questions. I pointed to the pervasive variability in these women's accounts which could have been overlooked or suppressed by more traditional, social psychological approaches. The accounts constructed by these respondents were sometimes flexible, inconsistent and even contradictory. Rather than seeing such variations

in discourse as problematic, discourse analysis argues that variability is better than consistency.

Regardless of the advantages I cited, there are limitations associated with the methodology of this study. In view of the often reported differences between attitude and behaviour, it is difficult on the basis of the results of the present study to really draw conclusions about the attitude of female students towards science since no class observations and follow-up studies were done to verify some of the findings. This can be an venue for future research. As I mentioned earlier on, the results obtained cannot be generalized to a larger population. However, they can be transferred to similar cases within population groups.

5.3 CONCLUSIONS

In this study, I attempted to investigate problems black female South African high school students face as they pursue Science subjects and the possible solutions to these problems. I examined some of the practical ideologies through which the lack of black South African female scientists is explained from these women's perspective. The accounts show that far from the women exposing a particular attitude or advancing a specific explanation to account for the lack of women in science subjects and careers, each had available a whole range of ways of accounting.

It is interesting to note that many of the accounts given by these respondents as causes of gender differences in perceptions and attitudes towards Science supported many of the arguments put across by early theorists. This literature was reviewed in Chapter Two. Reference was made to social practices, biological make-up, the nature of scientific knowledge and many others as sources of causes of gender differences between males and females in the way they perceive Science. However, the accounts were presented in a fluid

mechanism such that it was difficult to make clear distinctions between these broad views.

From what has been discussed in the previous chapter, it can be concluded that the causes of gender differences in perceptions and attitudes towards science subjects stem largely from the socio-cultural environment, the traits an individual possesses and the nature of science as a subject.

(a) **The socio-cultural environment:** Both the school and home cultures are seen as conveying images and values about men and women and roles appropriate for them in society which affect students' behaviour and decisions in later life. Most such accounts are within the normative feminine account. These images reflect the idea that women are inferior to men and such inferiority is conceived by most female students physically, psychologically and intellectually.

There are also a number of conflicting issues that hinder females from excelling in science. In the previous chapter, a number of double-binds that face women in science were identified. This was well illustrated by R7 in section 4.2.2.4. R1 and R4 brought this aspect out when they stated that females do not like dirty jobs. This showed that some females actively refuse to engage in certain scientific activities in order to maintain their gender identity. Their responses illustrate a situation where competency in science and in fulfilling feminine roles such as remaining attractive are seen in a male dominated society as conflicting.

The changing of this social dimension (as other respondents suggested) depends upon how determined females are in challenging male attitudes, expectations, fears and insecurities. The difference between women and men is not just a neutral difference. It is based on the principle of 'otherness'. In many practices, to be like men is not to be like a woman.

This, according to Hollway (1992) is the crucial feature of gender differences. To be good at science to a female means that one's personality must actually consist of all attributes which are meant to be characteristics of men. At the same time, by the virtue of the need to be accepted by men as a wife, etc., women try to preserve their feminine identity. This contradiction is difficult to reconcile. This double-bind facing women act as a major screening factor for those who fail to choose the non-traditional choice of entering science while the few who manage to reconcile the two or disregard their feminine roles choose to enter into Science. This indicates that female students are caught in a vicious cycle. Clearly, breaking the cycle is not easy. However, for the few who enter into scientific fields, being in the minority in a male-dominated area has many negative aspects like being ridiculed.

Findings in this research have also shown that men and women are prejudiced against women in science solely on the basis of their gender. Prejudice against women is most likely to occur towards those women who are seen as violating gender-role stereotypes (Basow, 1980).

(b) **The Characteristic Traits an Individual Possesses:** These may be biologically determined. The motivation for taking up a subject can be aligned with these traits.

From this particular perspective, the responsibility for increased academic involvement in a particular subject rests primarily on the student.

While the school system and other members in society can do the best they can in reducing practices that hinder female students in participating fully in Science, the onus is on the students themselves to learn to accept this positive change.

One of the broad steps female students must take is to liberate themselves from these cultural ties. Gouldner (1975) suggests the incorporation of reflexive thinking in decision making processes. This is what they must do when making decisions on subject and career choices. According to him, the reflexive view of knowledge as a world constructing activity, implies that female students not willing to take up science subjects must become aware of the way in which they are constructing the world around them. They must become aware of the fact that their knowledge of the present situation expresses their particular way of confronting the situation in the light of their interests, hopes and values (Gouldner, 1975, p. 492). By becoming aware of their own personal input into what they discover and observe, Gouldner believes that they will become more willing to listen and try to practise that which does not immediately tally with their original viewpoint. In other words, women must be prepared to come into confrontation with this new information. In terms of this argument, reflexivity suggests that women must look back at themselves and consider their own values, attitudes and interests in relation to science which lead them to see reality in a more positive way. By reflexively confronting themselves in this manner, they in turn become aware of the "*dodges which they may be using to deny, ignore or camouflage information which is hostile to their position*" (Gouldner, 1971, p. 495). To have such aspirations, Fennema (1985) argues, requires that women be androgynous, with a high spirit of adventure and a willingness to be non-traditional. It is also important for them to note that self change is an important part of any alteration in the social order.

In this study, I observed that it seems that though biological differences between males and females are too obvious to ignore, there seems to be little evidence to suggest that on their own, they are the causes of the manifold differences between the genders in perceptions and attitudes towards science subjects and related activities. From my point of view, it seems likely that gender differences

in perceptions and attitudes towards Science are largely culturally and societally based. Nevertheless, some interaction between biological and social or environmental factors cannot be ignored. Since these females' decisions to foster change in their perceptions are basically societal orientated, it would seem desirable that science educational reform should follow a social reform orientation.

These black South African females' voices in this study offered insight into female students' interpretations of causes of gender differences in perceptions and attitudes towards science subjects. The various accounts show that problems women aspiring and in science face are multi-dimensional. The experiences of these female students and professionals described in this study support most of the previous findings which have concluded that boys are socialized 'into Science' while females are socialized 'out of it' and that males have personality traits that make them be more interested in Science while most females do not. Another important point is that there appears to be something about the nature of science that make most females not prefer taking it as one of their subjects.

Because Science has been male dominated, its nature and methods of teaching are male orientated. They appear to have been designed by males with mainly males in mind. Most of the suggested possible solutions to the cited problems had also been suggested by former researchers - that the school and home environments must work hand-in-hand in trying to reduce gender stereotypic behaviour since they are the root causes of gender differences in Science.

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APPENDIX A

A VIGNETTE FOR GROUP DISCUSSIONS

X is a brilliant physics student at [names the name of the students' school] High School. X likes Science very much and wants to pursue a seven year engineering course after leaving high school. X's parents, teachers, relatives and friends encouraged X from a very early age to be an engineer. This was mainly due to the fact that X had always shown a lot of interest in scientific equipment both at home and at school.

Questions

In your own opinion, what do you think is the sex of X? Give as many reasons as possible.

APPENDIX B

INTERVIEW SCHEDULE FOR A SCIENCE STUDENT

Questions

1. Are you doing Science as one of your subjects?
2. Why did you choose to do Science?
3. Is that all?
4. Follow up questions to answers given in 2 above.
5. What do other people think *of your choice*?
6. Follow up questions to answers given in 5 above.
7. Which subject do you like best?
8. (If the answer given is not Science, then ask): Why don't you like Science best?
   (If the answer given is Science then ask): Why is Science your best subject?
9. Follow up questions to answers given in 7 and 8 above e.g. How do you think these problems can be solved?

APPENDIX C

INTERVIEW SCHEDULE FOR A NON-SCIENCE STUDENT

Questions

1. Are you doing Science as one of your subjects?
2. Why did you not choose to do Science?
3. Is that all?
4. (Follow up questions to answers given in 2 above.)
5. What do other people think of your choice?
6. (Follow up questions to answers given in 5 above.)
7. Before dropping Science which subject did you like best?
8. What did/do you like about that subject?
9. What do you think could have b[illegible]e to make you like Science?
10. (Follow up questions to answers given in 9 above).

APPENDIX D

INTERVIEW SCHEDULE FOR A PROFESSIONAL WOMAN IN SCIENCE

Questions

1. I understand that you are in a Science related profession. Can you please describe briefly the nature of your job?
2. What made you decide to join this profession?
3. (Follow up questions to answers given in 2 above.)
4. When you were still at high school, which subject did you like best?
5. Why did you like that subject best?
6. (If the answer in 4 above is not Science, then ask : Why was Science not your best subject?)
7. (Follow up questions to answers given in 5 & 6 above.)
8. How did you overcome the problems you encountered? (Picks one problematic area mentioned at a time then discusses it)
9. Follow up questions to answers given in 8 above.

APPENDIX E

INTERVIEW TRANSCRIPTS

INFORMATION FROM STUDENTS AT AN URBAN HIGH SCHOOL

Discussion On The Vignette

Facilitator: What do you think about the passage? (After reading the passage aloud)

R1: I can say X is a man because we as females we don't like jobs. Like jobs like uses hand, lie down and wear dirty clothes. We don't like something like we have to be dirty. To wear those overalls or the dirty clothes. I don't think X is a female. That's all I can say.

R2: I also think that X is a male because from, from the time like if you are a girl or a boy like girls like to play with dolls and like dolls and those things. Guys like to eh to do engineering and like to like to break up things and put them together again. So thus why I think X's parents encourage him to like do Science, to go on with Science.

R3: I also think that X is a male because us females are still believing that old habit that females were meant to work at homes. They are not supposed to be doing hard jobs as you have said that engineers also build bridges. Most females are found in hospitals or maybe they are caterers or (...). So I think X is a male because females are always interested in things like cooking and whatever and taking care of other peo

R4: I also think that X is a male

Facilitator: Speak up.

R4: I think X is a male because as we are females I don't think we like to wear dirty clothes and like to want like to use hands.

R3: And women are lazy, I think. And this says that he wants to do a seven year engineering course. Women are lazy. They wouldn't be able to bear that. They are so lazy that you find them, most of them are nurses. Nursing only takes three years. Women wouldn't bear a seven year degree. No ways.

R2: And they are scared like they always like to protect themselves. Like they don't want to be hurt so they are scared that the electricity will harm them. So I think they are scared.

R3: I also feel that X can be a female. Like if she , if she , if this X eh like wants to make a deference in this world. Like maybe this X is a girl and she wants to show the other women around that we can do it . Women can do what so ever they want, even if people are not encouraging us. So X can be a female like if she really wants to show the difference like to other girls that we can do it if we want. It's not like other people's choice to. If you want to do some thing go for it. Maybe X is a female.

In-depth Interview With A Science Student: Sizeka

I: Why did you choose to do Science?

S: **Because my main goal was to become a doctor and still want to become a doctor. So I**

have heard that you need a good Science.

I: OK. You want to become a medical doctor.

S: **Yes.**

I: Uh. Ah is that all?

S: **Yes I think so. I mean there were opportunities at first. I mean females especially females were allowed only to be at home cooking and all that. But now I just wanna become a doctor.**

I: That's interesting. Ah. Is there anyone who influenced you in making your decision? Is there someone else who influenced you to make your decision?

S: **Eh! Something outside inspired me. I mean like ... ehm ... it may sound a little stupid but it really affected me. Once a chicken died in front of me and I was very fond of this chicken. It was very sick and I was so helpless. I couldn't do anything to help it and it just passed out. And sometimes you see a person in pain and you feel like maybe, if maybe there would be a way to help that somebody but now you are just helpless. And I felt maybe this inspiration can get me somewhere. I mean there would be more things happening in my life that I'll feel helpless. And, so I really don't like feeling helpless and so that is why I just want to save the nation.**

I: OK. Saving the nation. OK. Now is there an individual, a friend, a parent who actually inspired you as well? Are there any such individuals or it was just up to you to decide on your own?

S: **Well I can say it was up to me. But I told my parents about it and they encouraged me especially my father. She was very worried about this lack of doctors in South Africa. She said, "Go for it. I mean it's really an opportunity. You will never struggle with it because there is really a lack of doctors in South Africa."**

I: Uh. That's interesting. What's your father's occupation?

S: **She is a teacher.**

I: Which subjects does he teach?

S: **Geography and Xhosa.**

I: OK. I thought he is in Science. (laughter). OK. But here at school which subject do you like best?

S: **Here at school. Uh. Three subjects. They are three subjects actually.**

I: Which ones?

S: **It's Maths, Science.**

I: Which Science?

S: **Physical Science and Biology.**

I: Biology. OK. You said Maths and physical Science. Now why is it, it looks like Maths and physical Science we know they are related. Why is Science one of your best subjects? What makes you like it so much?

S: **Well, it's the way we do Science. It's like you are experiencing an adventure. I mean some**

things you eat every day you don't know that it can contain such and such and such. It's good to know what is there and what could be harmful to what you eat. All that.

I: OK. Is there anything else that makes you like Maths?

S: And Science.

I: Actually Science.

S: Well eh.

I: Experimentation?

S: In the true sense there could be hope for the treatment of many diseases such as AIDS which has really became a dreadful disease. That is maybe through Science maybe you could see my face through TV saying, eh, I actually found the medicine to treat this disease.

I: Uh. But what about the way teachers teach you compared to how you are taught in other subjects. Is there any difference? As teachers. The way they teach.

S: Well no. I think there isn't any difference because I happen to excel in all the subjects so they are all encouraging, equally encouraging.

I: Do you think physical Science is a subject that is worth to be done by girls in school?

S: Yah! I mean it is worth to be done b[illegible] mean to end this the sexist. To end all those sexists. I mean we have the ability to do but they have worth the means can do and I mean if the, if we keep on isolating ourselves and saying no we can't do Science, I mean. We can actually make our country sink down because of that stubbornness. Because maybe one of the person who will find the medicine for AIDS is a female.

I: You have said that we keep on isolating ourselves. So you agree that there are some females who don't want to venture into Science?

S: Yes.

I: Now, what reasons do they give for not liking Science so much?

S: I really don't, I really don't know why they are so lazy. I mean they believe that laziness is the nature of women but I really don't believe that. I mean I really don't believe it. I mean the way, the way they look at me , the way they see how much I love Science, they sort of think maybe you were supposed to be a boy.

I: Uhm. Because normally Science is associated with boys?

S: Yes.

I: Why do people associate being a scientist and boys?

S: Science is adventurous and people who like adventures are boys so girls should sit there passive. I mean I don't believe in that. I mean they believe that boys are adventurous so then are good for Science not girls. But I happen to be a very adventurous person through and I associate myself with Science.

I: But where do you think those people got those beliefs from, that is Science should be for boys and not for girls?

S: **Well, maybe from in the olden days, it was the boys who, who were doing Science and women and other women were not even allowed go to school because their parents believed that there is only one career and that was being a house wife. And maybe it grew from there and got worse and got worse and even girls who then wanted to do Science maybe they got this wall of stubbornness, "No I am not supposed to be doing Science and I am supposed to be a housewife."**

I: Uh. But what about these days? Do you also hear maybe certain maybe friends of yours also discouraging others from, other girls from taking Science?

S: **Yes. There is only one word I can describe those with. I think they are old fashioned because, this that kind of living discouraging women from Science was done in the olden days and now are free to do Science but they are still living in the past.**

I: Do you know of any women who are in Science related careers, that is fields like engineering and so on? Do you know of any?

S: **Ah. I have no idea. I don't.**

I: So why do you think we don't have these women? You know it is a long time now since women actually went to school more in numbers but you still find that we have very few engineers. Like for example, there at the university of Fort Hare you find that like in the Physics department there is not even a single female lecture there. Why?

S: **I think it is because of what was happening in the past. Maybe it is difficult for them to accept the fact that the sexist, sexis[illegible]d so women are allowed to do. Maybe it is difficult for them now to actually see that.**

I: OK. But from what you see in your everyday life, what is a woman who is in Science? Are there any problems which you encounter? Of cause you have said some friends actually have a negative attitude towards it but besides that do you feel that there are problems you as a woman is facing in pursuing your interests? Are there any problems? It can be in the classroom, could be outside or inside or whatever? Are there any problems?

S: **Well, so far no. I don't know well in the future. But so far no. I'm just doing well. But I am really worried about my friends because I mean there are careers like teaching and whatever but how many people who have degrees of being a teacher or being a lawyer and yet are not working? I mean there are no opportunities for them. But Science really opens many gates.**

I: But have you ever asked them what their problem really is? Why they are not in Science and why they don't enjoy Science. What do they say is the real or what are their real problems? Because these are the problems we want to address.

S: **Well, I tried to but they told me that they can't just adjust to that Science world you know.**

I: Why can't they adjust?

S: **They don't actually give a straight answer.**

I: So is there anything else to say?

S: **I can say that I think women have to stand up. I mean we cannot be ruled by man in this world. I mean you find engineers whether it's right or wrong they do it their way. I mean we are actually trying to show that we don't appreciate the fact that the doors have been opened for us to do Science. If we, if we get stubborn and say, "No, I am not going to be**

involved in Science. I was never allowed to. It will not help". But now I think women should do Science because really now is the survival of the fittest.

I: Now what do you think could be possible solutions in assisting these friends of yours and some ladies who still see Science as a man's field? What do you think could be the solution? What could be done to sort of make them see what the reality is now like.

S: I mean they have, they have been shown. I mean what's left for them is to open their eyes and open their hearts and say no, we are going to do this because it really helps. If they could open their eyes and see all these.

I: How could the opening be done? That is the problem.

S: Many many of them just don't want to open maybe.

I: What can the schools and the community do to make them see what the reality is like so that they take part in Science because that is what the modern world is all about?

S: Yes. That is from their families. I mean, I think they need to be encouraged. See if you don't wanna do Science, you will end up being a disaster and your family will drown because you won't have a job, you won't get jobs from any employments so you will die of poverty.

I: Oh! Thank you very much. What an interesting conversation!

In-depth Interview With A Non-Science Stud

I: Are you doing Science as one of your subjects?

A: I am not.

I: Why not? Why did you choose not to do Science?

A: I think I am too lazy. I also think I am not intelligent enough.

I: You think you are not intelligent enough to?

A: Yes.

I: Is that all?

A: Yah.

I: Give as many reasons as you think.

A: I just thought Sciences are for boys and I never thought of entering the scientific field.

I: Why do you think Science is for boys?

A: I don't know. I was just brought up like that.

I: Is it!

A: I was considered one who is very dull so I just thought I could not do it.

I: You mean you were dull? What do you mean you were dull?

A: I mean in a family of five I always come the last so no one gave me the encouragement.

I: So you think Science subjects are for people who are said to be more intelligent. Is that so?

A: Yes that's it.

I: So what is now? Who gave you the motive maybe to drop Science or to take the subjects that you are doing now?

A: OK. Most of it is my father. He taught me in primary school. He told me that I won't be able to take Sciences. He said I must take arts.

I: What about Science?

A: Science?

I: Yes.

A: He said it was too difficult for me.

I: What about other relatives? What did they think of your choice?

A: Relatives?

I: Yes.

A: They just accepted that. They never said anything.

I: You said you think Science is meant for boys and you said it needs someone who is intelligent, so what is the implication there, being intelligent and being male or female.

A: Arts just need reading. Just reading with understanding and in Science you need both that is reading and reasoning.

I: So you mean boys can reason better than boys?

A: Yes.

I: Why do you think so?

A: They are just made that way (laughter).

I: Is it? OK. When did you last do Science? In what grade or form were you?

A: I only did general Science.

I: Up to what level?

A: Up to standard eight.

I: But before dropping Science, which one was your best subject?

A: Accounts and agriculture.

I: Accounts and Agriculture. Why did you rate those as your best subjects?

A: **I did much better in them.**

I: OK. What do you think made you do much better compared to other subjects?

A: **Pardon.**

I: What made you, what do you think made you do better in those subjects compared to Science and other subjects that were not your best?

A: **OK. As for Science I couldn't and with these arts, accounts and agriculture were the most challenging subjects in all my subjects so I worked hard in them so that I could pass.**

I: So you mean you worked harder?

A: **Yes.**

I: OK. In what way did you work harder?

A: **Well, in subjects like Accounts they need more practising and a little bit of reasoning.**

I: Why couldn't you do the same with Science, working a little more harder

A: **Maybe because no one gave me the confidence to. I just thought I was dull.**

I: You were not just good at Science.

A: **Yes.**

I: But what do you think could have been done to make you like Science? What do you think could have been done when you were still at school, when you were still in the process of choosing your subjects? I mean what do you think could have been done to make you like it as much as those you mentioned that you liked?

A: **Maybe, teachers were to pay more attention to those who are not very good.**

I: Paying more attention in what way?

A: **By sort of encouraging and giving chance to each and every one.**

I: Chance to do what?

A: **Maybe to like at least in a class at least being given chance to express yourself.**

I: So you mean you were not given enough chances to express yourself?

A: **Yes.**

I: Why do you think so?

A: **In a class there are always those who are good and it seems teachers pay more attention to those who can do better and quick to think.**

I: OK. So that is the first point. Before we move on to the next point, if you can compare maybe the abilities of boys and girls in your class before you dropped general Science who were better? Which ones were doing better, girls or boys?

A: **Mostly there were boys even though there were also girls who could compete with boys.**

The majority were boys.

I: So what do you think makes some girls also do better in Science? I mean, you said you did not want it because you were not good at it. But you have mentioned that there are also some girls who were competing with those boys. What do you think make them do that or what prompts them to compete with boys and to like Science?

A: Well I think it depends on the kind of family from which they come from. The influence which they got from elder brothers and sisters.

I: OK.

A: It also depends on intelligence.

I: Do you have elder brothers and sisters?

A: Yes I've got them.

I: Are they working?

A: Yes they are working.

I: Which professions are they in?

A: The first born is doing accounting, the second born is working in a bank and the third born is me.

I: OK. So we can say you got the influence from your other family members.

A: Yes.

I: Oh! Is it. Thank you very much.

<u>In-depth Interview With A Science Student : Felly</u>

I: I understand you are taking physical Science as one of your subjects.

F: Yes.

I: Please speak up so that I can hear you. Now why did you choose to do physical Science as one of your subjects?

F: I am, I see it as, it's not difficult.

I: OK.

F: And when you do physical Science, at the time when you want to look for a job, you will not suffer to get a job. And I think physical Science needs you to read and understand it. I don't like other subjects like history because it is difficult for me. In Standard 8 I did history but I, I was finding it difficult to pass it.

I: OK. Is that all?

F: Yes.

I: You said Science is not difficult, what do you think makes physical Science not to be a difficult

subject? You said, it's not difficult for you.

F: **You mean why I think Physical Science is not difficult.**

I: Yes. What makes it not difficult for you?

F: **It is because in some of the chapters we have practicals or experiments to do then we go to class and read that work. So I understand it.**

I: Ok. So you enjoy practical work?

F: **Yes.**

I: Ok. Are there any individuals who influenced your decision, who influenced you to do physical Science?

F: **Yes.**

I: Who are these people?

F: **Parents at home and (...)**

I: And who?

F: **And my brother.**

I: How did your parents influence you?

F: **They told me to do Physical Science. They want me not to suffer at the end when I finish school.**

I: Which one of your parents is it? Is it your father or your mother?

F: **It is the mother.**

I: Ok. Is she employed?

F: **She is not employed.**

I: I thought she is doing a Science related job.

F: **She is the the one who influenced me. And my brother, he is interested in Science. He is doing electrical engineering. He likes engineering.**

I: So he wants you also to do Science?

F: **Yes. He told me that it is an interesting job.**

I: What do you want to do after leaving school? I mean the career. The job you want to do.
II:

F: **I want to be a nurse. I want to help people.**

I: But even though you are doing physical Science which subject, which subject do you like best of all the subjects you are doing?

F: **I like Biology and English.**

I: Ok. Biology and English. But why don't you like Physical Science best?

F: I don't know. But I like English and Biology best because when I go for nursing, the subject they want me to pass is English and Biology.

I: Ok. Then do you think physical Science is a subject that is worth to be done by girls?

F: (Silence)

I: Do you think it is important for girls to do Physical Science at School?

F: Yes.

I: Why do you think so?

F: It is important that girls do it but most of the girls don't do it.

I: But is it more important for girls or boys?

F: More important for boys.

I: Why?

F: Some of the, in some of the jobs you need Physical Science are hard.

I: What makes them hard for girls?

F: Like in engineering some of the jobs, they are heavy. Girls can't do them. Girls are afraid to do the jobs. The types of jobs need someBody who has strength. Some females are afraid to do such jobs.

I: Ok. But from what you know or have observed in the African population who are more males or females in Science.

F: They are males.

I: What do you think are the problems that prevent women from also being more in this field. You said there are more males. What prevents females from being more?

F: Their level of education. They become, they cannot become engineers.

I: Are there any other reasons?

F: That is all.

I: Is there anything you want to comment on?

F: That is all.

I: Thank you very much.

<u>In-depth Interview With A Non-Science Student: Cathrine</u>

I: Are you doing Science as one of your subjects?

C: No I'm not.

I: Please speak up, otherwise I won't hear.

C: OK.

I: Why did you choose not to do Science?

C: It's like I spoke to my fellow seniors who are doing Science subjects. They told me that if you choose to do a Science subject, you will be trying to make life difficult for yourself.

I: Oh! Who are these seniors? What type of seniors are they?

C: Those who did Sciences at their matric level who are now in universities.

I: Why did they say you will just be trying to create trouble for yourself?

C: I think it's because of this mentality that Sciences are for men and not for females.

I: But what make people think that Sciences are for males and not for females?

C: I don't think it's what people see but it's the society in which we live in. If we try to look at people who are in professions that involve Sciences, most of them are males. You rarely find a female up here. So it's the society we live in that makes the Science professions be supposed to be reserved for males mainly.

I: And you believe that?

C: Yes I believe that. (Laughter)

I: How can you believe it without trying it? So you said they are your seniors who influenced you. So were they elder people or what type of seniors are they?

C: They are not old people as such but they are just people who have just completed their matric level.

I: So you mean to say they almost the same size as you?

C: Yes.

I: Were they males or females?

C: Females.

I: But did they manage to go to university to do Science after their matric?

C: They managed and they are actually doing Sciences at university. But they are telling me that they don't think they will finish. They are facing quite big problems.

I: Problems!

C: Yes.

I: Is it? But what do they say is the real problem that they face? What are the major problems which they say they face?

C: They are saying most of the things they are involved in at university are things which most guys are usually or they have got an idea of what it is all about. Lets say they are given an engine, to make connections and the like, most guys are already familiar with

such things but as for the ladies, it will be starting. It's like you don't even know what a screw driver is.

I: OK. So you mean that, that is the source of the problem.

C: Yaa.

I: But where do these guys get the experience from?

C: I think it's basically because of fathers at home who usually take guys with them when they are going out, lets say for a trip such that if anything happens on the way, that person will be there to come to help the father.

I: OK. So you mean to say the boys have got the experience they get from home?

C: Yes.

I: But why don't these parents also take their daughters at one time to show them what things are like?

C: I think it's because we are seen as people who are supposed to attend to house work. It's like if he takes me out when he is driving, who will remain behind cooking and the like?

I: OK. At home who does the cooking?

C: I do the cooking and the maid. We help each other.

I: What about the boys?

C: No they don't.

I: Why?

C: There times when guys come in to help is only when there are visitors at home. What they do in the home is to try to connect TVs and the like. They think things of the kitchen are supposed to be reserved for ladies

I: Ah! So they think housework is for girls and then the other things, those ones which are not within the kitchen are theirs. OK. That is where the problems begin.

C: Yaa.

I: But who actually determines who does what in the home? Who actually makes these job descriptions in the home?

C: I have also a problem there. It's not our parents who tell their children that they must be doing this. It comes naturally. It happens that lets say the handle of the door is removed, it's the guy who always go there and see to it that the handle if fixed.

I: Why don't you go and try as well?

C: I just make myself think that I am not capable of doing that.

I: But do you feel that if you try you can manage?

C: Yaa but I don't try in the presence of my brother because he might think that I have underestimated him. He thinks it's his work.

I: OK. So you have these distinctions that this is a girl and this is a boy within the home?

C: Exactly.

I: Do you think that it is a good arrangement in the home that there should be other things for females and other things for males to do in the home?

C: I believe it's supposed to be like that.

I: Why?

C: If we try to change some of these things, I think we will be trying to create a different situation altogether

I: And what is wrong with creating a different situation altogether?

C: It's impractical. It doesn't work. I think if I am to cite an example, of this issue, of equality between man and women, I don't think it works. If I am to take the example of women being heirs after their fathers, had died, it hadn't worked. If the woman is supposed to take care of the rest of the family, she is no longer expected to get married. Because if she does, do you think the husband is prepared to take care of this family? I don't think that would work. No it wont work.

I: But when it comes to domestic duties, it should work. Isn't it?

C: I don't think it will work.

I: We have seen that this is one of the problems which make females not enjoy doing Sciences even at school. What do you think could be the solution to this problem because it looks like we have identified the source of the problem? What can be the remedy for this? We have seen that the problem starts right in the home. How can we correct this situation so that girls even when they go in the schools they will also have some experience of these scientific things.

C: I think other ladies in high positions and are involved in Science professions should come and talk to students who are at matric level like myself. because if such people talk to us, it's more acceptable than someone who is a male and is talking me. I may say, "no" to what he will be talking about but if it is a female who tells me that "I am actually there, I actually did the things so it's actually possible with you girls," then I feel encouraged. I then know that I can also be able to do these things because such and such did it.

I: So in your case, since you actually diverted from the Sciences, you mean there is no one who actually come to talk to you?

C: There is nobody.

I: In your community where you stay, are there no women who are in Science or who are in Science related professions?

C: They are there. Such people studied overseas. They did not do it here in our country.

I: What are the professions of the ones whom you know?

C: Some are electricians, some are this, auto, something like automotive, I don't know I don't know what it is. It's auto something.

I: OK. So at least you know some women who are in Science. Since you saw some, you were supposed to be motivated to be like them - since they managed and are already working. Are

there any other people who influenced your decision to drop the Sciences and take up the arts subjects?

C: **Even some teachers themselves do that.**

I: What do they say?

C: **They tell that when you choose that you are going to do Science, the introductory part of the things are in such a way that they want to scare people away from the subject. (Laughter)**

I: (Laughter). What do they say?

C: **They tell you, "If you are here, we really mean business. There is no playing no what. If you are here, you have to be very serious." I don't know but what they will be telling oh, it's discouraging.**

I: Yaa. But what about in other subjects which you finally did, weren't you also told the same stories, that you have to be serious?

C: **Ah, no. With arts subjects it's different. In arts subjects it's different.**

I: So you mean Science teachers are the problem?

C: **Yaa, they can also be a problem especially when they look at the whole class and they see ladies, when they are talking they will be looking in the direction of these females. (Laughter)**

I: (Laughter). So they will be scaring them away.

C: **Yes.**

I: But what reasons do they give for saying we mean business here? You know, every student who takes up any subject means business. What is so special about Science?

C: **I think that goes back again to the community that we live in. It emphasises that it's man who can do challenging things and women are there to come and help here and there, not that they are supposed to be initiators of the thing.**

I: OK. So you yourself, how do you view Science? I mean physical Sciences. How do you view them? how do you see them compared to other subjects?

C: **I am in between. I really don't know because it's not something that I am not capable of doing but I am realising that there are others who are in high positions because they did it. I am beginning to question why I underrated myself and think that I could not do such a thing. It's possible with ladies to do it now.**

I: But if you had tried do you think you would have managed to do Sciences even up to university/

C: **I think I could have done it.**

I: So you were just scared away?

C: **Sometimes I regret why I dropped Science.**

I: But before you dropped Science which were your best subjects? I remember you said that you dropped Science maybe along the way. At what level was that?

C: **Standard eight.**

I: In standard eight. OK. How did you , I mean, which were your best subjects before you dropped Science.

C: **I liked Maths best.**

I: Maths. And then the other one?

C: **Science.**

I: So you liked it so much.

C: **I liked it very much especially the environmental Science. I used to like that very much.**

I: Environmental Science. What does it deal with? Environmental Science.

C: **You will be dealing with the things in nature. Things around us.**

I: Nature. So you like that so much?

C: **Yes.**

I: What is so interesting about these things around us?

C: **I think when you are learning about something which you can actually see, it's like you are actually being into it. It's actually more interesting unlike when you are talking about this history, you are told about other people you will never have seen before.**

I: OK. So this environmental Science was more interesting. Are there any other people besides these females and teachers who influenced you, whom you think influenced your decisions of taking up and dropping certain subjects?

C: **I also believe that parents also do that. But in my case, no. My parents did not influence me. I believe parents of my fellow friends had to make them do arts subjects. They thought they were not capable of doing Science.**

I: OK. But what did your parents say about your decision to drop Science?

C: **My parents just said, "You are preparing for your own life so you do what you think is right for you.**

I: So they did not actually encourage you or discourage you. So, did you like such a move or you felt that they needed to encourage you?

C: **The move from my parents?**

I: Yes.

C: **Actually I liked it - my parents being just neutral.**

I: So we have seen that some parents discourage their children as well as teachers. Now lets start with teachers, what do you think can be a solution for teachers? They discourage students from taking up Science. what do you think can be done to correct all this because we want to see that things are corrected.

C: **I don't think basically there is one solution that can be brought forward.**

I: Give any possible solutions that you may think about. Any.

C: The suggestion that I have is a silly one anyway.

I: It's not.

C: I think it is. They need to be talked to about this issue and they need to be told that they must not scare away students that come to their classes.

I: You are right, but whom do you think should be given the responsibility of talking to them?

C: I think people who are in the ministry of education should actually do that.

I: They must actually be told. OK. Is there any other solution?

C: I think for teachers that is the only one.

I: Which you can think of. This is for teachers who are already in the field. What about for those teachers, new teachers who are still undergoing training. Do you think there is anything that can be done before they actually go out to teach?

C: Another solution I have just thought about now is that maybe a lot of female teachers should be given the task of teaching Science subjects because if it is a lady teacher who is discouraging another lady, obviously that thing is not going to make sense to the students. They will actually say, "Ah, how can she say this when actually she is in the Sciences.

I: OK. But from your experiences, comparing the number of male and female teachers which ones are more?

C: Male teachers are more in Science.

I: At the present moment. OK. Those are the suggestions you have. What of parents?

C: I don't think there is any that they can be educated about this thing.

I: So it's difficult.

C: But for parents who understand what school is all about it makes sense to educate them. For those who never went to school, I don't think it makes sense to them to say,"no, you must not discourage your children by saying no, don't do Science because they can do it."

I: OK.

C: Parents also have a problem of saying, "When I pay my fees, it must be used properly. My child must pass." So, the child does what she knows she is definitely going to pass.

I: They are after passing but the child may not necessarily be benefiting. The student ends up doing what he or she knows that she is going to pass.

C: That's exactly.

I: OK. That's the problem. But from your other colleges who are in Science here in high school, how do they, how are they performing compared to boys?

C: I think girls on average are not performing as I would have expected them to perform.

Because in most cases it's boys who get the prizes in these subjects. I actually think that there is another factor which actually discourages females to excel in Science subjects. This issue of boys getting prices and girls not getting anything

I: Getting prizes. It means that a person who gets a prize would have done better than the rest.

C: **No, what it means is that when others who are below, when they see their seniors getting prizes, and they realize that most of these people are only boys who are getting the prizes. That means that this thing is for guys. It's not meant for females.**

I: OK. So that's interesting. Now, it there anything else you may want to comment on that is concerned with the absence of girls in Science? Is there anything you may want to say?

C: **I don't think there is anything I want to add. But I still want to emphasise the point that people should be sent to schools to talk to students who are yet to decide on subjects they want to undertake. At Matric Level so that they will understand that a Science subject is not as difficult as they are made to believe.**

I: So people believe that Science is difficult?

C: **Yaa. Generally people believe that it is.**

I: What about you?

C: **I no longer believe that. I used to believe so.**

I: That it is difficult.

C: **Yaa.**

I: OK. So you have given me the major problems as that girls are not familiar with what happens in the Sciences?

C: **Yaa.**

I: Boys will be familiar because they would have had some previous experiences and so on.

C: **Yes.**

I: That is interesting. Is there any other comment? Anything you might think about.

C: (Silence).

I: What about in the work places? Have you ever talked to someone who is in a Science related profession?

C: **Yaa. I have actually talked.**

I: What do they say? Is there anything that happens there that make other aspiring scientists maybe run away or they say everything is fine?

C: **No. There is this issue of, let me give an example. The manager of that company happens to be a lady. What you hear about that company is that things are not OK. We are not in good relations, maybe because they don't want to be or to have a lady leader above them. They want one of them to be above that lady and that lady to be below.**

I: Who are these people who normally say these things? Are they males or females?

C: **Other members of the company who will be males.**

I: So they don't want to see a woman up there?

C: **Yaa.**

I: But why?

C: **They say our society does not allow us to be led by a lady. They say males should be above everybody.**

I: OK.

C: **We don't get encouraged in any way because we know when we get the highest position there, nobody will like us. Life at work will not be as interesting as it should be.**

I: Does that influence you in any way?

C: **Now I am beginning to realize it now. Only after I had started doing my other subjects that are not Science.**

I: OK. What about, let me say, are there any other sources of problems. Other problems that may make females run away? Are there any other sources? Think of anywhere. We have talked about workplaces and the home. Is there anything else anywhere?

C: **Ah, no. Nothing I can think of now.**

I: So, if that is all, we can stop here for the time being. Thank you very much.

INFORMATION FROM STUDENTS AT A RURAL HIGH SCHOOL

Discussion On The Vignette

Facilitator: What you think about the passage?

R5: X had always shown a lot of interest in Science and equipment both at home and at school. I think X are males because (...)

Facilitator: Please speak up.

R5: I think X are male like at home when, when, something like to, to make eh to make electricity inside at home are the males who make that work and at school. Ah-a they are interested to, to, (laughter then whisperings).

R6: I think X is for man because they are the one who, who, who is having interest in doing engineering because they are the ones who have strength more than the females. So I think X is standing for the males.

R7: Yah, I think I'm going to say the same thing that she has said. I think X is a man. Why? Because man are the person who manage, who is able to do the job. Not because females can not do. It's just because we as females we don't like to concentrate on one thing. We like to do many things at the same times, so, I think he is a guy and is the one who can manage to stand for those seven years to do engineering and also believe that men are the ones who have the , the ability. The ability to do it and also as females they don't like to focus on one thing. We do have

many things, many interests like marriage and have your own house. And staying at least for four years is better for us. So I think he is a male. This is all I can say.

R8: To add to your opinion, I agree to your opinion. E-e I think, I think X is a guy or is a man because a man, they, they, most of them they have an experiment to do then work and they, they, and I can say mens if they, if, if they mens if they (whisperings).

R6: I can say X is a man because most of the men like to choose engineering course and because they, they have ability to do that.

R7: Yah. You know when someone is choosing a career, sometimes there are people who always will be on her side or him. I do believe it includes parents, teachers and friends. But unfortunately, I cannot say anything about our teachers. Why? Because you find out we don't have a subject called guidance and you will notice even teachers are not interested to guide you to choose a career. About parents, I can say there are some parents who manage to guide his or her child to , to, to whatever career she chooses to do. In engineering I can say that most parents in the side of a guy ,they, they, they encourage males to do . They encourage a male more than a female to do engineering. I don't, I don't know whether it is because it involves electricity even you can manage to do to (whispers). OK. to be a motor mechanical and also maybe it's because someone who is doing engineering have to put on overalls and dirty something like that. And I do believe our parents most of them see only males who can do engineering and also we as ladies most of the time they see us doing those office works and having our own things and owning whatever we can own. But not working so hard like males. Not because we don't have ability to do so. It's just that most of us as females we don't like to do jobs like that. So I do believe most of the parents they encourage males to do so. Their choice of choosing the career of engineering. That's all.

R8: And the reason why they, they, why, why parents and teachers and friends encourage for X from to be an engineer is that they see something to him for his (whispering) for his benefit to do it . To do his jobs for engineering.

Facilitator: Thank you very much.

In-depth Interview With A Science Student: Nompilo

I: Why did you choose to do Science?

Nom: The reason why I chose to do Science is, from a little girl, I wanted to be a doctor. So and then, I just grew up with it.

I: What had you seen that made you really want to be a doctor. Or, who influenced you into having this interest?

Nom: My dad. He said it would be much interesting if I did something different from my family members.

I: What are other family members?

Nom: Most of them are teachers or nurses.

I: What about your dad?

Nom: My dad is a (...) He is selling insurance.

I: OK. And your mum?

Nom: **She is a teacher.**

I: OK. So you want to be different? Oh! That's interesting. Now is there anything else which made you feel that you had to do this job of being a doctor?

Nom: **Yes there is.**

I: What did you like about being a doctor?

Nom: **I like helping people who cannot help themselves. So, that's why I chose to be a doctor. It's because there are people out there who cannot help themselves. So I would like to reach to them and help them if I can.**

I: Is that all?

Nom: **Yes.**

I: Hum. You said your dad influenced you . What about friends and other relatives?

Nom: **Yes. My relatives also influenced me. They also want me to be a doctor. They are encouraging me to be a doctor. And friends, some of my friends encouraging me.**

I: Hum.

Nom: **And some are not.**

I: Hoo. Why are some discouraging you [illegible]

Nom: **Because they say I am a sensitive person, so I won't be able to like help them. Or the only thing I can do is to be a lawyer.**

I: Oh. Is it. I see. Now, which one is your best subject?

Nom: **English and Science.**

I: English and Science.

Nom: **And Biology.**

I: So English, Science and Biology.

Nom: **Yes.**

I: So Science is near the top.

Nom: **Yes.**

I: Which branch of Science?

Nom: **What do you mean?**

I: Did you say Science implying physical Science?

Nom: **Yes.**

I: Now, what do you particularly like about physical Science?

Nom: **I like almost everything about it. I like the calculations. Everything about it.**

I: Calculations. You mean the mathematical part?

Nom: **Yes.**

I: So it means you are good at Maths?

Nom: **Yes.**

I: Is it. What else?

Nom: **I would like to know what other scientists discovered. Like that part. I like the theory.**

I: The theory. What about the practicals. You are leaving them out. So you hate them? (Laughter).

Nom: **No.**

I: OK. Do you feel that physical Science is a subject that is worth to be done by girls in school?

Nom: **Yes.**

I: Why?

Nom: **Because Science can take you very far, if like you want, it can take you very far because there are few people who are doing Science. So, and they are like there would be more jobs like in Science. Most people ar[illegible] same jobs and Science will be different .**

I: Why do you think there are very few people in Science? Why, especially females. Give your views of what you think they say are the problems which make them not get into Science.

Nom: **They say Science is difficult and I think it's because if you, if you are interested in something and you want to go on with it, you will go on with it even if it's difficult. So they say it's difficult and it needs much more attention. So that's why they are few. And they are lazy, laziness.**

I: (Laughter). Laziness. What do you mean by they are lazy?

Nom: **I mean they don't want to work. Also, Science is about working, about discovering things. So, you have to work hard.**

I: Do you know of any females who are in engineering or related careers?

Nom: **No.**

I: So what do you think could be the reason that makes females not want to enter into this scientific world. What could be the problems they say they face?

Nom: **It's difficult, they say. It's only the difficulty of the subject.**

I: What about the outside influence? Do you think there could be any outside influence?

Nom: **Yaa. Because if someone is discouraging you, you also feel down and you won't want to go on with it.**

I: So are there any people who discourage other people?

Nom: **Yes.**

I: How do they discourage?

Nom: **They tell them like they can't go on with whatever they want to do. They must just quit it.**

I: What reasons do they give for telling someone that no, you can't actually do this?

Nom: **They say may be you are not good in Science so you can't go on with it.**

I: Normally, what sort of people give these negative influences? Males or females? Let us say you are a female and you are in Science, and someone comes and discourages you. Normally where do these discouragements come from?

Nom: **Other females.**

I: Other females! It's interesting. So what could be the possible solutions to these problems?

Nom: **If we could just stand up for ourselves and then you can just put your fist on the table and just say , "I am going to do this," you can do it.**

I: OK. Thank you very much.

<u>In-depth Interview With A Science Student: Diana</u>

I: Are you doing Science as one of your subjects?

D: **I am doing Chemistry, Physics and Biology.**

I: But why did you decide to do Sciences?

D: **Sciences are challenging as compared to arts subjects because with arts subjects, it's just a matter of, you are just taught the things, learn and that's it. But in Science, we experiment.**

I: OK.

D: **Yaa. it has something to do with the lab.. you find like you will be discovering new things.**

I: So you like experiments? That's why you joined Science.

D: **Yes.**

I: Can you think of other reasons?

D: **Other reasons for joining Science?**

I: Yes. Why you decided to do Science.

D: **From the family that I come from, my mother is a nurse and my sister also did Science, so I just thought well, I have to do Science you know.**

I: OK.

D: **My mother was actually against the idea. I have some cousins of mine who did Science and they did not do well.**

I: Were they male or female?

D: **Females.**

I: OK. They did not do well.

D: **Yes.**

I: What did they say were the problems they faced that made them not do well?

D: **Well, they say they are tough.**

I: But you as one who is doing Sciences, how do you find them?

D: **They are quite demanding. You have to do quite a lot of work. You can't just do everything when exams are just around the corner. I personally can't just start working then. I just have to work constantly.**

I: So you mean you have to read or what?

D: **Yes I have to read. You have to read.**

I: What about other people who are doing subjects like history. Don't they also do the same?

D: **They also do the same but I think it's like they cram a lot of things. You are cramming dates, you are cramming that. But with Science, if you go to the lab, and do the experiments, you will not forget that experiment.**

I: OK, so you like the experimentation part of it, but which one is your best subject?

D: **I like chemistry.**

I: Uh, you like chemistry best!

D: **It's interesting compared to Biology. With Biology you go there to the lab and take a plant and you are asked to look at it and draw it, right. With Physics you do practicals and get the results but with Chemistry, you are looking at, we start with chemicals and you are supposed to view, you are supposed to see what happens when you mix that. I think that is the most exciting part, you know. When you see new things.**

I: But you also said you do Physics. Why don't you, how do you compare Physics and Chemistry. Why don't you like Physics in the same way you like Chemistry?

D: **Physics?**

I: Yes?

D: **It's not that experimental. It's like Biology. In Biology you are told, you have an experiment to do, right. It's either it's a right or a wrong.**

I: OK.

D: **But in Chemistry, if you are expected to get a certain colour pattern, maybe it's pink but others may get a white precipitate, you just have to explain that this one is white because**

of this, this one is pink because of this.

I: OK. So you like that?

D: You can come up with your own results and try to explain why.

I: OK. That is why you don't like Physics so much. But what do you want to do after leaving school? Your career after leaving school.

D: I want to be a doctor.

I: You mean a medical doctor?

D: Yes.

I: So there is a relationship between this chemistry and getting into medicine.

D: Yes it is. Apart from Biology, Chemistry and Physics are also linked to medicine than any other subjects.

I: OK. So that is why you feel that you like this chemistry, because what you want to do after leaving school is related to Chemistry. But as someone who is in Science, do you feel there are problems, you as a female in Science is facing as you are trying to pursue, especially in Physics. You said you don't enjoy that much. Maybe it could be due to certain problems which you encounter as you carry out Physics experiments or other things like that or even outside, anything that could affect your performance. Would you say there are such things like that? Even the content, anything.

D: I think the main problem in Science stems from the fact that we are women and I personally think that they are far more demanding than arts subjects. Again, if you don't have a very good teacher, who doesn't quite explain, because the thing is if the teacher is not very good, and he doesn't explain, it's so difficult to grasp the contents of the topic. But as a girl child, especially in our African culture, you get home and you have to do some work while your brothers are reading. So, by the time both of you are supposed to go to bed, or start reading, you will already be tired and your brother would have had his supper and has been sitting the whole day, he can do his work well.

I: OK.

D: And as a girl, you wake up early in the morning, clean the house and so on. The thing is that, at home we can never say , "I'm studying I cannot do that," you know. You just have to do it. If your mum says ,"Can you please do this", you have to do it or even if your dad asks for some help, you just have to do that.

I: What if you are in boarding school? If you and your brother are both in boarding school, do you still feel that there are some things that can affect your performance or the way you like Science? That is affecting the way you like subjects like physics or chemistry? Do you think there could be other things?

D: If you are in boarding school, I don't think there are any problems, anything that can stop anyone from achieving what they want or doing what they want to do. I personally think that basically man and women are basically the just the same. They are equally intelligent and I guess it can also be influence from your friend. You know usually if your friends are going to be doing Biology, Chemistry and Maths, you will be inclined to do that as well.

I: OK.

D: **I don't know if it looks like engineering is something that males have always done.**

I: But why is it like that? Why?

D: **I think society is to blame. Like with engineering, it's more like working with machines, like in mechanical engineering.**

I: You are right.

D: **And to find a mother, you know, a mother, someone who is supposed to be respectable doing mechanical engineering does not look right. In our culture, I don't think it's such a respectable job for a woman. It's more like a man's job. I mean can you imagine a pregnant woman.**

I: Yes.

D: **She can work in a hospital as a medical doctor or a nurse, but in engineering she has to go under cars and that kind of thing, I don't think in that sense women can do such a job.**

I: So because of such constraints, what are women supposed to do. I mean giving birth and so on, these are the things that disturb them. You also said that it's not respectable - seeing a pregnant woman fixing a car.

D: **It's not respectable. Because she is supposed to go under cars. If you are pregnant, I don't think it's proper for you to do that. But if you are a doctor, you can do your work.**

I: OK. Is there any other problem? You can even think of culturally related problems, whatever. I mean, what is the origin of that problem. Where do you think it originates?

D: **I think they originated from long back. Come to think of long back, man used to go out hunting and these used to be the brave people who could go hunting. They were supposed to be carrying the animals. Women were the ones left at home looking after the children and clean the house and that kind of thing. Women used to be around the home. Looking after the family. Now that all this has happened, and now that there is all this affirmative action and liberalization, we are moving towards when we will still have more women engineers and I know at the moment that there are now more women doctors as compared to the past years.**

I: So you feel that there will come a time when we shall have more women engineers.

D: **We are getting into it. We are definitely getting there. It's only that the process may be slow because of the influence of the past.**

I: OK. That's something interesting, but in your physics class, how many are more, males or females.

D: **I think in our class, there are more females that is in our physical Science class. It seems like there are more women. So we are coming up.**

I: So it's encouraging. It's interesting. But when it comes to performance, who normally perform better males or females?

D: **Are you talking of at school or in colleges?**

I: I mean here at school and even at colleges and even universities.

D: **In universities I think they are the same level but in school, we used too fluctuate.**

Because I remember that in my junior school, it is the girls who are on top.

I: In Physics?

D: No. We used to do general Science.

I: OK.

D: In high school, I don't know what happens because it's just like boys just come on top.

I: What do you think causes things to be like that?

D: I don't know. But I know that when they get to colleges they are at the same level. When you get to university, you are at the same level.

I: OK. What about at honours, from what you have heard, at honours normally what happens? In males and females which number decrease or increase or whatever.

D: I am not sure now.

I: So what do you think can be a contributing factor to boys suddenly becoming much better than girls. Even if you think of other things that may that happen in the classroom. How do teachers behave towards boys and girls or do they treat them the same way or anything.

D: They are treated in the same way. There is no difference.

I: Oh, so we just don't know? How can we account for that?

D: I think it's beyond my explanations. They were made like that. Or isn't it that the thing is we reach puberty faster than boys. So I think in that sense, we are a step ahead when we get to puberty. When they get to puberty, maybe they take over and at a point we meet. There comes (...)

I: Yaa a point at which we meet up there as we go up. But do you think there are other, other things that can also affect your performance or that can also affect the way you perceive Science subjects? Your participation and so on.

D: Yaa but it's not only in Science. It is school. There is something I have noticed. There are some girls who when they get to high school, and they meet some nice guy or something like that, they are deviated totally especially if that guy has promised to marry her, supporting them, buying them all these nice gifts and all that. They may decide that I don't need school any more. And some girls, they can get pregnant and they drop out of school and in a sense, that reduces the number of girls in high school compared to the number of boys.

I: OK. As you said that Science is a demanding subject, if you are deviated from school, you know especially in Science, you really loose out completely.

D: Yaa.

I: From your friends who are not in Science, what reasons do they give for not getting into Science, that is taking Science as one of their subjects - specifically physical Sciences?

D: They just say it's hard and they don't like the subject especially Physics, they just don't like it.

I: But what reasons do they give for not liking physics?

D: **They just say it's hard.**

I: OK.

D: **And even Maths, it's hard. There is no other reason.**

I: But more males take it up? You can't account for it?

D: **God made it like that.**

I: But in your case, from your personal experience, when you decide to do Science, how did your parents react to that?

D: **My mother was actually against the idea. I have some cousins of mine who did Science and they did not do well. It's because my cousins had failed. If you take Sciences, you have better chances of getting a job as compared to arts because in arts there are so many people and the competition is getting really tough, competition to get a job. The problem is, when you get into Science, you have to work really hard because I have heard from other people that you can easily fail.**

I: What about other members of society?

D: **Other members, my teachers told me that I should take up what I want to take. I should, because ten years from now, they would not be around. I will be alone feeling miserable and looking for a job. I should take up something that interests me.**

I: What about your friends?

D: **My friends didn't have much influence, because I had to pick up something that interested me.**

I: OK. You have said that some people say that this physics is a difficult subject, what do you think can be the solution to that problem - to draw more females into this field? What can they do? Any possible solution? What can be done to encourage more females?

D: **I think the problem is that it is difficult and so you know, maybe in junior school, they must start including more Physics. I'm sure by so doing they will understand gradually.**

I: That can be a solution, so that more females can get into Science especially physics. So that they can get to know that they can make it anyway. I think that can help.

D: **I think also they need to see other people who have made it. You know that can help a lot. If they can see that this person is now an engineer and it is someone I know, why can't I? You know there are so few women you can look up to, who have done engineering.**

I: Have you ever seen a woman engineer?

D: **Yes I have.**

I: So why didn't you copy her. You were supposed to know that it is possible.

D: **You know that depends on interest. (Laughter)**

I: (Laughter). By the way you said you were more interested in Chemistry. So you mean there are fewer women in engineering?

D: **I think they are few because I only know of one engineer woman. But I know of a lot of medical doctors, female medical doctors.**

I: The ones you copied?

D: **Yes.**

I: Is it so? There are fewer role models there.

D: **Yaa.**

I: And you said again it's, it's eh, when girls, when they grow up, they end up having more interest in other things that can end up making them not performing well in school generally. What can be a solution to that problem? I have also heard many people saying that.

D: **I think it's just that, if parents could sent their children to boarding schools, and all girls boarding schools and all boys boarding schools.**

I: Why?

D: **I think during that time they need to take their school life very seriously. In junior school she can be in a mixed school but in high school she must be in an all girls school and concentrate on her school work. Then during the holidays she can mix with the boys and all that. At school she will just stick to her books. And when she gets to college, she mixes again.**

I: You feel being in a girls' school make[illegible] perform better in school.

D: **With some girls, it will make them perform better. Others with their priorities straight and know what they want in life and know that I come to school to learn and I should not have other destructions. Some girls would not come to school, they will be in town with their boyfriends. They wouldn't come to classes and that type of thing.**

I: So that is a problem of boyfriends and girl friends.

D: **Yaa. It is.**

I: But why are women so much into relationships?

D: **I think that's just how women are, into marriage. They get more emotionally attached in relationships as compared to men.**

I: And that may end up destroying their careers even if they would have wanted to get into Science. That is a problem actually. That does not have maybe a solution. We also discussed the issue of what maybe done to have more women into Science so that the young ones can also see and learn from them. Do you think even the government and other responsible people can have a way to help at all?

D: **There maybe scholarships for women in particular. Specifically for women in Science subjects and engineering.**

I: OK. To encourage them. So that we can have many more up there. OK. have you ever heard other people discussing what happens in work places in Science related jobs? Maybe there could be other things that scare away females.

D: **Yaa. Harassment, especially with women in fields like engineering. If you are the only woman at work, you get just males and all of them may be busy harassing you when you**

get to work, degrading you and that kind of thing. They have to fight very hard. And I think for a woman to be a boss at the top, it's very difficult. Lets say there are fifteen men and one woman, it would be very hard for that woman to get to the top position.

I: OK. But why do you think it is difficult? What will these men say?

D: I mean if there are men at the top, and they are the board members who are going to choose who is going to be the manager, and then they can always pick on the other man. I mean it can take longer to get to the top.

I: OK.

D: In some job advertisements in the news paper, they like women who have passed a certain age, probably passed the child bearing age.

I: OK.

D: You will not keep on asking for maternity leave unlike a person who is still young. And another thing is that she is not likely going to start a relationship with her boss as compared to someone who is younger.

I: OK. So all those can be factors that scare women from Science. But is it easy for girls lets say a woman engineer who has completed her course to easily get employment compared to men? Is it easy?

D: I think if you did quite well, they will look at that aspect. If you did quite well. The thing is you just cant go straight into a very [illegible]. She will get something in the beginning and she will have to work her way to the top.

I: OK. It's possible as long as she has very good passes. I have heard other people saying it is very difficult especially if you are a woman. If you apply and you have the same qualifications with a male in a Science related job like engineering normally they will prefer a young man to a young woman for they know that there will be disturbances along the way like what you have explained. I have heard other people saying it's quite difficult to secure employment after completing because there are men who are biased.

D: The thing is if it is someone who really knows what she is doing who has got better grades or better qualifications than her male counterparts, if they know what they want, they will hire her.

I: OK. So is there anything else you may want to comment on? (Silence). Thank you very much.

In-depth Interview With A Non-Science Student: Zodwa

I: I am talking to a non-Science student. A student who does not do Science as one of her subjects. Is that so?

Z: Yes.

I: OK. Now, why did you not choose to do Science or physical Science as one of your subjects?

Z: I did not choose not to do Science because I just like History.

I: OK. Give me as many reasons as you wish or as you like. As many reasons why you did not

I: You brought out the point that people who do Physics most of the time they are serious and they are quiet. What do you think makes them serious and quiet like that?

Z: **I think maybe what they are doing needs concentration. They have to concentrate on what they are doing and also not moving that much.**

I: OK. They need more concentration.

Z: **Yes.**

I: Don't you need much more concentration as well in History?

Z: **Yah you need it in history but it's like in History you are able to move. It's just that in history we are talking most of the time. In, in maybe History is full of theory than practical. So in Physics they do both theory and practicals**

I: So how do you view practicals yourself? Do you like them or you hate them? (Laughter). Practicals.

Z: **In physics or whatever?**

I: Wherever.

Z: **I do like practicals.**

I: What about in physical Science?

Z: **I don't like physical Science.**

I: Why?

Z: **Because I don't know why I am doing that. It's just that in History I know what I am doing.**

I: OK. Because since you said it was not for you so maybe you don't understand a lot about those practicals. OK now. Do you think physical Science even though you are not doing it, is a subject worth to be done by girls at school? Do you think it is a subject worth doing?

Z: **Yah. I do believe.**

I: Why do you think it's worth doing?

Z: **It's their right to chose whatever they want to do.**

I: I mean in the outer world do you think it is of much use to a girl? I mean if you have done physical Science up to matric and you have passed it very well, do you think it is a subject which is worth having, worth passing for a girl?

Z: **Yah. I believe so. I believe so.**

I: Why? What use do you think may make use of a Science in the outer world?

Z: **As you know most of the time we know as males only who can, who can do it. Now we want to show that even girls, they have ability to do so. Like we know people who could work in industry and be in management there. It's only males so we want to show that even females can do so.**

I: So you know that females can also do it?

Z: **Yes.**

I: But from what you know and have observed in your everyday life or our culture, that is in South Africa, here in your race or whatever, are there more females or males in physical Science related careers?

Z: **There are more males than females.**

I: Now what do you think are the problems that prevent more women than men into these fields? What do you think are the problems females face which make them maybe hesitate or not take up Science as their major subjects as well as engaging themselves in Science related careers?

Z: **I think it's just because males were the ones who were on top and they were given more positions to do so than females. We females they were looking down, they were looking**

I: Looking down upon (...)

Z: **They were looking down upon us.**

I: OK. But why do you think they looked down upon females? Think of eh maybe, what happens. It could be anywhere in the world, in schools, in the classroom. Are there any things that you feel prevent females from liking Science?

Z: **Nowadays now, since we are in new South Africa, I think females and males are equal. They are free to do whatever they want to do as long as it is right, as long as it's their choice to do so.**

I: But do you think even in our school situation there is equal opportunities for both boys and girls to engage in Science subjects?

Z: **Yes. It is so.**

I: So you mean that there is no difference even in the way the students are taught by teachers, in the way the parents encourage maybe boys and girls into Science. There are no differences. It's all, it's all equal. It's only that girls don't want to do Science. Is that so? Or, there are some differences here and there?

Z: **But in the side of parents. Infact, I can say that now it depends on us to do Science. It's not much as it is.**

I: So you mean that there are no problems whatsoever that prevent women from liking or engaging themselves into Science related subjects and careers?

Z: **Yes. There are no problems.**

I: No problems?

Z: **No problems at all.**

I: OK. I see. But I think you mentioned something like ehe females were looked down upon and so on, what could be the possible solution to that problem of being looked down upon? Maybe people say females, these are not for Science. You know Science is for men. Now, how can this problem be solved?

Z: **I think now it's already solved.**

I: Why?

Z: **Because you will notice that males, infact both males and females are able to do physical Science.**

I: But why are there still fewer females in Science related professions compared to men? That is the question. Why are they still fewer?

Z: **Maybe because they are not much interested. Females don't like engineering or maybe it's because they don't get someone who can encourage them or counselling. Someone who can guide and encourage them and give them more encouragement.**

I: OK. So they don't have interest. So what do you think removes their interest. They have no interest.

Z: **I think they loose confidence.**

I: What makes them loose confidence?

Z: (Laughter).

I: That is what I want to hear from you.

Z: **It's because, it's because they, there is no one to encourage them.**

I: To encourage them.

Z: **Yaa.**

I: So what about man? Is there anyone wh... ges boys?

Z: **Yes.**

I: OK.

Z: **A lot of them.**

I: OK. Who are these people who encourage boys?

Z: **Even there are teachers who used to do so. Even parents at home. I don't know whether they think it's only the job that males can do, not females.**

I: Not females?

Z: **Yes.**

I: OK. It's interesting. Are there any Science clubs at this school? Science clubs.

Z: **No. Not yet.**

I: I thought there were. I wanted to know whether you are a member.

Z: **No.**

I: Thanks very much.

In-depth Interview With a Non-Science Student : Roselyn

I: Are you doing physical Science as one of your subjects?

R: No I am not.

I: Why did you choose not to do physical Science?

R: Because what I want to do in future does not involve Science. I would like to become a biologist. In order to become one you have to do Biology. Another thing is that I am good at this subject.

I: Is that all why you did not choose Science?

R: The other thing is I like my Biology teacher. So I ended up doing Biology.

I: What makes you like the teacher?

R: I think he is a good teacher.

I: What makes him a good teacher?

R: (Laughter). **The way he explains things is so clear. He allows people to go and ask things they don't understand.**

I: But what do you particularly like about B[redacted]elf?

R: Uh! The things I like are related to life. So, in Biology the things there are, you can see them everyday. If you look at animals , you learn what they eat, what their bodies are like. You also learn their behaviour, what they like and dislike. You also do things about human beings. Those are the things I like.

I: So you like animals?

R: Yes I do.

I: Now what do other people think of your choice. Other people.

R: Some people? They think that I should have done certain subjects. They wanted me to ... Like my parents they wanted me to become an accountant. They encouraged me to do other subjects. I am not interested in that. I want to become a biologist.

I: What of your friends?

R: Some of my friends encouraged me to do Biology. They know I am good at it.

I: Why did your parents want you to become an accountant? What made them feel that you should be an accountant?

R: Because they see some accountants prospering in life. So they just want me to become an accountant.

I: Are there no scientists who are prospering in life?

R: They are there. Maybe they don't known that. Maybe they have seen accountants only.

I: But have you seen one? Other female scientists who have better status in society? Do you know of any?

R: I don't remember seeing one except for teachers.

I: So the only women whom you have seen who are in Science professions are teachers? Is that so?

R: I have also seen doctors.

I: Why do you think very few women enter physical Science-related jobs?

R: I have a feeling that they have no interest in the jobs.

I: What do you think removes their interest? Including yours?

R: I don't like physical Science and such jobs because there are a lot of calculations. So I feel I'm not good at Maths.

I: So you mean Maths is difficult?

R: Yes to me and others.

I: But what makes you feel that Maths is difficult?

R: The calculations there. They are too many of them.

I: Ok.

R: You have to cram most of the things.

I: So you like which subject best?

R: I like Biology best.

I: But what about the way the lessons are conducted?

R: In the lesson - Biology - I like the way the practicals are done. The practicals, you will be quite involved in dong the practicals. So I like them. What I don't like is writing tests. Maybe if we could just write maybe homeworks.

I: Oh! You don't like tests? But you said you are good at Biology, it means you will be passing. So why do you hate tests?

R: I just hate them.

I: So your problem is with tests?

R: Yaa. I hate them. Not that I will be failing but I dislike them.

I: Are there any other problems which you feel most people dislike physics and/or chemistry?

R: No.

I: What do you think can be the possible solutions to those problems you mentioned. How can the problems of calculations and tests be solved?

R: **I think they have to remove those calculations and also give people homework and not write tests.**

I: Oh! Do you think it is possible?

R: **I don't know.**

I: Ok. Is there any other comment you want to make?

R: **I think that is all.**

I: Thank you very much.

INFORMATION FROM PROFESSIONAL WOMEN IN Science

<u>In-depth Interview With An Electronic Engineer: Nonhlanhla</u>

I: I understand that you are in a Science related profession. Can you please describe briefly the nature of your job?

Non: **I work in the electronic engineering department. I deal with telephones.**

I: OK. But what made you decide to join this profession?

Non: **I just found it challenging. Just thought it would be nice for me to join this profession.**

I: But did you decide on your own to join the profession or there is something that influenced you to join the profession?

Non: **I just decided on my own to join the profession.**

I: But what made you think of doing that profession?

Non: **It was because it was mainly male dominated so I just wanted to do it.**

I: OK. What things did you feel were challenging in that profession?

Non: **The males thought women could not do it so I just did it to prove that women could also do it.**

I: OK. But from your experience as a person who is in Science, why do you think men think that females cannot do Science related activities?

Non: **In some cases they think that women are not intelligent enough and others believe they don't have the courage to tackle problems in Science situations. And the way we grew up, we found girls given the lighter things to do.**

I: But from your experience do you think that it is true?

Non: **It's not true because I am finding that I can do it.**

I: How many ladies were you when you were training for that job? How many females were there and how many males were there?

Non: **There were more males than females.**

I: But you said things are not tough so what made less females join the course?

Non: **It is the fear. That idea that it is a male job. So even those that were capable I want to believe were not able to join because they thought that they were not able to do it'**

I: So you mean females are afraid.

Non: **Yaa! They are groomed to be afraid not that they are. They learn to be afraid.**

I: But who grooms them?

Non: **Where they grow up. The family does.**

I: So the family contributes much. But do you think there are other people besides parents who also influence these other females' decisions?

Non: **Yes. The peers as well. If you are going to be found in a male dominated area, they don't see any feminine characteristics in a person like that. They would want you to be elsewhere than in the area where they dominate. When you are in their place, they always find you to be a queer person.**

I: So you mean the males are the ones who chase away females?

Non: **Yes they do that.**

I: What about in your case? You said that [illegible] of the problems - males actually discouraging females. How did you manage to overcome that problem?

Non: **In the majority of cases I ignored them.**

I: But did you also encounter that problem?

Non: **Yes I did.**

I: Can you briefly explain an occasion when someone actually confronted you.

Non: **When we had written a test. I performed very well and the males actually challenged me and said it was not possible that a woman could get higher marks than they could do.**

I: So what did they do in order to discourage you?

Non: **They would always remark about me being abnormal.**

I: OK. What else?

Non: **Being abnormal because I was dominating over the males. They tried all things in order to make sure that they would get better marks in the tests that followed.**

I: You said that most people's parents discourage the. Did your parents also discourage you?

Non: **In my case maybe they had very little information about it but you could hear them saying for example "some mathematical aspects are very difficult especially to a girl."**

I: And when they said that how did you respond?

Non: **Because I found the Sciences and the Maths a bit easier, I did not really take them seriously.**

I: When you were at school, which were your best subjects?

Non: **I liked Sciences better.**

I: OK. Can you think of other problems which females who try to do Science besides the ones you have stated or there could be problems people of your times encountered?

Non: **Yaa. They are not exposed to the scientific world more than the boys. Like for example if you are staying in a rural area, it is the boy who is always sent to town to do things and you the girl will always be at home and you find you are not exposed enough and you don't feel confident in the area. The other thing maybe that of resources. You may find that when they are not enough, resources are always limited on the girl child. She suffers and you find more resources being given to the male. These are some of the problems.**

I: But why do you think parents do that?

Non: **They do that because they believe that the boy will look after them later on and not the female because she will get married.**

I: OK. Any other. Any other problem?

Non: **Not what I can think of now.**

I: But you have mentioned marriage. Do [illegible] has any effect on the choice of careers by women?

Non: **It does especially if you are going to be married by a man who is not in your area. It's like there is that label that Science is difficult. So if you can do well in it so it means you are better off. It might create problems.**

I: You mean you are better than him?

Non: **Yes.**

I: OK. How long was your course? I mean training for the job.

Non: **Four years.**

I: Four years. Could you comment on the time factor. Do you think it has any effect. The same effect on males and females or it has no effect.

Non: **I wouldn't think there would be much of a difference in the case of the period. Although maybe it would appear maybe a bit longer but I think I balances off.**

I: Longer in what aspect. You mean longer for men or for women?

Non: **No, I mean longer for both sexes. If you compare it with other areas, you might find that it takes a shorter period to cover their courses.**

I: So don't you think it is a disadvantage for females that the course is longer?

Non: **Yaa it can be. It can be a disadvantage but I don't see it as that.**

I: I have heard other people saying that if it is too long, it can be a disadvantage because women want to get married quickly.

Non: **Yaa if you have got things like marriage in your mind. For example, suppose you have gone and you already have kids, you will feel the pressure. Four years will be too long for you.**

I: OK. Now besides the problems you have stated, You have said that males are normally favoured by parents especially even from an early age they are exposed to more scientific activities. What do you think can be the solution to that problem?

Non: **I think parents must be informed for them to realise that opportunities should equally distributed to all children so that those who can attempt and succeed can do so and those who fail leave irrespective of whether they are males or females.**

I: How do you think they can be informed?

Non: **I think the children themselves can bring back the information**

I: From where?

Non: **From school.**

I: So who will be educating them at school?

Non: **I mean the children themselves. When they realise that they can tackle the subject easily they can come back and inform their parents. When there are public addresses or when people address parents publicly, either at school or at any other gathering, they can always be informed about those things.**

I: The other problem you have stated is that females are not, maybe are laughed at and some think that they are not intelligent enough, what can be done to assist these students?

Non: **I think where possible, since they have not been exposed enough, where chances are available, they can increase the numbers in intakes. Lets say they were taking ten females, they can try to increase the numbers and encourage more women to join in.**

I: You mean in the training institutions?

Non: **Yes in the training institutions.**

I: Here you were talking about exposure, what do you actually mean?

Non: **I mean creating more places for the females.**

I: OK. Won't that be discriminative?

Non: **It won't be discriminatory because men have been benefiting for too long.**

I: What do you mean benefitting? Maybe they are more intelligent.

Non: **No I don't think it's because they are more intelligent. They were just more exposed. So now that the females are getting exposed, they can as well get the chances. Not very large numbers but just increasing the numbers.**

I: You mean even those who would not have passed.

Non: **No. There are lots of them who pass but it is only that they wouldn't want to venture into those areas because of the stigma attached to the courses.**

I: OK. But what do you think can be done by the school or the state to sort of assist these girls? We have talked about the training institutions. What about the state?

Non: They should try to create a balance. To create a balance using whatever method possible. It means making sure that as many of the females as possible go into the Science areas because when they start appreciating it, they would join in larger numbers.

I: But besides participating in Science subjects and careers, are there any problems in general associated with attending school besides those specifically related to Science? Problems.

Non: Yaa. There are several of these problems like for example finance is not being available for girls. That's one. Two, where there is too much work for the girl child at home than the boy child especially when it is late in the day. When every one else is resting you find the girl child busy. By the time she is through, she is already too tired to do anything.

I: But this last problem of working and then spending more time doing housework than reading books. What can be a solution to that?

Non: To try and balance. To make sure that both boys and girls do the work at home and share the responsibilities so that they finish the work a little bit earlier and have time to study.

I: Can all have time to study?

Non: Yes.

I: Is there anything else?

Non: No.

I: But you have talked about the responsibilities and housework, normally, when we say house work we think of normally cleaning and things done in the kitchen. Are there any other things which may affect them?

Non: Not what I can think of now.

I: OK. Is there anything else that you might want to say or comment on?

Non: Just a comment that as much as possible we should encourage girls to go into technical and scientific fields so that this world maybe a more balanced place to live.

I: So, what about in your workplace, since there are fewer women, how do you feel working in an environment where there are lots of men?

Non: In most cases they do not want to believe that you can do your job. But you always prove them wrong when you actually do it in the right way.

I: So, are there any problems which you face or all is well with you in your workplace?

Non: In cases where now you might be given a responsibility, you will always find a situation where they think that you have been given responsibility just because you are a woman not that you deserve it.

I: So what do you do in such a situation?

Non: You have no option but just to leave things as they are. It is an area that is male dominated.

I: So, is there any other problem which you encounter?

Non: Not what I can think of right now.

I: OK. So usually it's only fear that makes.....

Non: A lot of it is the fear that one has been told when young that it is an area which is manly for men.

I: So the major problem is with parents. The moment parents start encouraging them then things may change for the better. Thank you very much.

In-depth Interview With A Laboratory Assistant: Tulisile

I: I understand that you are in a Science related profession. Can you please tell me briefly about the nature of your job.

T: I am a laboratory assistant. So, I normally help and also make all the chemicals needed for the work I am also somehow responsible for the safety of the company. That is basically all.

I: That sounds interesting. What made you decide to join this profession?

T: At high school all my courses were Science and I came to university and also did chemistry as one of my major.

I: OK. Did you also do Physics?

T: Yes. I also did Physics at university level.

I: It sounds interesting. Were there people who were doing Chemistry and Physics - ladies I mean?

T: **At first everything was normal. We had large numbers irrespective of sex. It's only when you go on when numbers of females gets less.**

I: Oh! Why do you think they decrease?

T: **Basically, I think with Chemistry and even with Physics, at first you do any course because you know that you qualify. And when you come to university Physics and Chemistry are separated and with Chemistry also, it is in four sections. Females, we normally find the organic section very difficult. Ladies are always discouraged not to go on with Chemistry.**

I: But you managed.

T: **Yes I managed with the help of some honours students who were already here during that time. I had some consultations with the lecturers although at times I consulted my friends.**

I: Were they females who were assisting you?

T: **By the time I arrived, there was one honours lady student and the males were the majority.**

I: So was it the female who was assisting you?

T: **No. They were male.**

I: OK. It was a male. Was it like that until you completed your university chemistry?

T: **Yaa. By the time I was doing my final year there were also ladies who were doing honours to whom I could go and ask for help.**

I: And how many males were there?

T: **They are always dominating. If there are lets say twenty students doing honours chemistry you will find that about fifteen of them are males.**

I: Oh. What do you think is the problem?

T: **I think it is the attitude we females normally take Science or related courses - that they are difficult or that they are normally meant for men. You know and sometimes you just find that you get discouraged. You fail a course for one year, the following year you are just discouraged. You don't wanna do it because you feel it's hard. You get discouraged. You feel you just cant do it.**

I: But do males also fail as females?

T: **Yes they do.**

I: And when failing do they drop out or what do they do?

T: **With men they do continue because somehow they don't have a choice like where to go on. Unlike us we can just fit anywhere. You can go and do your BA or you go and do your B.Com.**

I: Why do males don't go and do BA?

T: **They regard those as easy. They are meant for women.**

I: Is it so? So you mean they prefer the hard options? (Laughter)

T: **Yes.**

I: But have you ever head them explaining why they opt for the hard options?

T: **They always believe that that is always meant for males. I mean mathematics is meant for males. If a female can take Mathematics as major, they will just wonder whether she is going to make it anyway.**

I: Is it! But what made you desire to join this profession? This Science related field.

T: **Well as I have said that when I came to university I did Chemistry. So with Chemistry as a major subject divided into four sections which are the physical part, the organic part, the inorganic part and the analytical part, they are very applicable to our daily lives. You know we use their applications. So I chose it because I had an interest in analytic Chemistry. It is very applicable.**

I: OK. But is there anyone or some other people who influenced your choice?

T: **Yes! My lecturer of analytical Chemistry.**

I: Is he male or female?

T: **He is a male.**

I: OK. What did he say?

T: **You should do analytical Chemistry. It is simple and straight forward. It's mainly part of our daily living.**

I: What about at Matric level? Were there other people who influenced you to take up Science?

T: **Yes. Initially I wanted to do medicine. But since I completed my three years, I don't regret.**

I: Why did you want to do medicine?

T: **I wanted to have a profession in life you know. Not just having a B.Sc. and know that you are going to industry. But if you are a doctor you go to your own place of practising. And being a doctor you know that you are somehow part of the people. You know you are helping unlike in industry.**

I: OK. So you are interested in helping people?

T: **Yes.**

I: Why then did you not become a social worker?

T: **With social work you know at times where you grew up our families were independent and you don't often grow up seeing social workers. You find that there is no role model.**

I: OK. But are there any other lab assistants whom you know? Black South Africans.

T: **Yes there are.**

I: What did other people think of your choice? That is friends and relatives.

T: **As with my parents they are fine with my choice I have chosen. With friends it just sometimes happens that we are all doing the same choices.**

I: So you were good at Mathematics?

T: **Yes I was good at Mathematics.**

I: When you were still at high school, which subject or subjects did you like best?

T: **At high school I liked Biology and Mathematics.**

I: So you liked Mathematics. Why did you like those two best?

T: **I think with these I could easily understand them if I listen in class. I could do follow up on my own. They are just straight forward to me.**

I: You have also said Mathematics. So you could follow up that easily as well?

T: **Yaa. With Mathematics I could but when I came to university you know it was something different you know. I just managed to do Maths one.**

I: Why didn't you continue with it?

T: **I think it was a different approach from the Mathematics I expected.**

I: What was the difference?

T: It was very very difficult if I might say. I couldn't see myself continuing with Mathematics.

I: Which aspects were very difficult for you? Do you still remember one or two of those aspects?

T: I had a problem maybe basically in how the course was presented you know.

I: OK. Maybe it was more of how it was taught.

T: And presented.

I: OK. Since you have been through the system, that is in Science up to university level I'm sure you have had a lot of experience in Science. Comparing numbers of males and females who take up Science and pass from matric to university level, how do you compare them? Which ones have higher pass rates in Science?

T: Well, like in Chemistry and Physics, with Physics to be honest there are very very few ladies. The case with Chemistry it is a fifty-fifty. It's no longer that males are dominating or more passing. I will say it is a fifty-fifty.

I: What about as you move up to honours?

T: There would be now more males. If you go to honours and masters you find that we females just do our honours. We'll get a good pass although distinctions normally come from man. It's that females then go and look for a good job or they go to technikons. Then it's obvious that the only people who will remain for masters or continue are males. Because of this, they will start to take the lecturing posts that of which they are many.

I: OK. Why is it like that?

T: I think maybe although I'm not sure, it's always that when you have done a degree, there isn't that much of solving practical problems so you would rather go to a technikon to get the practical experience.

I: So given the option you feel more should be done to the curriculum in universities.

T: It needs to be changed. Because when you try to go out of universities, you are not prepared to be part of the field. You cannot say when you are from university you have trained for the job. You have to undergo some training of some sort.

I: So the curriculum needs to be reviewed. OK. So we have seen that here are more males in Science related fields compared to females. So, can you briefly tell me the problems since you have been through the system. I am sure you have observed certain things or certain practices which ladies don't like maybe which make them shy away from Science or whatever. Can you please tell me?

T: I would rather say firstly you would find that maybe the whole Chemistry department there isn't any female person who is in position. All lecturers are male. Everyone else, technicians are male you know. So you just feel insecure working under that environment. So even if you are at times an honours student, if you want this you have to go to Mr. So and So. If you want this again you have to go to Mr. So and So. You might not know, they might not be as approachable as they should. So as a woman you know you might feel somehow frightened.

I: So in other words, in male dominated fields, there are shortages of role models for females to follow because all are males.

T: **Yes.**

I: OK. Is there any other reason why you think even at matric level the majority of girls don't perform as good as boys?

T: **Even at matric level it's the same thing. The maths teacher is male, the biology teacher is male. I just don't know. Maybe we may try. It might happen that at times the biology teacher might be a female. Most of the time you know there are male Science teachers.**

I: They are males?

T: **They are males.**

I: OK. But what do females say are the problems which they face which make them run away from Science related subjects besides maybe the lack of role models?

T: **Basically there are no other reasons besides that you just tell yourself that Science is difficult. I cannot do it.**

I: OK. From our discussion, I gathered that you have highlighted that males do better than females in these Science subjects. Now what do you think could be contributing factors on why males do better?

T: **I think that has to do with individual persons other than being male. Like in my case, at high school I knew I was among the best students in Mathematics and Physics so while I was there, I found that a person was just doing Mathematics and Physics just because she didn't want to do History and G[illegible]o, a person would not have understood the basic teachings if I might say. So, in standard ten she may meet this teacher who might teach differently from the standard nine teacher. The teacher might be very impatient he can't understand that you can't understand the very simple things. We also fail maybe because we are sometimes lazy even to push ourselves, putting more extra time in our work. At times it might be a different case with males.**

I: What do females normally channel their energy towards? I've heard that laziness aspect coming up again. Females are lazy. So you mean that males are more hard-working compared to females.

T: **We can take that if we are looking at final results. You might say we are more lazy than men because our brains are just equal if we can just pull ourselves. We can just make it as they normally do.**

I: OK. Like for example you made it. What about the way teachers see you? What about if there is a male teacher and a female teacher, do they treat boys and girls in the same way?

T: **Yes we are treated in the same way. But it differs if he is a bit impatient with you. It does not matter whether you are a male or a female. Otherwise, at times the problem might be with you and you might be scared of the teacher and you might not want to go and ask the teacher for assistance.**

I: Why do females, why are they normally scared of the teacher?

T: **Because they feel that their problems might not be solved because they are females, I don't know. Otherwise, the treatment is the same because we all students.**

I: OK.

T: **Even at university level, if they say you must come to my office. Infact, you find that**

males are complaining that we are given more attention because we are females.

I: But is that true?

T: It's not. That's how they think.

I: Ok. So when you were doing your matric, both boys and girls were free to go to the teacher any time except for those who did not want to.

T: Yes that was the situation.

I: Ok. So it means it is up to the ladies . What about in the classroom? Who actually participated more boys or girls?

T: Yaa, in the classroom situation you find that in the classroom situation only the first ten would participate in class.

I: What do you mean the first ten?

T: I mean the best ten. You know like looking at the results, you find that all boys and girls participate.

I: So you mean, so it's just that they could be males or females?

T: Yes.

I: What about at home? Generally speaking do guardians or parents treat their male and female children in the same way?

T: Yes they do. Actually they are just told that you do Science courses because you know technology is just changing. It is everything you know. If you have done Science courses you are always equipped with knowledge at this present situation. So, it just becomes a child's choice not to take Science courses otherwise it's every parent's wish to see every child being an engineer, a doctor or being a pharmacist you know.

I: So all parents want ....

T: Yes! All parents want that because those are the things that we see now. Unlike saying I am going to do Commerce. You trouble parents if you say you are going to be an accountant. They won't even understand. So it's every parent's dream to see his or her child being a doctor if I might say.

I: Ok. But since you have been through the system, I think not everything was well with you in these Science subjects. What can you say are the problems which you faced even though you managed to pull yourself through. It could be at matric level or at university level. problems which you felt could have threatened your aspirations. As a female student what are the problems which you encountered

T: Ok. Well, it will seem as if I am repeating myself.

I: It doesn't matter.

T: Well, sometimes lets say you are doing chemistry three. Well lets say you are fifty-fifty males and females. But you know at times females might say "We don't know this so we are going to ask from so and so." But so and so could be a male and at times even if you take your books, you are not quite sure whether you are in the right track. So, sometimes you just wake up and tell yourself that this thing is difficult you know. I can't do it.

I: What about practical work in Physics, since you said you dropped Physics?

T: Practical work in Physics was just too fine but I couldn't continue.

I: What about Chemistry?

T: With Chemistry at times it's disappointing. You spent five hours in the lab and you are expected to come up with a product. Sometime you come up with nothing. At times you do get the product and sometimes it's very very low than what is expected. Sometimes our system of practicals need to be changed. You have to go to the library to get some theory and discussion and our library has nothing unfortunately. At the end of the day you end up copying practicals from the person who has managed to get it of which is not good.

I: And normally which group of people get it right, males or females?

T: It's interdependent. It's not fixed.

I: Besides practicals you said the organic part was difficult. What made it difficult for you?

T: I think it's because organic chemistry is a complicated but the key to it is you need to understand it , not memorizing it but you just have to understand it and practise it. I think the most important thing is structures, the mechanisms and if you understand you can make it.

I: So you mean there is more of knowing. You don't have to cram. You have to know.

T: You have to know what you are doing so that whatever question that comes you know that you can do it.

I: Thank you very much.

<u>In-depth Interview With An Engineer: Pamela</u>

I: I understand that you are in a Science related profession. Can you please describe briefly the nature of your job? Just briefly.

P: I am an engineer here. I look at the engines. Generally the whole aeroplane engine before it takes off.

I: That is an interesting job.

P: Yaa. It's quite interesting especially (...). There isn't much.

I: OK.

P: Because basically most of the time there are no faults. Only whenever there is a fault it's only when I highlight before the plane takes off.

I: That is interesting.

P: They do something about it before it takes off.

I: OK. But what made you decide to join this profession?

P: It's quite an interesting profession. Imagine, I was interested in Biology but now I am

thinking in a physical Science direction. It does not really require much of the Physics. What is there is during the course or during the training That's when you start and finish every thing about the job. It's like there was career guidance at our school. They were just highlighting us on the kind of jobs, any kind of jobs in the country. So, there was this part about DEED. That is (...)

I: The abbreviations?

P: Yes. It's an abbreviation.

I: OK. So that's where you got this interest from?

P: Yes.

I: From that career day or whatever?

P: Yaa.

I: Uh! OK. Did you use to have career guidance as a subject at your school?

P: Yaa. We used to have that one at our school but that was sort of our free time. We couldn't concentrate much but that day it really made a difference in my life.

I: OK.

P: It really aroused my interest. I discovered that there wasn't much of the Physics. Otherwise you train to look at the aeroplane and you train to know what is really about the aeroplane such that in the end or by the end you finish the seven years of the training at least you know everything about the aeroplane.

I: It was seven years!

P: Yes, it was seven years of apprenticeship. You will be knowing everything.

I: OK. So you said that was the first thing that made you join this profession - that you were inspired by this career day. Now, is there any other reason?

P: Of training?

I: Yes.

P: Otherwise professional conditions. The people there are real professionals.

I: OK.

P: You don't really don't see much of the problems. For example, so many bosses - you are told to do this at what time. Otherwise, you know you have to do your job and at a particular time and no one looks around at what you are doing. There is no one right at your back who looks around like at what you are doing like what happens at most of these jobs.

I: So that is what you wanted about it?

P: Yaa. The other reason is when you train as an apprentice, you don't have to look for other alternative employment, for you have your employment there. That's one other aspect I really wanted - to have my job ready for me.

I: OK. The job was guaranteed?

P: Yes I knew I was guaranteed of getting one.

I: Of getting a job?

P: Yaa. That was one main reason.

I: OK.

P: That is if I was going to pass.

I: Like what you did. You passed.

P: Now I am OK. There was also my aunt. She was very small and she didn't really do all those subjects like Maths but she did Physics.

I: OK.

P: She also did Geography so I was inspired that I could do it. Actually, I could do this. She wasn't really someone like an intellect like I was saying. I thought "this is possible even if I am not an intellect". Actually, it was possible.

I: So you said your aunt inspired you?

P: Yes! She was working at the same company as an engineer.

I: Uh! So, if it had not been for your aunt, do you think you could have joined that?

P: I don't think I could have got the guts, I don't think I could have got the guts.

I: Why?

P: You know the Science field as it is. As you can see there are fewer women in that field. There are few women. It's quite a lot. It's quite demanding.

I: So why do you think there are fewer women? You are saying it's quite demanding. Can you explain that. Why are there more man and women find it more demanding?

P: Like what, what I felt before joining the course I thought you would spent the whole day doing all these Physics and Mathematics like that.

I: So what is wrong with Physics and Mathematics?

P: These subjects are actually, actually they are difficult. They are difficult. They are difficult to understand. They need you to, to know and understand what you are doing such that whenever you are presented with any type of problem, you can work it out. They are difficult. You should be able to interpret each situation you are given. Like, you are taught in class and the question comes in a very different way but it wants you to apply the same information you have learnt in class. So, you just have to have some sort of intelligence to know how to interpret each situation. So, it requires a bit of intelligence.

I: But why do you think more males still join these professions or do these subjects even though you call them difficult. Why?

P: I am sure man have been created like that, with that courage more than women. Otherwise women have the same degree of intelligence but then they don't have the

courage to join.

I: OK. So it's a matter of courage?

P: I am sure it's a matter of courage.

I: Because you found that when you got in there, how did you see it?

P: It was really nothing much. Otherwise, I was having the same problems I was having with English, I was having the same problems with Geography but when I went into this, I discovered that the problems were just the same.

I: But how did you rate yourself compared to the males you were studying with?

P: Uhm! Sometimes much better, sometimes just at the same level.

I: You talked about intelligence. So in other words you now realize that after all there isn't much difference?

P: There isn't much difference between man and women. It requires the courage only. I am sure it's courage.

I: It's courage. Otherwise the level of ability is the same?

P: I am sure it is. It is the same.

I: So, it's a matter of courage. But why do you think women lack this courage? Why? Why don't women have the courage to go in these scientific fields?

P: People are told. It's like you listen to some stones. You listen to some teachers. Usually I'm sure it's the teachers. They tell you that these subjects are difficult. They actually tell you, "Please make sure you have enough confidence to join these subjects. They have got, there is a high failure rate in these subjects at this school." And you find the subjects she is talking about will be all Science subjects so you find yourself, you divert your interests and join the other subjects that you think are easy.

I: So, actually the problem is with the teachers themselves?

P: I am sure at the grassroots level.

I: They are the major source of the problem?

P: Yes.

I: So what do you think can be done to these teachers so that they realize that they are doing more harm than good in the schools?

P: (Laughter)

I: What can be a solution for such a problem?(Giggling)

P: The teachers should not take time to tell the students that this subject is difficult. They should just try to teach each and every student they have. If they find that this person is not intelligent enough they should try to make him or her understand to the level others are understanding. With time everyone will find that the subjects are just the same.

I: Yaa. Unlike if you are told that this is difficult already, you start it with the impression that it is

difficult and sometimes it can end up being difficult for you.

P: **Yaa.**

I: So you have mentioned teachers. Are there any other people?

P: **Friends. Mob psychology. Friends.**

I: OK.

P: **They tell you,"You want to do Maths, Physics and chemistry at this high level? You won't get anything. They are difficult."**

I: OK.

P: **Friends. You just end up not doing the subject.**

I: So mainly it's teachers and friends. Are there any other people who influence?

P: **I don't think there are any other.**

I: OK. I thought parents have also a part to play.

P: **Parents!**

I: It depends maybe.

P: **On the type of parents.**

I: OK.

P: **Sure.**

I: You have said that man and women are just the same. It's only a matter of confidence.

P: **Confidence**

I: OK. But during your days, did you face any problems as a woman who was doing maybe Physics or Chemistry. It could have been in the classroom or anywhere else?

P: **Problems were there. Problems were there.**

I: Like which ones?

P: **You find the reference section in the library is fully occupied by students - that is the Science library. The arts library will be deserted - there is no-one there.**

I: Why?

P: **They will be enjoying life.**

I: OK.

P: **Our work was too much. It was really much. Too much work. You just had to work, to work hard in order to pass. It's like you do practicals in the Science field. You would spent I don't know how many hours. From eleven in the morning to six in the evening doing a practical session. That was on Wednesday and Friday. that is twice a week.**

I: Twice a week! So there was a lot of work. But among these problems are there particular ones you as a woman you know, faced? We have seen that there are more males. But you as a woman do you think there were unique problems you faced. Problems you might think were not faced by males which you think may contribute to driving away females from Science. Were there any such experiences?

P: (Silence)

I: From anywhere. So you mean everything was fine?

P: **I'm sure it was. No wonder why I am saying there isn't any problem only directed to woman.**

I: But what do you think about the course - even the length of the course as a woman? I mean think of even some of the social expectations. What a woman is expected to do. There could be problems associated with that.

P: **One thing that somehow wanted to drive us away was (...) Because some of us were married by then so it was a controversial issue.**

I: The time of training was too long.

P: **It was too long and you won't have enough time of being a real mother, you know. You will have a lot of work. You will be too busy and the kids want to play with you. They will have a lot of stories to tell you. So there were problems for us.**

I: OK.

P: **Sometimes you are forced to move away from home for a number of weeks. I am sure a people want you to be at home at least before five o'clock.**

I: But then how did your husband see it or react to it. Did he just accept it - or even the relatives when they saw you going for all those weeks?

P: **Most of the time there were problems. I am sure is only a matter of time. We had problems and we still have at certain points in our lives.**

I: Related to what?

P: **Moving, moving away from home. The problems are there. That's one particular problem in this particular field, to move away from home for sometime.**

I: OK. But how did you view the content of what you were taught? Would you say it had any problems or it was OK for a woman in the way you understood it and the way males saw it.

P: **I would like to agree with you. It seems like especially at degree level. Most of the boys did not find as much difficulty as we females since they had time at least to relax. Sometimes we had to go to these boys and ask for explanations to some concepts.**

I: OK. Normally you went to the boys to be assisted.

P: **Yes.**

I: Why not to the other girls?

P: **Ah! They usually will also have similar problems. You then find yourself going to the boys instead of to the girls in Science. You really see that there is a problem.**

I: So you said you went to ask for assistance from boys. How do you account for that? Not going to other females for assistance.

P: I am sure in this field, to a certain extent, we just have to agree with this, boys find it easier than girls. Naturally, they are more creative than girls.

I: OK. You mean they are more creative?

P: I am sure they are more gifted in the Science field. We have to agree with that.

I: OK. But what do you think could be the source of their creativity? Where could their creativity come from? Why are they more creative than girls?

P: I am sure that is natural. Don't we have not to agree that, that is natural. They are just created like that.

I: But also think of other things even like what happens in the home and so on.

P: The fact that the way you are brought up. He is a boy. You are a girl. You are discriminated.

I: In what way do you think you are discriminated?

P: It's like from the word go, when they buy you toys, boys are presented with aeroplanes, pistons etc. and we are presented with dolls.

I: OK.

P: From the word go, you are made to be a woman and he is made to be a man such that from that level, he starts enjoying it. You see, motor cars and aeroplanes are in the Science field and dolls and cooking are found inside the home. That way, they become very creative and females stick to the kitchen and the home.

I: So that could be a contributing factor.

P: Yes it's contributing.

I: But when you were training, how many ladies were you?

P: Females in the first instance there were a lot of us.

I: More than males?

P: Ah! No. Males were more than women. It's like we were fifteen females and thirty five males. At the end of second year we were five girls!

I: Where had the others gone?

P: They couldn't make it due to the kind of work, especially the kind of work.

I: But were there also other males who could not make it?

P: Most of the males made it.

I: OK. For those who could not make it were they allowed to repeat or whatever?

P: You were not allowed to repeat especially if you failed more than seven courses each

year and if you failed more than seven courses, you were not allowed to repeat.

I: So it means during your days, there weren't any who were repeating?

P: When you failed, you just had to quit. Some of them just had to quit not because they had failed but they just could not withstand the kind of work, the type or I can just say the amount of work was just too much.

I: It was too much.

P: It was really too much for most of us. It was too demanding.

I: In terms of what? Reading and so on?

P: Yes.

I: So it was really tough. You highlighted the point that the work is too much, what do you think can be done? Do you think there is something that can be done about the work load to reduce this stress and whatever?

P: I am sure they know why the work has got to be that much. It is necessary because you will not be able to grasp all the concepts in seven years so if they try to reduce it will be a problem.

I: What about lengthening the course?

P: Maybe lengthening the course. But [illegible] means more people quitting because they have other commitments.

I: We have seen that there are fewer females so it means that for someone who is already working in a scientific field how do males see you?

P: Obviously they underrate us. It's natural. Just like that.

I: But you have the same qualifications and you are doing the same job?

P: That doesn't matter. They just underate us. Maybe you make a mistake in one's presence, ah, they like that. They like our failure so much. So, I am sure if you make a mistake in a male's presence, you know that mistake is going to be taken down, it's recorded then you find (...)

I: But don't males also make such mistakes?

P: It's like we really don't bother. Man want their pride. They just want to be at a higher level than us. Somehow, they are at a higher level.

I: In what way? I mean you are doing the same job, you have done the same training. I mean you should be the same in all respects.

P: But it's only that we would always want to think that they are at the top. I'm sure they work extra hard to gain or to attain that. You know, you work extra hard to become first position in class. If you work for it, obviously you get it. If they get that position then all of you who are behind that you are in trouble and there is no way you can refuse because maybe because he has a better qualification than you.

I: OK. So when you realize that someone is underrating your performance, how do you respond as a woman?

P: **It's like, there are five of us at the same level, we just try to discuss. Ask other ladies, "Are you facing the same problems like those that face me?" It seems like all of us are having the same kinds of problems. They underate our performance.**

I: OK.

P: **So you find you are relieved from that. That's when sometimes you find yourself going home very sad. You will not even be happy.**

I: Shame. But you can't actually answer back or whatever?

P: **We can't.**

I: What about in high school, did you face such confrontations from males?

P: **At high school it was better. Our performance didn't really show much difference.**

I: OK.

P: **The problems are there in the work places. Girls are always despised. It seems like that even when they grow up, they just want to be told that they become realised by the extra work they do.**

I: So you mean males are hard-working? That they can work harder than females?

P: **Yes they can work much harder, much harder than females.**

I: So you agree that males are hard working?

P: **Yaa, I have to. They are more hard working than us.**

I: But let me go back to those who are not in Science, the females who don't take up Science. I know that when you were in high school, you could have discussed about it. What do they say are the problems that drive them from Science. You said normally they say it is difficult. Now, what are other problems that they face or they anticipated that made them not get into Science?

P: **Problems from them?**

I: Yes. Those women who actually don't want to get into Science. Or you can't think of any now?

P: **They are just made to believe that it is difficult. Maybe the person couldn't do Maths well at a lower level and decided not to do Science.**

I: So it means you decided to do that type a physics related job at what level?

P: **I was in the Science field. I even passed my Mathematics well at primary school level. I also did really well at secondary level.**

I: So you just felt you wanted to continue with Science?

P: **Yes.**

I: OK. So that is interesting. Is there anything you want to comment on? Anything.

P: **I want to challenge more females. Work hard just the way males work. And if you have kids at home, don't buy those dolls and pots to cook in for girls. You can also buy them those cars so that they develop a scientific mind just equal to that of boys.**

I: OK.

P: I think that's one of the major problems.

I: I also feel so. That the problem originates in the home. The parents are also to blame in one way or the other. Is there anything you want to say?

P: Yes. That they need to be encouraged.

I: But what about the state? Can it assist in any way? The state or any other organization? Do you think they can assist in making more women join the scientific field or there is nothing they can do.

P: They can do something. When you are encouraged to do something, you find the guts to do it. So, the media can actually help.

I: By?

P: Maybe the kind of advertisements they put. Normally when they advertise a scientific thing, they make sure there are males there. Why not put females there and some may find themselves saying, "I can be like this lady if I really work for it." I think they can take part in it. The state, obviously it has got some money to publish pamphlets and it can disseminate information to people - encouraging them to join the scientific fields.

I: Publishing in through media. Anything else you can think of?

P: And the system of our education. That career guidance is very important. It's like it's taken for fun.

I: I am sure people don't take it seriously.

P: They can make it as a real serious subject.

I: Some people brought up the issue of scholarships.

P: Yaa. Scholarships should be available for women.

I: So that more could join. But traditionally, do you think there are other traditional practices that disadvantage women from getting into the Sciences? The traditional practices, if you can think of any?

P: The traditional practices are there. Women are expected to be in the house. You should be a real mother. She should be under the man. I am sure you will agree with me. Most of these Science jobs most of them, if you are really going into the scientific field, they are quite paying. That's one of the aspects that drew me into this field. And if you get more than the husband, he may feel insecure.

I: You are right.

P: He may run away from you and get another wife who has a lower status. That's tradition.

I: OK. Man always want to be on the top, to prove himself better than the woman. Are there any other practices? Traditional practices?

P: Not I can think of.

I: I think those are important. So what do you think can be done with these traditional practices -

a woman should always be below the man and a man who marries a wife who is getting more than what he gets makes him feel inferior? Now, what can be done?

P: **I'm sure those organizations that deal with women issues need also educate these males.**

I: Thank you very much.

In-depth Interview With A Lecturer: Babalwa

I: I understand that you are working in this faculty - that is in a Science department. Can you briefly describe the nature of your work, what you really do in this Chemistry department.

B: **Yes. I lecture Chemistry, and you know, it's lecturing and supervision of graduate students. They are M.SC. and Ph.D. students. I have about nine of them, well sorry, eight of those, four M.Sc. and four Ph.D I forget. I have eight students in there. I don't remember but I supervise them in their studies. And in addition teaching first years, second years and third years, I also teach honours students.**

I: Uh! So have a lot of work.

B: **Well it is a lot of work, but you know, students do their researches. The way we run our researches is quite different from the social Sciences and the arts. The students do the research under my supervision and we write joint publications. So, that helps in getting something done and at the same time we get a publication out of it. So, it helps.**

I: That's interesting. But, did you also do physics at university level or you just specialized in Chemistry?

B: **Now it's Chemistry only. It's only at undergraduate level where they have to do Physics.**

I: OK. but in your case, did you also do Physics when you were also in first year?

B: **Yes, I also did Physics.**

I: Up to what level?

B: **I did only at first year. Physics and Maths were a necessity and then whatever you wanted to major with, Chemistry, Biology or whatever. But if you were going to do Chemistry, you were supposed to do Physics and Maths. I did maths up to second year level but Physics, I only did it up to first year level.**

I: But why did you drop Physics?

B: **Well, you know, if you are interested in something, and you keep going on with the others, up to second year level, it can be a bit too much.**

I: So you had more interest in Chemistry?

B: **Certainly I did.**

I: OK. But could you say, I mean, what do you think made you more interested in Chemistry than in Physics?

B: **I think my lecturer had a lot to do with it. You know, I had a very good lecturer at university whom I really admired a lot and who made the subject, you know, come to life.**

I: That is interesting.

B: Chemistry come to life. Well I liked physics and I enjoyed Physics but that urge of the lecturer made the difference.

I: OK. but lets say in high school, if you could go back to your high school days, when you were doing this Physics and Chemistry, do you sense any difference in the way you felt about Physics and Chemistry or you were just doing it collectively as physical Science?

B: We did those separately during those days, also the good old days. But I will tell you, when I first went into high school, in the high school I was in, you had to choose between two streams. Either you had to take a Science stream or an art stream. From primary school, people scared me so much out of Science that I went into the arts stream where we were doing History, Geography and so on for three years of my high school. But then I realised that when I was supposed to write History, it was difficult for me.

I: At what level was that?

B: We had a different system. I did my high school in Lesotho. It was a third year in high school and it was called J.C. I don't know what you call it here.

I: Standard eight maybe. In Zimbabwe they also call it J.C., Junior Certificate.

B: So up until that level I was in the stream for arts.

I: So you were not doing Science at all?

B: No, not at all. It's only up to when I realized that (...) I still remember when I was asked to write an essay in history. You know, people wrote like seven pages but I could only write a paragraph. I put all my facts there. I did not see the need for all the sentences. That's when I realized that really, I was not in it. I was passing but I couldn't really write. I preferred the Sciences. That is only when I moved. So it is only my last two years in my high school that is when I did Science, that is Physics and Chemistry.

I: But who determined that you should do arts and you should do Sciences?

B: You know, it's pressure for me to go into the arts. It was peer pressure in the sense that they told me that "If you go into Science, you are going to fail. Science is difficult, so don't go into it."

I: So people see Science as a difficult subject?

B: Yaa! You know , other people, other students, they have a lot of influence on you but then I realized that no, it wasn't my field. I preferred Sciences and I really excelled. I think the minute I got in, I had to work hard because I was three years behind.

I: That's why you made it.

B: I made it.

I: Didn't the teachers, your parents and other influential people also influence your decisions?

B: My parents really come from a very humble background. They don't even know what I am doing even now. Teachers really played an important role. There was a teacher I admired a lot. She was from Lesotho but she had stayed in America for some time. She taught very well. I enjoyed it and that is why I entered into the Science stream. And then, the teachers were quite helpful. They were quite helpful. The fact that I had come from the

arts stream into the Sciences, the teachers liked that and they helped and encouraged me.

I: So, when you got into this Science field or when you were pursuing these scientific fields, were there any specific problems, if at all there any, which you encountered here and there throughout your high school days or even at university? Can you think of such problems.

B: **I think throughout my high school days, not as a female, I don't think so. In Lesotho where I went to school, to be very honest, people are encouraged regardless of gender. Maybe it's because I also come from a strange background because my father in a sense, never let me feel that I am a woman really. He actually made me feel like I was a man. (Laughter).**

I: (Laughter).

B: **He did not have sons. There were three girls and then there were no boys. You know how people really are with boys. So we had to do all the manly things. So, right from the beginning really, I never felt I was any different from a man, so it really never entered my head. So problems, even if problems were there, I never really saw them. Throughout my university days, no. The limitations I think that come are during the child bearing years.**

I: OK.

B: **That is when the problems come. You have to take care of the children, you have to raise the family and at the same time, continue to do studies. It could apply both to arts and non-arts subjects really, you know. That the female has to take care of the family. But I experienced that at university as I w[illegible]on with my M.SC. and my Ph.D.**

I: You had a family by then?

B: **I had a family by then. But to actually do research which I had to do during my Masters and Ph.D, and have children, because it's long hours, it's not something you can do at home at home like the arts. It's something you have to do in the lab. That is when women really begin to fall off.**

I: OK.

B: **Because the pressures of the family are there. But as a general rule, also, I feel that generally, women don't get the support. Well, they don't get it from their colleagues, they should accept that. As long as women are few at the top, they wont really get much encouragement from their colleagues. But also, at the same time, from the home. You know, that doesn't really only apply to Sciences but it's a bit more felt when you are in the Sciences.**

I: OK.

B: **People normally see it as a male job. But I really don't know. I feel women don't get the same support that we give our men. Do man really give us the same support in the home? Support to go on in the way we treat them. I feel that maybe, that could also be a problem. Not only in Science sometimes.**

I: So now this eh, this absence of support is really a problem.

B: **You have to come back home in the evening, tired now but the home issue is still there. One doesn't know what really happens in each home. One doesn't know that but I would say as an African, there isn't that much support of a female to say, "Well, today I will take**

care of the children or I will cook while you go to the lab".

I: Males always expect you to do your duties as a woman.

B: Yes, so it is quite tiring.

I: What can be a solution to this problem?

B: I think you know, if I look at my situation, women just have to work very hard unfortunately.

I: Very hard.

B: Yaa! for the start until man accept to help them. Probably that can be helpful to women. I knew I had to work very hard when I was overseas doing my Ph.D as a single parent.

I: So you had your children there?

B: Yes, I had my children there. When I first arrived, one was two years old and the other one was between four and five years or so. I actually had to work first of all because my bursary could not cover the whole family. I had to work doing a bit of teaching at the university I was studying. To raise the family on my own and still do my studies it was very, it really was difficult. Women have to work that hard unfortunately.

I: They have to. So, the only problem you see as confronting women is (...)

B: Support. It's true that once you are up there, my problem really in the job situation I'm in now is that, I don't know whether my [illegible] are due to being female or due to colour. I really can't separate the two. They are all in one. I am in a traditionally white university. So I will still have that resistance on the basis of colour. Whether it's also on the basis of gender, I can't separate the two. I don't know which one is at play.

I: OK. Lets say now, as someone who is in the teaching field, teaching both males and females, what do you think are the major problems that actually make females drop out as they go up? You have said the family, yes. But do you think there are also other problems?

B: But at a younger age. At the age of high school, sorry, of university, there are no drop outs. Our best students are females.

I: Is it?

B: There could be a bias in the Sciences that they are probably more in the biological Sciences. But there are equal numbers, not equal but there are. I haven't done the statistics but our best students if you could go downstairs and look at where we put our best students of the year, there are females and now females are there up to until masters level. I said I have eight students doing M.SC. and Ph.D., Six of them are female. I don't think we have a problem there any more.

I: OK. So that is now fading out.

B: I think so. I think it's an old problem. It's a problem of bias - that they are more in the biological Sciences.

I: Yaa, because actually my research is based on the physical Sciences, Chemistry and Physics.

B: Even Chemistry isn't a problem any more but maybe Physics still is. I am not sure about that.

I: OK. So you feel now that it's just a matter of choice for these females whether they want to do it or not.

B: It's a matter of pressure because look at somebody who is like you. If you finish your Masters or Ph.D, you have to look for a job. For young people, you also have to start a family. That is where problems begin. So you find fewer and fewer females because if you also have to start a family, and also going to like do as I am doing, really it's a lot of work. You have to work long hours and also at the same time, have a family. And also you are not going to get to the top quickly. There is a bottom line and there are fewer females at the top like it is in careers in Science. You do not get as much support from the people at the top.

I: It means males are not supportive. They are not, especially those who are holding top positions in these scientific jobs. They are not supportive for the time being.

B: Well, I wouldn't really put it bluntly like that. I'm just saying that could be a possibility. I haven't encountered anything I may contribute to not being supportive. Again I have a problem. I have two things in one. Which ones attribute to my colour and which ones to my gender I don't know. Because both of them are with me, so (laughter) it is very difficult for me.

I: Very difficult. But think of other women who are in other scientific fields, not necessarily teaching, do they experience any problems , lets say from what you hear from your friends in other scientific fields, do they encounter any problems maybe in their work places or not?

B: I think, I don't want to comment too much on that but I think there could be there could be some in the sense that there a[illegible]men at the top. There could always be problems. The more we have at the top the better. So that you cant just be one woman up there. There have got to be more. If here are more, there could be more acceptability. So they have to be more to increase acceptability. So, there could be a problem of acceptability. It also depends on the character of the woman, how you portray yourself and pull yourself.

I: But then as a female, do you think there can be or something can be done lets say during the times when the students want to enter into masters or Ph.D. in scientific fields. Do you think something can be done in the education system? Do you think there can be changes that can be done to make women maybe more comfortable as they attain higher levels academically?

B: Where I went to university for example, the university had a day centre which cared for children there. I had to take my child there at something like six in the morning and it was unfortunate that I had to wake him up so early in the morning I collected him at about seven in the evening.

I: The whole day!

B: Yes. There was a facility for me for somebody to take care of the children for me. So that was a positive move I think. There was also a school for the older one who was going to school. There was a school right where I was staying , you know. There were residence for graduate students and there was a school there. The facilities were there to help those people who had families.

I: OK.

B: They were for women in particular. Man also with families I think must also learn to help in the home. I actually don't want to comment on that because each home is different.

I: This actually is what I am looking at. What are the actual constraints women face? These cultural practices also play a role in actually moulding man and women so that they end up failing to do what they want.

B: Yaa! Yes, I'm sure there are. In a way I am looking at it from outside. Whether we like it or not, women still have to get home, take care of the family, have to prepare supper and everything. they take care of the children in addition to working long hours at work. I think it still means hard work.

I: If men could be educated so that they know that we have to help each other in the home, I think that could lessen the burden.

B: I think it could lessen the burden.

I: I think I have also heard others commenting on the duration of Science courses. Some of them, they are long and some of them you can't break them. You can't break them and start again later.

B: You can't. I think it's again another problem. It's actually a problem. If you have a family and you have to spent a year or so out, that's it. To come back it's really difficult - to start all over again. Unfortunately, a lot of women have to. Maybe you have to, I don't know. I really don't know if there is really need for a woman to stay home after having children any more. (Laughter) Until children are ten years old. I don't think there is any need now. Not, not any more. I don't think children will be less advantaged if the mother works than when she doesn't work. There is no difference. I think my children are fine.

I: Yaa. They are. But lets say normally on average, in these Science related careers, how long does it take for someone to be trained compared to non-scientific ones? Could there be any difference or it just depends?

B: I think it depends on the nature of the course. If it's a B.A. degree it takes three years, honours will take one to two years and masters will take two years or so. Because you can do your masters in one year but with us females, it's very difficult. It can be done but it's very difficult.

I: Let's say you fail to finish within that time span, what normally happens if you are not yet through?

B: There are always regulations. If you cannot finish you can go on for some time but it depends on the university. There comes a time when they tell you to stop.

I: Now, if you are a woman and you are out for a year then you can't finish.

B: Really, to me, that is when the problem starts. It has passed the level of saying maybe we need to worry more about the fact that we need more students in Science regardless of gender but it has passed a level where females don't get in. They do get in and they do very well. The problem is with pressure from society. Problems also really are that once you start working, some people really get deceased by lack of acceptability. That really throws people off. It's a very harsh world, that is the academic world. It's quite harsh and competitive. And you really, as a woman may find it very difficult. But the more females we are, the better. We have to accept that we have to work hard because the fewer we are up there, the more the problem will continue to be hard for us. But the more females up there, it would demystify the whole thing.

I: You have given me as a solution of the day care centres. What can be another solution for us to have more females up there. What do you think the state can do to help if it can maybe?

B: **I think, I think honestly women have to work harder, I'm afraid. They have to work hard, you know.**

I: I mean , what else can the state do to help besides providing the day care centres? What else can they do.?

B: **Scholarships. But these are open to everyone. I don't think they look at gender. I don't know.**

I: Maybe introducing special ones?

B: **I don't know. Well, the more help you give to people, the more they become disabled. (Laughter).**

I: (Laughter).

B: **I think really they have to realize that they have to work harder. There is a woman I heard about at another university here in South Africa. She had a little baby. She had to come to work with the little baby. She had to come to meetings with the little baby. People have to be patient with that unfortunately. They have to accept things like that. If this woman had to leave work for a year to raise the baby, that could mark the end of her career. People had to accept the fact that there was a baby in the meeting. This means that they have to provide facilities that babies could be taken care of while they are in the meeting.**

I: I think that is very important.

B: **I think it is very important.**

I: Because definitely you can't wait to have children at the age of forty. It will be too late.

B: **It is the time when you really start your career basically. If you are an academic, that is when you start.**

I: So again that is a problem. OK. Now, are there any other comments that you want to make concerning this issue of women in Science?

B: **I think we should concentrate less now in saying there are less women in Science but more on what to do with women that have graduated and now want to start careers. That is where we should concentrate because there are problems. My statistics, not even just mine, they show that there were enough, there are now women in Science. The problem is that they are not going up there because it is hard work. It's hard work to get to the top. The problem of raising a family, I think it is very important and probably the tolerance of the society that we live in. The fact is that as a woman sometimes you can't work. Your baby sitter decides not to show up that day and the man won't leave the job to go and look after the baby. It's the woman who has to do that. Those are the problems I feel women face. You know, women also have to work harder and have to be stronger, I am afraid. To be accepted into the club that has been there for a long time as a male club, it's not easy.**

I: But what do you think is the source of this problem? Science was just taken as a masculine field - as just for males. Where could have the problem started? Maybe it is historical?

B: **I have heard of female scientists from the seventeenth sorry nineteenth century or eighteenth or something like that. We have them, women who were in Science. Why it ended up being a male field, I don't know.**

I: Maybe in the South African context maybe.

B: **Yaa. The South African context is a strange one. Females as a whole are not treated well here. They are not viewed well compared to many African countries. I sometimes think that way really.**

I: What do you notice that make you feel that way?

B: **I think even laws. I think it has changed now. Not even as a married woman you could not go to the bank to get a credit card. I went to Lesotho to get a credit card regardless of whether I was married or not. You get what I am saying. The laws really are anti-women. They say community of property and all that. I just feel that that is where the problem lies. Somebody wanted to open an account at a certain shop, it is your husband who must sign or if you are young, it is your father who must sign and all that. The laws assume that that's meant for men.**

I: If you are a woman you can't do that.

B: **Look, if you have more men in a certain area, and they mystify the subject, it's very easy. They will be the people who will have to teach you. They can mystify the subject such that young people feel that it is very difficult and it's a male field.**

I: OK. I thought that maybe the parents were sending more males or their sons to school and daughters remaining behind.

B: **In South Africa, I don't think many parents do that. They just take you to school. Sometimes they don't even know w... you will be doing. Maybe it could actually be the role of the teachers. I know that teachers in South Africa... I know that teachers in South Africa in particular maybe ready to discourage not only girls but children in general from doing Science in higher grade. Schools are mostly interested in getting one hundred pass rate.**

I: Yes you are right.

B: **Pass rate. And that makes you not do Science at high grade as much as possible. So they discourage children from doing higher grade Science especially those they think are a little bit weak.**

I: Especially those they see as if they will not make it. They may say, "No, this is not your area. Try something easier."

B: **And maybe in the heads of girls also many girls don't have many role models. Maybe, they don't have any role models to follow so they easily give up.**

I: OK.

B: **Though I say there is no problem at university level, as one looks at what happens at high school, maybe because they mainly think about when they get married and have children anyway. They feel they will not be able to pursue Science. There are fewer role models in the Sciences than in the arts. There are more role models there.**

I: So it's a question of role models.

B: **We have to have more of them.**

I: I talked to some female students who said that they have never seen a female engineer. Said they have never seen one.

B: **So they feel it's difficult.**

I: Yaa. Especially black South African students. They actually said that they have never seen one. Some said that they did not even know that females can be engineers. It's something males can do.

B: **Yaa. Role models help. Like I am saying, in chemistry really, there are lots of them. Maybe it's particularly in this university, I don't know.**

I: Maybe it's because it's a white university. Maybe that contributes. Maybe there are more white females in scientific fields than black women.

B: **That's another thing. That's another thing. I attended a conference in Natal in which we were talking about the female roles in Science. There was a presentation from (...) But the problem was whether there were not enough females any more. I think everyone agreed. But the number of females all over the SADAC region is about the same now for those doing Science.**

I: So that's interesting.

B: **But the bias is another story now.**

I: I also noticed in the schools I went interviewing students, everyone was doing Biology. And everyone, most of them actually, who was in the Sciences was doing Biology and physical Science or with Physics and Chemistry. So that is why I decided to look at this aspect - why, what actually makes these females run away from the physical Sciences into the biological Sciences.

B: **Yaa. Because to do Chemistry you need Maths, the same applies to Physics. But it does not mean that women cannot do Maths.**

I: That's another area where there are fewer women. Are there any women who major in mathematics here?

B: **Yaa but there are few. Even in Physics they are few.**

I: So, now, this is something. I want to find out what is wrong with that Science - Physics? What is wrong with it?

B: **Don't you think it's the role model problem now? Because I mean there is nothing wrong with the brain of the person.**

I: Yaa. I also agree but they always say it's difficult, most of them. They always say they can't do it but why is it not difficult to the males because there are more males coming in - that is into Physics and Mathematics, more males come in. What do we females lack which make more males get in while females actually prefer not to?

B: **One wonders really whether it's only lack of role models or maybe lack of encouragement. I don't want to comment on that since I don't have the evidence for this. You know, maybe encouragement from, from, not special treatment but probably it's more of discouragement from the male staff. You know, if people have something they have owned for a long time as a male field, to encourage females and make them equals is difficult. The tendency could actually be to discourage. I don't know.**

I: Or don't you think the family can also play a role? The way children are brought up, maybe? Someone commented on that. Boys are given technical things. Girls are given the dolls to play with. Such things can influence them. Can that be true?

B: **That is very true. I know of myself like what I said that my father treated me as a boy. (Laughter)**

I: (Laughter). Here you are now, so it should be true.

B: **I don't know, maybe it's the toys. But in schools also. Why should girls do Home Economics while boys do, what do they do? Mechanics? What do they do?**

I: Metalwork, Wood work etc.

B: **You find that those are orientated in such a way that I wonder if at all there are male students who want to do Home Economics, whether they would be allowed.**

I: They may be allowed but their friends may laugh at them. I only know of one. Where I once taught, it's only one boy who has ever done fashion and fabrics and he passed it so well. Even in the history of the school, he was the first boy to do Home Economics otherwise, they went to do other subjects.

B: **Also, you know there are girls' schools like (names the school) here where my daughter went to school. Why should they only have Home Economics and not Woodwork and other technical subjects? Those things are not there. They are not on offer.**

I: Oh! That's bad.

B: **That is a limitation. Girls are not technical minded. I also think that women are encouraged not to have this techno[illegible]id right from the beginning, from a very early age. I never looked at it that way right from the beginning that from an early age that this can be part of it. I looked at it from up there. It is really true that they have to give girls a technical mind. They need that right from the beginning.**

I: So I think there is something wrong with this idea of girls' schools and boys' schools.

B: **There is nothing wrong with a girls' school but I don't see why it shouldn't provide technical subjects.**

I: So that is a problem. Normally there won't be any metal work there and no technical graphics.

B: **It will just be Home Economics. I feel that they should train girls in a different way. I think people need to benefit skills and training of some sort in high school - things like how to change a light bulb, how to change a car wheel - little maintenance jobs. How to change oil in a car - for survival would be useful for every body, man or female. I have to go under my car, I have to change my car oil. I have to.**

I: So you can do that on your own?

B: **Yes. I have to.**

I: Without having any problems?

B: **I think it is because I am technically minded.**

I: OK. Of cause it helps. So you mean your daughter, I mean, in which area is she now?

B: **My daughter is in management and my son is in computer Science. But even in my home, my son is even smarter than my daughter.**

I: Is it! And your daughter, can she also do exactly what you can do?

B: No, no she doesn't. She hasn't taken any interest in that at all. No matter how much I do it. Yes, my son really is technical.

I: May be it is because you never asked her maybe to help you or (...)

B: Yes I did but she really doesn't show interest. Even the type of school she went to, it could have contributed.

I: OK. It's so interesting. Do you think there are other sources of problems?

B: I think you educated me more than I did. I commented on it from the higher level. By looking at it from the bottom, it is interesting also.

I: So, any other comments if you think there is anything else to say?

B: I think we have covered everything.

I: Thank you very much for your time and contributions.

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