CAREER ASPIRATIONS OF FEMALE ENGINEERING STUDENTS AT AN FET INSTITUTION

by

VUYISWA XOLISWA NONTUTHUZELO FOSTER

Submitted in part fulfillment of the requirements for the degree of

MASTER OF EDUCATION - WITH SPECIALIZATION IN GUIDANCE AND COUNSELLING

at the

UNIVERSITY OF SOUTH AFRICA

SUPERVISOR: PROFESSOR F.E GOUWS

NOVEMBER 2005

ACKNOWLEDGEMENTS

I wish to express my gratitude to the following people:

- To God Almighty who gave me the courage and strength to complete this degree.
- To my supervisor, Professor F.E. Gouws for her encouragement, support and guidance that she has provided throughout this study.
- Mr H.J. Gerber for his expert advice and assistance with the statistical data.
- To my parents for encouraging and supporting me.
- To my mother in-law for her understanding and support.

DEDICATION

To my husband –
who never failed in giving me his support,
encouraging me all the way and
keeping the fires burning.
Thank you so much my love.

To my loving daughter who was so understanding and supportive in her own way.

CAREER ASPIRATIONS OF FEMALE ENGINEERING STUDENTS AT AN FET INSTITUTION

SUMMARY

The purpose of the study was to describe factors that influence black females to choose engineering as a career. It transpired from the literature study that enabling environment, gender of role models, self-efficacy and socialization are important factors in terms of causing and attracting females into the fields of science and engineering study.

From the empirical study it came out clearly that family members, female role members, and confidence in mathematics and science were factors that caused the females in engineering group to choose it as a career. Findings also revealed that gender stereotypes did not deter them from choosing engineering and that they were content with their career choice.

For the above factors to be addressed incentives exclusive to females should be launched by government so as to attract more females to the fields of science and engineering. Schools also need to pursue programmes that expose learners to these fields.

KEY TERMS

Further education and training, technician, technologist, graduate engineer, blacks, engineering field, engineering career, gender stereotypes, career aspirations.

CHAPTER ONE

BACKGROUND AND ORIENTATION

1.1 INTRODUCTION

Career aspirations of black youth in South Africa need to be understood against the broader background of educational realities facing them. It thus becomes imperative to look at career development and in the process focus on career education. Career education according to Stead and Nqweni (1999:161) is one of the most critical modes of career service delivery. In career education school guidance forms a fundamental part.

Dovey (1980:8) notes that school guidance was only introduced in Black schools in 1981 whereas it was legislated in White schools in 1967. School guidance programmes (which incorporate career counselling) are constructed on the premise of the Bantu Education Act No 47 of 1953 which reasons that:

"We (the ruling Nationalist Party) *should not give the Natives an academic education, as some of the people are too prone to do. If we do this we shall later be burdened with a number of academically trained Europeans and non-Europeans, and who is going to do the manual labour in the country? We should so conduct our schools that the natives who attend schools will know that to a great extent they must be the labourers in the country".* (Eiselen Report in Kgoale 1987:60).

The researcher's experiences of Guidance as a student and guidance teacher are captured in Mathabe and Temane (1993:31-32) as follows:

"

I. *There are no adequately trained career counsellors to provide the service effectively in the schools.*
II. *Teacher training syllabi focus heavily on theory. Graduating teachers, therefore, lack in practical skills to use readily in schools.*

III. *Probably because of lack of training, teachers tend to miss the developmental task of guidance....*

IV. *There is negligible involvement by parents in the career development of the students, their children. The teacher-parent link is still by far the weakest in African education, in South Africa.*

V. *Career counselling /guidance lack an identity in the school system. It is treated as peripheral and a threat to the main concern, the examinable curriculum.*

VI. *The definition of the concept career as something that is future related tends to affect the students' motivation to use career counselling services....."*

There are also limited subject choice options (and still no changes) available to learners. The decision about subject choice is to be taken at the end of Grade 9. Arkhurst and Mkhize (1999:168), argue that "*most learners that are 14 and 15 years of age are still at career exploration phase therefore their decisions are informed by other reasons (e.g. friends) rather than future career planning"*.

Career problems that Black youth have are also captured by Hartman, (in Stead, 1996:271), that many Black matriculants tend to make career choices on a trial-and-error basis because they do not have the skills of integrating career and self knowledge.

The fact that black students are a product of an educational environment that is infested with inequalities in its delivery has resulted in few role models in their communities. Williams (2001:6) notes that Blacks that have career achievements are normally found in teaching, nursing and social work. Studies conducted by Cloete (1981:69), Watson, Foxcroft, Horn and Stead (1997:633) also give evidence that Black students tend to choose careers that are in the humanities or of social type and least in the technical fields. The politico-historical context of the South African education system therefore gives some clue as to the causes of the problem of career development among the black youth.

Black females do not only face challenges of disadvantaged educational background, they also face social values as women imposed on them by society. It therefore becomes important to look at career development of women and how women are affected by career issues in the context of social issues like gender stereotypes.

Sharf (1997:53) notes that interest inventories reveal that women in general show more interest in artistic, clerical and social occupations than men and have less interest in scientific and technical occupations. Sharf points out that even with the improvement of these inventories to be more accurate, they still reflect social values. The social values they reflect are that women should enter occupations such as teaching, nursing and social work. He argues that these social values continue to exist and he calls for counsellors to help women develop occupational interests in areas such as science and maths. From these assertions it becomes apparent that female career choices conform to the values of the society they are part of. This is dealt with in detail in chapter 2.

The purpose of this study is to describe factors that influence black females in choosing engineering as a career. It is also to explore ways in which women can be drawn into the field of engineering as early as in high school where they have to do science and mathematics, as these are the gateway subjects to scientific and engineering fields of study.

1.2 AWARENESS OF THE PROBLEM

The researcher is observing the flow of Black female engineering students at a Further Education and Training (FET) College where she works. She notices a slight increment in their numbers each year. The percentage of black female students at this FET College was 16% and 17% in 2003 and 2004 respectively. Of the student population in 2005 at the said college, 18.8% comprised black female students (DB 2000 Data Programme of the College). A concern arises from the fact that females remain under-represented in the engineering department despite the opportunities created by the government for females through its legislative framework. The under-representation of females in engineering at this particular FET College is not unique to this college. It is a national problem. At the macrocosmic level the same point is observed by the National Minister of Education, Naledi Pandor, who notes that "*women remain under-represented in key areas of study such as science, engineering and technology, and in postgraduate studies, as well as in the senior echelons* of *academic institutions"* (Department of Education, 2004). Due to the researcher's observations at the college she became interested as to why females are under-represented in the field of engineering in

academic institutions and in the labour market. Regarding those females that are already in the field of engineering the question is: what is it that has made them follow a career in engineering? What are the factors that influenced them?

1.3 EXPLORATION AND FORMULATION OF THE PROBLEM

"The feminisation of the labour force has been associated largely with an increase in unemployment among women in South Africa". (Afrol News 2004)

According to Statistics South Africa (Stats SA), 32% of Blacks are unemployed (i.e. according to the narrow definition of employment). Unemployment is 46% on the expanded definition of employment. Unemployment is substantially higher among women than men with 36.0% and 27.6% respectively (narrow definition of employment used). Significantly, the highest percentage of female unemployment is among Black females. The government's introduction of the Equity Act deals with the question of unemployment which is the highest among Black people (64, 4% in the formal sector), (Stats SA, 2005). It also addresses gender inequality that exists in the labour market. Hence the Department of Labour (2001:23), in its National Skills Development Strategy (NSDS) notes that:

"The very high rate of unemployment among Black women is the key factor that has informed the NSDS's focus on women in its equity targets".

Since women are a priority in the agenda of the government, that on its own addresses the question of under-representation of women in the labour market. The results of this are opportunities that are opened to them even in those fields which women could not tread on, e.g. engineering. The question arises as to whether women are ready for the opportunities that are open to them. Pertinent to this question of opportunities is the existence of skills among women to utilise these opportunities, for the opportunities are informed by the skills shortage in the labour market. The NSDS maintains that:

"Skills development is about enabling and empowering individuals through the acquisition of competencies that are in demand. It is not about the provision of

diversionary activities simply to keep unemployed people active for short periods of time or about merely filling programmes offered by training providers".

From the assertions above, it therefore follows that women have to respond to these opportunities by following careers that enable them to utilise the opportunities. The researcher's observation is that the growth rate in the utilisation of opportunities is so small that it is almost insignificant. One needs to note that this phenomenon exists despite an enabling legislative framework. In grappling with this question of why the phenomenon exists the researcher engages in a literature review in the next chapter. The researcher suggests that gender stereotypes and the socialisation of women are contributing factors in the under-representation of women in the engineering field and therefore has isolated these factors in the literature review.

From the assertions in the preceding paragraphs it is apparent that the career choice and aspirations of Black youth are not informed by the shortfalls in the scientific, technological and computer science fields in the labour market (Human Resource Development Review, 2003:568). Hence there is a small proportion of Black engineers in the market and an even smaller proportion among females. There is a contradiction though in terms of shortfalls when in comes to the engineering field. The Human Resource Development Review (HRD) (2003:557-566) report the question of skills shortage in the engineering field and concludes that:

".....overall, there is currently little sign that there is a skills shortage of engineers" rather *"challenges remain in changing the equity profile of the profession and in balancing the need for high quality specialist engineers with a need to address the neglect of technician and technologist education and employment"*.

HRD also reports that the proportion of females in engineering employment increased from 5% to 12% between 1990 and 2000. Taking into consideration the percentages, it is evident that the proportion of women is still small and yet women are in the majority in this country.

The question is how equity is going to be addressed by employers in the engineering profession if female numbers continue to be small at academic institutions. For example,

Human Resource Development Review (2003:572) observes that at technikon level, the proportion of female students studying the national diploma in engineering increased from 3% to 12% between 1991 and 1999. In technical colleges, (now Further Education and Training Colleges - FET), in 1998 females constituted 13% of the engineering students (i.e. all races included) according to Bird (2001:13-14). At the college where the study was conducted females constituted 18.8% of the engineering students in 2005.

The fact that there are low numbers of students in engineering in the academic institutions is a direct result of poor preparation of black matriculants in mathematics and science (Bird, 2001:12). Hence the department of education started a Dinaledi (Sotho meaning "star") schools programme in 2000 which addresses the problem of *"poor output of mathematics and science graduates in Grade 12; unqualified and under-qualified teachers of mathematics and science; and lack of adequate facilities and resources for effective teaching and learning"* (Department of Education, 2004). The Department of Education is responding to the Human Sciences Research Council (HSRC) report on the Trends in Mathematics and Science Study 2003.

The HSRC review reports that Blacks constitute 50% of higher grade mathematics candidates and yet their pass rate is below 30%. Kahn's 2002 study asserts that gender inequality in mathematics and science is *"real and persistent"*. It states that girls are under-enrolled across provinces and constantly under-performing. Kahn notes that the same pattern is occurring in science, with gender disparity being statistically significant. His study serves to confirm the small proportion of African higher grade passes in the gateway subjects that restrict access to university programmes that lead to science-based careers (Herald Newspaper, 2005). It thus follows that poor results in mathematics and science directly affect the flow of students (women included) into the engineering field and that in turn causes under-representation both in academic institutions and in the labour market.

1.4 STATEMENT OF THE PROBLEM

From the assertions above it is clear that girls at matric level are persistently under-enrolled and under-performing in mathematics and science. Gender stereotyping and the socialisation of women are assumed in this study as the contributing factor to under-

representation of women in engineering in academic institutions. The under-representation in academic institutions filters to the labour market and high rate of unemployment among women as shown in the preceding paragraphs.

1.5 AIMS OF THE STUDY

1.5.1 Primary aim

To describe factors that influence black females to choose engineering as a career.

1.5.2 Secondary aim

To explore ways that can be used to draw females to the field of engineering.

1.6 DEMARCATION OF STUDY

This study will explore occupational aspirations and gender stereotyping of Black females and how this relates to today's Black female youth in making a career choice.

1.7 DEFINITION OF CONCEPTS

- **FET,** according to the legislation, is defined as consisting of all learning and training programmes from National Qualifications Framework (NQF) level 2 to 4, or the equivalent of Grade 10 to 12 in the school system. Learners enter FET after the completion of the compulsory phase of education at Grade 9 or Level 1 of the NQF. By definition, it has no age limit (Department of Education, 1998:3).

TABLE 1 – THE STRUCTURE OF THE NATIONAL QUALIFICATIONS FRAMEWORK (NQF)

NQF Level	Band				
8 7 6 5	Higher education and training	Post-doctoral research degree Doctorates Masters degrees Professional qualifications Honours degrees National first degrees Higher diplomas National certificates		Universities Technikons Colleges	
Further Education and Training Certificate					
4 3 2	FET	School/ College/trade certificates	Private school Government schools	Technical, community some police, some nursing, private college	RDP and labour market schemes, unions, workplaces, etc.
General Education and Training Certificate					

Source: Department of Labour: 2001

- **Blacks** are the African group of the population groupings in South Africa.

- **Career** refers to the activities and positions involved in vocations, occupations and jobs as well as related activities associated with an individual's lifetime of work (Zunker, 1994:3).

- **Aspiration** refers to a strong desire to achieve an end; an ambition. (Reader's Digest Oxford, 1993:79).

- **Gender stereotypes** are socially constructed beliefs about men and women. They are constructed through sayings, songs, proverbs, the media, religion, custom, culture, education, drama, etc. (Gender Links Associates, 2001:4).

- **Technician** is defined as one who has graduated with a national diploma or certificate in engineering (Human Resource Development Review, 2003:557).

- **Technologist** is defined as one who has graduated with a bachelor's or master's degree in technology from a technikon (Human Resource Development Review, 2003:557).

- **Graduate engineer** is defined as one who has graduated from university with a graduate or postgraduate degree in engineering (Human Resource Development Review, 2003:557).

- **Unemployment** refers to those in the economically active population who 1) have not worked during the last seven days prior to being interviewed, 2) want to work, and are available to start work within a week of interview by Stats SA and 3) have taken steps to look for work or to provide themselves with self-employment in the four weeks preceding the interview. (South Africa Survey, 2001/2002:213).

- **Engineering field and engineering career** are used interchangeably.

1.8 METHOD OF RESEARCH

A literature study will be conducted and quantitative and qualitative research methods used. This study will use quantitative and qualitative approaches in an integrated manner. Questionnaires will be used in the quantitative approach and open-ended questions will be used for the qualitative approach. A sample will be drawn from all the campuses of the college where the investigation of this study is taking place.

1.9 PROGRAMME OF INVESTIGATION

This introductory chapter has described a background within which the present study occurs and also serves to contextualise the study.

The second chapter discusses the theoretical background of career development among women.

Chapter three deals with barriers which women encounter in scientific and engineering fields of study.

Chapter four details the research methodology.

Chapter five reports the findings and discusses the results.

Chapter six summarizes and makes conclusions and recommendations .

1.10 CONCLUSION

The educational background and context under which this study is taking place has been laid. Chapter two will focus on the theory of the challenges that women are faced with in their career development.

CHAPTER TWO

THE PROCESS OF CAREER CHOICE AMONG WOMEN

2.1 INTRODUCTION

The career development of both men and women consists of two sections that correspond with two major phases of career behaviour which are career choice and career adjustment. Betz (1994:2) states that:

"Career choice theory and research attempts to describe the nature and influences of the career choices people make. The most common choice points studied are the educational and career choices made by adolescents and young adults. Career adjustment, on the other hand, is the term describing what happens to the individual after career entry".

The focus of this study is on the career choices that women in general make.

Schreuder and Theron (1997:37) define career choice as a concept and a construct in psychological theorizing. As a concept, they maintain that

"it can be defined in the subjective context of the individual's preferences, aspirations, orientations, images and intentions, as well as in the objective context of economic conditions and sociological factors such as family and education".

As a psychological construct Schreuder and Theron (1997:37) state that *"career choice acquires meanings in accordance with how it is conceptualized by different theorists. Some theorists distinguish between career choice, career or work adjustment and career development, while others use the terms as relatively interchangeable".*

In this study career choice and development are used interchangeably.

There are many theories that examine and explain how career choice takes place in people. These theories are inappropriate for black South Africans for they focus on career development of Western white middle-class men (Stead and Watson, 1998:91).

There are theories which are based on trait-and-factor approach which matches the person with the job. Trait refers to the characteristics of the individual (Schreuder and Theron, 1997:37). The aspect of factor in the theory refers to *"characteristics of the work environment that are required if work performance is to be successful"* (Stead and Watson, 1999:37).

From the trait-and-factor theory, the person-environment fit theory developed which emphasises the interaction between the environment and the personality of an individual. An example of this theory is that of Holland which is widely used. Needs based theory also evolved which maintains that a person's occupation satisfies all the levels of needs mentioned in Maslow's hierarchy of needs (Schreuder and Theron, 1997:40). An example of this theory is that of Roe.

There are developmental theories as well of which one example is mentioned, namely that of Super, because of his extensive work in career development and the wide usage of his theory. Super's life-span life-space theory emphasises life roles in that one's career involves everything that one does whether it is a paid activity or not. People's lifestyle activities are interrelated with their work, therefore career is not exclusive to work (Stead and Watson, 1999:20). These theories, as Osipow (1983:186) notes, do not take into consideration the social psychological and the changing economic and social situation that shapes the lives of racial minorities. It therefore follows that the socio-economic and psychological context in which black South Africans find themselves is not taken into account by these theories. These theories are even more inappropriate when it comes to explaining the career development of women. Thus the career theories that examine women's career issues had to be developed. This takes us to the emergence of theories relevant to women pertaining to their career behaviour.

2.2 CAREER DEVELOPMENT OF WOMEN

2.2.1 Introduction

Historically men were expected to work and women were expected to be homemakers. As a result, "studies investigating the kinds of vocational choices made by women were less important than were the issues of whether or not and why women pursued careers at all" (Betz and Fitzgerald, 1987:16). Therefore the early body of research on women and work concentrated on factors that differentiated career-oriented women from homemakers.

Brown, Brook and Associates (1990:365) note that efforts to develop theory that more adequately explains women's career development take three routes. Of the three only two routes are discussed, as they bear relevance for this study. One route is to apply a theory from one realm to another. This is seen in Hackett and Betz's (1981) career self-efficacy theory. Self-efficacy theory from the general social cognitive theory is applied into the career domain of women because of its relevance in explaining career behaviour of both men and women. Hackett and Betz's (1981) career self-efficacy theory is dealt with in detail in this chapter.

Another route is that of developing a theory that applies to both men and women, for example Gottfredson's (1981) theory of circumscription and compromise. Gottfredson's theory does not only apply to both women and men, it also deals with gender stereotypes; hence its relevance for this study.

Social cognitive career theory is also chosen, for it takes into consideration the unique socio-economic and socio-cultural context of South Africa as observed by De Bruin (1999:91-2).

The following section describes career development theories of women. Career Self-efficacy Theory and Social Cognitive Career Theory describe how career aspirations of women develop and what influences their choice of careers. The Theory of Circumscription and Compromise deals with the influence of gender stereotypes on career choice.

2.2.2 Career Self-efficacy Theory

Career self-efficacy has implications for the career development of both men and women. Based on the rationale that cognitions mediate behaviour, career self-efficacy theory attempts to understand how beliefs about the self influence the career development. Hackett and Betz (1981) use the self-efficacy concept to understand career development of women and they look at differences in the range and nature of occupations considered by males and females. In their research of college students they find differences between males and females in terms of traditional occupations. Their findings are that females have high levels of self-efficacy in relation to traditional occupations and low levels of self-efficacy when it comes to non-traditional occupations (Osipow and Fitzgerald, 1996:171). Males' occupational self-efficacy results are equivalent for both traditional and non-traditional occupations. Their theory, backed up by findings, postulates that due to socialization experiences, women lack strong expectations of personal efficacy in relation to much career-related behaviour and therefore fail to utilize their capabilities and talents in career pursuits optimally (Hackett and Betz, 1981:326). Fitzgerald, Fassinger and Betz (1995:94) assert that this notion bases on the assumption that gender socialisation influences cognitive processes, particularly expectations of personal efficacy, which in turn influence career decision making and adjustment.

Lent and Hackett (1987:350) are of the opinion that the continued under-representation of women in the labour force, may be due to differential expectations of self-efficacy among women versus men. Under-representation of South African women in the labour force is observed by Casale (in AlfroNewspaper 2004) who notes that women who are employed are

"*crowded into specific, generally low-paying, categories of employment and occupation, and that women also still earn significantly lower returns to their work than men in the same categories of formal education, employment and occupation*".

Hackett and Betz (1981) are of the opinion that women's under-utilisation of their career talents and their under-representation in many higher status, higher earning,

male-dominated careers may be a direct result of socialisation-based gender differences between traditionally male and female career domains. As Hackett and Betz make use of Bandura's (1977:100) self-efficacy expectations concept to explain women's career development, this concept is briefly discussed below.

Self-efficacy expectations are beliefs or expectations concerning one's ability to successfully perform a given behaviour. These expectations influence the behaviour by determining whether the behaviour will be initiated, the degree of effort that will be expended and how long the behaviour will be maintained in the face of adversities (Brown, Brooks and Associates, 1990:367). Thus, a woman's beliefs about her mechanical engineering skills, for example, affect the choice of beginning and continuing in a job as a mechanical engineer as well as the choice of maintaining the job in the face of friends' and colleagues' pressures to find a job more suitable for her gender.

Bandura (1977:104) conceptualises self-efficacy as varying along three dimensions: level, strength and generality. Level refers to the degree of difficulty in the tasks or behaviours that an individual feels capable of performing. For example individuals may have the same level of skills but not perform at the same level. People with a low sense of self-efficacy may not persist in a difficult task, they may have thoughts that they will be unable to do the task well, and they may feel discouraged or overwhelmed by the task. Strength refers to the confidence a person has in his or her performance estimates. Individuals with strong self-efficacy will persist in the face of obstacles. Generality of self-efficacy refers to the range of situations in which an individual feels efficacious (Lent and Hackett, 1987:348).

From this assertion, low expectations of self-efficacy are viewed as a major means by which barriers to women classified as internal are manifested in career-related behaviours. External barriers to women are, for example, discrimination, sexual harassment, and lack of support systems, and represent obstacles which require strong self-efficacy expectations to surmount. Thus Hackett and Betz (1981:329) consider self-efficacy theory relevant for the modification of internal barriers and management of external barriers among women.

According to Bandura (1977:105; 1986:412) self-efficacy expectations interact with outcome expectations. Outcome expectations refer to what people estimate the outcome of a particular action or behaviour will be. They are a belief about the consequences of behaviour whereas efficacy expectations are a belief concerning the performance of behaviour.

Self-efficacy expectations or judgements are different from outcome expectations. Examples of outcome expectations are: "What will happen if I fail?", "Will I pass if I try?" In contrast self-efficacy is: "Can I do this task?" These two concepts in interplay (self-efficacy and outcome expectations) influence choice, performance, and persistence in career-related domains. The first paragraph of 2.2.2 notes that females tend to opt for occupations dominated by their own sex. Hackett and Betz (1981) explain this by stating that gender differences and low expectations of self-efficacy are

"a major mediator of gender differences in vocational choice and subsequent behaviour". (Fitzgerald, Fassinger and Betz, 1995:95).

The evidence they looked at shows that socialisation experiences of females and males in terms of the variety of careers both sexes can opt for differs remarkably. Male socialisation provides efficacy information that points them to a broad variety of career options. This therefore means that the sources of efficacy information that males and females are exposed to is not the same.

Bandura (1986:399-401) describes four sources of efficacy information through which individuals acquire self-efficacy expectations as: personal accomplishments; vicarious learning, including observational learning through modelling; social or verbal persuasion and one's physiological state. The above are the bases from which the postulation of lower, weaker, and less generalized career-related self-efficacy expectations emanate. The four sources of efficacy information are discussed briefly.

- **Performance accomplishment**

Successful performance of a task or behaviour provides information that tends to increase expectations regarding efficacy in relation to that task or behaviour. Research

cited in Hackett and Betz (1981:331) states that females have characteristics or qualities that are emotionally expressive e.g. nurturance, sensitivity, and passive-submissiveness whereas males have qualities such as assertiveness, activity, competitiveness and dominance. Those qualities that females possess are nurtured by socialisation and they facilitate positive efficacy in tasks that are of a nurturance nature. Hence females are concentrated in fields like social work, nursing and teaching. Sherman as quoted in Hackett and Betz (1981) postulates that:

"*while qualities related to emotional expressiveness are indeed positive in nature, the feminine-role characteristics do not lead as readily to successful task accomplishments or, in general, to the development of competence*".

Hence females have low efficacy expectations to challenging subjects like mathematics and science which are a gateway to science-related fields like engineering.

- **Vicarious learning**

Vicarious learning is another source of information crucial to increasing efficacy expectations. Vicarious learning is learning through observance of other people. Males are exposed to vicarious learning experiences that are more relevant to career-related efficacy expectations. For example children's literature and media portray women as homemakers and as having mother roles. Another example is that boys are exposed more to outdoor activities like mechanical tasks, sports, etc, than indoor activities, and girls are exposed to domestic activities. Hence differential availability of vocational role models and lack of encouragement by significant others to pursue non-sex-stereotyped endeavours (Lent and Hackett, 1987:350).

- **Physiological state**

Another source of information which affects self-efficacy is emotional arousal. Research cited in Hackett and Betz (1981:332) generally indicates that females have higher levels of anxiety than males. It is further suggested that the presence of this anxiety further decreases the initiation and sustenance of behaviour or a task in efficacy expectations.

- **Verbal persuasion**

The fourth and final source of information is verbal persuasion which comes from verbal suggestions of other people e.g. parents, teachers and peers. Lack of encouragement from these people decreases efficacy expectations. Males have received more encouragement than females in their career pursuits because of societal beliefs on achievement.

2.2.3 Evaluation of Career Self-Efficacy Theory

Lent and Hackett (1987:363), in their review of the work of Hackett and Betz (1981), state that in general the empirical work supports the predicted relationships between self-efficacy and vocational behaviour. Some results, showing that self-efficacy is related to the range of perceived options for women but not for men, suggest that women may be more heterogeneous than men with regard to efficacy beliefs about traditional and non-traditional occupations.

According to Brown et al. (1990:373) there is a need to investigate the influence of incentives on career preferences. They postulate that a person may feel efficacious with regard to his or her ability to perform a particular job but would not choose to do so because he or she does not value the expected outcomes that good performance would bring. For example a male may feel efficacious about teaching at pre-primary school but not do so because of the low remuneration of pre-primary school teachers. Brown et al. (1990:373), point out that there is a need to research the fact that outcome expectations are joined with self-efficacy beliefs in the career domain since only self-efficacy has been measured. Brown et al. (1990:373) further assert that it is likely that:

"*in many career situations individuals would perceive the outcome of their behaviour to be dependent not only on their own performance but also on environmental contingencies*".

2.2.4 Social Cognitive Career Theory

Fitzgerald, Fassinger and Betz (1995:99) describe the Social Cognitive Career Theory developed by Lent, Brown and Hackett (1994) as an:

"*attempt to explain how career and academic interests develop, how career-related choices are made and enacted and how performance outcomes are achieved in terms of the construct of personal agency"*.

The theory is built on Bandura's general social cognitive theory (1986). It emphasises triadic reciprocal causality and focuses on self-efficacy, expected outcome and goal mechanisms (Walsh and Osipow, 1995:99). Triadic reciprocality occurs between the external environment, overt behaviour and personal attributes e.g. feelings, attitudes, gender and aptitude, (De Bruin, 1999:92). These three aspects affect one another bi-directionally in that the environment influences a person's behaviour and personal attributes, whereas the same behaviour and personal attributes also influence the environment (Lent, Brown, and Hackett, 1996:379). Similarly, personal attributes can influence behaviour and behaviour can lead to a change in personal attributes. The emphasis from the social cognitive perspective is that individuals are at once influenced by and influence, their environments and therefore are not passive recipients of what is happening in their environment.

The theory incorporates three central variables from the general social cognitive theory of Bandura (1986:383)' i.e. self-efficacy expectations, outcome expectations and goals. With regard to self-efficacy expectations (see page 21 paragraph 2 for the explanation of self-efficacy expectations), there are four sources of self-efficacy information as already mentioned earlier on: personal performance accomplishments, vicarious learning, physiological arousal, and verbal persuasion. These four sources of information are briefly discussed below in terms of their application in social cognitive theory.

- **Performance accomplishment**

Bandura (1986:399) states that the more one experiences success in a given task the higher one's self-efficacy expectations for that particular task (direct learning success). In the South African situation students lack qualified science teachers, books, well equipped laboratories, etc., therefore their exposure does not allow for positive self-efficacy expectations to develop in science-related fields as it would be the case of the example of the young girl cited under 2.3.4 below.

- **Vicarious learning**

Vicarious learning is learning through observance of other people. According to De Bruin, (1999:97) there is a lack of black role models in South Africa as many students tend to avoid mathematics courses and do not complete degrees and diplomas in the sciences and engineering fields of study.

- **Physiological arousal**

Bandura (1986:401) asserts that physiological and emotional arousal (anxiety) are a very important source of self-efficacy. The more anxious one becomes, the lower one's self-efficacy expectations become. Students from disadvantaged backgrounds may feel inadequately prepared for tertiary education. Tertiary education may be a scary thing for them because of not knowing what to expect and language difficulties. Therefore it follows that the anxiety of disadvantaged students about their ability to cope with the requirements of tertiary institutions could have a negative influence on their academic performance and academic self-efficacy expectations (De Bruin, 1999:98).

- **Verbal persuasion**

In the past blacks did not have opportunities that allowed them to venture into science and engineering-related occupations (Mathabe and Temane, 1993:26). Blacks are now encouraged to enter those professions and the government has created an environment (e.g. equity) in which to do so. De Bruin (1999:98) argues that encouraging blacks to

take up these careers without creating support programmes in those fields of study will not have a major impact on students' efficacy expectations.

Self-efficacy beliefs and outcome expectations (see 2.2.2 performance accomplishment for the explanation of outcome expectations) interact directly to influence interest development. People are interested in activities (e.g. playing netball) in which they believe they can perform well (Lent, Larkin and Brown, 1989:281). Because of their interest in those particular activities and their positive self-efficacy and outcome expectations they form goals that will help them sustain their involvement in those particular activities.

Goals are defined by Lent et al., (1996:283) as "the determination to engage in a particular activity or to effect a particular future outcome". The theory states that individuals give direction to their lives through goals. Goals, self-efficacy, and outcome expectations are related to each other and affect each other.

Self-efficacy and outcome expectations have an indirect influence on goals and activities but may also have a direct influence in instances where career choices that are made are not congruent with interests. In those instances in which career choice may be based on self-efficacy and outcome expectations for jobs that are available. Individuals would then have to assess whether they think they can do what is required and whether the outcomes will be favourable (De Bruin, 1999:95).

The actual career choice and implementation are influenced by a number of direct and indirect variables (other than self-efficacy) which are outcome expectations, goals and performance. These variables are things like gender, race, disability, personality, predisposition and background context. They influence learning experiences which impact on self-efficacy beliefs and outcome expectancies. These in turn influence interests which influence goals and goals influence actions which in turn influence performance attainments. An example Swanson and Fouad (1999:128) give in explaining how career choice takes place is that of a young girl from an affluent background. The girl is exposed to science museums and famous scientists, encouraged to read science material and attends science summer camp. These learning experiences, afforded by her socioeconomic status, influence the development of her beliefs in her

ability to do well in science. Her performance in science and her knowledge that doing well in science will lead to positive outcomes, such as good grades, parental approval and time spent with friends, leads to the development of her interest in science. This girl now believes that she can do well in science in college and learns that science is a field that is well compensated. She then develops an intention to enter a science major in college. According to social cognitive career theory the process of making a career choice involves choosing a goal (which would be becoming a scientist in this case), taking action to implement that goal (i.e. completing courses in a biology major), and the subsequent consequences of those actions (successful graduation) (Swanson and Fouad, 1999:129).

In the South African situation the environment (i.e. apartheid) posed a barrier in that Black South Africans were not always free to pursue occupations of their own choice. The availability of opportunities prevented Black South Africans from

"*translating their career interests into career-related goals and activities*".
(De Bruin, 1999:95).

2.2.5 Evaluation of Social Cognitive Career Theory

Walsh and Osipow (1995:101) point out that the incorporation of contextual factors in this theory makes it relevant or applicable to women as contextual factors

"*have been highlighted as critical in understanding the career development of women, people of color, working-class people, and others whose vocational behavior does not seem to fit into existing frameworks"*.

According to De Bruin (1999:100), the social cognitive career theory is a very useful model for a South African situation as it takes into consideration the socio-cultural context in which career development takes place. It is therefore a good model in understanding the career behaviour of the South African youth and can be used to change their career behaviour. He further explains that the approach of this theory does not assume that everyone has only one developmental route to follow as suggested by

these dominant Western theories (e.g. Super's and Holland's). De Bruin, (1999:100) notes that the social cognitive career theory recognises the important influence of the environment on the career development process.

Lent et al. (1996:399) assert that even though the theory considers the influence of gender, ethnicity and socio-economic status on career development and choice, it needs to be clearer on these issues. De Bruin (1999:100) states that not much research has been done in South Africa on this theory, therefore *"career counsellors and researchers could further explore the influence of gender, ethnicity and socio-economic status on career-related self-efficacy and outcome expectations in South Africa."*

2.2.6 Gottfredson's Theory of Circumscription and Compromise

Gottfredson's (1981:545) theory focuses on how occupational aspirations develop from childhood to the adolescent stage. The focus of this theory is primarily on social class, gender and intelligence and only secondarily on aspects like values, personality and plans for family (1981:545; 1996:181). There are four major concepts which are the building blocks of this theory, namely: a) self-concept, b) images of occupations, c) cognitive map of occupations and d) occupational preferences. These concepts will be briefly discussed below.

a) Self-concept

Self-concept refers to the view that an individual holds about himself or herself. This includes who the individual thinks he or she is or is not and who she or he likes to be. Included in the individual's self-concept is one's understanding of one's abilities, interests, personality, gender, values and place in society (Gottfredson, 1981:547). Gottfredson asserts that occupational aspiration is the reflection of one's effort to implement one's self-concept (Isaacson and Brown, 1997:36). Therefore the individual's basis for considering whether the occupation is or is not suitable for him or her is in the self-concept. In other words, occupations that are compatible with the individual's self-concept are valued more than those that are not. Elements of the self-concept that are relevant vocationally are gender, social class, intelligence, interests,

values and abilities. Thus, the gender stereotypes and class and occupational biases that individuals develop will have a direct impact on their occupational choice (Brown, et al., 1990:374-5).

b) Images of occupations

Images of occupations or occupational images refer to occupational stereotypes. People have stereotypes about the personalities of persons in specific occupations, the kind of work they do, their lifestyles, the rewards and conditions of the work they are in and the appropriateness of the work for those particular people (Gottfredson 1996:184).

c) Cognitive map of occupations

Individuals tend to make sense of the occupational images discussed above by putting them into a map of the social standing of the particular occupations in society. They do this by distinguishing occupations along the dimensions of sex type (i.e. masculinity and femininity), prestige level and field of work. Individuals then identify the occupations they most prefer by assessing the compatibility of different occupations with their images of themselves**.**

d) Occupational preferences

Preferences refer to what one likes or dislikes and are according to one's desires. What one desires may not necessarily be within reach, and that makes an individual, when implementing the occupational preference, assess the accessibility of the desired occupation and alternatives thereof. Gottfredson (1996:187) asserts therefore that occupational aspirations *"are the joint product of assessments of compatibility and accessibility"*.

These major concepts that are discussed above play themselves out in two important facets of Gottfredson's (1981, 1996) theory, namely circumscription and compromise. Circumscription is a process of narrowing down of career choice alternatives and *"compromise between preferences and employment realities"* (Fitzegerald et al. 1995:87). Gottfredson (1996:187) states that circumscription is the process of

eliminating occupations that are not acceptable to the particular youngster and coming up with the one that is acceptable. In the process of circumscription people reject occupations as unsuitable on the basis of the self-concept. People's occupational preferences are the product of job-self compatibility and are about the accessibility of jobs.

Gottfredson explains the process of circumscription by asserting that initially children have a positive attitude towards all occupations. As the self-concept develops, it shapes their occupational preferences in terms of occupational alternatives. These occupational preferences are circumscribed over time and one ends up with few acceptable alternatives. In adolescence, the list of occupational alternatives is further reduced so as to include interests, capacities and values.

Compromise is defined by Gottfredson (1996:187) as the process whereby youngsters start giving up occupations that they prefer and go for the less compatible ones because they are more accessible than the preferred ones. Youngsters adapt their career choices due to restrictive environmental factors such as academic performance and financial barriers (Els, 2004:30). This could be the case with the black South African youth.

The researcher's experiences are that in her high school years lots of the youth were choosing teaching and nursing for two reasons. One, government was giving bursaries to those who wanted to go teaching. Others went for nursing because one gets paid while still in training. The researcher herself wanted to do Bachelor of Commerce at university but because of poor results in mathematics changed her career and went for Bachelor of Arts and a diploma in teaching. This was the order of the day among the youth at that stage. One would sacrifice her interests and choose a career that was accessible. Thus Gottfredson (1981:549) hypothesized that sex type, prestige and interest will be compromised or sacrificed in such a way that, when making a change in career choice, individuals will give up their interests first, then prestige and finally sex type. The limiting environmental factors that cause people to relinquish their preferred career choices for those that are accessible include realities of getting a job.
According to Gottfredson (1981:548)

"accessibility refers to obstacles or opportunities in the social or economic environment that affect one's chances of getting into a particular occupation". "*Perceptions of accessibility are based on such factors as availability of a job in the preferred geographical area, perceptions of discrimination or favouritism etc*" (Brown et al., 1990:375).

This may be why there are few black engineers as youth tended not to choose these careers in science due to the apartheid laws that prevailed both in schools (refer to paragraph 1.1) and in the job market (Bird, 2001:18-24).

A further explanation of why there are few females in science and engineering is described in Fitzgerald et al. (1995:87), who explains that the compromise process elaborates on "*women's downscaling of their aspirations in college and beyond*". Fitzgerald et al. (1995:87) further states that

"additionally, as discussed by Hesketh, Elmslie, & Kaldor (1990a), the compromise process may also explain why interventions intended to facilitate women's exploration of non-traditional careers are often ineffective".

Brown et al., (1990:376) conclude that as far as accessibility is concerned, Gottfredson's explanation of why women are in lower-status, lower-level positions is that these occupations are compatible with self-concepts and views about accessibility.

Vocationally relevant elements of the self-concept are developed during four stages of development and circumscription and compromise occur during these stages which are briefly discussed below.

- **Power and size**

The first stage is that of power and size occurring at 3 to 5 years of age. Children this stage grasp the idea of becoming an adult by orientating themselves to the differences that exist between them and adults in terms of size (Sharf, 2002:200). They also become aware of the fact that adults have occupational roles and they recognize observable differences between males and females.

- **Orientation to sex roles**

The second stage, which is orientation to sex roles, occurs between the ages of 6 and 8 years. This stage is marked by developing an orientation to gender roles and becoming more aware of the diverse gender roles that males and females fullfil. In this stage an idea that females hold different occupational roles to males begins to emerge. Children's occupational aspirations are influenced by their perception of these roles (Gottfredson, 1996:192; 2000:191). In other words the occupational aspirations that females hold during adolescence and adulthood develop during childhood.

- **Orientation to social valuation**

The third stage is known as orientation to social valuation and occurs from 9 to 13 years of age. At this stage youngsters begin to recognise prestige differences among jobs as well as social class and ability differences among people. According to Gottfredson's (1981:560; 2000:184-5) theory prestige level of work is differentiated by social class and ability level. There is an increasing awareness about social and intellectual differences. At this point social class becomes an important factor in career choice.

- **Orientation to internal unique self**

During the fourth stage, which is orientation to internal unique self occurring after the age of 14, adolescents become more introspective and develop a more insightful view of vocational aspirations as they are affected by their view of themselves, sex roles and social class. This stage involves a refinement of one's distinctive values, traits, attitudes and interests. The participants of the present study are in the fourth stage of development which means that it is in this stage that they start to identify which acceptable choices are the most preferred and most accessible occupations. At this stage, in choosing a career they also consider their personality, values, aptitude, experiences and family needs. This is also a stage in which compromise takes place. A young woman for example looking at how hard it is for a woman to get a job in the male dominated field of science and engineering may start to rethink her interest in those fields.

2.2.7 Evaluation of Gottfredson's Theory of Circumscription and Compromise

Gottfredson's (1981) theory has received both support and criticism. Henderson, Hesketh and Tuffin (1988:37) postulate that Gottfredson's cognitive map of occupations (sex type, level of work and field of work) concept can be a useful tool for teaching adolescents how sex typing and prestige levels can influence one's career aspirations. Henderson et al. (1988:39) also conducted a study on

"*whether occupational preferences are narrowed by sex typing before being narrowed by social background and whether this circumscription occured at the ages suggested by Gottfredson*".

The results of the study supported the developmental propositions in general, but the narrowing by sex type occured at an earlier age than that proposed by Gottfredson. Also, girls' sex type for occupations was more flexible than boys', a result also found by Taylor and Pryor (1985:107) and many others. Brown et al. (1996:523) pointed out that Gottfredson's compromise and circumscription lacks specificity. They argue that many people may not circumscribe and compromise as Gottfredson claims. This is also echoed by Stead and Watson (1999:28) saying that the theory gives inadequate explanation on why some people broaden rather than narrow their options, while others appear not to stereotype and choose occupations that are not sex typed. According to Stead and Watson (1999:28), Gottfredson's theory has not been researched in the South African context.

2.3 SUMMARY

This chapter is gives a theoretical background which throws light on why women are under-represented in scientific and technological fields.

Self-efficacy theory explains this under-representation as due to a low self-efficacy expectation caused by gender differences in the socialisation of males and females. Self-efficacy influences the degree to which individuals utilise their abilities, develop a range of interests, and consider an expanded rather than restricted range of career

options. This theory explains the career behaviour of women in general and when applying its assertions to black South African women it does not take into consideration other factors that affect these women. The results of apartheid play a big role in the determination of black South African women's career behaviour as these women are not only facing the challenges faced by women in general (i.e. women of all races), but also challenges of having a disadvantaged educational history as blacks. The legacy of the disadvantaged educational background is shown by De Bruin (1999:97-98) when discussing the sources of efficacy information with regard to black South Africans (see paragraph 2.2.4).

Social cognitive career theory examines the impact of the environment on the career behaviour of individuals. It therefore takes into consideration the disadvantaged educational environment from which the females in this study come.

One of the issues the theory of circumscription and compromise highlights is compromise, which is sacrificing one's interests due to the availability of jobs. Black people did not have opportunities in scientific and technological fields in the past and therefore did not choose these fields as there would be no jobs for them. Again females suffer double jeopardy, first as blacks then as females, for these scientific and technological fields are dominated by males.

The following chapter reviews educational barriers and parental and peer influences specifically in the engineering field that affect career aspirations and career choice of women.

CHAPTER THREE

BARRIERS TO WOMEN'S CHOICE OF SCIENCE AND ENGINEERING FIELD

3.1 INTRODUCTION

In chapter two it comes out clearly that through gender role stereotyping boys and girls learn very early in life which occupations are suitable for them and that these in turn limit their career choices and planning. Bailey (in Weiler, 2000:2) asserts that low self-esteem, lack of role models, low parental expectations, stereotypes of scientists, and lack of hands-on experiences in science, contribute to the development of negative attitudes to mathematics and science in girls.

South African black females are not only faced with the limitations mentioned above, they are also disadvantaged by the educational environment that surrounds them, as it is noted in chapter 1 that science teachers are under-qualified and that there is lack of apparatus and facilities. The limitations that are mentioned above are briefly discussed as they pose as barriers for women to enter the fields of science and engineering and/or continue with these fields to tertiary institutions.

3.2 EDUCATIONAL ENVIRONMENT

The educational environment, both formal and informal, facilitates learning, develops aspirations and moulds the future of an individual be it male or female. Informal education is in the form of socialisation and is acquired through the parents, religion, media, teachers etc. Formal education is structured and is received in educational institutions. The section below examines the effects that the educational environment has on the career development of the girls in terms of science and engineering.

3.2.1 Informal education

a) Socialisation

It is crucial to examine how informal education (which is in the form of socialisation) impact on the career development of females.

Children from an early age are put in a box of sex-roles and gender stereotypes by parents and society. Erinosho (1997: v) notes that girls are given work that involves domestic activities and boys given chores or exposed to experiences outside home. The researcher's observation and experience for example is that when a baby is born, clothes that are bought for the girl are pink and for boys blue. It does not end there, as toys that are bought for girls are toys that prepare the girl for motherhood and domestic chores e.g. dolls, tea set, etc., and toys bought for boys are cars, guns, Lego etc. Therefore toys are used to reinforce gender conformity. Children take these socialisation experiences with them to the classroom situation (Department of Education, 1997:76). This was seen in the way girls responded when both girls and boys were given a Lego to play with in a study done by Burn (in Whitelegg, 1992:180).

"Lego play showed that boys appear more task-oriented, have developed superior construction skills and pre-plan models independently by 6 to 7 years of age. Girls, however, see Lego [as] mainly for boys, their models are more simple in design and are not incorporated into fantasy play. They appear to gain little satisfaction from such activities.

Brown (in Whitelegg, 1992:178) notes that

"*crucial ideas about the relevance of science and technology to girls is formed in these early years and their motivation for engaging in these areas of the curriculum can be easily undermined*."

Therefore preparing girls to study science and technology in their early years of schooling is very important.

If the idea about the importance of science is formed at an early age then it becomes important to instill and nurture the interest in science and mathematics and its usefulness at that age. Zietsman (1997:4) notes for example that the belief of students about the usefulness of mathematics and science in later life "*is perceived as a major contributing factor to their continued participation in maths and science.* Zietsman (1997:1) observes that

"central to the teaching and learning of mathematics and science are the perceptions, aspirations, beliefs and motives the learner brings to the classroom. These affective elements are influenced by social interactions and expectations as well as previous classroom experiences.

From the assertions above one can see how the socialisation process curves the career behaviour of women from an early age.

3.2.2 Formal education

According to Erinosho (1997: v) the school formalizes gender stereotypes by reinforcing them. One of the ways the school does this is through the curriculum materials.

a) Sex bias in curriculum material

Science textbooks and curriculum material are biased against women in that the examples used have reference to men and women are often depicted in passive roles (Erinosho, 1997:3; Hackett & Betz, 1981: 331; Whitelegg, 1992:186). Erinosho (1997:3) notes that bias is also found in the references to equipment, activities and occupations. It is further noted that the very fact that science literature is full of sex stereotyped examples shows that this literature is written with male readership in mind.

b) Stereotypes of scientists

Scientists are perceived as people who are asocial. Erinosho (1997:2) notes that scientific traits male scientists are associated with include remoteness, abstractness, impersonality, detachment and objectivity. Traits like passivity, coyness, nuturance and subjectivity are attributed to females. Betz (1994:243) asserts that these stereotypes still exist with a different word used, that of a 'nerd'. The Department of Education (1997:103) states that one of the reasons for girls' avoidance of mathematics and science is that mathematics and science are regarded as suitable for males.

c) Subject choice

Attitudes are brought to the primary school from home by both teachers and children and from there they go with them to high school. The results are that girls undervalue their abilities and underachieve in the sciences, technology and mathematics (Whitelegg, 1992:181-2). Leigh-Doyle (1992:9) captures these barriers in a report of a pilot project in Africa as follows:

"Girls are up against barriers in the education and training system right from the start. As emerged especially from the interviews with heads of primary and secondary schools, girls typically receive a poor foundation in mathematics and science subjects at primary level, and very little exposure subsequently to technically oriented subjects. This in turn limits their participation and performance in these subjects at secondary school and their access to technical programmes at the higher education level. Most girls' secondary schools do not offer technical subjects such as metalwork, woodwork and technical drawing as part of the curriculum".

In the South African education system students have to choose subjects that will forge their career path at the end of Grade 9. Therefore women have to choose science and mathematics at this level for them to be able to enter scientific and engineering fields. Instead of choosing these subjects they choose human sciences. Mathematical background is very important for

it gives entry to many career opportunities in both academic institutions and in the job market such as engineering, medicine, computer science and scientific careers. Lack of mathematical background becomes a serious barrier to the career development of females to enter into scientific and engineering fields. Choosing science as a subject at high school is also important as the study of physics inspires one to follow a career in engineering (Betz (1994:240).

From the assertions above one can conclude that females avoid mathematics and science.

d) Lack of role models

Role models can influence females' career choices, but as so few women teach science and technical subjects at high school and higher education levels, females have little chance of being positively influenced by them (Zietsman, 1997:4; Leigh-Doyle, 1992:9; Hargrow and Hendricks, 2001:145; Byrne, 1993:127). International research cited in Betz (1994:240) reports on a longitudinal study done on mathematically gifted students. The study follows the students up to higher education level. Of the mathematically talented girls 21% stopped with high school diplomas, in comparison with 9% of mathematically talented high school boys. The finding states that almost two thirds of talented boys ended up with at least a master's degree, in comparison with only 30% of girls. Of mathematically gifted boys 32% obtained PhDs, in comparison with 6% of mathematically gifted girls. In South Africa the Department of Science and Technology (2004:12) reports that only 21% of black females were enrolled at doctoral level at university in 2001. The fact that there are few women in undergraduate studies also affects the postgraduate studies. The reasons why women are so few in undergraduate studies are shown in a study done in the Western Cape Province in three Xhosa speaking high schools. The study reveals that science students both male and female do not continue to the tertiary level with these subjects due to (amongst other things) lack of teacher explanations, lack of science laboratory practicals, and personal lack of scientific background knowledge. In another study in Qwaqwa, Free State Province, findings reveal that final year high school students consider science as difficult and that they have poor teachers. Teachers apportion the blame on the lack of apparatus and facilities (Rochford, Sokopo and Kleinsmith, 1997:3). The effects of this under-representation in

higher education are that women are and still will be under-represented in jobs that require higher order skills in the engineering field. This poses a problem because a shift in demand of higher order skills is reported in the engineering field Human Resource Development Review (2003:557-566).

The lack of same-sex and even same-race role models impacts negatively at both high school and higher education levels. Betz (1994:249) notes that the advantages of having same-sex and same-race role models are greater willingness to work with a same-sex person, greater comfort in interaction, and the vicarious learning that occurs by virtue of associating with a same-sex person who has already accomplished what you intend to accomplish. Thus lack of same-sex and even same-race role models results in fewer women being available for both academic and industry job markets. Therefore females will continue to be under-represented in the labour force despite the legal framework that attempts to deal with inequalities.

e) Achievement and confidence

Fennema and Tatre (in Zietsman 1997:2) note that girls with low spatial visualization ability obtain low marks in mathematics. Whitelegg (1992:181) states that the development of spatial abilities is linked to increased mathematical ability. The preceding paragraphs state that socialization of girls does not facilitate learning of spatial abilities. This is apparent in the toys bought for girls. This disadvantages the girl child and does not promote interest in mathematics and therefore eliminates girls from careers in science and engineering. In chapter two it came out clearly in the social cognitive career theory that people are interested in those things that they feel they can perform well. In the example given of Lego play in paragraph (a) above it is reported that girls did not feel confident when given Lego to play yet boys did. Confidence plays a very big role in achievement for if one is not efficacious one will underachieve even though one has the ability. This also became very clear in the self-efficacy career theory in chapter two. So females' under-achievement and lack of continued participation in mathematics (see paragraph [e], with females being gifted in science and mathematics but not continuing to masters and doctorate levels) is due to low levels of efficacy. Zietsman (1997:4) notes that one may enjoy mathematics but if one feels

less competent she is likely to discontinue with more advanced mathematics. Girls in single-sex classrooms display more confidence than in mixed classrooms and that enables them to develop problem solving skills (Kaiser-Messmer, 1993:231-3; Mallam, 1993:236-9). Zietsman and Sproule (1997:2) attribute this as possibly being due to the quality and quantity of time spent by teachers with girls in single-sex classrooms. This leads us into examining the role played by teachers in classroom interaction.

f) Classroom interaction

According to Whitelegg (1992:180) teachers are agents of socialization too and therefore come to the classroom with culturally acquired perspectives and biases. Hence teachers encourage boys to express themselves more while females are not given the same encouragement (Zietsman, 1997:5; Erinosho, 1997:2). They direct more questions to boys and this happens irrespective of the teacher's gender (Jungwirth, 1991:283). Teachers are more involved with reprimanding boys, whereas girls who conform to the rules are given little attention. Boys are able to obtain more teacher time and monopolise scarce resources in the classroom because the environment enables them to do so. The way girls are treated in a science and mathematics classroom is that when girls answer questions, teachers tend to unpack the answer even though it is complete. Boys are given leading questions when it comes to difficult questions thus encouraging problem solving, whereas girls are given answers (Leach, 1994:58; Fedhusen and Willard-Holt, 1993:360-2). From the assertions above it is apparent that the failures to accord recognition to both sexes limit the horizons of girls, whereas teachers unknowingly and in some cases knowingly encourage boys. The negative classroom environment promotes mathematics and science avoidance in girls and yet participation in physics is very important because it is where interests in careers in the engineering field are often born (Betz, 1994:240).

g) Gender-biased career counselling

Betz (1994:18-9) reports on counsellors that treat women in the same gender-stereotypic, limiting ways characteristic of society in general. It is stated that even those counsellors who

are conscious of these stereotypes are not helpful to women in that they let women choose for themselves (they adopt a laissez-faire approach). Thus this leaves the woman at the mercy of her socialisation experiences as she will choose accordingly.

Vocational interest inventories are also gender biased, for example aptitude tests. The experience of the researcher is that some of these tests have differentiated norming, e.g. different norm scores given to the spatial visualization test for males and females. Sharf (1997:53) points out that although these inventories have been improved to be more accurate, they still reflect social values. He argues that these social values continue to exist and he calls for counselors to help women develop occupational interests in areas such as science and mathematics.

3.3 INFLUENCE OF PARENTS

Research has shown that parents are the primary influence and the single most influential factor in the career development and choice of their children (Kortlik and Harrison, 1989:64; Trusty, 1996:68). Parents influence their children in different aspects, namely: sex role socialisation, acquisition of social and educational skills, character development, values or beliefs, and the development of a sense of responsibility (Young and Friedsen, 1992:204). Poole, Langan-Fox, Ciavarella and Omodei, (1991:622-4) state that parents have more influence on their children's careers than teachers, peers (Sebald, 1989; in Clark and Horan, 2001:2), gender, socio-economic status and academic achievement (Penick and Jepsen, 1992:208). The findings of Kracke (1997:348) reveal that parents who encourage their children in independent thinking and in career exploration tend to have children who participate greatly in career exploration when compared to children whose parents do not encourage independent thinking. Mau, Domnick and Ellsworth (1995:323-334) state that females who follow science and engineering careers are more likely to have high self-esteem, high parental expectations and score higher on measures of internal locus of control, in all of which parental influence is the mediator. Lunneborg's (in Clark and Horan 2001:10) findings in a study of women in non-traditional occupations, state that the majority of these women had fathers and mothers who had positive attitudes about work, the parents

had close relationships with their daughters and to these parents adhering to traditional gender roles was not an issue. Jacobs, Finken and Griffin, (1998:702-4) have evidence about the relationship that exists between the attitudes of parents about the importance of science and their perceptions about the value of science for women and their daughters' abilities. Erinosho (1997:71) conducted a study on Nigerian women who are in science and technology and found that the background of these women scientists is that they have highly educated parents especially fathers and that the fathers are in professions that have scientific orientation. Otto (in Ndahi 2002:2) investigated the perceptions of parental influence on the career development of young people and found that both girls and boys look to their parents when making career choices.

3.4 INFLUENCE OF PEERS

There is little research and literature about the influence peers have on each other in terms of choosing careers in the scientific field of study (Stake 2005:1). Research and literature concentrate mostly on parental influence (Kahle, J.B., Parker, L.H., Rennie, L.J., and Riley, D., 1993:382; Poole et al., 1992; Kracke, 1997:347; Trusty, 1996:68), educational materials, (Erinosho, 1997:3; Whitelegg, 1992:186; Hacket and Betz, 1981:331; Guzzetti and Williams, 1996:7) teacher attitudes and differential treatment of boys and girls (Whitelegg, 1992:180; Zietsman, 1997:5; Erinonsho, 1997:2; Guzzetti and Williams, 1996:15; Kahle et al., 1993:387). The findings of the research done on peer influence indicate that both boys' and girls' peers influence each other in terms of aspiring to careers in the scientific field of study. For example, Baker and Leary (1995:7) report that when girls have a friend that is studying science, they become more positive and hold less stereotyped views of science and science-related careers. Stake (2005:2) also states that girls do not feel appreciated and accepted when they have few positive science experiences with their peers and this makes them think that a science career will not be rewarding for their future personal life.

3.5 CONCLUSION

Women are faced with many barriers in terms of aspiring to and choosing careers in the scientific and engineering fields of study. The environment women find themselves in impacts negatively on their career development, hence their number in the above mentioned fields of study is low.

Chapter four discusses the research methodology used in this study.

CHAPTER FOUR

METHODOLOGY

4.1 INTRODUCTION

Chapter two provided a theoretical background of the career development of women and chapter three discussed the barriers posed by the educational environment, society, peers and family to the career aspirations of women in the scientific and engineering fields. These chapters offered a context for understanding the broader framework on which this study is based. This chapter describes the methodology employed in conducting the present study. The chapter is divided into subsections starting with the formulation of the problem. It then moves on to the discussion of the research method and a description of the participants and sampling and the measure of the research. A brief discussion of the problem formulation is provided in the next subsection of the chapter.

4.2 PROBLEM FORMULATION AND AIMS

The previous chapters highlighted the socialisation of females from childhood right through their lives as impacting negatively on the career choice of women in relation to non-traditional careers, specifically the scientific and engineering fields. Hence women are under-represented in academic institutions and in the world of work in these fields (Betz, 1994:240; Department of Science and technology, 2004:12; De Bruin, 1999:97). Despite this kind of socialisation of women there are women who aspired to careers in the scientific and engineering fields, few as they are.

4.2.1 Primary aim

The primary aim of the study was to describe factors that influence black females in choosing engineering as a career.

4.2.2 Secondary aim

The secondary aim of the study was to explore ways by which females could be drawn into the field of engineering.

In describing factors that influence females to choose engineering as a career the study examined the following research questions:

4.3. HYPOTHESES

There is no significant relationship between the field of study (Engineering and Non-Engineering) in terms of:

1) Type of school attended (model C vs township).
2) The role model (teacher, family member, community member) of these students.
3) The gender of the role model (male or female).
4) Contentedness with choice of study field.
5) The confidence of females about their success in the field of engineering.
6) The suitability of engineering careers for females.

4.4. RESEARCH METHOD

The present study utilized a mixed method approach which employs aspects of both quantitative and qualitative procedures. A mixed method approach involves collecting and analyzing both qualitative and quantitative data in a single study (Creswell, 2003:15). The advantage of using this method is that biases inherent in one method could neutralize or cancel the biases of the other method (Creswell 2003:16). Another benefit which Creswell (2003:16) notes, is that one method can be used to provide insight or enhance understanding about the information provided. The research method this study utilized suits the kind of group that was being investigated in that according to Creswell (2003:16) it serves as an advocate to marginalized groups such as women, the poor and ethnic and racial groups. The

participants of this study suffered from the effects of apartheid which marginalized them socially, economically and educationally; hence the mixed method was relevant to them.

The mixed method utilizes three procedures, namely sequential, concurrent and transformative procedures. A sequential procedure involves explanation or expansion of the findings of one method using another method. Transformative procedures refer to the utilization of "*a theoretical lens as an overarching perspective within a design that contains both quantitative and qualitative data* (Creswell, 2003:16). The third one, concurrent procedures, which this study is using, involves collecting both quantitative and qualitative data at the same time and the integration of the information thereof in the interpretation of the overall results.

From the quantitative point of view the study utilized a non-experimental, descriptive, comparative method. A descriptive research method is a method that gives more details and meaning to the phenomena that currently exist and the frequency with which they occur and categorization of information (Struwig and Stead, 2001:8; Charles, 1995:23). The benefits of descriptive research are that it is objective and that a researcher can gather information in terms of individuals' opinions and attitudes through a questionnaire. The use of a descriptive method is popular in education settings as suggestions for improvement of educational practices and instruction and other data can be obtained (Koul, 1988:403). That is why the researcher used this method as it provided information on opinions and beliefs women had about scientific and engineering career paths and provided suggestions about educational practices and instruction. The disadvantage of the descriptive method is that the independent variable is not manipulated in order to determine its effect on the dependent variable.

The present study used the chi-square test to compare two groups so as to obtain information on what it is that has made the female students that are enrolled in engineering aspire to a career in the engineering field. Two groups had to be used, one, female students that were in engineering and two, those females that had mathematics and science in Grade 12 but were registered in other courses in commerce and the humanities. This second group was used to help the researcher arrive at an answer to the question provided by the primary aim of this

study, by getting the reasons why these particular students did not choose engineering although their subjects in Grade 12 allowed them to do so. The second group was therefore used to enhance the understanding of the factors that influenced the participants of the first group's choice of engineering as a career, as comparative research looks at the similarities and differences of variables according to Neuman (2000:401). Comparison is advantageous in that when two groups are compared the focus of analysis of the research subject is enhanced as gaps in knowledge get identified. In this section the method employed in the study was dealt with and this leads to the next section which discusses the characteristics of the learners who participated in the research.

4.4.1 Participants and Sampling

The present study has drawn its participants from the Xhosa-speaking population who reside in the Nelson Mandela Metropole (Port Elizabeth) in the Eastern Cape.

The participants for this study were drawn according to the convenience sampling method. In convenience sampling, the researcher simply samples people who are easily available to survey. Harris (1998:257) notes that convenience sampling is a process whereby the researcher selects a sample because of its accessibility. Cohen, Manion and Morrison (2001:102) refer to convenience sampling as involving the choice of the nearest individuals to serve as respondents. All the females in N4, N5 and N6 levels of study who were in attendance on the day that the data collection took place were included in the sample. The researcher chose the convenience sampling procedure because she is employed at the FET College where the research was conducted which made the population under study readily available and nearer to the researcher. However the disadvantage of this sampling method is that it has limitations in terms of generalizing the results of the study beyond the specific sample researched (Charles, 1995:98; Cohen et al., 2001:103). A practical problem experienced by the researcher is that the research was conducted during the last trimester of engineering. In general, the last trimester (duration of tuition of engineering N-levels of study) every year has small enrolments of students and this applies to both males and females.

The study also employed purposive sampling method. Cohen et.al. (2001:103) and Strydom and De Vos 1998:189) contend that the researcher uses her judgement to select people to be included in this kind of sampling. The researcher in this case selected all the females that were enrolled in engineering N4, N5 and N6 levels (i.e. post- matric). She also selected all N4, N5 and N6 females in other courses of study like Business Studies, Art and Design, and Utilities, who had science and mathematics subjects in their Grade 12 irrespective of having passed or failed the mentioned subjects in the said grade. The advantage of the purposive sampling method is that it satisfies the needs of the researcher. The disadvantage is that it does not represent the wider population (Neuman, 2000:100) and it is biased in its selection. The sample consisted of 24 females enrolled in Business Studies, Utilities and Art and Design and 37 females enrolled in engineering. The total number of participants was 61. The ages of participants ranged from 16 to 26 years.

4.4.2 Measures

The study utilized a self-report questionnaire. The questions in the questionnaire were both closed and open-ended (see appendix B). The questionnaire was divided into four sections.

Section A dealt with the biographical details of the respondents such as age, course, grade 12 subjects and results, type of school attended, and occupations of parents and also established people that might have had influence on their occupational aspirations.

Section B examined their current careers and reasons for choosing the particular career path.

Section C dealt with their self-efficacy in relation to mathematics and science, and scientific and engineering fields. In this section reasons for low numbers of females in the said fields were explored and suggestions for improving these numbers were sought.

Section D examined gender stereotypes that might be existing in the respondents, their families and their community at large in terms of scientific and engineering fields.

4.4.3 Pilot study

De Vos (1998:179) described a pilot study as a rehearsal for the main investigation. The questionnaire was given to four female engineering students so as to check for any ambiguity and misunderstanding of questions and statements. Two questions were modified as they were found to be ambiguous after the administration of the questionnaire.

4.4.4 Procedures

Permission to conduct the research was obtained from the particular further education and training institution's authorities. Following this the researcher consulted with the lecturers of the relevant N levels and explained the purpose of the research and that participation was voluntary. They were then given the questionnaire to distribute it to their students who then filled them in at their homes and returned them. The response rate of the questionnaires was 61 out of 70 that were distributed. The disadvantage of this route of administering questionnaires is that they do not all come back and those that do come back have questions that are not completed. This was also the case in this study and this posed a limitation.

4.4.5 Data coding and data analysis

The responses for the closed questions were coded and open-ended questions were categorized based on patterns of responses. Descriptive statistics produced with the SAS system was used to analyze the data. Frequencies and percentages were generated to describe the number of respondents with a yes or no response in each statement. A chi-square test was used to check for any associations between the questions. Significance levels used were at 95%.

4.4.6 Validity

Validity of a measuring instrument's score according to Struwig and Stead (2001:138) refers to the extent to which the instrument measures what it is supposed to measure. According to

Gall, Borg and Gall (1996:130) questionnaires are supposed to be piloted so as to ensure validity. The questionnaire in this study was piloted so as to ensure validity; hence two questions had to be modified after the piloting of the questionnaire. Content validity was also used to ensure validity. Content validity refers to the extent to which the items in the test reflect the field for which they are intended to serve as a measuring instrument (Struwig and Stead, 2001:139). In this study the items of the questionnaire were validated by the literature in chapters two and three and by an expert.

4.4.7 Reliability

Reliability refers to the extent to which test scores are accurate and consistent (Bester, 1992:31). Reliability in this study was enhanced by the pilot study. Reliability could not be statistically determined because the respondents were too few.

4.5 CONCLUSION

This chapter explained the methodology followed in carrying out the research. Quantitative and qualitative approaches were presented, for the study combined these approaches in its use as the questionnaire involved closed and open-ended questions. The results of the present study are reported and discussed in the following chapter.

CHAPTER FIVE

RESULTS AND DISCUSSION

5.1 INTRODUCTION

The primary aim of the study was to determine factors that influence black females to choose engineering as a career. The secondary aim was to explore ways which could be used to draw women into the field of engineering. Two groups of students were given the same questionnaire. One group consisted of engineering students and the other comprised students enrolled in Business Studies, Utilities, and Art and Design courses. Only students with Grade 12 mathematics and science were selected in these other courses. Participants in other courses were statistically analyzed as "other", therefore in the results they are reported as other. The total number of participants was 61 with engineering being 37 and the other group 24. The questionnaire was given to students who were at the N4, N5 and N6 levels of their study (i.e. post-matric level). Findings of the study are presented in this chapter and discussed according to the hypotheses.

5.2 HYPOTHESES

There is no significant relationship between the field of study (Engineering and Non-engineering) in terms of:

5.2.1 Type of school attended (model C vs township).
5.2.2 The role model (teacher, family member, community member) of these students.
5.2.3 The gender of the role model (male or female).
5.2.4 Contentedness with choice of study field.
5.2.5 The confidence of females about their success in the field of engineering.
5.2.6 The suitability of engineering careers for females.

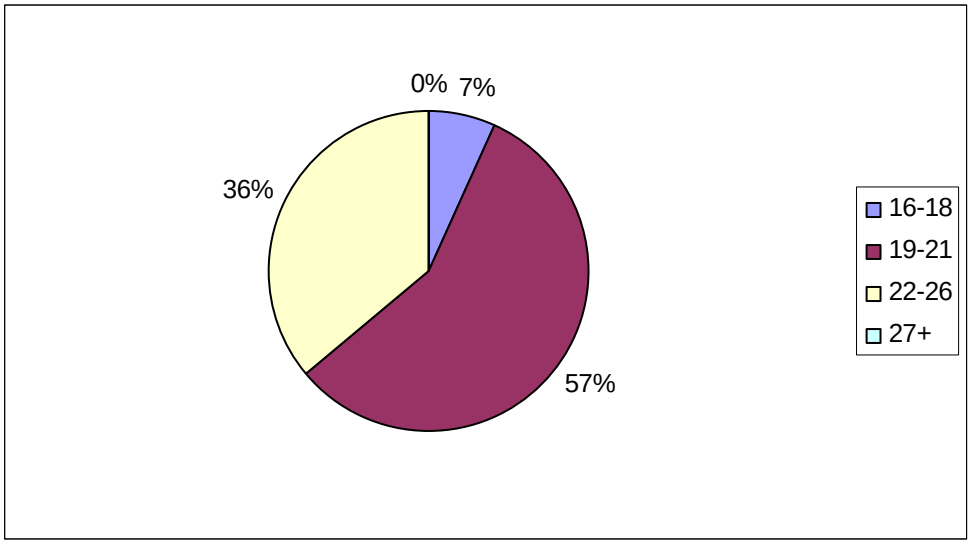
5.3 RESEARCH FINDINGS

Results are presented according to the hypotheses. The discussions of the quantitative findings are presented in an integrated way with the qualitative findings. The integration of the quantitative and qualitative results is due to the fact that the closed questions were followed up by open-ended questions in which participants had to give reasons for their answers. In cases where the open-ended questions were not a follow up of closed questions, results are presented and discussed separately. In the following section the biographical information of the respondents is presented and discussed.

5.3.1 Biographical information

a) AGE

FIGURE 1 - AGE

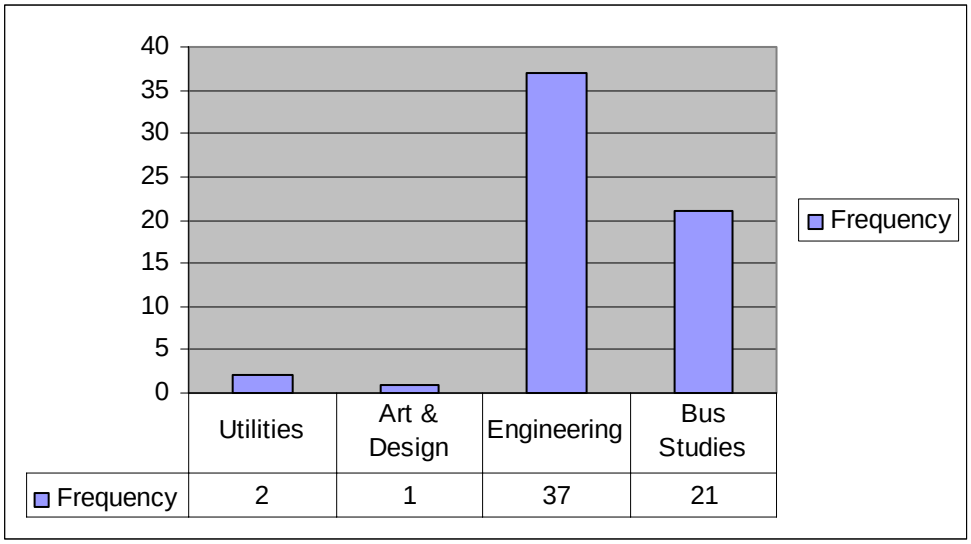


Results showed 35 (57.38%) out of 61 students sampled were in the category of 19 to 21 years of age. Twenty-two (36.07%) fell in the 22 to 26 years category. The 16 to 18 years category had only four (6.56%). Most of the students (57.38%) sampled were in the 19 to 21 years of age category, since N4 to N6 levels are post-matric studies and the sample was

selected from students in the N4 to N6 levels of study. The ones in the 22 to 26 years category were most likely those that did not continue with their studies immediately after matriculation due to financial and other challenges.

b) Course of study

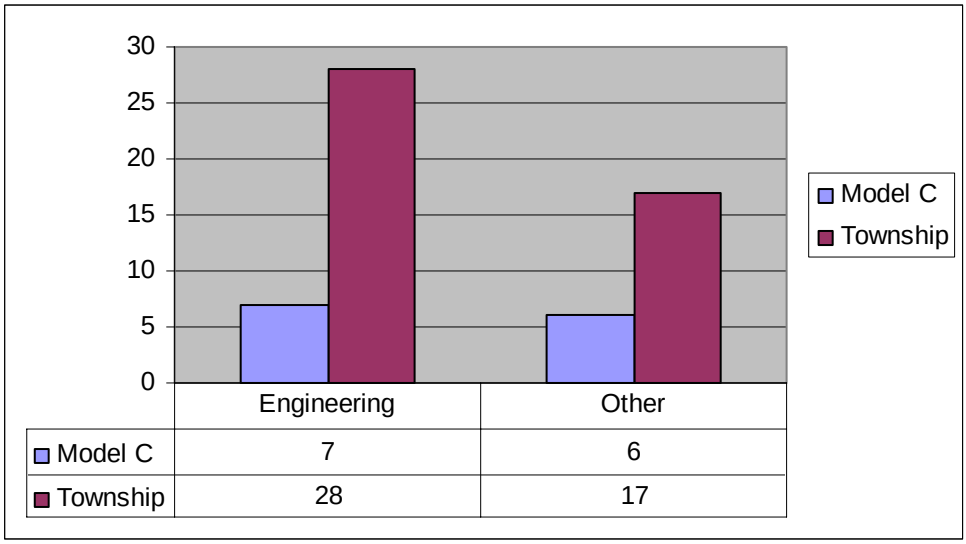
FIGURE 2 – COURSE OF STUDY



There were 37 students studying engineering, 21 in Business Studies, 2 in Utilities, and 1 in Art and Design. The number of the engineering students was small due to the fact that the number of overall students in the engineering department is normally low during the last trimester (which is September to November) as opposed to other trimesters in the year. The number in the other group was small due to the fact that most students enrolled in those departments were students that did commerce and the humanities in Grade 12.

c) Type of school attended

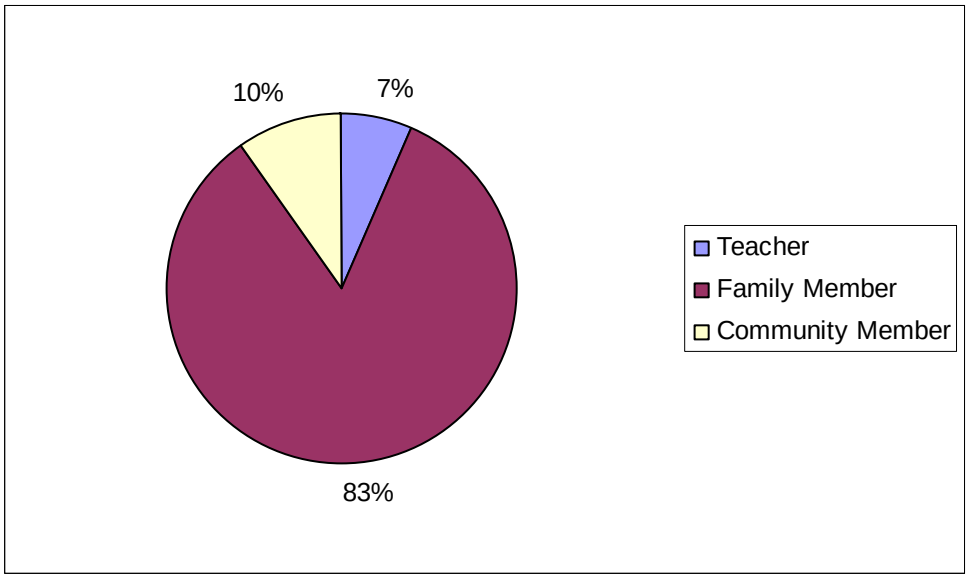
FIGURE 3 – TYPE OF SCHOOL



Out of the 61 students that were sampled, 45 (77.59%) matriculated at a township school and 13 (22.41%) from a model C school. From this it is clear that the majority of students are from a disadvantaged educational environment as the schools in the township lack resources and career education. Model C schools are well resourced and equipped therefore students who matriculated in these schools have a good educational background.

d) Role model

FIGURE 4 – ROLE MODEL

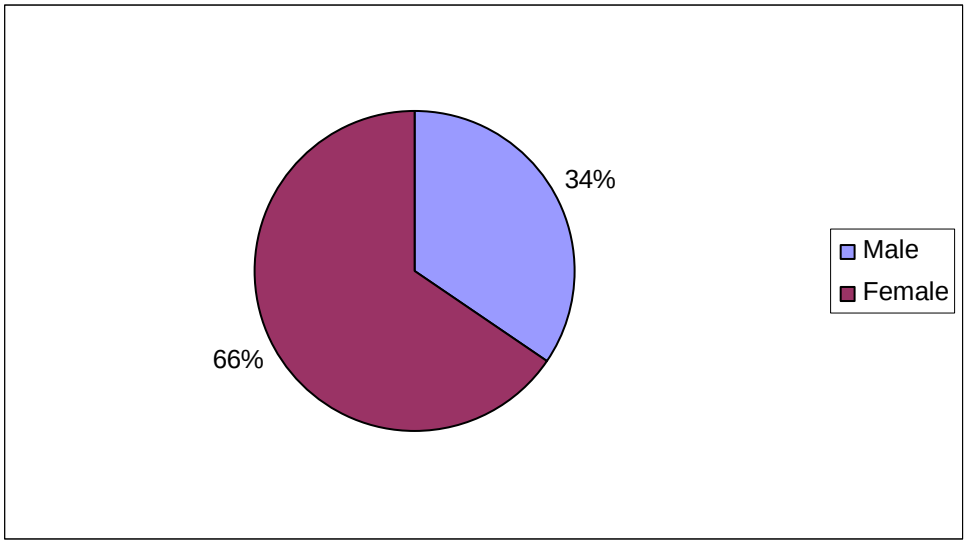


Fifty-one (83.61%) out of 61 students had family members as role models. Four (6.56%) of the 61 students had teachers as role models and 6 (9.84%) had somebody in the community as a role model.

The role played by role models is very important as individuals who identify with particular role models tend to be motivated and encouraged by the achievement of the role models. It follows therefore that the kind of people who fulfilled that role in the lives of these students were family members. Teachers and community members seem to be doing little in terms of fulfilling this role.

e) Gender of role model

FIGURE 5 – GENDER OF ROLE MODEL



Of the 61 students who participated in this study, 40 (65.57%) had female role models and only 21 (34.43%) had male role models. It therefore follows that most females in this study were inspired to a large extent by females rather than males.

5.3.2 Hypotheses

a) Hypothesis 1

H_{o1}: There is a significant relationship between the field of study and the type of school attended.

H_{o1}: There is no significant relationship between the field of study and the type of school attended.

The contingency table of type of school attended and field of study is presented below.

TABLE 2 – TYPE OF SCHOOL ATTENDED

School	Group Frequency		Total
	Engineering	Other	
Model C	7 (20.00%)	6 (26.09%)	13 (22.41%)
Township	28 (80.00%)	17 (73.91%)	45 (77.59%)
Total	35 (60.34%)	23 (39.66%)	58 (100.00%)

Out of the 35 engineering respondents, 28 (80%) matriculated at a township school and 7 (20%) from a model C school. In the other group 17 out of 23 (73.91%) matriculated from a township school and 6 (26.09%) at a model C school. Thus 77.59%, (45/58), respondents completed Grade 12 in a township school. The proportion stayed the same (28/35 vs 17/23) between engineering and the other group. The p-value was bigger than 0.05 (p=0.5866), therefore there was no significant relationship between the field of study and the type of school attended. The hypothesis may thus be accepted.

It transpired in the literature study that schools in the townships lacked laboratories. Where these were available, they lacked the necessary apparatus with which to conduct the experiments; in addition most science teachers were under-qualified (Department of Education, 2004). The findings of the research done by Rochford, Sokopo and Kleinsmith, (1997:3) was that the above-mentioned educational environment caused black students both male and female not to continue with mathematics and science after their matriculation. The purpose therefore of the question on the type of school attended was to determine the impact this negative educational environment had on the career aspirations of black female students in terms of following science and engineering career paths. It therefore follows from the

results of this study that the negative educational environment these females have had, had no negative effect on their career choice as claimed by the literature study and previous findings.

b) Hypothesis 2

H_{02}: There is a significant relationship between the field of study and the role model (teacher, family member, community member) of these students.

H_{02}: There is no significant relationship between the field of study and the role model (teacher, family member, community member) of these students.

The contingency table of role model and field of study is presented below.

TABLE 3 – ROLE MODEL[1]

Role model	Group Frequency		Total
	Engineering	Other	
Teacher	2 (5.41%)	2 (8.33%)	4 (6.56%)
Family member	32 (86.49%)	19 (79.17%)	51 (83.61%)
Community member	3 (8.11%)	3 (12.50%)	6 (9.84%)
Total	37 (60.66%)	24 (39.34%)	61 (100.00%)

[1] Where the cell values are smaller than 5 interpretations must be made with care. (Refer to table 3)

The results of this study were that of the 37 engineering respondents 32 (86.49%) had family members as role models and 19 (79.17%) of the other 24 respondents. In total, 51 of the 61 (83.61%) respondents had family members as role models. There were 2 (5.41%) engineering students and 2 (8.33%) students in the other group who had role models who are teachers. There were also 3 (8.11%) students in the engineering group and 3 (12.50%) students in the other group who had community members as role models. The proportion stayed the same (2/4 vs 19/51 vs 3/6) between engineering and the other students. The p-value was bigger than 0.05 (p=0.7524) therefore it appeared there was no significant relationship between the field of study and the role model. The hypothesis may thus be accepted.

The following interesting facts can be noted from these two groups:

- Role models who are family members inspired the students in the engineering group to follow a career in engineering.
- The students in the other group also have family members as role models. As much as these family members do encourage females to follow careers in scientific and engineering fields (see table 4), these students did not choose engineering even though their subjects allowed them to do so.

The results that show that family members do encourage females to follow careers in scientific and engineering fields are presented below:

TABLE 4 – FAMILY MEMBERS ENCOURAGING SCIENTIFIC AND ENGINEERING CAREERS

Item: Is there any encouragement from family members for females to choose careers in scientific and engineering fields?	Group Frequency		Total
	Engineering	Other	
Yes	31 (86.11%)	16 (79.16%)	47 (82.46%)
No	5 (13.89%)	5 (23.81%)	10 (17.54%)
Total	36 (63.16%)	21 (36.84%)	57 (100.00%)

Both groups of students have family members that do encourage females to follow careers in the scientific and engineering fields. Of the 36 engineering students, 31 (86.11%) have family members that do encourage females to follow careers in the said fields and 16 (79.16%) of the 21 in the other group as well.

The aim of the study is to describe factors that influence black females to choose engineering as a career. This therefore means that reasons for not choosing engineering by the students in the other group should be explored. These reasons will be compared and contrasted with those of engineering students so as to enhance the researcher's findings on factors that influence females to choose engineering as a career.

The qualitative component's findings provide reasons why students in the engineering group specifically chose engineering as a career and are discussed below:

In the qualitative results (open-ended question in Section D of question 1) it transpired that those females who chose engineering, did so because one of the family members was either an engineer or worked in an engineering firm or advocated an engineering career based on the belief and knowledge that there were many opportunities for black females in the industry. In some cases the family wanted diversity hence the advice on engineering. Therefore they were exposed to role models that were in the engineering field and exposed to career education conducted by family members.

Findings about the opinions students in the other group have, are briefly discussed below. These opinions partly and indirectly provide reasons why they did not choose engineering as a career.

In an open-ended question the students in both groups were asked why there are few females in the engineering field. The responses of students in the other group were as follows: Females are few in engineering because it is hard work, it is male dominated and women are not welcomed, and there are no jobs for females in the field. They are also of the opinion that females lack interest in the said field, experience financial difficulties in pursuit the course, mathematics and science were difficult and they lack confidence in their ability to make it in the field. The question of confidence is discussed in depth in hypothesis five. It seems the effects of gender stereotypes existing within students in the other group are very strong, hence their not choosing engineering in spite of having family members that do encourage pursuance of careers in scientific and engineering fields.

It is not surprising that students in the engineering group chose engineering as it was claimed in the literature study that the attitudes of parents about the importance of science and their perceptions about its value for women does influence the child (Jacobs et al., 1998:702-4). Poole et al. (1991:622-4) also state that parents have more influence on their children's careers.

c) Hypothesis 3

H_{03}: There is a significant relationship between the field of study and the gender of the role model (male or female).

H_{03}: There is no significant relationship between the field of study and the gender of the role model (male or female).

The contingency table of gender of role model and field of study is presented below.

TABLE 5 – GENDER OF ROLE MODEL[2]

Gender of role model	Group Frequency		Total
	Engineering	Other	
Male	14 (37.84%)	7 (29.17%)	21 (34.43%)
Female	23 (62.16%)	19 (70.83%)	40 (65.57%)
Total	37 (60.66%)	24 (39.34%)	61 (100.00%)

The results were that 23 (62.16%) out of 37 respondents in the engineering group, had females as their role models and 17 (70.83%) of the 24 respondents in the other. 14 (37.84%) of the 37 engineering respondents had male role models and 7 (29.17%) of the 24 respondents in the other group. The p-value was bigger than 0.05 (p=0.4682) therefore there was no significant relationship between the field of study and the gender of the role model. The hypothesis may thus be accepted.

[2] Where cell values are smaller than 5 interpretations must be made with care (refer to table 5)

Of these female students, 65.57% (40/61) in both groups have females as their role models. These females stated the effect and importance of having the same-sex role model through the suggestion they gave in Section C, question 3, where respondents were asked to give suggestions on what could be done to attract women to study engineering. Their response was that they should be given motivational talks by female role models who were already practising in the field of engineering. This therefore shows the importance of same-sex role models in their career aspirations.

According to the literature study, role models can influence the career choices of females and since women are under-represented in scientific and engineering fields, there is little chance of them being positively influenced (Zietsman, 1997:4; Leigh-Doyle, 1992:9; Hargrow and Hendricks, 2001:145; Byrne, 1993:127). The fact that there are few role models for them both in academic institutions and in the world of work (Betz, 1994:240; Department of Science and Technology, 2004:12; De Bruin, 1999:97) also makes them have little chance of being positively influenced. This therefore means that teachers must play a big role in influencing their students. This applies to teachers who are in the scientific field and those outside the field. So far, teachers are not playing that role as students look at family members for role models.

According to the literature same-sex and even same-race role models are advantageous in that vicarious learning occurs just by virtue of associating with the same-sex person who has already achieved what he/she wants to achieve. Hence in the questionnaire the question was posed as to whether the role models of these females were females or males.

d) Hypothesis 4

H_{04}: There is a significant relationship between the field of study and contentness with the choice of the field of study.

H_{04}: There is no significant relationship between the field of study and contentness with the choice of the field of study.

The contingency table of career choices and field of study is presented below.

TABLE 6 – PARTICIPANTS' CAREER CHOICES

Item- Are you studying what you always wanted to study?	Group Frequency		Total
	Engineering	Other	
Yes	27 (72.97%)	8 (33.33%)	35 (57.38%)
No	10 (27.03%)	16 (66.67%)	26 (42.62%)
Total	37 (60.66%)	24 (39.34%)	61 (100.00%)

Results showed that 27 (72.97%) out of the 37 engineering students were studying what they really wanted to study, but of the other group only 8 **(**33.33%**)** out of 24 were studying what they preferred to study. The majority of the other students, that is 16 (66.67%) out of 24, were not studying what they ideally wanted to study. In the engineering group, 10 (27.03%) out of 37 were not studying what they wanted to study. The p-value was smaller than 0.01 (p=0.0022) therefore there was a significant relationship between the field of study and contentedness with the choice of the field of study at a 99% level of confidence. The hypothesis may thus be rejected.

Some interesting facts from the findings are noted below:

- 72.97% of the engineering students are in engineering because they wanted to follow an engineering career.
- 66.67% of students in the other group are in other careers, despite the fact that they had mathematics and science in Grade 12. Thus, they did not choose engineering.

In light of the study aiming at describing factors that influence black females to choose engineering as a career, reasons why the students in the other group did not choose engineering were explored. These reasons are presented in table 7 below:

TABLE 7 – REASONS FOR THE CURRENT CAREER CHOICE

Reasons	Frequency
Did not meet requirements	6 (37.5%)
Did not have enough money to pay fees	4 (25.00%)
Family advised me to do the course	6 (37.5%)
Total	16 (100.00%)

Sixteen (66.67%) of these students gave the following reasons. Six of (37.5%) of the 16 did not meet the requirements of the courses they wanted to study, 4 (25.00%) did not study what they wanted because they could not afford the fees for the course they wanted to pursue and 6 (37.5%) were advised by family to do the current course they were doing despite it not being their first choice.

The reasons given above are confirmed by findings of the open-ended question (in the qualitative component) where participants had to comment on why there were few women studying in the field of engineering. The responses of the students in the other group were that engineering is hard work, it is more suitable for males, they did not have an interest in the field, fees were high, mathematics and science were difficult and they did not feel confident in the field of engineering.

Attention is drawn to the last three reasons respectively as these reasons were also confirmed in other questions of the questionnaire. The first one is that fees were high. The question of fees came out in Section B, question 2 (refer to table 7), and in Section C, question 2, the qualitative component (where they had to give reasons for the fact that there are few women studying engineering). It came out again in Section C, question 3, in the form of a recommendation where they had to answer a question on what is it that could be done to attract women to studying engineering. The response was that they should be offered study bursaries. The very fact that these females highlight the issue of finance amongst things that could be done to attract women to studying engineering, shows that it is one of the factors that make black female students not to choose engineering as a career. It looks as if the question of fees serves as a barrier for black female students in not choosing engineering as a career.

The second reason was that of mathematics and science being difficult subjects. Of the participants, 40.91% in the other group did not feel confident about their abilities in mathematics and science (refer to table 9 and the discussion thereof). Results of the qualitative component in a follow up open-ended question showed that those students in the other group who did not feel confident about their capabilities in mathematics and science did so because they were not good at the subjects and they struggled a lot with them. The ones in the other group (59.09%) that were confident about their subject abilities felt so because they were doing well in them.

As the aim of the study is to describe factors that influence black females to choose engineering as a career, it seems that some of the factors that cause these females to do so are:

- Having interest in the engineering field.
- Being at good in mathematics and science.
- Enjoyment of mathematics and science subjects.

This conclusion came about due to the reasons given by the engineering students in the open-ended question where they had to give reasons on what makes them confident about their capabilities in mathematics and science. The conclusion about students in the other group resulted from the reasons they provided in Section C, question 2. They were to give reasons on why there were few women studying engineering. One of the reasons they gave was lack of interest in the field.

Emphasis is also placed on the third reason, dealing with the issue of confidence in engineering. Females in the other group did not feel confident, hence they were not in the engineering career field. This issue of confidence is dealt with in detail in hypothesis 5 below.

e) Hypothesis 5

H_{05}: There is a significant relationship between the field of study and the confidence of females about their success in the field of engineering.

H_{05}: There is no significant relationship between the field of study and the confidence of females about their success in the field of engineering.

The contingency table of confidence and field of study is presented below:

TABLE 8 – FEMALE CONFIDENCE ABOUT THEIR SUCCESS IN ENGINEERING

Item- Do you feel confident that you can be successful in the scientific and/or engineering field	Group Frequency		Total
	Engineering	Other	
Yes	35 (97.22%)	13 (56.52%)	48 (81.36%)
No	1 (2.78%)	10 (43.48%)	11 (18.64%)
Total	36 (61.02%)	23 (38.98%)	59 (100.00%)

Results showed that 35 (97.22%) of the 36 engineering respondents feel confident and 13 (56.52%) of the 23 respondents in the other group are confident as well. Of the 36 engineering respondents 1 (2.78%) did not feel confident as did 10 (43.48%) out of 23 in the other group. The p-value was smaller than 0.01 (p=0.0001), therefore it appeared that there was a significant relationship at a 99% level of confidence between the field of study and the confidence women had about being successful in scientific and engineering fields. The hypothesis may thus be rejected.

For one to be confident about being successful in the field of engineering one would somehow have to be confident in mathematics and science as these subjects are a requirement for following a career in engineering. Therefore an investigation into the confidence the females in this study have about their capabilities in science and mathematics was carried out. The results are given in table 9 below:

TABLE 9 – FEMALE CONFIDENCE ABOUT THEIR CAPABILITY IN MATHEMATICS AND SCIENCE

Item: Do you feel confident about your capabilities in science and/or mathematics?	Group Frequency		Total
	Engineering	Other	
Yes	34 (94.44%)	13 (59.09%)	47 (81.03%)
No	2 (5.56%)	9 (40.91%)	11 (18.97%)
Total	36 (62.07%)	22 (37.93%)	58 (100.00%)

The results showed that 34 (94.44%) out of 36 engineering respondents and 13 (59.09%) out of 22 in the other group felt confident about their capabilities in mathematics and science. There were 2 (5.56%) in the engineering group and 9 (40.91%) in the other group that lacked confidence. The p-value was smaller than 0.01 (p=0.0009) and it appeared that there was a significant relationship at a 99% level of confidence. The above shows some differences between the engineering group students that felt confident about their capabilities in mathematics and science and the students in the other group who did not feel confident about their capabilities in maths and science.

Since mathematics is a prerequisite for one to be able to do engineering, this therefore means that one must have mathematics as one of one's subjects at school. The study therefore also investigated the opinions these females have about mathematics. They were asked if they thought mathematics should be compulsory at school. The results are given in table 10 below:

TABLE 10 – FEMALES THAT THINK MATHEMATICS SHOULD BE COMPULSORY AT SCHOOL

Item: Do you think maths should be compulsory at school?	Group Frequency		Total
	Engineering	Other	
Yes	31 (88.57%)	13 (59.09%)	44 (77.19%)
No	4 (11.43%)	9 (40.91%)	13 (22.81%)
Total	35 (61.40%)	22 (38.60%)	57 (100.00%)

Of the 35 engineering students that responded 31 (88.57%) thought mathematics should be compulsory at school and 13 (59.09%) of the 22 in the other group. There were 4 (11.43%) in the engineering group and 9 (40.91%) in the other group that were not of the opinion that mathematics should be compulsory at school. The p-value was smaller than 0.01 (p=0.0098) therefore there was a significant relationship at a 99% level of confidence.

This again shows some differences between the engineering group students that felt mathematics should be compulsory at school and the students in the other group who felt mathematics should not be compulsory at school.

When the percentages are studied, the following interesting facts can be noted about the students in the other group:

- 40.91% of females do not think mathematics should be compulsory at school.
- 40.91% of females feel they do not have confidence about their capabilities in mathematics and science.
- 43.48% of females lack confidence that they can be successful in the field of engineering.

It seems therefore that the females that do not think mathematics should be compulsory at school are the same females that do not have confidence in their capabilities in maths and science and also the same females that do not have confidence about being successful in the field of engineering. In the qualitative component section, participants threw light on the observations mentioned above. The reasons for not having confidence in their abilities in mathematics and science and also not being confident about being successful in the field of engineering are provided below:

Summary of reasons given why mathematics should not be compulsory at school are:

- Subject difficulty: They do not understand it.
- Capability: People have different capabilities.
- Lack of interest: They do not like it.

Reasons given for not having confidence in mathematics and science abilities are:

- Subject success: They did not pass the subjects.
- Subject difficulty: These subjects are not easily understandable. They are not good at these subjects.
- Subject practicality: They were not exposed to the practical side of the subject.
- Change of interest: They are no longer interested in these subjects.

Reasons given for not having confidence in the fact that they can be successful in the field of engineering are:

- Subject success: They had low marks in the subjects.
- Subject difficulty: They are not good at these subjects.
- Lack of interest: They are not interested in the field of engineering.
- Gender stereotypes: Women are not taken seriously in this field.

Students in the engineering group who felt confident that they could make it in the field of engineering cited the following reasons as indicated by the qualitative component:

- Employment: Promising job opportunities for women.
- Role models: Being inspired by those that are already in the field.
- Interest: Liking the fields of science and engineering and the fact that being enrolled in these fields, is a dream come true.
- Challenge: The fact that the nature of the job is a challenge.
- Determination: Being determined to make it and working hard.
- Ability: Having the ability to make it.
- Career exposure: Family members being involved in the engineering or science field in one way or another (e.g. working in an engineering firm or being an engineer oneself).

f) Hypothesis 6

H_{06}: There is a significant relationship between the field of study and the suitability of engineering careers for females.

H_{06}: There is no significant relationship between the field of study and the suitability of engineering careers for females.

The contingency table of belief on suitability of engineering careers for females and field of study is presented below:

TABLE 11 – BELIEF IN SUITABILITY OF ENGINEERING CAREERS FOR FEMALES[3]

Item: Do you believe that there are careers that are suitable only for males and females in scientific & engineering fields?	Group Frequency		Total
	Engineering	Other	
Yes	4 (11.11%)	4 (19.05%)	8 (14.04%)
No	32 (88.89%)	17 (80.95%)	49 (85.96%)
Total	36 (63.16%)	21 (36.84%)	57 (100.00%)

Results indicated that 32 (88.89%) of the 36 respondents in engineering and 17 (80.95%) of the 21 respondents in the group referred to as "other" do not believe that there are careers suitable only for males or females. Therefore 49 (85.96%) of the 57 respondents of both groups believe that there are no careers suitable for males only or females only. The p-value was bigger than 0.05 ($p=0.4053$) therefore it appeared there was no significant relationship between the field of study and suitability of engineering careers for females. The hypothesis may be accepted.

In the open-ended question as a follow up to the response of those who believe there are careers for males and females only it is interesting to note that their reasons are :

- The kind of work done in the engineering field is not good for women's bodies.
- Women do not have the strength to do men's kind of work.
- The field is dominated by males.

[3] Where the cell values are smaller than 5 interpretations must be made with care (refer to table 11)

Looking at the results one could say that gender stereotypes which have been brought about by socialisation as noted in the literature have changed. This, in the researcher's view, could be due to feminism and also changes in the way children are brought up in the present society. A woman's place is no longer in the kitchen, getting married and bearing of children only. The message children get these days from both family and community is that they must be educated so as to secure a career for themselves. Perceptions indicate that women are continually seeing themselves as being equal to men and having the same potential and abilities as their male counterparts. This is clearly seen in responses by participants in an open-ended question which asked why they thought they had the capability in the field of engineering just like their male counterparts.

The following were their statements:

"Men and women are equal in these days."
"Women are as smart and competent as men; it's just that they don't have faith in themselves."
"Sex or gender should not be an issue in the work place."

5.3.3 Qualitative results

The secondary aim of this study was to explore ways to attract more females to the field of engineering. For one to be able to pursue an engineering course one has to study mathematics and science at school. The problem originates at school level and that is where it should be addressed. In finding ways to draw females into engineering there must be strategies in place that will draw them into choosing mathematics and science at school level; hence the question in the questionnaire was included on what can be done to draw females into studying mathematics and science at school.

Suggestions given by these females were:

- Let mathematics be compulsory at school.
- Mathematics and science should be taught in a simple way.
- These subjects must be made interesting and fun.
- The subjects should be taught by qualified teachers.
- There must be equipment and facilities at school.
- Fear of these subjects should be removed.

Suggestions they gave about what it is that can be done to attract women to study engineering are presented below:

Results were categorized and the following categories describe what these women thought could be done.

- Motivation: Parents, teachers and the community at large should motivate them. Encouragement of women should start at an early age.
- School subjects: Mathematics and science should be made compulsory at school. Women should be conscientized from as early as childhood.
- School practical work: Science should be more practical or application based at school.
- Career education: Students should be given information on engineering and about the world of work in engineering. Women should be advised and encouraged to do engineering.
- Employment: There should be more job opportunities for them. They should be paid more (salary incentives for women).
- Gender stereotypes: Gender stereotypes should change. Women should be made to feel more comfortable in working alongside men.
- Financial aid: They should be offered bursaries.
- Role models: They must see more females in the field.

This study made use of a questionnaire, normally used in descriptive statistics. According to Koul (1988:403) the descriptive method is popular in education settings as suggestions for improvement of educational practices and instruction can be obtained. The suggestions above are providing ways and strategies that can be used to draw women into the said field.

.

5.3.4 Summary of quantitative and qualitative results

The current study is about what the factors are that influence black female students to choose engineering as a career. For this reason, the summary will highlight factors that had influenced the engineering female students in this particular study to choose engineering as a career. The summary will integrate both qualitative and quantitative results in its presentation.

TYPE OF SCHOOL ATTENDED - MODEL C VS TOWNSHIP

Results indicated that 77.59% of students in both engineering and the other group matriculated from township schools. Of the participants, 80% of students in engineering did their Grade 12 at a township school and this therefore meant that the disadvantaged educational environment (e.g. lack of facilities like laboratories, qualified teachers, etc.) did not affect their career aspirations and choice negatively by not going beyond the Grade 12 mathematics and science.

ROLE MODEL – TEACHER, FAMILY MEMBER AND COMMUNITY MEMBER

Results indicated that 83.61% of students in engineering and the other group combined had their family members as role models. The percentage for the students in the engineering group was 86.49%. Factors that influenced students in the engineering group to choose engineering as a career were exposure to family members that were in the engineering industry.

GENDER OF ROLE MODEL – MALE VS FEMALE

Results indicated that 83.61% of students in both groups had role models that were females. 62.16% of engineering students had females as role models. It became clear that the family members that were role models of these engineering students were females. Therefore female role models had an influence on the choice of engineering as a career in these females.

CONTENTMENT WITH CHOSEN FIELD OF STUDY

Results indicated that a total of 57.38% in both groups combined were content with the choice of their career field. Of the participants, 72.97% in the engineering group were content with studying engineering. They did engineering because they were interested in it and felt competent in the field. Those were some of the factors that influenced their choice.

CONFIDENCE IN BEING SUCCESSFUL IN ENGINEERING

Results showed that 81.36% of students in both groups felt confident about being successful in the field of engineering. There were 97.22% of engineering students who were confident about making it in the engineering field. These chose engineering because they were competent in mathematics and science.

SUITABILITY OF ENGINEERING CAREER FOR FEMALES

The results indicated that 85.96% of females in this study did not believe that there are careers only suitable for females in the engineering field. Of the participants, 88.89% in the engineering group felt that females have the potential to follow any career within the engineering field. Therefore the females in this study overlooked some of the gender and occupational stereotypes that exist in society and chose engineering. The assertion to be made from this, can be that factors influencing them to choose engineering in particular are that there is no male or female job or sex-typed occupation.

5.4 SUMMARY

In this chapter quantitative and qualitative results of this study were presented and discussed in an integrated fashion. In some instances qualitative data was also discussed separately. The results were discussed with specific reference to the theory and previous research. In chapter 6, conclusions will be drawn and recommendations made and the limitations of the research will be discussed.

CHAPTER SIX

CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

This study has examined factors that cause black females to choose engineering as their career path. The interest in factors that cause them to choose engineering arose from the fact that there were few females in engineering both in academia and the world of work. The government has opened many opportunities for blacks and females across the spectrum of colour through its legal framework. The concern the researcher had was that opportunities are opened but for females to make use of those opportunities they need to be empowered. The fact that there were few females in the scientific and engineering fields made the researcher interested in what it is that has caused those females already in the engineering field to choose it. The researcher also wanted to explore strategies that could be used to draw other females into the field of engineering.

In chapter one the educational environment from which the females of this study come was discussed. It came out that these females came from an environment which lacked career guidance, education and counselling, an environment which exposed them to role models in society that were in teaching, nursing and social work. As a result the majority of them chose careers in the humanities and social fields (Cloete, 1981:69; Watson et al., 1997:633); hence their small number in scientific and engineering fields. It seemed that there were other factors that contributed to the low number of females in scientific and engineering fields.

Chapter two therefore explored factors like the self-efficacy of females in traditionally male dominated occupations. To what extent did self-efficacy contribute to the low numbers of females in scientific and engineering fields? The issue of socialisation was discussed in career self-efficacy theory.

In chapter two the issue of the environment was also discussed: how the environment affected and influenced individuals and how that affected the interests, goals and career choice of individuals. This was dealt with in social cognitive career theory. This chapter also dealt with the theory of circumscription and compromise. In the theory, career development through the self-concept was examined and how as a consequence careers and jobs were scaled down through compromise because of the availability of opportunities in the world of work.

There were other factors which contributed to the low number of females in the scientific and engineering fields. These factors were dealt with in chapter three. This chapter examined barriers women were facing in choosing scientific and engineering fields. The barriers that were dealt with were socialisation, sex bias in curriculum material, stereotypes of scientists, subject choice, lack of role models, achievement and confidence, classroom interaction, gender-biased career counselling, influence of parents and the influence of peers.

In chapter four the research methodology was discussed. The present study combined quantitative and qualitative research methods. A questionnaire which contained both closed and open-ended questions was used. The formulation of the problem was presented and hypotheses were formulated.

In chapter five the findings of the study were presented and discussed. The presentation and discussions were according to the hypotheses.

In this chapter conclusions will be drawn and recommendations made. The limitations of the study will also be discussed. Conclusions will be drawn in terms of females that are in engineering. This is done because the purpose of the inclusion of the other group in the research was only to enhance the understanding of the reasons that make black females choose engineering as a career. The aim of this study was to determine factors that cause black females to choose engineering as a career.

6.2 FINDINGS FROM THE LITERATURE STUDY

6.2.1 Educational environment

South African black students lacked qualified science teachers, books, well equipped laboratories, etc., therefore their exposure did not allow for positive self-efficacy expectations to develop in science-related fields (see section 2.2.2). Females were faced with a lot of barriers in education, for example the curriculum material was sex biased (see 3.2.2).

6.2.2 Role model and gender of role model

Role models could influence females' career choices but because there were so few women teaching science at high school and higher education levels, females were having little chance of being influenced. Lack of the same-sex and even same-race models impacted negatively in both high school and higher education levels [see section 3.2.2 (d)]. There was a lack of role models among blacks as black students avoided mathematics and also did not complete degrees and diplomas in the sciences and engineering fields of study (see section 2.2.4 vicarious learning).

6.2.3 Self-efficacy

Females had high levels of self-efficacy in relation to traditional occupations and low levels of self-efficacy in relation to non-traditional occupations (see section 2.2.2). Scientific and engineering fields were fields that were traditionally male and females had low self-efficacy (confidence) in those fields.

6.2.4 Socialisation

Children from an early age were socialised in gender and occupational stereotypes by parents and society [see section 3.2.1 (a)]. Children brought those socialisation experiences with them to school. Teachers reinforced the stereotypes by being biased in favour of males in mathematics and science classroom interaction [section 3.2.2 (b)]. That therefore did not allow a conducive learning environment for females in scientific and engineering fields. As a result there were few females in the said fields and that affected the presence of role models in those fields. It also affected the confidence of females in science and mathematics subjects.

6.3 FINDINGS FROM THE EMPIRICAL STUDY

Hypotheses were formulated and tested through a questionnaire which was administered to a sample of students in a further education and training college. In the results of the study some hypotheses were accepted and others rejected. The results of the hypotheses were as follows:

- **Type of school attended – Model C/township (see hypothesis 1)**

Of the engineering participants 80% matriculated at a township school. Schools in the townships were faced with problems of poor physical and human resources. It appears therefore that the disadvantaged educational environment which these females come from did not affect their career aspirations in terms of choosing engineering as a career instead of other courses of study. The hypothesis was accepted.

- **The role model – family member/teacher/community member**

(see hypothesis 2)

Of the participants in the engineering group, 86.49% had their family members as role models. It appears that teachers do not have an impact in terms of serving as role models

to their students. It seems that students are not looking up to their teachers for inspiration. This may be due to the fact that teachers in the township schools are generally not motivated because of the poor conditions their schools are in and lack of discipline from the students. In the olden days when the researcher was still at school teachers were enthusiastic and there was discipline at schools. Teachers were very inspiring and students wanted to be like them. As a consequence of these conditions the researcher (currently in the education system herself) knows schools that have lost many good science and mathematics teachers, thus contributing to the reduction in the number of qualified science and mathematics teachers in township schools. The hypothesis was accepted.

- **The gender of the role model – male/female (see hypothesis 3)**

Of the engineering participants 62.16% had females as their role models. It seems that these particular females were inspired by females that are in the engineering field; hence their choice of engineering. The hypothesis was accepted.

- **Contentment with choice of study field (see hypothesis 4)**

Of the engineering participants 72,97% wanted to study engineering and were satisfied with their choice of study. The 33,33% of engineering participants that were not satisfied with their career choice were not satisfied because they were in engineering as a result of the advice of the family and not because they wanted to study engineering. The hypothesis was rejected.

- **The confidence of females about their success in the field of engineering (see hypothesis 5)**

Of the participants in the engineering group 97.22% felt confident about their success in the engineering field of study. It seems that these particular females had high self-efficacy levels towards the engineering field of study. This may be due to the fact that

they have been in this field of study for some time and therefore they have had a chance to build their confidence or self- efficacy in the said field. Thus they are exposed to vicarious learning experiences that are more relevant to career-related efficacy expectations (see 2.2.2 vicarious learning). The hypothesis was rejected.

- **The suitability of engineering careers for females (see hypothesis 6)**

Of the engineering participants 88.89% did not believe that there were engineering careers only suitable for men. This finding contradicts the literature study which claimed that females chose traditional female occupations because of their socialisation. It appears that gender stereotypes are changing as females are no longer hesitant to choose careers that were initially traditionally male. The hypothesis was accepted.

6.4 SUMMARY OF THE LITERATURE AND EMPIRICAL STUDY

It transpired from the literature study that enabling environment, gender of role models, self-efficacy and socialization are important factors in terms of attracting females into the fields of science and engineering study.

From the empirical study it came out that family members, female role models, and confidence in mathematics and science were factors that caused the females in the engineering group to choose it as a career. Findings also revealed that gender stereotypes did not deter them from choosing engineering and that they were content with their career choice.

6.5 RECOMMENDATIONS

Lack of an enabling environment, gender stereotypes, lack of same-sex and same-race role models and the presence of many barriers with which females are faced did not deter these females from choosing engineering as a career.

In light of the above conclusions on literature and empirical study, it is therefore recommended that:

- The government should help through its education engine by creating an educational environment that would attract more females to the scientific and engineering fields of study. The government can create an enabling environment by attracting qualified science and mathematics teachers through the provision of incentives. The incentives can be in the form of providing bursaries and high salaries exclusively for females in the engineering field of study and employment.

- The government also needs to provide ongoing support for those already in the system by providing in-service training for them so as to address the issue of under-qualified science and mathematics teachers.

- Schools should invite female role models for motivational talks and to their career exhibitions.

- Educational tours to the engineering firms should also be embarked upon by schools.

- Schools should facilitate the mentoring of their mathematics and science learners by forming partnerships and linkages with engineering firms as a way of assisting and exposing their learners.

- Mathematics and science should be made compulsory at schools.

- There must be career guidance at schools. Those schools which already have this guidance should consciously concentrate on giving information about careers in the scientific and engineering fields of study.

- The teaching and learning of science and mathematics should be made fun, more interesting and more practical.

- There should be parents' nights on which parents are called to come and view scientific projects made by learners.

- Career education in schools should be embarked upon from as early as lower grades.

- Teachers should concentrate on building self-efficacy to learners that are studying mathematics and science.

- Learners that enjoy the challenge that mathematics and science bring, should be stimulated more by being given projects and also entered in competitions like Science Olympiad.

6.6 LIMITATIONS OF THE STUDY

The sample was small (n=37) and consisted of Xhosa speakers and therefore the results can not be considered as representative of all Xhosa speaking female or all Black female engineering students. Reliability could not be tested because of the small sample, therefore for future research a bigger sample should be used for suitable representation.

6.6 CONCLUSION

Conclusions were drawn in the light of the findings of the study and recommendations made for the intervention of the government so as to improve the situation faced by females. Recommendations for schools on how they can improve and change the plight of females were also drawn. Government and schools are seen as critical for changing the status quo of the females, hence recommendations focused on these two institutions. These institutions are the power engines for change in society.

The recommendations captured factors that caused females already in engineering to choose that career path (e.g. self-efficacy in mathematics and science, career education,

inspired by role models and being intrigued by the challenge of these subjects) and also factors that caused those female students in other courses not to choose it (e.g. difficulty of mathematics and science, lack of self-efficacy etc.). The researcher therefore hopes that the recommendations of this study will be implemented by the education officials in government and the principals and teachers of schools so as to increase the number of females in scientific and engineering fields of study. In this way females will be empowered and they will be able to make use of the opportunities opened by the government for females through its legal framework.

BIBLIOGRAPHY

Afrol News (28 April 2004). South Africa's women from housework to unemployment queue. www.PressDisplay.com

Arkhurst, J. and Mkhize, N.J. (1999). Career education in South Africa. In Stead, G.B. and Watson, M.B. (Eds.) Career psychology in the South African Context. Pretoria: Van Schaik

Bailey, S. (1992). Shortchanging girls, shortchanging America: A call to action. In Weiler, J. Career Development for African American and Latin Females. www.parentsassociation.com/education/career_develop.html

Baker, D., and Leary, R. (1995). Letting girls speak out about science. *Journal of Research in Science Teaching*, 32, 3-27

Bandura, A. (1977). Social Learning Theory. Englewood Cliffs: Prentice-Hall

Bandura, A. (1986). Social Foundations of Thought and Action: A Social Cognitive Approach. Englewood Cliffs: Prentice-Hall Inc.,

Bester, G. (1992). School Guidance and Counseling (BEd Specialisation) Psychometrics. OSV454-6. Unisa

Betz, N.E. (1994). Basic Issues and Concepts in Career Counseling for Women. In Walsh W.B. and Osipow S.H. Career Counseling for Women (1994). Lawrence Earlbaum: Associates Inc Publishers

Betz, N.E. and Fitzgerald, L.F. (1987). The career psychology of women. New York: Academic Press

Betz, N.E. and Hackett, G. (1983). The Relationship of Mathematics Self-Efficacy Expectations to the Selection of Science-Based College Majors. *Journal of Vocational Behaviour*, 23, 329-345

Bird, A. (2001). National Monograph on Technical and Vocational Training in South Africa. www.ilo.org/public/english/employment/skills/recomm/pub1/006.htm

Brown, D., Brooks, L., and Associates (1990). Career Choice and Development (2nd Ed.). San Franscisco: Jossey-Bass Inc. Publishers

Brown, D., Brooks, L., and Associates (1996). Career Choice and Development (3rd Ed.). San Franscisco: Jossey-Bass Inc. Publishers

Brooks, L. (1990). In Brown, D., Brooks, L., and Associates (1990). Career Choice and Development (2nd Ed). San Franscisco: Jossey-Bass Inc. Publishers

Byrne, E.M. (1993). Women and Science: The snark syndrome. London: The Falmer Press, Taylor and Francis Inc.

Charles, C.M. (1995). Introduction to Educational Research (2nd Ed.). New York: Longman Publishers

Cloete, N. (1981). Occupational Orientation Of Black Youth In Southern Africa. *Psychologia Africana*, 20.

Clark, G., and Horan, J.J. (2001). Interactive Internet Program Teaches Parents to Facilitate Children's Career Development. http://horan.asu.edu/d-gc-apa-y2k-diss.htm

Cohen, L., Manion, L., and Morrison, K. (2001). Research Methods in Education (5th Ed.). New York: Routledge Falmer

Creswell, J.W. (2003). Qualitative, Quantitative, and Mixed Method Approaches. (2nd Ed.). London: Sage Publications

DB 2000 Computer Programme. Port Elizabeth FET College

De Bruin, G.P., (1999). Social cognitive career theory as an explanatory model for career counselling in South Africa. In Stead, G.B. and Watson, M.B. (Eds.) Career psychology in South African Context. Pretoria: Van Schaik

Department of Education, (1997). Gender Equity in Education: Report of the gender equity task team.

Department of Education. (15 April 1998). Green Paper For Further Education And Training: Preparing For Twenty-First Century Through Education, Training And Work.

Department of Education (2004). Pandor orders review of progress in gender equity in the education system. www.education.gov.za

Department of Education (2004). Statement by the Minister of Education on the release of the results of the 2003 trends in mathematics and science study (TIMSS) www.education.gov.za

Department of Education (2006). Statement by the Minister of Education on Mathematics and science teachers being considered as "scarce resources" www.education.gov.za

Department of Labour (June, 2001). National Skills Development Strategy: Setting the Context.

Department of Science and Technology (2004). Facing the Facts: Women's Participation in Science, Engineering and Technology

Dovey, K.A. (1980). Politics and guidance: An overview of the South African school guidance service. *British Journal of Guidance & Counselling*, 8.

De Vos, A.S. (1998). Research at grass roots: A primer for the caring professions. Pretoria: J.L. van Schaik

Erinosho, S. (1997). Female participation in sciences: An analysis of secondary school science curriculum materials in Nigeria. Abridged Research Report No 29. Nairobi: Academy Science Publishers

Erinosho, S.Y. (1997). The making of Nigerian women scientists and technologists. *Journal of Career Development*, 24, 71-80

Els, C. (2004). Occupational Aspirations and Gender Stereotyping of Xhosa-Speaking Senior Primary Learners. Masters Treatise. University of Port Elizabeth

Feldhusen, J.F. and Willard-Holt, C. (1993). Gender differences in classroom interactions and career aspirations of gifted students. Contemporary Educational Psychology 18. 355-362

Fitzgerald, L.F., Fassinger, R.E., and Betz, N.E. (1995). Theoretical Advances in the study of Women's Career Development. In Walsh, W.B. and Osipow, S.H. (2nd Ed). Handbook of Vocational Psychology: Theory, Research, and Practice. Mahwah, New Jersey: Lawrence Erlbaum Associates, Inc. Publishers

Gajendra, K.V., and Beard, R.M. (1981). What is educational research. Aldeonot Hants: Gower Publishing Company Ltd

Gall, M.D., Borg, W.R. and Gall, J.P. (1996). Educational Research: An Introduction. (6th Ed). New York: Longman

Gottfredson, L.S. (1981). Circumscription and Compromise: A Developmental Theory of Occupational Aspirations. *Journal of Counseling Psychology Monograph*, v 28, No.6

Gottfredson, L.S. (1996). Gottfredson's Theory of Circumscription and Compromise. In Brown, D., Brooks, L. and Associates (3rd Ed). Career Choice and Development. Publishers San Francisco: Jossey-Bass Inc.

Gottfredson, L.S. (2000). Gottfredson's Theory of Circumscription and Compromise. In Brown, D., Brooks, L., and Associates (4th Ed). Career Choice and Development. San Francisco: Jossey-Bass Inc. Publishers

Guzzetti, B.J., and Williams, W.O. (1996). Gender, text, and discussion: Examining intellectual safety in the science classroom. *Journal of Research in Science Teaching*, 33, 5-20

Hackett, G. and Betz, N.E. (1981). A Self-Efficacy Approach to the Career Development of Women. *Journal of Vocation Behaviour*, 18, 326-339

Hargrow, A.M. and Hendricks, F. (2001). Career Counseling With African Americans In NonTraditional Career Fields. In Walsh, W.B., Bingham, R.P., Brown, M.T. and Ward, C.M. Career Counseling For African Americans. New Jersey: Lawrence Erlbaum Associates, Inc. Publishers

Harris, M.B. (1998). Basic statistics for behavioural science research (2nd Ed.). Boston: Allyn and Bacon.

Hartman, W. (1988). Aspekte van beroepsorintering van swart stedelike leerlinge [Aspects of career orientation among urban Black students]. In Stead, G.B. (1996). Career development of black South African adolescents: A developmental-contextual perspective. *Journal of Counseling and Development*, 74.

Henderson, S., Hesketh, B. and Tuffin, K. (1988). A test of Gottfredson's theory of circumscription. *Journal of Vocational Behavior*, 32, 37-48

Herald Newspaper, (2005). www.herald.co.za

Holland, J.L. (1973). Making vocational choices: A theory of careers. Englewood Cliffs, NJ: Prentice Hall

Human Resource Development Review, (2003). Future human resource needs of the South African economy. Pretoria. Pretoria, South Africa: Human Sciences Research Council. www.hsrc.ac.za

Human Resource Development Review (2003). Engineers and Technicians. http://hrdwarehouse.hsrc.ac.za/hrd/engineers/engineers.pdf

Isaacson, L.E. and Brown, D. (1997). Career Information, Career Counseling, and Career Development, (6th Ed). Needham Heights: Viacom Company

Jacobs, J.E., Finken, L.L., and Griffin, N.L. (1998). The career plans of science-talented rural adolescent girls. American Educational Research, 35(4), 681-704

Jungwirth, H. (1991). Interaction and gender – findings of a microethnographicals: approach to classroom discourse. Educational Studies in Mathematics 22. 263-284

Kahle, J.B., Parker, L.H., Rennie, L.J., and Riley, D. (1993). Gender differences in science education: Building a model. Educational Psychologist, 28, 379-404

Kaiser-Messmer, G. (1993). Results of an imperil study into gender differences in attitudes towards mathematics. Educational Studies in Mathematics 25. 209-233

Kgoale, M. (1987). Education in South Africa: Compiled conference papers. Unibo, August

Kortlik, J.W. and Harrison, B.C. (1989). Career decision patterns of high school seniors in Louisiana. *Journal of vocational education research*, 14, 47-65

Koul, L. (1988). Methodology of Educational Research. (2nd Ed.). New Delhi: Vikas Publishing House Pty Ltd

Kracke, B. (1997). Parental behaviors and adolescents' career exploration. The Career development quarterly, 45, 341-350

Leach, L.S. (1994). Sexism in the classroom: a self-quiz for teachers. Science scop March, 54-59

Leigh-Doyle, S. (1992). Increasing women's participation in technical fields: A pilot project in Africa. Geneva: International Labour Organisation

Lent, R.W., Brown, S.D. and Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice and performance [Monograph]. *Journal of Vocational Behavior,* 45, 79-122

Lent, R.W., Brown, S.D. and Hackett, G. (1996). Social Cognitive Career Theory. In Duane Brown and Associates. Career Choice and Development (3rd Ed). San Francisco: Jossey-Bass

Lent, R.W., Brown, S.D. and Hackett, G. (2002). Social Cognitive Career Theory. In Duane Brown and Associates. Career Choice and Development (4th Ed). San Francisco: Jossey-Bass

Lent, R.W. and Hackett, G. (1987). Career Self-Efficacy: Emperical Status and Future Directions. *Journal of Vocational Behaviour*, 30, 347-382

Lent, R.W., Larkin, K.C. and Brown, S.D. (1989). Relation of self-efficacy in inventoried vocational interests. *Journal of Vocational Behavior*, 34, 279-288

Lunneborg, P.W. (1982). Role model influences of non-traditional professional women. *Journal of vocational behavior*, 20, 276-281

Mallam, W.A. (1993). Impact of school-type and sex of the teacher on female students'attitudes towards mathematics in Nigerian Secondary schools. Educational Studies in Mathematics 24(2). 223-239

Mathabe, N.R., and Temane, M.Q. (1993). The realities and imperatives of career counseling for a developing South Africa. *Journal of Career Development*, 20.

Mau, W., Domnick, M. and Ellsworth, R.A. (1995). Characteristics of female students who aspire to science and engineering or homemaking occupations. The career development quarterly, 43, 323-337

Ndahi, H. (2002). Gender Inequity in Industrial and Technical Education in Nigeria: Parents' Perspectives in the 21st Century. JITE, v 39, No.2. http://scholar.lib.vt.edu/ejournals/JITE/v39n2/ndahi.html

Neuman, W.R. (2000). Social Research Methods: Qualitative and Quantitative Approaches (4th Ed.). Boston: Pearson Education

Osipow, S.H. (1983). Handbook of vocational psychology. Hillsdale, N.J.: Lawrence Erlbaum Associates

Osipow, S.H., Fitzgerald, L.F. (1996). Theories of Career Development (4th Ed). Needham Heights Mass: Simon & Schuster Company

Otto, L.B. (2000). Youth perspective on parental career influence. In Ndahi, H. (2002). Gender Inequity in Industrial and Technical Education in Nigeria: Parents' Perspectives in the 21st Century. *JITE*, v 39, No.2. http://scholar.lib.vt.edu/ejournals/JITE/v39n2/ndahi.html

Penick, N.I. and Jepsen, D.A. (1992). Family functioning and adolescent career development. The career development quarterly, 40, 208-222

Poole, M.E., Langan-Fox, J., Ciavarella, M. and Omodei, M. (1991). A contextualist model of professional attainment: Results of a longitudinal study of career paths of men and women. *The counseling psychologist*, 19, 603-624

Rochford, K., Sokopo, Z., and Kleinsmith, C. (1997). Improving the Teaching of Science and Technology in the New South Africa: Concurrence Between the Policy Preferences of Lecturers, Teachers and Students. *Global J. of Engng. Educ*., Vol.I, No.2, Australia. www.eng.monash.edu.au/uicee/gjee/vol1no2/paper2.htm

Roe, A. (1956). The psychology of occupations. New York: Wiley

Sebald, H. (1989). Adolescents' peer orientation: Changes in the support system during the past three decades. In Clark, G. and Horan, J.J. (2001). Interactive Internet Program Teaches Parents to Facilitate Children's Career Development. http://horan.asu.edu/d-gc-apa-y2k-diss.htm

Schreuder, A.M.G. and Theron, A.L. (1997). Careers: An Organisational Perspective. (2nd Ed.). Lansdowne: Juta & Co Ltd

Sharf, R.S. (1997). Applying career development theory to counseling (2nd Ed). Pacific Grove: Brooks/Cole Publishing Company

Sharf, R.S. (2002). Applying career development theory to counseling (3rd Ed). Pacific Grove: Brooks/Cole Publishing Company

Smith, E.L. (1983). Issues in Racial Minorities' Career Behaviour. In Walsh, W.B. and Osipow, S.H. Handbook of Vocational Psychology, Volume 1, Foundations. New Jersey: Lawrence Erlbaum Associates Inc. Publisher

Stake, J.E. (2005). Adolescent girls' and boys' science peer relationships and perceptions of the possible self as scientist. Sex roles: *A Journal of Research.* http://www.findarticles.com/p/articles/mi_2294/is_1-2_52/ai_...

Statistics South Africa (September 2005). www.statssa.gov.za

Stead, G.B. (1996). Career Development of Black South African Adolescents: A Developmental-Contextual Perspective. *Journal of Counselling and Development*, January/February, Vol, 74, 270-275

Stead, G.B. and Watson, M.B. (1998). Career Research in South Africa: Challenge for the Future. *Journal of Vocational Behavior*, 52, 289-299

Stead, G.B. and Nqweni, Z.C. (1999). Introduction to career education and information technology. In Stead, G.B and Watson, M.B. (Eds). Career psychology in the South African Context. Pretoria: Van Schaik

Stead, G.B. and Watson, M.B. (1999). Introduction to career education and information technology. In Stead, G.B. and Watson, M.B. (Eds.). Career psychology in South African Context. Pretoria: Van Schaik

Struwig, F.W., and Stead, G.B. (2001). Planning, designing and reporting research. Cape Town: Masker Miller Longman.

Strydom, H. and De Vos, A.S. (1998). Sampling and Sampling Methods. In De Vos, A.S. (Ed.). Research at grass roots: A primer for the caring professions. Pretoria: J.L. van Schaik.

South Africa Survey 2001/2002. South African Institute of Race Relations. Braamfontein

Super, D.E. (1990). A life-span, life-space approach to career development. In Brown, D., Brooks, L. and Associates (Eds.), Career choice and development (3rd ed.). San Francisco, CA: Jossey-Bass

Swanson, J.L. and Fouad, N.A. (1999). Career Theory and Practice. Thousand Oaks: Sage Publications, Inc.

Taylor, N.B. and Pryor, R.G.L. (1985). Exploring the process of compromise in career decision-making. *Journal of Vocational Behavior*, 27, 171-190

Trusty, J. (1996). Relationship of parental involvement in teens' career development to teens' attitudes, perceptions, and behavior. *Journal of research and development in education*, 30, 65-69

Walsh, W.B. and Osipow, S.H. (1994). Career Counseling for Women. Mahwah: Lawrence Erlbaum Associates, Inc. Publishers

Walsh, W.B. and Osipow, S.H (1995). Handbook of Vocational Psychology: Theory, Research and Practice (2nd Ed). Mahwah: Lawrence Erlbaum Associates, Inc., Publishers

Watson, M.B., Foxcroft, C.D., Horn, M.A. and Stead, G.B. (1997). Occupational Aspirations Of Black South African Adolescents. *Psychological Reports*, 1997, 80, 627-635

Weiler, J. (2000). Career Development for African American and Latin Females. www.parentsassociation.com/education/career_develop.html

Williams, S.C. (2001). Career decision-making self-efficacy and career identity amongst black senior high school learners. Masters Treatise. University of Port Elizabeth

Whitelegg, L. (1992). Girls in science education: of rice and fruit trees. In Kirkup, G. and Keller, L.S. Inventing Women: Science, Technology and Gender. Polity Press, Basil Blackwell Ltd, Open University

Young, R.A. and Friedsen, J.D. (1992). The intentions of parents in influencing the career development of their children. The career development quarterly, 40, 198-207

Zietsman, A. and Sproule, S. (1997). Girls' Attitudes Towards The Teaching and Learning Of Mathematics and Science http://64.233.187.104/search?q=cache:gj9g8tvdRFkJ:www.wigsat.org/gasat/.../13.txt+&hl=en&ie=UTF-

Zietsman, A. (1997). Girls' in maths and science classroom: A study in Malawi and South Africa. Abridged Research Report No. 28. Nairobi: Academy Science Publishers

Zunker, V.G. (1994). Career Counselling: Applied concepts of life planning. Pacific Grove, California: Brookes/Cole

QUESTIONNAIRE

Please read the questions carefully and answer all the questions.

SECTION A

Office use

1. How old are you? Please put a cross.

16-18 years..... ☐1 ☐1
19-21 years..... ☐2
22-26 years..... ☐3
27 years or older..... ☐4

2. Indicate the division of your course? Please put a cross.

Engineering..... ☐1 ☐2
Business studies..... ☐2
Utilities..... ☐3
Arts and Design..... ☐4

3. What requirements should be met for one to be able to do the course you are studying?

Grade 12 with science and maths..... ☐1 ☐3
Grade 12 with drawings and maths..... ☐2
Grade 12 with maths..... ☐3
Grade 12 with commercial subjects..... ☐4
Grade 12 with any subjects..... ☐5

4. Indicate your Grade 12 results of the following subjects by putting a symbol (e.g. A, B, C, etc.) in the relevant box.

Science HG..... ☐1 ☐4
Science SG..... ☐2
Science LG..... ☐3
Mathematics HG..... ☐1 ☐5

Mathematics SG..... ☐2

Mathematics LG..... ☐3

5. Did you complete your Grade 12 at a model C school (school in town) or at a school in the township? Put a cross in the relevant box.

Mode C school..... ☐1 ☐6

Township school..... ☐2

7. Occupation of father_____

8. Occupation of mother_____

9. Who is your role model (who inspires you). Indicate your answer in the relevant box below.

Teacher..... ☐1 ☐7

Family member..... ☐2

Somebody in the community..... ☐3

10. Is it a male or a female. Put a cross in the box.

Male..... ☐1 ☐8

Female..... ☐2

SECTION B

1. Is the course you are studying at the moment something that you wanted to study?

Yes..... ☐1 ☐9

No..... ☐2

2. If you answered no to number 1 what is it that made you not to study what you always wanted? Choose your answer from the statements below by making a cross in the relevant box.

Did not meet the requirements……☐1

Did not have enough money to pay fees……☐2

Family advised me to do the course……☐3

Chose the course because of friends……☐4

☐10

3. Are you going to change the course you are studying in the near future or are you going to continue with it? Choose your answer from the statements below by making a cross in the relevant box.

I will change it and study the one I want……☐1

I will continue until I finish then change……☐2

I will continue and seek employment in this field…☐3

☐11

SECTION C (Qualitative component)

Answer by putting a cross on the "yes" or "no" and give a reason for your answer.

1. Do you think women have the capability to be successful in the field of engineering as their male counterparts?

Yes……☐1

No……☐2

☐12

Give reasons for your answer.

_____

_____

_____

_____

2. Why are there few women studying towards the field of engineering?

_____

_____

_____

_____

3. What is it that can be done to attract women to study engineering?

_____
_____
_____
_____

4. Do you think mathematics should be compulsory at school?

Yes..... ☐1 ☐13

No..... ☐2

Give reasons for your answer.

_____
_____
_____
_____

5. Why are women studying science and mathematics at school few?

_____
_____
_____
_____

6. What can be done to draw them into studying science and mathematics at school?

_____
_____
_____
_____

7. Do you feel confident about your capabilities in science and/or mathematics?

Yes..... ☐1 ☐14

No..... ☐2

What makes you to feel confident or not feel confident?

_____
_____
_____
_____

8. Do you feel confident that you can be successful in the scientific and/or engineering field.

Yes..... ☐1 ☐15

No..... ☐2

What makes you to feel confident or not confident?

_____
_____
_____
_____

SECTION D

1. Is there any encouragement from family members for females to choose careers that are in the scientific or engineering fields?

Yes..... ☐1 ☐16

No..... ☐2

Give reasons for your answer.

_____
_____
_____
_____

2. Is there encouragement from your community for females to choose careers that are in the scientific or engineering fields?

Yes..... ☐1 ☐17

No..... ☐2

3. Do you believe that there are careers that are suitable only for males and those that are suitable only for females in the scientific and/or engineering fields?

Yes..... ☐1 ☐18

No..... ☐2

4. If you answered yes to number 3 give reasons for your answer.

_____
_____
_____
_____

5. Indicate by putting a cross in the relevant box occupations that are only suitable for males.

Mechanical engineer..... ☐1
Technician..... ☐2 ☐19
Electrical engineer..... ☐3
Civil engineer..... ☐4
Sound engineer..... ☐5