WOMEN IN ENGINEERING: IDENTIFYING AND ANALYZING GENDER SOCIALIZATION IN THE FACULTY OF ENGINEERING AT THE UNIVERSITY OF KWAZULU-NATAL

by

MARYANN MARILYN FRANCIS

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SUPERVISOR: PROF L CORNWELL

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DECLARATION

I declare that this research is my original work, except where due acknowledgement is made in the text, and that I have not previously submitted this paper in its entirety or part thereof at any university or institution of higher learning for a degree of any qualification.

Name : Maryann Marilyn Francis

Signature :

Date : November 2009

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SUMMARY

The research problem reflected a lower number of female postgraduate students and academics as compared to their male counterparts within the Faculty of Engineering at the University of KwaZulu-Natal.

A descriptive survey was disseminated to a stratified sample of undergraduate final year students in the disciplines of Chemical, Civil, Mechanical, Electrical, Electronic, Computer and Bioresources Engineering. An online survey was also sent to the nine female academics within the Faculty.

The study indicates that the social and academic environment within the Faculty of Engineering at the University of KwaZulu-Natal was not a deterrent to female graduates studying further and entering academia. The exam performance of both male and female students was similar and neither the drop-out rate nor failure was due to gender but rather to the choice of degree. An issue of concern to both the student and the academic group was the low numbers of female academics.

Key Words: Gender socialization, women, engineering, higher educational institutions, academic.

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CHAPTER 1
INTRODUCTION AND BACKGROUND TO STUDY

1.1 Introduction

In 1996, the South African Department of Arts, Culture, Science and Technology signed the White Paper on Science and Technology. The White Paper outlined many requirements for the promotion of competitiveness and employment in South Africa. One of its requirements was the targeting of historically disadvantaged students and especially women into the fields of science and technology.

The increase of women in the participation of the Science, Engineering and Technology (SET) fields has received attention at the national policy level, within the National Research and Development Strategy (NRDS) with the Department of Science and Technology and also through the Department of Education’s National Plan for Higher Education. This information was extracted from the Department of Science and Technology’s website (www.dst.org.za). A discussion of the aims of the NRDS follows.

In August 2002, the South African Government released the National Research and Development Strategy. In January 2002 (NRDS 2002:1), former president Thabo Mbeki stated that, “the main aim of the NRDS in light of globalization, is wealth creation, through the training of increased numbers of people”. He went on to mention that global statistics indicate that the real determinant of technology driven economic development is a sustained high level of research and innovation and in order to achieve this South Africa needs to invest in its science base. Mr Mbeki also pointed out that there needs to exist a highly targeted approach towards increasing excellence in mathematics and the sciences among young women and black matriculants.

In order to ensure that the aims of the NRDS are met and its progress monitored, in 2003, the Department of Science and Technology set up the South African Reference Group (SARG) on women. SARG was commissioned to investigate the participation of women in public sector science, engineering and technology (SET) in South Africa. SARG found that there was a significant growth in the enrolment of female students into the SET sector since 2001. In fact female students consisted of 53% of the total registration statistics at higher education institutions (SARG 2004:9).

However, the more advanced the level of study, the fewer the number of female enrolments. The report indicated that only 7% of Doctoral graduations were in Engineering (SARG 2004:10). The report also found that women academic staff were significantly over-represented in the Social Sciences and Humanities and under-represented in the Sciences and Engineering. Only 14% of research staff in Engineering Faculties were women. That is only 33 women within a total population of 230 researchers (SARG 2004:12).

1.2 Problem Statement

In South Africa, there is very little literature on the performance of female engineering students in higher education institutions as opposed to their male counterparts. There is also very little literature analyzing the reasons for the low number of female engineering students and more especially the diminishing numbers of postgraduate engineering students that enter academia who are female. It is hoped that this study will provide an insight into the situation within the Faculty of Engineering in the University of KwaZulu-Natal.

The status quo in the Faculty of Engineering at the University of KwaZulu-Natal is as follows. The information has been downloaded from the university's Management Information System database (dmi, 18 December 2008).

The following table indicates the number of postgraduate students within the Faculty of Engineering from 2005-2008. This indicates that male postgraduate enrolments far exceed that of female enrolments.

Year	**Females**	**Males**
2005	58	282
2006	56	269
2007	41	224
2008	52	270

Lower numbers of female postgraduate students ensures equally lower numbers of female academics as opposed to their male counterparts. As at 18 December 2008, there were 99 male academic members of staff in the faculty as opposed to only 9 female academics. The breakdown of academic ranking is as follows:

Rank	**Male**	**Female**
Professor	18	Nil
Associate Professor	10	1
Senior Lecturer	25	1
Lecturer	45	7
Tutor	1	Nil
Total	99	9

According to Sturge (1996: 4) mentors, who are invariably described as friends, advisors, teachers and counsellors, are thought to be a useful way of attracting more girls into Science, Engineering and Technology (SET) careers as well as involving women already working in non-traditional areas in role-modelling.

Therefore what are the implications for a university whose female academic staff complement is only 8.33% of the total population? If, as mentioned by Sturge (1996:4) mentors are a useful way of encouraging women into SET careers, how can institutions attract and retain female postgraduate students into academia when there is a severe shortage of female academics to provide that mentorship and act as role models? This is a problem that's not only facing the University of KwaZulu-Natal but also other prominent higher education institutions in South Africa. Comparison statistics are mentioned below however for the purposes of this study, insight was only provided into the status quo at the University of KwaZulu-Natal.

The researcher contacted the University of Witwatersrand (WITS), Pretoria and Cape Town (UCT) to obtain comparative statistics. At WITS, information received from the university's web site (wits, 9 February 2009) indicated the following complement of academic staff within the Faculty of Engineering, 99 males and 8 females. Hence, female staff represent 7.47% of the total population.

At the University of Pretoria, information sourced from the faculty web site (up, 10 February 2009), indicates the following, 94 males and 10 females. Hence, women academic staff represent 11% of the total academic population.

The University of Cape Town indicated a slight increase with regards to their female complement of academic staff in their Faculty of Engineering. The staff complement consisted of 91 males and 30 females. Females constituted 33% of the total complement. Information was obtained from the faculty office and personal communication with Mrs Zahrah Matthews, Human Resources Officer (personal communication: 12 February 2009).

At the 2006 South African Women in Science Awards, the minister of Science and Technology in South Africa, the Honourable Mosibudi Mangena, spoke about the effects of gender socialisation on the advancement of women in fields of technology. He mentions, "while engineering has emerged as a major milestone in the history of the twentieth century for its contribution towards the creation of economic and social infrastructure, in South Africa, engineering is a field in which women's participation is very low (dst, 20 January 2008)."

1.3 Research Objectives

In view of this research problem, the primary aim of this research study was to describe the social and academic environment within the Faculty of Engineering at the University of KwaZulu-Natal in 2008 as perceived by the final year classes that may be a contributing factor to the decreased number of females in postgraduate education and academia at the University of KwaZulu-Natal, South Africa.

This research project also illustrated the performance at the undergraduate level of study between female and male engineering students over a 3-year period. The aim was to ascertain whether there is a significant difference in the end of year results between female and male students that could be one of the factors that prevents female students from enrolling for postgraduate study.

The third objective of the study was to establish whether there is a marked difference in the perception of the final year students and the female academics in the Faculty with regards to issues around gender socialization such as whether the number of female academics is an important issue for both groups?, do the groups perceive the social and academic climate as being conducive to academic progression?, are male and female students perceived to be different in their relationships with both technicians and academic staff?, whether gender bias is perceived to exist in the Faculty, etc..

1.4 Limitations to and Scope of the Study

A major limitation of the study was that due to time constraints experienced by the final year classes, no personal interviews could be conducted and hence only e-mailed surveys were used to collect data on the experiences of the students within the Faculty.

This factor impacted on the number of respondents, especially the number of female students that responded to the e-mailed questionnaire. As the main aim of this research project was to establish reasons why female students do not pursue postgraduate studies, a low response from the female students impacted on findings which hence could not be generalised to the entire population or even to other higher education institutions. The female response rate was 25% of the total sample of female students invited to participate in the study.

1.5 Importance of the Study

There is limited systematic data available in South Africa that has focused on undergraduate female engineering students at universities in relation to their performance from first year to final year of study. It is therefore important to note if a marked difference in performance between female and male engineering students exists. If there is a difference, is it due to the academic and social environment within the Faculty of Engineering, which may be related to gender socialization?

In other words, are the classroom and faculty dynamics perceived by both female and male students, differently? Are these dynamics influenced by gender socialization? Hence, does the experience of gender socialization affect women's motivation and career commitment and therefore impacts on the number of both female postgraduate students and academics within the Faculty of Engineering?

1.6 Research Methodology

The research focussed on students within the Faculty of Engineering at the University of KwaZulu-Natal (UKZN) that enrolled in 2005 as first year students and followed their progress to their fourth and final year of study. The study analysed data on the performance of female students as well as male students.

An e-mail questionnaire was distributed to a randomized stratified sample of male and female students in their final year of study in 2008. These were 129 students, 12 female and 117 male. The questionnaire focused on the relationship between the two genders in the classroom and in workshops. It also focused on the social and academic environment within the Faculty of Engineering at the University of KwaZulu-Natal from 2005-2008.

The study also only focused on students enrolled for seven out of the nine programmes offered within the Faculty of Engineering at UKZN. These were Bioresources Engineering and Environmental Hydrology, Civil Engineering, Chemical Engineering, Mechanical Engineering, Electrical Engineering, Electronic Engineering and Computer Engineering.

The two disciplines not included in this study are Land Surveying and Property Development. These two disciplines are not regarded as hard-core Engineering disciplines by the Engineering Council of South Africa but have a more business management approach. The project is limited to the University of KwaZulu-Natal and to the cities of Durban and Pietermaritzburg.

The study is both quantitative and qualitative. The qualitative aspect allows one to focus on the subjective experiences of individuals and also to study people in their own definition of the world. At the same time data obtained was analysed to determine the distinction in performance of both male and female students with the Faculty of Engineering. Two types of data sources were used, namely self-reporting and documentary sources.

The University's Management Information system has a record of the students' examination results for each year of study. This documentary source was captured into spreadsheet formats and then into charts. The charts illustrate the performance of both the male and female students for the degrees mentioned.

Self-reporting consisted of electronic descriptive surveys. These surveys were e-mailed to a sample of both female and male final year students. The data obtained was categorised and the material within each category then coded and compared for variations or similarities in experiences of the students. A similar survey was disseminated to a sample of female lecturers within the Faculty and their feedback analysed to ascertain whether they note differences in the experiences between female and male undergraduate students. This is discussed in great detail in Chapter 3.

1.7 Clarification of Terms

The term “sex” refers to the biological differences between men and women. The term “gender” refers to the socially constructed “masculine” and “feminine” characteristics and associated roles attributed to men and women that shape the lives and experiences of men and women differently. This research took the form of a gender analysis. Hence, it focused on the experiences of female students in Engineering and has both a quantitative and qualitative framework. Higher education, for the purpose of this study will refer to universities. The term Science, Engineering and Technology (SET) refers to careers within these fields covering the pure and life sciences, manufacturing, innovation and engineering.

1.8 Chapter Layout

- Chapter 1: Introduction
- Chapter 2: Literature Review
- Chapter 3: Research Design and Methodology
- Chapter 4: Results and Discussion
- Chapter 5: Recommendations
- Chapter 6: Conclusion
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    - Statistical data from UKZN Management Information System

1.8 Conclusion

Dr Mangena, former Minister of Science and Technology, in his keynote address at the 2006 South African Women In Science Awards, (dst, 20 January 2008), stated that “the South African society lags behind regarding gender equality issues and in accommodating the life-cycle experiences of women. The South African Science and Engineering sector is not seen to be proactive enough when it comes to advancing women up the career ladder and recognizing their achievements through promotions and positions of science leadership.” He encouraged all from the industry sector present at the awards ceremony to institutionalise the move from the current emphasis on recruitment to the advancement and retention of women in SET.

"There is no doubt that South Africa needs to increase the number of engineers entering its workforce in order to create a strong economy to be able to compete globally in an increasingly technology-driven world. However, research globally indicates that higher education institutions have a poor rate of educating and retaining engineering students and adequately preparing them for the workplace", (Chen, 1995:1).

Hence, the following chapter focuses on the issues of gender socialization and how this impacts on the problems identified earlier in this chapter of both recruiting and retaining both female postgraduate students and academics in Engineering. What are the issues of gender socialization facing women around the globe with reference to career choice and upward mobility and what is the situation in higher education institutions in South Africa?

CHAPTER 2
GENDER SOCIALIZATION: A LITERATURE REVIEW

2.1 Introduction

An interesting statement was made by a top female engineer in the United States, Diane Matt who is the Executive Director of the Women in Engineering Programmes and Advocates Network (WEPAN). Matt (2006:42) states that, "children are affected by the stereotypes in society, which assumes that boys are better suited to technology and engineering. In response girls deselect themselves from educational paths that would prepare them for engineering". Matt mentions that one of the reasons for this is that female engineers have not adequately prepared the general public on the impact of engineering on the quality of lives. She further states that during the higher education experience female students often receive messages-- some intentional and others not -- that "they do not belong".

The cumulative effect of this is that some females start to question whether a career in engineering is appropriate for them. In Chapter 4, the researcher indicated that this is the experience of female academics in the Faculty of Engineering at the University of KwaZulu-Natal when trying to recruit female graduates into postgraduate studies. The classroom experience also indicated that the female students find it difficult grasping the technical and practical aspects of the course and this, as mentioned by an academic respondent, could be due to stereotyping.

Once women find themselves as students of engineering, what are some of the challenges they face and how have higher education institutions improved the performance rates and increased the numbers of female engineering students in postgraduate study?

2.2 A Critical Overview of the Entrenchment of Gender Socialization

The term socialization is used by sociologists, social psychologists and educationalists to refer to the process of learning one's culture and how to live within it. For the individual it provides the skills and habits necessary for acting and participating within their society. Clausen (1968:5) states, "for the society, inducting all individual members into its moral norms, attitudes, values, motives, social roles, language and symbols is the 'means by which social and cultural continuity are attained".

Sociologists such as Durkheim as described by Thompson (1982:34) profile socialization into various categories and an explanation of each category follows. The first is primary socialization which occurs when a child learns attitudes, values and actions appropriate to individuals as members of a particular culture. Secondary socialization refers to the process of learning what is appropriate behaviour as part of a smaller group within the larger society. Developmental socialization is the process of learning behaviour in a social institution and developing one's social skills. How does one then define gender socialization?

According to the Unite For Children Foundation (UNICEF) as defined on their web site (unicef, 10 March 2008), "Early gender socialization starts at birth and is a process of learning cultural roles according to one's sex. Right from the beginning, boys and girls are treated differently by the members of their own environment, and learn the differences between boys and girls, women and men. Parental and societal expectations from boys and girls, their selection of gender-specific toys, and/or giving gender based assignments seem to define a differentiating socialization process that can be termed as gender socialization".

Lippa (2005:71) describes various theories of gender development beginning with the biological theory which suggests that there are some innate differences between males and females. The biological basis of sex differences is obvious due to differing physical traits.

However, many psychologists and sociologists argue that biological theories of gender do not adequately describe the differences in behaviour of the two genders. Sigmund Freud, renowned psychologist, based his theory on boys and girls perceptions of their bodies. For him the acquisition of a gender identity was totally a psychological process in which children are born psychosexually neutral then learn to identify with the same sex parent.

The second theory of gender according to Lippa (2005:72) is that of the Evolutionary Theory which is based on the assumptions of Darwin's 1859 theory. Darwin (1859: 5) mentions that, "firstly the traits of all living things show variation, secondly traits can be passed from one generation to the next and thirdly natural selection is the 'filter' that determines which traits are passed from generation to generation".

The core assumption of Darwin's theory is that the organism's environment selects which traits are passed from generation to generation, based on the notion of survival and reproduction. Darwin proposes that survival and reproduction depends on the adaptation of the genes.

Although the researcher came across many critiques of Darwinism none of them completely refuted the theory except those that arose from a Religious perspective and do not support the theory of evolution. Modern evolutionary theory has refined Darwinism and focuses more on genetic survival. In Lippa (2005:73), "natural selection is a process that maximises the transmission of genes to future generations".

The third theory on gender is that of causal cascades and social interventions. According to Lippa (2005:203), "cascade implies a sequence of interlocking causal events where small initial effects may combine over time to produce large ultimate effects".

Hence the values and norms within a particular culture in relation to gender roles can be passed on through the generations. With the impact of such forces as globalisation and the emergence of diverse types of occupations, technological advancement and the expansion of adult and school education, changes are likely to take place in the status and role of women in the family as well as in the socialization of children as stated by Autumn (1993:4).

Kabeer (2003:14) indicates that, "in order for women to have real choice and to be truly empowered certain conditions need to be fulfilled. Firstly, there must be alternatives to provide men and women with the opportunity to choose differently". She mentions that poverty and disempowerment go hand in hand and therefore the inability to meet one's basic needs usually results from the dependence on powerful others to do so. This in turn rules out the capacity for meaningful choice. Kabeer further states that the absence of choice is likely to affect men and women differently because gender-related inequalities often intensify the effects of poverty.

Kabeer proposes that gender often operates through the unquestioned acceptance of power. Thus women who for example internalise their lesser claim on household goods or accept violence at the hands of their husbands, do so because to behave otherwise is considered outside the realm of possibility.

This is in line with the definition of gender socialization where one is expected to learn attitudes, values and actions appropriate to individuals as members of a particular culture or gender.

Grabrucker (1988:20) mentions that gender stereotyping often occurs unintentionally, without reflection or a real understanding of the situation. Her study found that children's upbringing was gender differentiated. Mothers that believe in the innate differences in behaviour of the sexes are falling victim to a mechanism that keeps on reproducing itself.

In the educational setting, one should offer an education that is personally and socially worthwhile. Care needs to be taken that a broad range of views of women and girls from different groups are included in curriculum development and review processes. "In South Africa, the presence of women in decision-making bodies at national and local government levels has had an extremely beneficial effect on shaping curriculum that is responsive to diverse needs" (Aikman et al, 2004: 46).

In order to understand the need for curriculum change, one needs to fully understand the experiences of girls in school, with special reference to areas of science and technology development. In other words what are the barriers in the early school years to the development of girls in areas of science and technology?

According to the findings of research that was undertaken by the Engineering Council in 1991 (Engineering Council, 1991: 26), girls' alienation from science and technology subjects begins early. As part of this research, children were asked to assess jobs and activities according to those suitable for men, those suitable for women and those that are suitable to both genders. The findings of the study were that children thought science was more of a man's pursuit than say firefighting.

Hence, research suggests that there is quite a psychological barrier to overcome if more girls are to be attracted to science subjects. On the other hand it also means that teachers have a huge role to play in the classroom in challenging children's beliefs about what they can or cannot do.

Many assumptions are made that there are gender differences in scientific abilities. Wyer, Barbercheck, Giesman, Ozturk and Wayne (2001:15) clearly outline these gender differences as being attributed to the following reasons:

- Firstly they mention that there is evidence that girls do less well than boys in mathematics. This is due to the fact that there is a marked gender difference in socialization and exposure to mathematics. This theory is challenged by Spelke (2005:950) further on in this chapter.
- The second reason is that career attainments are shaped by decisions that individuals make for themselves. Women's decision to have children and thus take on a distinctive domestic and parental role is said to interfere with their scientific work. Thus this decision benefits families but is damaging to their careers. (However, the researcher found no evidence to support this claim).
- Thirdly, there is an unsubstantiated feeling that there are gender differences on career commitment of men and women. That instead of focusing on research and one's own personal development within the profession, that women prefer to teach. Hence, one's career related preference prevents one from moving up the ranks. (However, there is no data to support this hypothesis).

An interesting review by Spelke (2005:950) challenges the above-mentioned longstanding belief that males are more focused on objects from the beginning of life and therefore are predisposed to learning about mechanical systems, that males have a profile of spatial and numerical abilities producing greater aptitude for mathematics and that males are more variable in their cognitive abilities and therefore predominate at the upper reaches of mathematical talent. The underlying assumption of these beliefs is that sex difference has a genetic basis. In other words women have less intrinsic aptitude for mathematics and science.

Through Spelke's review of various studies on infants and literature she found that evidence indicated that girls and boys show equal primary abilities for mathematics. However sex differences emerge on more complex quantitative tasks during and after elementary school and grow larger with increasing age. Spelke asserts that because the differences emerge well after infancy, it is difficult to tease apart the biological and social factors that produce them. However, she concludes that male and female infants do not differ in the cognitive abilities at the foundations of mathematics and scientific thinking. They have common abilities to represent and learn about objects, numbers, language and space.

Hence, the gifts for mathematics and science have been bestowed in equal measure on males and females. So if there is enough evidence to support the basis that sex differences with regards to Science and Engineering careers does not have a genetic basis, then one can only assume that the difference is due to socialization.

2.3 Higher Education in Science, Engineering and Technology: *A Global Perspective*

In the 1960's and through the feminist movements, many new graduates were produced in the field of engineering. Jean Michel (1988:12) found that, "until today the engineering profession is still a male dominated field, as the average five percent of female involvement proves. This rate is extremely weak in the majority of developing countries but also in several of the major industrialized countries".

Due to this continuing discrimination of women, the United Nations declared 1975 as International Women's Year. For the first time in history the eyes of the world were focused on that half of its population, who perform two-thirds of the world's work, receive one tenth of its income and own less than one hundredth of its property. It was the start of an international effort to right the wrongs of history.

That same year the United Nations General Assembly declared the years between 1976 and 1985 to be the United Nations Decade for Women. Marking the end of that decade, the

World Conference on Women was held in Nairobi in July 1985, where delegates from over 140 countries gathered to assess the achievements of ten years of international commitment to improving the status of women (Kitetu, 2006:8).

The Conference adopted the Nairobi Forward-Looking Strategies for the Advancement of Women and proposed the Fourth World Conference on Women in 1995. The purpose of the World conference would be to review the Nairobi Forward-looking strategies and set out measures for their immediate implementation and for the overall achievement of the goals and objectives of the United Nations Decade for Women: Equality, Development and Peace.

These strategies focused on many factors of discrimination against women but for the purposes of this research, only those related to education are mentioned. This extract was taken from the United Nations Millennium Project web site and is quoted directly below (United Nations, 10 March 2008).

- “Advance the goal of equal access to education by taking measures to eliminate discrimination in education at all levels on the basis of gender, race, language, religion, national origin, age or disability, or any other form of discrimination and, as appropriate, consider establishing procedures to address grievances;
- Eliminate gender disparities in access to all areas of tertiary education by ensuring that women have equal access to career development, training, scholarships and fellowships, and by adopting positive action when appropriate;
- Create a gender-sensitive educational system in order to ensure equal educational and training opportunities and full and equal participation of women in educational administration and policy- and decision-making;
- Diversify vocational and technical training and improve access for and retention of girls and women in education and vocational training in such fields as science, mathematics, engineering, environmental sciences and technology, information technology and high technology, as well as management training;
- Elaborate recommendations and develop curricula, textbooks and teaching aids free of gender-based stereotypes for all levels of education, including teacher training, in association with all concerned - publishers, teachers, public authorities and parents' associations;

- Provide funding for special programmes, such as programmes in mathematics, science and computer technology, to advance opportunities for all girls and women."

In 1995 another World Conference on Women was held in Beijing attended by over 40,000 women from non-governmental organizations. A Plan of Action was adopted to guide action required in the years ahead. One of the concerns raised at the Beijing Platform for Action in 1995 is that science curricula is gender biased. Science textbooks do not relate to women and girls' daily experience and fails to give recognition to women scientists. Girls are often deprived of basic education in mathematics and science and technical training, which provides knowledge they could apply to improve their daily lives and enhance their employment opportunities. Advanced study in science and technology prepares women to take an active role in the technological and industrial development of their countries, thus necessitating a diverse approach to vocational and technical training. It is essential that women not only benefit from technology, but also participate in the process from the design to the application, monitoring and evaluation stages.

A study conducted by Gibson (2003:217) across Europe indicated that," gender stereotypes are well established in secondary schools at 16 year's old. In choosing a career, the girls in the study indicated that their career advisors played a large influence in their decision-making. However, a survey of female students enrolled in engineering programmes indicated that their career advisors usually advised them against choosing a career in engineering".

Another factor is how do teachers, who possess different social identities and are themselves located within gendered social relations; translate curriculum documents into classroom practices. (Aikman, 2004:46)," One needs to also recognize the fact that very little work has been done in teacher-training courses to develop teachers' understanding of gender inequalities and how to overcome them in the classroom setting".

In his keynote address at the 2006 South African Women In Science Awards, the Honorable Mosibudi Mangena, Minister of Science and Technology (dst, 20 January 2008) quoted an award recipient, Zia Maharaj who in her thank you speech said, "My final thank you is to my school headmaster, Mr. Cook and Mr. Naidoo, my science teacher, for ensuring that Beaulieu College is an institution that encourages independent thinking as well as an enjoyable learning experience." Minister Mangena commented on whether Zia would continue to enjoy her studies in science, engineering and technology or will the environment in many of our South African institutions dampen her enthusiasm? An important question that clearly highlights the dynamics of the educational system in South Africa and the role it plays in socializing the youth and stigmatizing careers according to gender.

Hence research indicates that gender socialization is particularly relevant to the success of women in the sciences and engineering and in order to change gender discrimination over time within these careers, a lot of work needs to be done within the educational system, beginning in the primary school years.

Recognizing this many countries began to focus on increasing the number of female engineers and scientists. In various countries, this change took the form of local, regional or national initiatives.

Beraud (2003:435) describes a study commissioned by a consortium of seven countries in Europe to determine why there are so few women in engineering and what could be done to increase the number of female engineering students. The consortium consisted of representatives from Germany, France, Finland, The United Kingdom, Greece, Austria and Slovakia. Findings indicated that women preferred interdisciplinary degrees as opposed to single, traditional or classical degrees. The recommendation of the findings was that universities should include 25% of socio-economic contents into the Engineering degree syllabi to attract more females into the degrees. These interdisciplinary subjects must be introduced as early as possible. The recommendations of the consortium were adopted by the European Union in 2003 and implemented in all partner countries. These programmes are to be reviewed in 2010 (womensciencenet, 13 February 2009).

South Africa together with selected funding agencies introduced funding mechanisms that were designed to increase the participation, retention and promotion of women in SET. Some of these initiatives exist within the University of KwaZulu-Natal such as the Women in Water Awards which is awarded to women that have played a leading role in water research. Another is the Carnegie Corporation of New York's International Development

Programme which focuses on enhancing women's opportunities in higher education (Synthesis Report 2004:5).

The Carnegie Corporation introduced the WOSA (Women in Science, Engineering and Agriculture) Scholarships in 2004 at the University of KwaZulu-Natal (UKZN) to attract more women of high academic abilities into these fields and also to retain then up to the Doctorate levels. Although, seen as an excellent Scholarship, whilst talking to Professor Nelson Ijumba, the former Dean of the Faculty of Engineering at UKZN (personal communication, December 1, 2008) the statistics thus far indicated that female students were not applying for the scholarship beyond the undergraduate years.

2.4 Higher Education: *A Gendered Difference*

In the United States in January 2001 as quoted in Rosser (2003:1), a statement was released on behalf of the nine US research universities. That is the California Institute of Technology, MIT, Harvard, Princeton, Stanford, Yale, Michigan, Pennsylvania and California. The report suggested that institutional barriers prevented women engineers from having a level playing field in their profession. The statement declared that institutions of higher learning have an obligation to both themselves and the nation to develop and utilize all creative talent available. It went on to state that the signatories in the statement recognize that barriers exist for women faculty and that this recognition will require some significant change within each university as well as engineering establishments as a whole. A discussion leading to the culmination of this report ensues.

In 1998, within these universities, women received 74.4% of the Bachelor's Degrees in Psychology, 52.7% in the Biological and Agricultural Sciences, 52.5% in the Social Sciences, 39% in the Physical Sciences, 37% in the Geosciences but they only received 18.6% in Engineering. In graduate degrees, the scenario was similar with Psychology (71.9%), Social Sciences (50.2%), Biological and Agricultural Sciences (49%), Mathematics (40%), Physical Sciences (33.2%), Geosciences (29.3%), Computer Sciences (26.9%) and Engineering only 17.1%. The PhD statistics were also similar with Engineering awarding only 12.3% of PhD Degrees as compared to Psychology's 66.6%.

The statement declared that institutions of higher learning have an obligation to both themselves and the nation to develop and utilize all creative talent available. This indicated a dawning awareness on these universities to address the barriers for women through institutional rather than individual change.

According to Bystydzienski (2002:9) most of the intervention programmes developed on university campuses and supported by government and private foundations, focused on how to fit women into existing engineering departments in the US. She asserts that it was assumed that women were “deficient” in math and science achievement and lacked the motivation to participate. Hence, they had to be individually encouraged, mentored, supported and appropriately socialized to enter and remain in the engineering and technology fields. Bystydzienski mentions that rather than trying to change women to fit the sciences and engineering fields, these fields need to be changed in order to accommodate women. This will be further explained under recommendations of this research project in Chapter 5.

A study conducted by Alha and Gibson in (2003:216) looked at the situation in various countries across Africa, South America and Europe. The study found a similar pattern in all the countries that women tend to be less well represented on engineering programmes in comparison with the Sciences and Humanities. They also found that cultural and social differences represent the most striking differences in participation rates. Zambia, for example, yielded only 1% of female engineering graduates whereas Kuwait yielded 3%. Both countries having adopted a very conservative culture in comparison with European countries. Sweden yielded 29% of engineering graduates, which seems to be a typical figure for Northern Europe.

Alha and Gibson (2003:216) found that essentially, the situation in 2003 was the same in 1993 across Europe were there were far more men than women studying Engineering. Italian statistics showed that at secondary level, there were 47.5% of girls in technical schools but at university level, only 8% of engineering graduates were women. However, the scenario in Spain and Ireland was very different and saw a sharp increase in female enrollments in Engineering. This was attributed to the influence of cultural dimensions on the participation of women in Engineering.

In addition to social and cultural factors influencing girls' choices, the role of career advisors at school is also important. From all of these studies, we can come to the conclusion that countries across the globe, whether developed or not, are finding it a challenge to attract and retain women in the Engineering field.

A similar scenario exists in South Africa.

According to a study published by the National Advisory Council on Innovation and the Department of Science and Technology in South Africa (South Africa 2004: 3), South Africa's ability to produce well-trained, effective scientists, engineers and technologists is critical to the country's future.

In South Africa, demographics indicate a female proportion of 51%. Yet, the results of the South African Reference Group on Women in Science and Technology (SARG) reflects a low participation rate by women in the higher ranks of the broader South African science and technology sector. In March 2003, SARG was commissioned by the National Advisory Council for Innovation (NACI) to investigate the participation of women in the Science, Engineering and Technology (SET) sector. The results of this study follows and are taken from the report by Malcolm (2004:6-19).

According to Malcolm (2004:7), in 2001, women constituted more than half of all enrollments (53%) in the higher education sector as a whole. Also in 2001, 43% of upper postgraduate graduations in the university sector were women. Within scientific fields, women were best represented in the Health Sciences (47%) and the Social Sciences and Humanities (41%). In terms of the Natural Sciences and Engineering, the majority of enrollments were women (75% or 500 out of 669). However, the majority of women that graduated with Doctoral Degrees were from the Life Sciences and Physical Sciences. In comparison, only 7% of female Doctoral enrolments and graduations were in Engineering as compared to 23% among men.

Malcolm (2004: 4) goes on to state that it has been 30 years since the first UN Women's Conference in Mexico City was convened to advance issues of women's equality. It has been six years since the World Conference on Science raised the issue of women's development and advancement as a central component of national development. The Millennium Development Goals of the United Nations specifically mention gender equality as one of the 8 goals but without specific attention to the gender dimension, these goals will never be reached.

An interesting South African study by Cosser, du Toit and Visser (2004:14) compared enrolments into higher education institutions by male and female students to the choices of learners in their matric year. They found that the most popular choice for men was business and commerce with the second most popular choice was engineering. The most popular choice for women was business and commerce but their second most popular choice was the humanities and social sciences. The researchers reviewed the preferences as well as actual enrollments of students in 2001 and compared to 2002. They found the gender differentials in choice and actual enrollments for female learners was much larger than the male learners.

The actual enrollment figures indicated in the study reflected a higher enrollment of females into the social sciences and humanities rather than into business and commerce. Male counterparts enrolled for the choices they had indicated in their high school years. Cosser, du Toit and Visser (2004:15) concluded that either female learners have less choice than their male counterparts or that female learners are less sure about their higher education preferences whilst still at school.

In order to address these issues in 2007 an organization was formed at the University of Cape Town, namely SAWomEng by two of its Engineering undergraduate students (sawomeng, 12 February 2009). SAWomEng uses a 5 pillar approach to address barriers to entry for female engineering students. One of these pillars addresses the promotion of engineering amongst girls in high schools across South Africa.

GirlEng focuses on mentorship and “igniting the Engineering flame” to encourage girls into the field of engineering. In terms of mentorship, female engineers will mentor at least one female high school learner. In this way, school girls will be inspired to study engineering and excel in industry.

The second focus, “igniting the flame” encourages interaction between school girls and SAWomEng delegates which will result in mutual excitement about the engineering industry. The founders of GirlEng believe that this will aid both attraction and retention of female engineers hence “igniting and fuelling the engineering flame” (sawomeng, 12 February 2009). In 2009 the organization hosts its 3rd Annual Conference. The efforts of this organization can only be measured years from now.

2.5. Conclusion

Dr Malcolm, in her presentation to the National Council on Innovation (2004:3) states that, “South Africa has put in place a Gender Advisory Board to encourage, monitor and implement transformative actions. She mentions that there are gender dimensions to science and technology and that these dimensions occur in both the developing and developed nations but the implementation of transformative actions affects not only the situation for women but also the quality and direction of science and technology”.

On the 6th March 2008, the International Electrical and Electronic Engineering Society (Women in Engineering)-IEEE WIE hosted its inaugural event. Chair of the Society Oladayo Salami said, “A huge challenge that was identified by the Society is the common misconception that to succeed in Engineering you have to be masculine. This puts pressure on women to compete with males in class and to try to prove they are not ‘too feminine’.”

She went on to state that the IEEE WIE wants to support women studying engineering and show them that you don’t have to be masculine to succeed in Engineering. She made it clear that this goal is difficult to meet when they are hardly any female lecturers or academics in the Faculties of Engineering.

An interesting comparison was another speaker at the inaugural event, Dr Hahn who is a female engineer from Vietnam. She stated, “I find it difficult to understand why it is a problem being a female in the engineering world. In Vietnam there are equal numbers of male and female engineers studying engineering. Never lose yourself and think that just because you’re a woman that you will have problems working as an engineer” (ieee, 12 February 2009).

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Introduction

The research methodology was an analysis of a research problem through scientific investigation. Kothari (1985:1) explains, “Research is a search for knowledge, a systematic search for pertinent information on a specific topic”. The investigative option this researcher chose is a descriptive research focus using the survey method. Due to the various social dimensions of the research project, it consisted of both a quantitative and qualitative study.

3.2 Research Design

In conducting research it is important that one acknowledges various factors that impact directly on the task at hand. Gray (2004:100) mentions that factors which need to be taken into consideration during scientific investigation are as follows:

a. Time frame of the Study: Is one looking at issues of the past, present or future? As we’re living in an ever changing society, it is important that the time frame is considered so that an appropriate methodology can be adopted. For example, if timescales are more generous, a longitudinal study may be undertaken.

b. Geographical location of the research: The geography is important for both sampling techniques and understanding the context of the study.

c. Is the focus of the research broad or general or does it compare the specific patterns among sub-groups? In order to understand a particular research question, the researcher needs to investigate a particular group to which conclusions may be drawn. This is the purpose of inferential research.

d. What aspect of the topic is of interest? This is the aspect that will guide the entire research project as all aims/objectives will be based on this.

d. How abstract is the research interest? Is the main focus on gathering data or on what the data may reveal about the research question? In understanding this question, the researcher will be able to determine the research methodology.

In studying the effects of gender socialisation, it’s important to bear in mind that the study is social in nature. For this reason, this study is both quantitative and qualitative. Two types of data sources were used consisting of self-reporting through means of a descriptive survey and a quantitative analysis of documentary sources.

The first aim of this research project was to compare the performance in engineering studies over a three-year period between male and female students at the University of KwaZulu-Natal (UKZN). This involved a quantitative analysis of examination data available from the Student Management Information System at the University. This quantitative data consisted of a single variable, that is, exam performance. The main advantage of using this type of research design is that data is both measurable and quantifiable and can also be statistically manipulated.

The second aim of the project was the analysis of data acquired through the use of a descriptive survey. The survey focused on the classroom and workshop experiences between male and female students to ascertain both the academic and social environment within the Faculty of Engineering.

Creswell (1994:118) points out that the advantage of the descriptive survey research method is that it allows the researcher to generalize from a sample to a population so that inferences can be made about some characteristic, attitude or behaviour of a population. He also mentions some of its advantages as the economy of the design, the rapid turn around in data collection and the ability to identify attributes of a population from a small group of individuals.

This analysis of the survey data was qualitative in nature. LeCompte, M.D and Preissle, J. (1993:2) state, "Qualitative research is a loosely defined category of research designs or models, all of which elicit verbal, visual, tactile, olfactory, and gustatory data in the form of descriptive narratives like field notes, recordings, or other transcriptions from audio- and videotapes and other written records and pictures or films."

There are many advantages to using a mixed research design, inclusive of both quantitative and qualitative methods. According to Patton (1990a:16) qualitative research methods are advantageous for the following reasons:

a. It provides one with depth and detailed data.

b. One is able to generate new theories and recognize phenomena ignored by most or all previous researchers and literature.

c. It helps people see the world view of those studies, that is, it simulates their experience of the world

d. It also attempts to avoid pre-judgments. The goal is to try to capture what is happening without being judgmental; and to present people on their own terms.

On the other hand quantitative research allows one to quantify data in a systematic and scientific manner. It's objective and allows one to present a questionnaire, tabulate the data, summarize the data, analyze the findings and then draw conclusions. (Patton, 1990b:20) "It is easier to quantify through the use of well-established guidelines and statistical analysis is increasingly a computer-operation."

The qualitative data dealt with variables that are not measurable or quantifiable. Some of the aims of the qualitative data were to describe the relationship of the two genders in the classroom and workshop setting. It also described the social and academic environment within the Faculty of Engineering at the University of KwaZulu-Natal.

3.3 Sampling

The population of this study are engineering students within the Faculty of Engineering at the University of KwaZulu-Natal. These students would currently be in their final year of study in the year 2008 and in the disciplines of Chemical, Mechanical, Electronic, Electrical, Computer, Civil and Bioresources Engineering. The registration statistics for students in these seven disciplines that were in their first year of study in 2005 is 854 as reflected on the University's Management Information Systems Database (dmi, 18 January 2008). The population consisted of 211 females and 643 males.

In 2008, there were 533 final year students within the seven disciplines this study has focused on out of a total student population within the Faculty of Engineering of 2342 at the University of KwaZulu-Natal. That amounts to 23% of the total population. A stratified sampling technique was implemented through the use of the Randomiser software programme (randomiser, 11 June 2008). 23% of the 533 final year students presented a sample of 129 students. Through randomiser 23% of students were selected from each of the seven disciplines, totalling 129. Out of the 129, the computer randomly selected 12 females. Hence the females invited to participate in the study constituted 9% of the total sample.

This sample of 129 students was contacted and administered an online descriptive survey questionnaire. The sample consisted of 38 Chemical Engineering students, 10 Civil Engineering students, 4 Bioresources Engineering and Hydrology students, 29 Electrical Engineering students, 10 Electronic Engineering students, 28 Mechanical Engineering students and 10 Computer Engineering students.

The researcher ensured that the students were informed that their participation is entirely on a voluntary basis. All efforts were made to increase the response rate of the participants.

The examination results of male and female students within the Faculty of Engineering at the University of KwaZulu-Natal for the seven disciplines mentioned from the year 2005 to 2007 were obtained from the University Online statistical database (Student Management System). This included the entire population of the students' results from first until their third year of study that is the end of the year 2007. This amounted to a total of 854 undergraduate students across the seven disciplines.

Within the Faculty, there are 9 female academics. All 9 were contacted to either complete an e-mailed questionnaire or to participate in an interview. Four of the academics responded and chose to complete the questionnaire.

3.4 Surveys

Descriptive and Analytical surveys are a common methodology in research because they allow for the collection of significant amounts of data from a huge population. Surveys are also helpful as they look for associations between social, economic and psychological variables. Most surveys are conducted using questionnaires and for the purposes of this study a descriptive survey will be used.

Gray (2004, 100) mentions that at the heart of a survey lies the importance of standardization. Surveys attempt to identify something about a population that is a set of objectives about which one is able to make generalisations.

For the purposes of this study, descriptive questionnaires will be e-mailed to the sample of students chosen to participate in this study. E-mail addresses of the students will be obtained from the University's Student Management System. A preliminary e-mail will be sent out inviting students to participate in the study and describing the sampling technique that was used to select them. All attempts will be made to encourage students to participate in the study.

In April of 2008, a focus group consisting of four members of the Student Engineering Council were interviewed with regards to their input into the Survey Questionnaire. Some of the amendments to the initial survey included questions about relationships between technical staff and students as well as questions that would trigger a response regarding the relationship of males and females in the classroom.

3.5 Data Analysis Procedures

All data from the e-mail questionnaires will be coded and summarised by the researcher and the findings described through the use of tables and charts. In this study the computer statistics programme that has been used to analyse data is the Statistical Package for The Social Sciences (SPSS), which is available on the University of KwaZulu-Natal's inner web as a resource for students and academics. (UKZN, 8 June 2008)

The data received from the Universities Information Management System contains the results of all the students that is the entire population across the seven disciplines of 854 students. The analysis of this data requires the skills of an expert statistician. The information was provided to a statistician, Ms Tonya Esterhuizen, by the researcher. The variables required to analyse the various aspects of the aims of the project were detailed to the statistician. . The most important data is qualitative in nature and hence the use of research analysis tools such as the ANOVA was used to describe relationships between male and female students. The next chapter discusses both quantitative and qualitative data findings.

3.6 Conclusion

The following chapter will indicate the tables and charts of reported data. The data is divided into the biographical data where students' contact information was obtained as well as information on their choice of a career. The second group of data analysed consisted of a range of questions exploring classroom dynamics, the relationship between academics, technical staff and students as well as the opportunities faculty provides to students to pursue postgraduate studies. The last group of data looked at faculty experiences. The researcher sought to determine whether the faculty provides an ideal environment for learning, according to the students' perception.

The second report highlights the performance of the students' from first year until the end of their third year. The researcher sough to determine whether there exists a difference in performance between male and female students and also looked at the drop-out rate from a gender perspective.

The third report analyzes the responses from the female academics and compares the findings with that of the students.

CHAPTER 4
ANALYSIS OF DATA AND FINDINGS

4.1. Introduction

The quantitative data illustrates the performance at the undergraduate level of study between female and male engineering students over a 3-year period. The objective of analysing this data was to ascertain whether there was a significant difference in the end of year results between female and male students. The researcher proposed that a significant difference in achievement between males and females with female students under-performing could contribute to the low numbers of female postgraduates and academics.

Data received from the e-mailed questionnaire describes the social and academic environment within the Faculty of Engineering at the University of KwaZulu-Natal in 2008 as perceived by the final year classes and academics. This data would highlight differences in which the male and female students interact in their social environment with both each other and their teachers. It also assessed the perceptions of the female academics within the faculty with regards to gender issues.

An e-mail survey was mailed to all 129 students together with a covering statement detailing the study. A deadline for responses was set for 2 months after the e-mail was mailed. Several e-mail reminders were also mailed out.

Gray (2004:99) states that it is essential for a researcher to ascertain the rate of responsiveness of completed surveys by monitoring:

a. Non-contacts (That is those students who do not respond at all). The researcher should attempt to re-contact

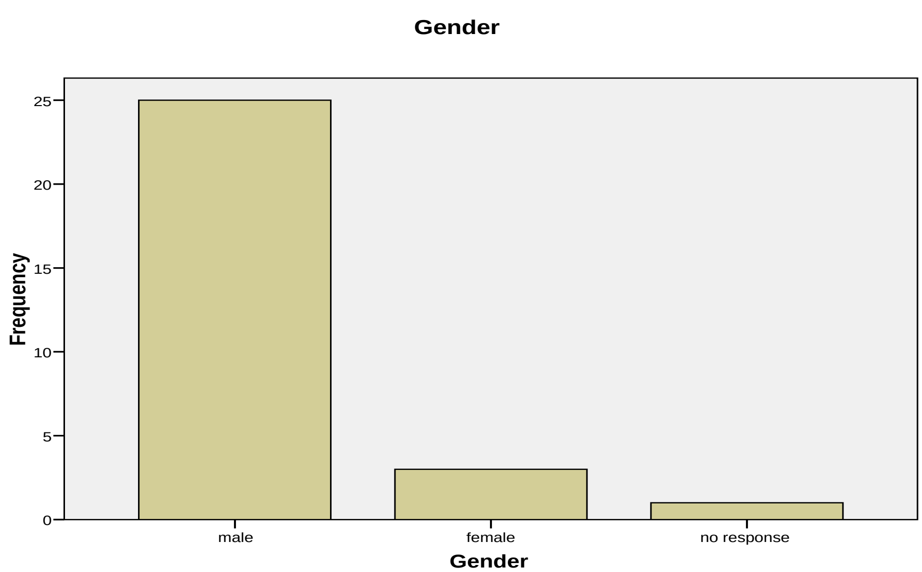
b. Refusals (Try to ascertain the reasons for refusal to participate)

c. Ineligibles (Replace with eligible respondents)

From the 129 students that received the questionnaire, only 29 responded, indicating a response rate of 22.48%. Although the researcher attempted to contact the non-respondents, no further responses were received. No reasons for the refusal to participate were also established. The respondents consisted of three female students and 25 male students. One respondent did not indicate gender. However, from the 129 students that's were randomly selected to form part of the study, only 12 of them were female. Out of the 12 females invited to participate, only 3 responded indicating a response rate of 25%.

This is extremely problematic for this study as the primary objective was to ascertain some of the reasons why so few female students enrol for postgraduate study in the Faculty of Engineering at the University of KwaZulu-Natal. The low response rate also made it impossible for the researcher to generalize the findings to all students in the Faculty or to other higher education institutions.

Chart 1

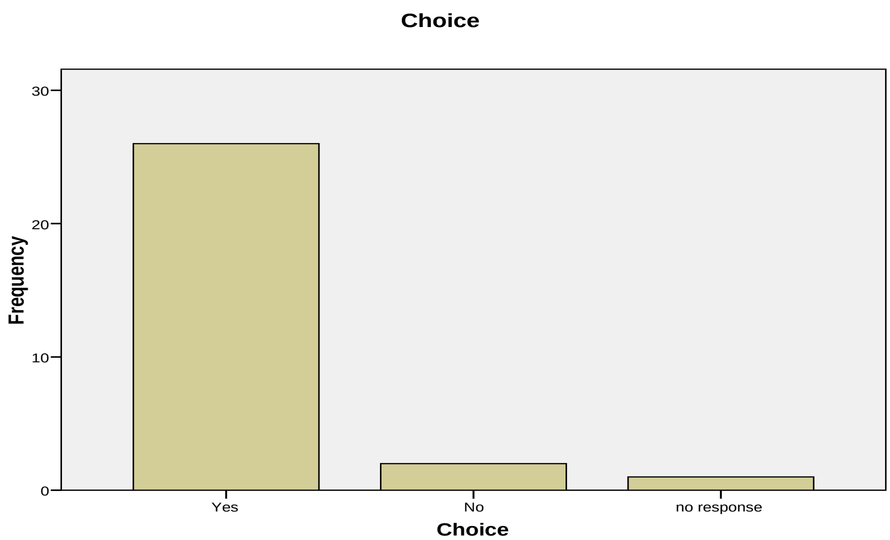


4.2 Presentation of Results

An analysis of each question will follow:

a. Within the biographical questions, the first question was whether Engineering was the student's first career choice. 26 students answered yes, two students answered no and one student did not respond.

Chart 2:



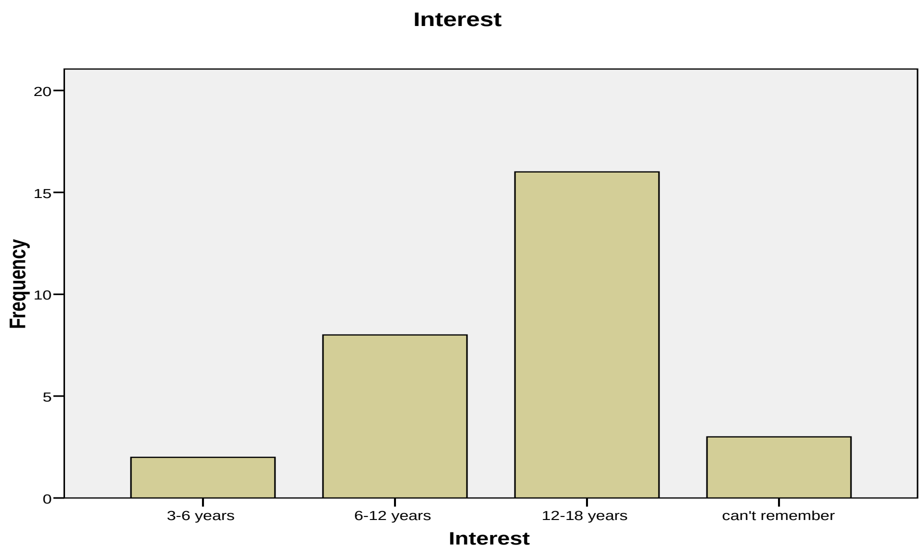
b. The second question was, "When did you first develop an interest in Engineering?" The aim of this question was to ascertain at which age the student starting thinking about Engineering as a career.

Table1:

Interest

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3-6 years	2	6.9	6.9	6.9
	6-12 years	8	27.6	27.6	34.5
	12-18 years	16	55.2	55.2	89.7
	can't remember	3	10.3	10.3	100.0
	Total	29	100.0	100.0	

Chart 3:



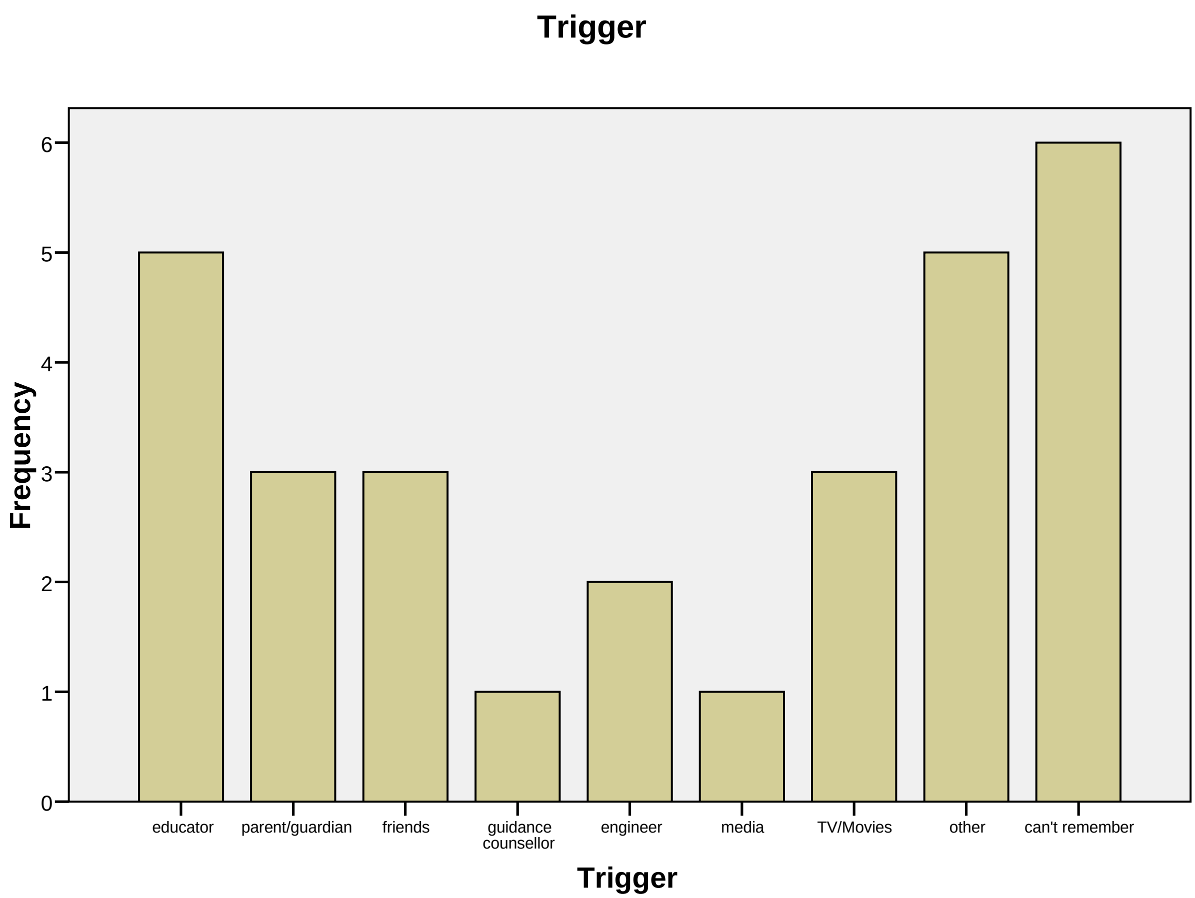
c. The third question aimed to understand what or who influenced the student to develop an interest in Engineering as a career. Table 2 indicates the results;

Table 2:

Trigger

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	educator	5	17.2	17.2	17.2
	parent/guardian	3	10.3	10.3	27.6
	friends	3	10.3	10.3	37.9
	guidance counsellor	1	3.4	3.4	41.4
	engineer	2	6.9	6.9	48.3
	media	1	3.4	3.4	51.7
	TV/Movies	3	10.3	10.3	62.1
	other	5	17.2	17.2	79.3
	can't remember	6	20.7	20.7	100.0
	Total	29	100.0	100.0	

Chart 4



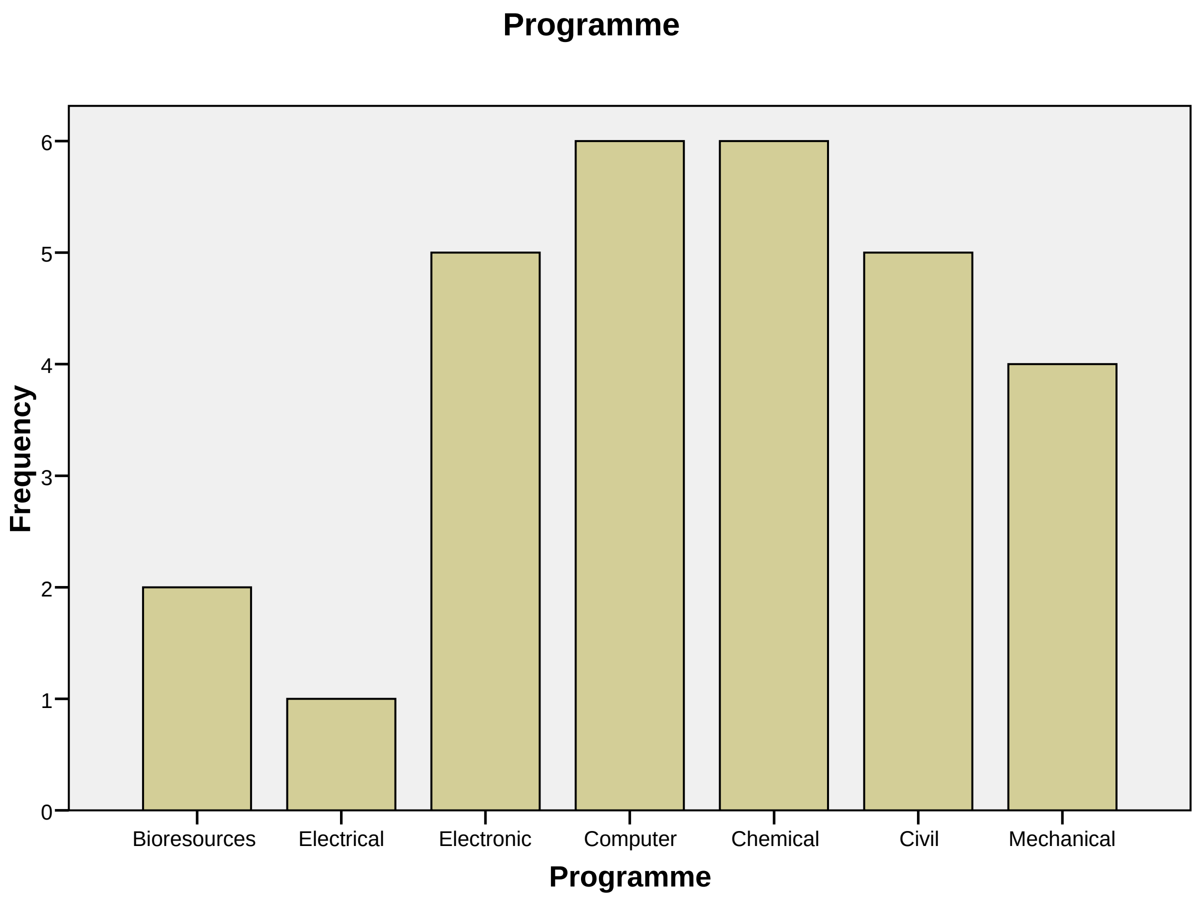
d. Question 4: What programme are you registered for? Table 3 indicates the response

Table 3:

Programme

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bioresources	2	6.9	6.9	6.9
	Electrical	1	3.4	3.4	10.3
	Electronic	5	17.2	17.2	27.6
	Computer	6	20.7	20.7	48.3
	Chemical	6	20.7	20.7	69.0
	Civil	5	17.2	17.2	86.2
	Mechanical	4	13.8	13.8	100.0
	Total	29	100.0	100.0	

Chart 5



The next batch of questions was based on the 5 point Likert scale with the intention of obtaining the student's views regarding the Faculty of Engineering at the University of KwaZulu-Natal. The scale consisted of responses strongly disagree, disagree, neutral, agree and strongly agree. For the purposes of analysis, due to the poor response rate, the first two points and the last two were grouped together. Hence, strongly disagree and disagree was equivalent to value 1, neutral value 3 and agree and strongly agree value 5.

Each question was cross tabulated against gender. Questions 1-15 indicated the intermediate influences on the student during the course of study whilst questions 1-4 of the biographical set of questions focused on gender socialisation issues. An analysis of each of the questions in relation to the responses received by gender will be discussed.

Faculty-Specific Questions

Question 1: The number of female lecturers within the Faculty is sufficient.

Crosstab

Table 4

			one			Total
			1.00	3.00	5.00	1.00
Gender	male	Count	10	10	5	25
		% within one	71.4%	100.0%	100.0%	86.2%
	female	Count	3	0	0	3
		% within one	21.4%	.0%	.0%	10.3%
	no response	Count	1	0	0	1
		% within one	7.1%	.0%	.0%	3.4%
Total		Count	14	10	5	29
		% within one	100.0%	100.0%	100.0%	100.0%

In summary 44.8% of the students disagreed with the statement that the number of female lecturers within the Faculty is sufficient. 34% were neutral and 17.24% agreed with the statement. It can be concluded that the majority of students are not happy with the low numbers of female academics within the Faculty. Statistics for 2008 indicate that out of a total population of 106 teaching staff within the Faculty of Engineering at the University of KwaZulu-Natal, only 9 are female whilst 97 are male. This compares with the male-female ratio amongst teaching staff at other leading Faculties of Engineering in the country as indicated in Chapter 1.

Question 2: The School/Faculty provides opportunities for social contact with lecturers.

Crosstab

Table 5

			two			Total
			1.00	3.00	5.00	1.00
Gender	male	Count	9	7	9	25
		% within two	90.0%	77.8%	90.0%	86.2%
	female	Count	1	1	1	3
		% within two	10.0%	11.1%	10.0%	10.3%
	no response	Count	0	1	0	1
		% within two	.0%	11.1%	.0%	3.4%
Total		Count	10	9	10	29
		% within two	100.0%	100.0%	100.0%	100.0%

The response as indicated in Table 5 was fairly neutral and no interpretation can be incurred.

Question 3: I am exposed to the research undertaken by Postgraduates. This aimed to indicate whether students were exposed to postgraduate research during their undergraduate years. The aim was to establish whether this would in any way influence one to pursue postgraduate studies.

Table 6 indicates the response

Crosstab

			three			Total
			1.00	3.00	5.00	1.00
Gender	male	Count	13	6	6	25
		% within three	92.9%	75.0%	85.7%	86.2%
	female	Count	1	1	1	3
		% within three	7.1%	12.5%	14.3%	10.3%
	no response	Count	0	1	0	1
		% within three	.0%	12.5%	.0%	3.4%
Total		Count	14	8	7	29
		% within three	100.0%	100.0%	100.0%	100.0%

48.27% of students disagreed with the statement. It is difficult to analyse male versus the female response due to the poor response by female students and the fact that the three respondents all answered differently to this question. Hence, the conclusion is that the majority of respondents are not exposed to research undertaken by postgraduate students in the Faculty.

Question 4: The Faculty should offer tutorials with male-only and female-only classes

Table 7

Crosstab

			four			Total
			1.00	3.00	5.00	1.00
Gender	male	Count	22	2	1	25
		% within four	84.6%	100.0%	100.0%	86.2%
	female	Count	3	0	0	3
		% within four	11.5%	.0%	.0%	10.3%
	no response	Count	1	0	0	1
		% within four	3.8%	.0%	.0%	3.4%
Total		Count	26	2	1	29
		% within four	100.0%	100.0%	100.0%	100.0%

In conclusion the majority of students disagreed with the statement with 100% of female respondents disagreeing.

Question 5: Female students perform better than male students in their specific programmes

Table 8

Crosstab

			five			Total
			1.00	3.00	5.00	1.00
Gender	male	Count	15	10	0	25
		% within five	88.2%	90.9%	.0%	86.2%
	female	Count	1	1	1	3
		% within five	5.9%	9.1%	100.0%	10.3%
	no response	Count	1	0	0	1
		% within five	5.9%	.0%	.0%	3.4%
Total		Count	17	11	1	29
		% within five	100.0%	100.0%	100.0%	100.0%

55.17 % of respondents disagreed with the statement.

Question 6: The School/Faculty provides opportunities for social contact with Postgraduates

Table 9

Crosstab

			six			Total
			1.00	3.00	5.00	1.00
Gender	male	Count	12	6	7	25
		% within six	85.7%	100.0%	77.8%	86.2%
	female	Count	1	0	2	3
		% within six	7.1%	.0%	22.2%	10.3%
	no response	Count	1	0	0	1
		% within six	7.1%	.0%	.0%	3.4%
Total		Count	14	6	9	29
		% within six	100.0%	100.0%	100.0%	100.0%

The majority of the students felt that the Faculty does not provide opportunities for social contact with postgraduates.

Question 7: Male students dominate discussions in the laboratories/workshops. This was aimed at establishing whether male students dominated discussions in the lecture halls and workshops.

Table 10

Crosstab

			seven			Total
			1.00	3.00	5.00	1.00
Gender	male	Count	3	13	9	25
		% within seven	60.0%	100.0%	81.8%	86.2%
	female	Count	2	0	1	3
		% within seven	40.0%	.0%	9.1%	10.3%
	no response	Count	0	0	1	1
		% within seven	.0%	.0%	9.1%	3.4%
Total		Count	5	13	11	29
		% within seven	100.0%	100.0%	100.0%	100.0%

The majority of male respondents were neutral about this and the majority of female respondents disagreed with the statement. A total of 34.48% of respondents agreed with the statement.

Question 8: Male students are offered more opportunities to pursue postgraduate studies than their female counterparts

Table 11

Crosstab

			eight			Total
			1.00	3.00	5.00	1.00
Gender	male	Count	18	5	2	25
		% within eight	81.8%	100.0%	100.0%	86.2%
	female	Count	3	0	0	3
		% within eight	13.6%	.0%	.0%	10.3%
	no response	Count	1	0	0	1
		% within eight	4.5%	.0%	.0%	3.4%
Total		Count	22	5	2	29
		% within eight	100.0%	100.0%	100.0%	100.0%

The majority of students disagreed with the statement.

Question 9: Female students are unable to cope with the workload in the workshops/laboratories

Table 12

Crosstab

			nine			Total
			1.00	3.00	5.00	1.00
Gender	male	Count	17	6	2	25
		% within nine	85.0%	85.7%	100.0%	86.2%
	female	Count	3	0	0	3
		% within nine	15.0%	.0%	.0%	10.3%
	no response	Count	0	1	0	1
		% within nine	.0%	14.3%	.0%	3.4%
Total		Count	20	7	2	29
		% within nine	100.0%	100.0%	100.0%	100.0%

The majority of respondents disagreed with the statement.

Question10 was a rephrased and repeated question examining whether the faculty provided good access to research opportunities.

Question 10: The School/Faculty provides good access to research opportunities

Table 13

Crosstab

			ten			Total
			1.00	3.00	5.00	1.00
Gender	male	Count	6	7	12	25
		% within ten	75.0%	87.5%	92.3%	86.2%
	female	Count	2	1	0	3
		% within ten	25.0%	12.5%	.0%	10.3%
	no response	Count	0	0	1	1
		% within ten	.0%	.0%	7.7%	3.4%
Total		Count	8	8	13	29
		% within ten	100.0%	100.0%	100.0%	100.0%

The majority of respondents agreed with this statement and hence contradicted the previous response as indicated in question 3 where 48.27% of respondents indicated that the Faculty did not expose undergraduates to research.

Question 11: Gender differences do not hinder the learning process

Table 14

Crosstab

			eleven			Total
			1.00	3.00	5.00	1.00
Gender	male	Count	2	3	20	25
		% within eleven	100.0%	75.0%	87.0%	86.2%
	female	Count	0	1	2	3
		% within eleven	.0%	25.0%	8.7%	10.3%
	no response	Count	0	0	1	1
		% within eleven	.0%	.0%	4.3%	3.4%
Total		Count	2	4	23	29
		% within eleven	100.0%	100.0%	100.0%	100.0%

The vast majority of respondents, 75.86% agreed with the statement.

Question 12: Lecturers prefer teaching male students

Table 15

Crosstab

			twelve			Total
			1.00	3.00	5.00	1.00
Gender	male	Count	17	6	2	25
		% within twelve	89.5%	85.7%	66.7%	86.2%
	female	Count	1	1	1	3
		% within twelve	5.3%	14.3%	33.3%	10.3%
	no response	Count	1	0	0	1
		% within twelve	5.3%	.0%	.0%	3.4%
Total		Count	19	7	3	29
		% within twelve	100.0%	100.0%	100.0%	100.0%

The majority of students disagreed with the statement.

Question 13: Male students dominate discussions in class

Table 16

Crosstab

			thirteen			Total
			1.00	3.00	5.00	1.00
Gender	male	Count	9	4	12	25
		% within thirteen	81.8%	80.0%	92.3%	86.2%
	female	Count	2	0	1	3
		% within thirteen	18.2%	.0%	7.7%	10.3%
	no response	Count	0	1	0	1
		% within thirteen	.0%	20.0%	.0%	3.4%
Total		Count	11	5	13	29
		% within thirteen	100.0%	100.0%	100.0%	100.0%

Interestingly the majority of the male respondents agreed that the statement was true whilst 2 of the female respondents disagreed. The statement can not be generalised to indicate a gender bias as the majority of all Engineering programmes have a higher number of male students. Hence, male students could by virtue of their numbers dominate the discussions.

Question 14: Technical staff discriminate against female students. This question tried to find out whether technical staff within the faculty discriminate against the students on the basis of their gender.

Table 17

Crosstab

			fourteen			Total
			1.00	3.00	5.00	1.00
Gender	male	Count	20	5	0	25
		% within fourteen	87.0%	100.0%	.0%	86.2%
	female	Count	2	0	1	3
		% within fourteen	8.7%	.0%	100.0%	10.3%
	no response	Count	1	0	0	1
		% within fourteen	4.3%	.0%	.0%	3.4%
Total		Count	23	5	1	29
		% within fourteen	100.0%	100.0%	100.0%	100.0%

The majority of the students disagreed with the statement indicating no gender bias is felt by the students through interaction with technical staff in the workshops.

Question 15: Gender bias exists in the Academic and Administration of the Faculty

Table 18

Crosstab

			fifteen			Total
			1.00	3.00	5.00	1.00
Gender	male	Count	15	8	1	24
		% within fifteen	88.2%	88.9%	50.0%	85.7%
	female	Count	1	1	1	3
		% within fifteen	5.9%	11.1%	50.0%	10.7%
	no response	Count	1	0	0	1
		% within fifteen	5.9%	.0%	.0%	3.6%
Total		Count	17	9	2	28
		% within fifteen	100.0%	100.0%	100.0%	100.0%

The majority of the students felt that gender bias does not exist within the Faculty.

4.3 Discussion of the Results of the Online Student Survey

In order to analyze the experiences of the final year students selected to form part of the study, the researcher conducted an online survey questioning students about their interaction in the classroom, with each other, with their lecturers and with the technical staff. Other questions focused on the exposure of students to postgraduate opportunities and their perception on whether gender contributes to one's performance.

An interesting finding was that both the male and female respondents disagreed that gender plays a role in performance. The respondents also felt that the faculty should not offer separate classes that are gender-based. Of the respondents, 67% also disagreed that female students were unable to cope in the laboratories and workshops.

When faced with the question of whether male students dominate discussions in class, the majority of the male students agreed with the statement. However, across all the disciplines, the majority of students were male and could by virtue of their numbers have dominated discussions in class rather than due to their gender. On average male students consisted of 75% of the class across the seven disciplines. However, the researcher found it difficult to reach an accurate conclusion due to the poor response of only 22.48% of the 129 students who responded to the questionnaire. This issue would need to be explored in future through a broader study to ascertain whether this is a trend across the various Engineering faculties at higher education institutions.

The respondents also felt no discrimination due to their gender within the faculty, both from academic and administrative staff. The researcher could not conclude that a lack of exposure to postgraduate research and social contact with postgraduates would deter female students from pursuing a postgraduate education as all respondents mentioned that they did not receive any exposure to research within the faculty. Hence, the question still remains on what are the factors that contribute to a higher proportion of males pursuing a postgraduate degree in engineering than their female classmates?

The one question that saw respondents differ in their answers was with regards to the number of female lecturers in the faculty being sufficient. All female respondents disagreed with this statement whilst only 35% of the male respondents disagreed, 35% of males were neutral about this fact and 17% of males agreed that the number of female lecturers were sufficient. Hence, the gender of an academic seems to be an important factor in the classroom for the female students but not for the male students. One can deduce that female academics tend to play an important role both as role models and mentors for female students.

With regards to the general biographical questions that were asked, 90% of respondents stated that engineering was their first choice of study. The majority of respondents (83.2%) developed an interest in engineering during their formative years of 6-18. In line with this fact, 34.4% of respondents stated that they were influenced to choose engineering as a career by their educators, relatives and role models. This is in line with earlier discussions that educators have a huge role to play in influencing the career choice of their students.

The overall trend amongst the students is that gender does not play a role in the classroom dynamics however, the poor response rate of the female students, makes it very difficult for the researcher to draw firm conclusions.

4.4. Results of the Exam Performance of Male and Female Engineering Students within the Faculty of Engineering at the University of KwaZulu-Natal from 2005-2008.

The aim of this analysis is to determine whether there is a huge difference in the performance of male and female engineering students from their first year of study until the end of their third year. The exam results of the entire student population from 2005-2008 were analysed and the results presented.

Statistical methodology

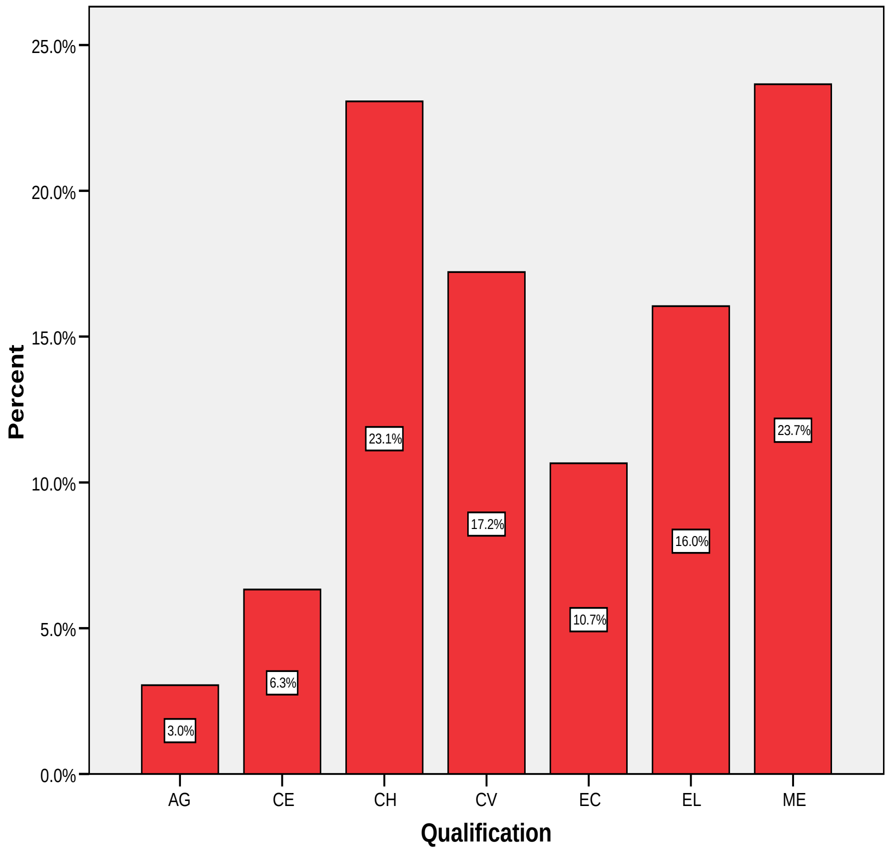
SPSS version 15.0 (SPSS Inc., Chicago, Illinois, USA) was used for analysis of data. A p value <0.05 was considered as statistically significant. Pearson's chi square tests were used to assess associations between demographics and drop out. Repeated measures ANOVA testing was used to assess the significance the effect of gender and qualification on the change in marks over the three years in those who completed the three years. Independent samples t-tests were used to compare marks between the genders at each year and one-way ANOVA testing was used to compare marks between the qualifications.

Results

The majority of the students were male (75.3%) as shown in Table 1.

		Frequency	Percent
Valid	Female	211	24.7
	Male	643	75.3
	Total	854	100.0

They were from seven different engineering departments, as shown in Figure 1. The majority of students were from Chemical and Mechanical engineering.



AG: Agricultural Engineering (name was changed to Bioresources Engineering in 2006)

CE: Computer Engineering

CH: Chemical Engineering

CV: Civil Engineering

EC: Electrical Engineering

EL: Electronic Engineering

ME: Mechanical Engineering

Drop out

Overall there were 540 (63.2%) dropouts over the 2 years. There was a borderline non-statistically significant association between gender and dropout ($p=0.057$). The table shows that females (68.7%) were slightly more likely to drop out than males (61.4%).

			Dropout		Total
			No	yes	
Gender	F	Count	66	145	211
		% within Gender	31.3%	68.7%	100.0%
	M	Count	248	395	643
		% within Gender	38.6%	61.4%	100.0%
Total		Count	314	540	854
		% within Gender	36.8%	63.2%	100.0%
Pearson Chi-Square				p=0.057	

There was a statistically significant association between qualification and drop out ($p<0.001$). The table shows that the AG engineers were most likely to drop out (77%) followed by Chemical (75.1%) and the others had a lower drop out rate.

			dropout		Total
			no	yes	no
Qualification	AG	Count	6	20	26
		% within Qualification	23.1%	76.9%	100.0%
	CE	Count	29	25	54
		% within Qualification	53.7%	46.3%	100.0%
	CH	Count	49	148	197
		% within Qualification	24.9%	75.1%	100.0%
	CV	Count	56	91	147
		% within Qualification	38.1%	61.9%	100.0%
	EC	Count	40	51	91
		% within Qualification	44.0%	56.0%	100.0%
	EL	Count	48	89	137
		% within Qualification	35.0%	65.0%	100.0%
	ME	Count	86	116	202
		% within Qualification	42.6%	57.4%	100.0%
Total		Count	314	540	854
		% within Qualification	36.8%	63.2%	100.0%
Pearson Chi-Square			P<0.001		

Performance

Students that did not drop out

Repeated measures ANOVA testing was performed on the marks of those who completed the 3 years. (n=314). Between-subjects effects were gender and qualification. There was a significant year effect ($p<0.001$) and the marks dropped significantly over time in all groups. However, there was no significant year*gender ($p=0.121$) effect. There was a significant year*qualification effect ($p<0.001$) but no 3 way interaction effect (year*gender*qualification $p=0.629$). The profile plot of time*gender shows that the rate of decline of the marks over the three years was similar in both genders, thus gender did not influence the rate of decline in marks. The profile plot of time*qualification shows different gradients of decline for each of the qualifications. Therefore qualification influenced the decline in marks but gender did not.

Multivariate Tests(c)

Effect		Value	F	Hypothesis df	Error df	Sig.
year	Pillai's Trace	.128	21.560(a)	2.000	293.000	.000
	Wilks' Lambda	.872	21.560(a)	2.000	293.000	.000
	Hotelling's Trace	.147	21.560(a)	2.000	293.000	.000
	Roy's Largest Root	.147	21.560(a)	2.000	293.000	.000
year * Gender	Pillai's Trace	.014	2.126(a)	2.000	293.000	.121
	Wilks' Lambda	.986	2.126(a)	2.000	293.000	.121
	Hotelling's Trace	.015	2.126(a)	2.000	293.000	.121
	Roy's Largest Root	.015	2.126(a)	2.000	293.000	.121
year * Qual1	Pillai's Trace	.231	6.410	12.000	588.000	.000
	Wilks' Lambda	.778	6.537(a)	12.000	586.000	.000
	Hotelling's Trace	.274	6.663	12.000	584.000	.000
	Roy's Largest Root	.220	10.791(b)	6.000	294.000	.000
year * Gender * Qual1	Pillai's Trace	.033	.823	12.000	588.000	.627
	Wilks' Lambda	.967	.821(a)	12.000	586.000	.629
	Hotelling's Trace	.034	.819	12.000	584.000	.631
	Roy's Largest Root	.022	1.054(b)	6.000	294.000	.391

a Exact statistic

b The statistic is an upper bound on F that yields a lower bound on the significance level.

c Design: Intercept+Gender+Qual1+Gender * Qual1

Within Subjects Design: year

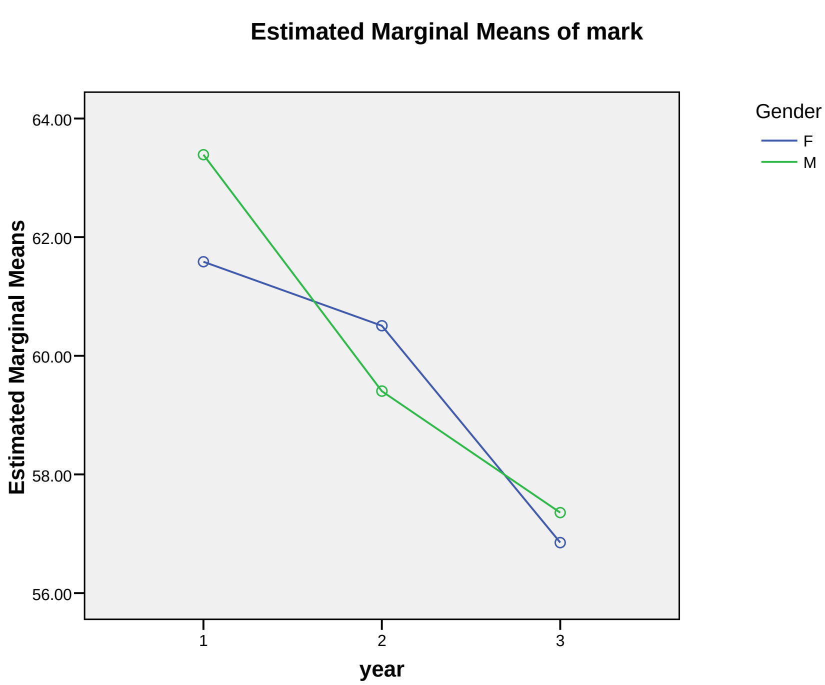
Tests of Between-Subjects Effects

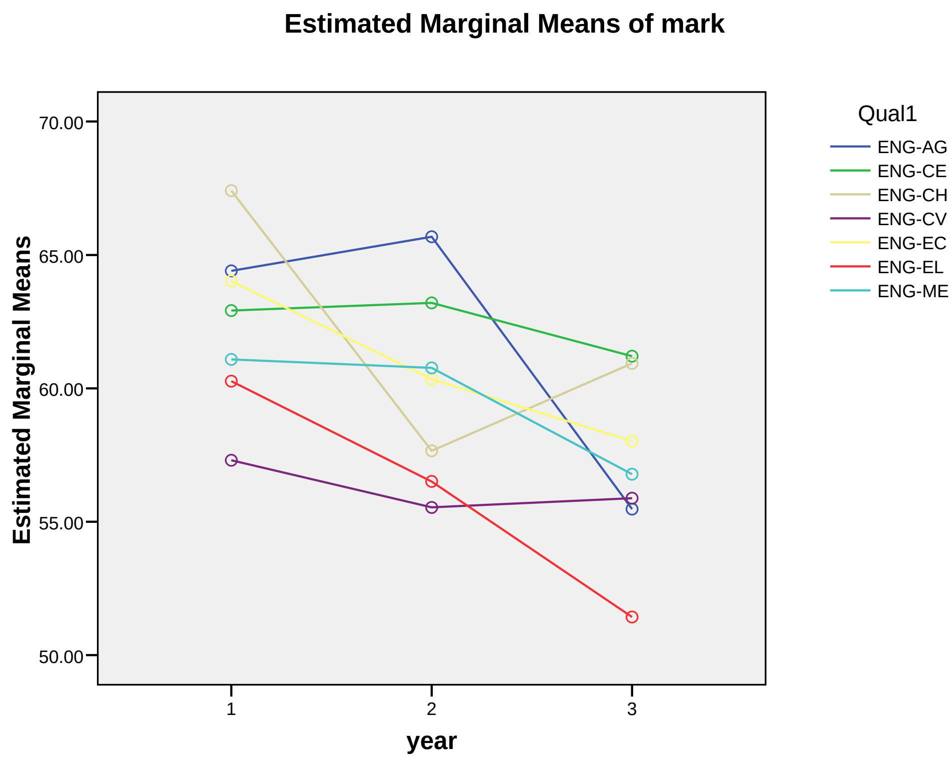
Measure: mark

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	1011015.701	1	1011015.701	6558.300	.000
Gender	11.453	1	11.453	.074	.785
Qual1	3268.791	6	544.798	3.534	.002
Gender * Qual1	1005.209	6	167.535	1.087	.370
Error	45322.512	294	154.158		

Profile Plots




Estimated Marginal Means of mark
Estimated Marginal Means
70.00
65.00
60.00
55.00
50.00
1
2
3
year
Qual1
ENG-AG
ENG-CE
ENG-CH
ENG-CV
ENG-EC
ENG-EL
ENG-ME

Cross-sectional analysis of marks

Marks by gender

Gender		Year 1 mark	Year 2 mark	Year 3 mark	total mean mark
F	Mean	51.2741	53.4068	57.3374	49.8678
	N	211	116	66	211
	Std. Deviation	11.44238	10.19047	7.46938	10.42696
M	Mean	53.0260	54.2301	57.3215	51.2714
	N	642	389	248	643
	Std. Deviation	12.31095	10.71603	9.15514	11.27676
Total	Mean	52.5926	54.0410	57.3248	50.9246
	N	853	505	314	854
	Std. Deviation	12.11893	10.59332	8.81640	11.08343

Year 1

There was a non significant difference between the genders with respect to marks in first year ($p=0.068$) although males tended to score slightly higher.

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Year 1 mark	M	642	53.0260	12.31095	.48587
	F	211	51.2741	11.44238	.78773

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of The Difference	
Year 1 mark	Equal variances assumed	1.535	.216	1.824	851	.068	1.75192	.96037	-.13305	3.63688
	Equal variances not assumed			1.893	382.068	.059	1.75192	.92552	-.06783	3.57167

Year 2

There was no difference between the genders in terms of marks in second year (p=0.463).

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Year 2 mark	M	389	54.2301	10.71603	.54332
	F	116	53.4068	10.19047	.94616

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
Year 2 mark	Equal variances assumed	.068	.795	.734	503	.463	.82335	1.12117	-1.37941	3.02611
	Equal variances not assumed			.755	196.999	.451	.82335	1.09107	-1.32832	2.97501

Year 3

There was no difference between the marks of males and females at year 3 (p=0.990). The average mark is slightly higher in year 3 than in the other 2 years since the year 1 and 2 average includes those who dropped out, thus the average is skewed by those who dropped out due to failure, while the year 3 mark includes only those who completed the three years and thus are those who tended not to fail. Also the gap between males and females was almost non existent at year 3, so the females that made it to year 3 had caught up with the males in their marks by year 3.

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Year 3 mark	M	248	57.3215	9.15514	.58135
	F	66	57.3374	7.46938	.91942

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
Year 3 mark	Equal variances assumed	2.300	.130	-.013	312	.990	-.01587	1.22307	-2.42239	2.39065
	Equal variances not assumed			-.015	122.224	.988	-.01587	1.08780	-2.16923	2.13749

Total mean mark vs drop out

dropout		Year 1 mark	Year 2 mark	Year 3 mark	total mean mark
no	Mean	62.0933	59.0076	57.3248	59.4261
	N	314	308	314	314
	Std. Deviation	8.21507	9.12277	8.81640	7.46906
yes	Mean	47.0579	46.2759		45.9811
	N	539	197		540
	Std. Deviation	10.48586	7.67055		9.76841
Total	Mean	52.5926	54.0410	57.3248	50.9246
	N	853	505	314	854
	Std. Deviation	12.11893	10.59332	8.81640	11.08343

Total mean mark was the average of each student's marks regardless of how many years they had studied for. There was a highly significant difference in mean mark between those who dropped out and those who completed the three years ($p<0.001$). The mean mark for the drop outs was a failure (46%).

Group Statistics

	dropout	N	Mean	Std. Deviation	Std. Error Mean
Total mean mark	no	314	59.4261	7.46906	.42150
	yes	540	45.9811	9.76841	.42037

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
Total mean mark	Equal variances assumed	8.832	.003	21.068	852	.000	13.44495	.63817	12.19238	14.69752
	Equal variances not assumed			22.585	790.912	.000	13.44495	.59529	12.27641	14.61349

Qualification vs marks

Qualification		Year 1 mark	Year 2 mark	Year 3 mark	total mean mark
AG	Mean	52.2942	54.6093	53.0806	51.0596
	N	26	17	6	26
	Std. Deviation	11.20962	10.64341	9.30578	9.88063
CE	Mean	58.7563	59.2142	61.9552	57.4051
	N	54	41	29	54
	Std. Deviation	10.65698	12.50381	10.82193	10.58712
CH	Mean	53.3868	50.1763	60.9935	50.4857
	N	197	120	49	197
	Std. Deviation	13.92883	10.10907	8.62704	12.28840
CV	Mean	49.0104	55.1222	57.1265	48.5992
	N	147	75	56	147
	Std. Deviation	12.10059	8.95339	8.26842	11.61181
EC	Mean	56.1654	55.1435	58.1354	54.0900
	N	91	63	40	91
	Std. Deviation	10.81076	11.37291	10.52038	10.32819
EL	Mean	50.7425	50.9420	52.3733	48.3981
	N	136	75	48	137
	Std. Deviation	10.75397	9.34252	6.53637	9.21463
ME	Mean	52.4518	56.8819	56.4851	51.5826
	N	202	114	86	202
	Std. Deviation	11.09444	9.96494	7.11626	10.22081
Total	Mean	52.5926	54.0410	57.3248	50.9246
	N	853	505	314	854
	Std. Deviation	12.11893	10.59332	8.81640	11.08343

Dependent Variable	(I) Qualification	(J) Qualification	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
Year 1 mark	AG	CE	-6.46210	2.83625	.482	-15.1050	2.1808
		CH	-1.09259	2.47922	1.000	-8.6475	6.4623
		CV	3.28387	2.52791	1.000	-4.4194	10.9871
		EC	-3.87115	2.64222	1.000	-11.9227	4.1804
		EL	1.55177	2.54322	1.000	-6.1982	9.3017
		ME	-.15758	2.47564	1.000	-7.7016	7.3864
	CE	AG	6.46210	2.83625	.482	-2.1808	15.1050
		CH	5.36951	1.82511	.070	-.1921	10.9311
		CV	9.74596(*)	1.89071	.000	3.9844	15.5075
		EC	2.59094	2.04103	1.000	-3.6287	8.8105
		EL	8.01386(*)	1.91114	.001	2.1901	13.8377
		ME	6.30451(*)	1.82025	.012	.7577	11.8513
	CH	AG	1.09259	2.47922	1.000	-6.4623	8.6475
		CE	-5.36951	1.82511	.070	-10.9311	.1921
		CV	4.37646(*)	1.29500	.016	.4302	8.3227
		EC	-2.77857	1.50600	1.000	-7.3678	1.8107
		EL	2.64436	1.32465	.971	-1.3922	6.6810
		ME	.93500	1.18976	1.000	-2.6905	4.5606
	CV	AG	-3.28387	2.52791	1.000	-10.9871	4.4194
		CE	-9.74596(*)	1.89071	.000	-15.5075	-3.9844
		CH	-4.37646(*)	1.29500	.016	-8.3227	-.4302
		EC	-7.15502(*)	1.58486	.000	-11.9846	-2.3255
		EL	-1.73210	1.41367	1.000	-6.0400	2.5758
		ME	-3.44145	1.28814	.162	-7.3668	.4839
	EC	AG	3.87115	2.64222	1.000	-4.1804	11.9227
		CE	-2.59094	2.04103	1.000	-8.8105	3.6287
		CH	2.77857	1.50600	1.000	-1.8107	7.3678
		CV	7.15502(*)	1.58486	.000	2.3255	11.9846
		EL	5.42292(*)	1.60918	.017	.5193	10.3266
		ME	3.71357	1.50010	.283	-.8577	8.2848
	EL	AG	-1.55177	2.54322	1.000	-9.3017	6.1982
		CE	-8.01386(*)	1.91114	.001	-13.8377	-2.1901
		CH	-2.64436	1.32465	.971	-6.6810	1.3922
		CV	1.73210	1.41367	1.000	-2.5758	6.0400
		EC	-5.42292(*)	1.60918	.017	-10.3266	-.5193
		ME	-1.70935	1.31794	1.000	-5.7255	2.3068
	ME	AG	.15758	2.47564	1.000	-7.3864	7.7016
		CE	-6.30451(*)	1.82025	.012	-11.8513	-.7577
		CH	-.93500	1.18976	1.000	-4.5606	2.6905
		CV	3.44145	1.28814	.162	-.4839	7.3668
		EC	-3.71357	1.50010	.283	-8.2848	.8577
		EL	1.70935	1.31794	1.000	-2.3068	5.7255
	AG	CE	-4.60491	2.94370	1.000	-13.5942	4.3844
		CH	4.43299	2.64448	1.000	-3.6426	12.5086
		CV	-.51291	2.74116	1.000	-8.8837	7.8579
		EC	-.53420	2.78898	1.000	-9.0511	7.9826
		EL	3.66731	2.74116	1.000	-4.7035	12.0381
		ME	-2.27256	2.65310	1.000	-10.3745	5.8294

One-way ANOVA showed that qualification affected marks highly significantly ($p<0.001$) at each of the three years and in total. The post hoc tests show which qualifications achieved different marks from each other and which were not significantly different. For example in first year AG was not significantly different to any other qualification but CE vs CV ($p<0.001$), CE vs EL ($p<0.001$) and CE vs ME ($p=0.012$) were significantly different in terms of first year marks.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Year 1 mark	Between Groups	5695.616	6	949.269	6.724	P<0.001
	Within Groups	119436.363	846	141.178		
	Total	125131.980	852			
Year 2 mark	Between Groups	4699.620	6	783.270	7.522	P<0.001
	Within Groups	51858.515	498	104.134		
	Total	56558.135	504			
Year 3 mark	Between Groups	2655.352	6	442.559	6.269	P<0.001
	Within Groups	21673.797	307	70.599		
	Total	24329.148	313			
Total mean mark	Between Groups	4974.934	6	829.156	7.036	P<0.001
	Within Groups	99809.607	847	117.839		
	Total	104784.542	853			

Post Hoc Tests

Multiple Comparisons

Bonferroni

* The mean difference is significant at the .05 level.

In essence these results indicate that gender did not affect drop out or marks of the students from first to third year of study but qualification did highly significantly over the three years and in total.

4.5 Responses from Female Academics

There are 9 female academics within the Faculty of Engineering. Of these 4 responded to the online questionnaire indicating a 44% response rate.

The respondents were requested to answer a range of faculty-specific questions that were based on the 5 point Likert scale ranging from strongly disagree, disagree, neutral, agree and strongly agree as well as open-ended questions. The results are as follows:

- Question 1: The number of female lecturers is sufficient: All respondents disagreed with the statement. This is in line with the responses obtained from the female students.
- Question 2: The School/Faculty provides opportunities for social contact with Undergraduate students: All respondents disagreed with the statement. Again this is in line with the responses received from all the students that participated in the study.
- Question 3: I expose my undergraduates to research by postgraduate students: 1 respondent disagreed, 2 were neutral and 1 agreed
- Question 4: The Faculty should offer male-only and female-only classes: All respondents strongly disagreed with the statement as did all the students
- Question 5: Female students perform better than male students: 3 respondents disagreed and 1 was neutral. The statistics on the exam performance of the students indicated that gender does not play a significant role in performance.
- Question 6: The School/faculty provides opportunities for social contact: 2 respondents disagreed, 1 was neutral and 1 agreed
- Question 7: Male students dominate discussions in the laboratories/workshops: 2 respondents disagreed, 1 was neutral and 1 strongly agreed. The majority of students agreed with this statement and as mentioned previously male students dominate discussions by mere virtue of their numbers.
- Question 8: Female students are unable to cope with the workload in the workshops: 3 respondents disagreed and 1 agreed

- Question 9: Gender differences do not hinder the learning process: 2 agreed, 1 was neutral and 1 did not respond
- Question 10: Male students dominate discussions in class: 2 disagreed and 2 agreed with the statement
- Question 11: Gender bias exists in the Faculty: 3 agreed and 1 disagreed. Clearly the academics experiences of gender bias differs from the students who did not feel that this was an issue of concern in the faculty.
- Question 12: Respondents were asked whether they would like to mentor and female-only class: 3 disagreed and 1 was neutral. Overall, it can be concluded that a division of the classes along gender lines is not perceived as a solution to the research problem by both the academics and students.
- Question 13: Is gender an issues within industry?: 2 agreed, 1 was neutral and 1 disagreed. Both female academics from the Department of Chemical Engineering did not agree with the statement inferring that gender bias within industry could be discipline specific. However, the researcher does not investigate this issue within this project.
- Question 14: Females can’t cope with the work load in industry: All the respondents disagreed with the statement
- Question 15: Management is male-dominated in the faculty: All respondents agreed
- Question 16: Females lecturers are not provided with adequate support in the faculty: 2 respondents strongly agreed, 1 agreed and 1 disagreed with the statement. Again both respondents that strongly agreed where from the same department. Experiences could differ amongst departments.
- Question 17: Gender should not be an issue in the field of engineering: 2 strongly disagreed, 1 agreed and 1 strongly agreed. No conclusion could be drawn from these responses.

In comparing the responses between the female students and academics, their experiences within the faculty are similar. In order to expand on specific fields, the researcher provided open-ended questions to obtain more detailed responses. This consisted of four questions.

1. In question one, the researcher sought to establish whether the female academics prefer working with male students. The responses are very different. Two respondents stated that they work equally well with both genders. One respondent

stated that she finds it difficult working with White male students. Another respondent mentioned that she does find it easier working with male students as they grasp concepts better than the females. She also mentioned that male students are among the top 10% of the class and usually this group dominates discussions and are more familiar with the practical and technical aspects of the degree.

The researcher found it difficult to draw a conclusion here as the majority of the respondents worked equally well with both genders. The exam performance statistics confirmed that both genders also perform equally well in their exams so teaching and exam performance does not seem to have a gendered difference.

2. Question two established whether female academics find it easier to recruit male students into postgraduate programmes? Three of the respondents mentioned that they find it easier to recruit males into postgraduate study as there are more male students in the total student body. They also mentioned that females tend to prefer to go into industry after graduation rather than stay on for postgraduate studies. One respondent mentioned that it depends on the calibre of the student rather than their gender. Hence, the researcher concluded that female students preferred to begin their careers earlier than their male counterparts. Could this be due to extraneous factors such as family responsibilities which would prevent a female graduate from studying further? The many successful female engineers who have been mentioned in this study all mentioned that balancing work and family is a huge challenge they had to overcome.

3. Question three sought to establish whether male students performed better academically than female students. Only one respondent agreed with the statement. As the researcher has earlier indicated exam performance seems to be discipline related and not based on gender.

4. Question four ascertained whether male students performed better than females, technically? One respondent did not understand the question. One mentioned that performance is not gender related. Two respondents mentioned that the female students have a problem in understanding the technical aspects and that this may be due to gender stereotyping. In other words, female students may be inclined to think they can’t do something technical.

4.6 Conclusion

Through a quantitative analysis of performance from first to third year, a significant factor that was noted was that male students performed slightly better than their female classmates in their first year of study across the seven disciplines of engineering. However, in the second year of study the mean average for male students is 54.23 and for female students 53.40. Hence, indicating a very slight statistical difference in marks. In the third year of study, female students had caught up with the male students with a mean average score of 57.33 as compared to the male mean average of 57.32.

Another factor of note is that the main reason for the high drop out rate within the various disciplines was due to failure with the average mean of the students that dropped out being 46%. Gender also did not influence drop out but the specific discipline of choice did.

Through the analysis of both the online survey and the marks of students from first to third year, it can concluded that gender does not play a significant role in the classroom dynamics and interaction between males and females and neither does it play a significant role in performance. The responses from the female academics also indicated that gender and performance were not related.

Hence, both genders were given equal opportunities and perform similarly. Thus the social and academic environment within the Faculty of Engineering in the University of KwaZulu-Natal does not deter female students from studying further.

Female academics found it easier to recruit male students into postgraduate studies as they were found to be keener to stay on at university and study further. Female students were more inclined to pursue their careers in industry sooner and this may be due to family responsibilities and the need to earn an income soon after graduation.

The experiences of the female academics indicated that female students have a problem understanding technical aspects due to stereotyping in society. Hence, female students are inclined to think they can’t do something technical.

The following chapter provides recommendations on strategies the Faculty of Engineering within the University of KwaZulu-Natal may use to increase the number of female postgraduates and academics. The gender of an academic seems to be an important factor in the classroom for the female students but not for the male students. One can deduce that female academics tend to play an important role both as role models and mentors for female students. One of the recommendations described is that of mentorship and role models.

CHAPTER 5
RECOMMENDATIONS

5.1 Introduction

A study, commissioned by the National Department of Science and Technology in 2003 to the University of Stellenbosch was to investigate women in SET in South Africa. The study focused on women as postgraduate students, researchers or academics in the higher education sector in South Africa. The research found that women constituted a 58% of all graduates within this sector. However, there were fewer women as academics, researchers, scientists and postgraduates. Through the analysis of various studies and initiatives across the globe, the researcher mentioned some of the recommendations that may be relevant to the South African higher education setting. These include Pedagogy change and Gender informed mentoring strategies.

5.2 Pedagogy Change

Beraud (2002: 435) conducted a study in Europe looking at the potential of Interdisciplinary courses in Engineering, Information technology, Natural and Socio-economic Sciences in a changing society. In 2001, a consortium of teams from seven European countries was created to understand why the number of women involved in Engineering is increasing too slowly and to look at an effective method of attracting women into engineering training. The hypothesis that the study tested was whether a percentage of human and social sciences included in the training would make a significant difference. A discussion of this report which was presented to the European Union in 2003 follows.

The study found that degree courses in Engineering have consistently proved unattractive for women students, especially in the disciplines of Civil and Electrical Engineering. This is in spite of the fact that a high proportion of schoolgirls have a high academic performance in Mathematics and Natural Sciences. Hence, the overall objective of the study was to propose a methodology toolbox for international cross-cultural degrees in engineering that were combined with Socio-Economic sciences.

To carry out the work, the team decided that the degree courses would consist of Civil, Mechanical, Industrial Production and Information Engineering with a percentage of not less than 25% of non-technical content. The non-interdisciplinary degree course would also continue to exist as a control group within the various universities that participated in the study.

The conclusions of the study attained through questionnaires and interviews were that interdisciplinary approach seems to be interesting for all students and could also help them in their professional lives. Inter-disciplinarity could also help recruit women engineers. Employers and academics consider women as technically highly skilled engineers now and in the future global economy. Hence, the recommendations of the study are to set up interdisciplinary degrees to increase the proportion of women taking up engineering. At least 25% of the course content should have a socio-economic content.

The Open University in the UK adopted a similar approach in 2002 as found in Alha and Gibson (2002: 219). The university introduced an interdisciplinary approach to course content but included computer-mediated communication and resource-based learning. The three courses that were introduced as teaching mechanisms were Your Computer and The Net, Communicating Technology and Digital Communications. The study found that the course appealed to a greater number of people with an increase in both male and female students and the dropout rate was reduced.

However, gender differences emerged which saw that 82% of women were positive about computer referencing as compared to 58% of men. In the use of the World Wide Web, there were 91% women that were positive about the content as opposed to only 50% of men.

In South Africa within the University of Cape Town, (Jawitz 2000a:15) states that many engineering faculties in the country need to keep abreast of change. He mentions that the challenges facing engineering educators of future generations of engineers' demands imaginative foresight and planning, as well as creative implementation. He states that a great deal of re-thinking and re-working of objectives, curricula and methods needs to take place due to the changing nature of engineering as well as rapid development in technology.

The driving force in South African universities is to ensure that engineering graduates achieve learning outcomes that are appropriate for students entering the engineering profession. The Engineering Council of South Africa has adopted this approach together with signatories of the Washington Accord, which is an international agreement to work towards mutual recognition of undergraduate engineering qualifications. (Jawitz 2000b: 16) goes on to assert in his article that the engineering industry no longer wants engineers that are schooled in narrow technical disciplines with a limited range of knowledge and skills. Instead firms are becoming increasingly multi-disciplinary and need graduates who have the ability to learn whatever the job requires them to know.

Hence, it is necessary for South African Engineering Faculties to assess whether their programmes are still relevant and whether they will continue to be relevant once their students are in the working world. Either way, it is crucial that Higher Education institutions across the globe embark on pedagogy change that not only embraces the changing economy but also to contribute toward a growth in female participation in the engineering sector.

One of the methods within higher education institutions to ensure a growth in postgraduate numbers of female engineering students has been to adopt a mentoring approach. A critical overview of this teaching method follows.

5.3 Gender Informed Mentoring Strategies

According to Sturge (1996: 4) mentors, who are invariably described as friends, advisors, teachers and counsellors, are thought to be a useful way of attracting more girls into Science, Engineering and Technology (SET) careers as well as involving women already working in a non-traditional areas in role-modelling. According to Sturge, the Tower Hamlets Education Business Partnership in the UK runs a mentoring programme involving 110 mentors that are employees of large city organizations, which aims to make students more aware of the range of career possibilities that exist in the world of work.

Another example within the UK is an initiative by BP and the University of Sunderland where undergraduates are sponsored to work in nursery, primary as well as secondary schools to help out on science projects. These projects help to raise the level of science education in schools and female undergraduates provide role models for girls of all ages.

Jawitz (2000c:18) argues that the engineering profession has traditionally been limited to males and hence higher education institutions have a responsibility to help facilitate the increased participation of women in engineering, in line with the broader social project to bring about social equity in South Africa. As part of his study, Jawitz interviewed a number of students at the University of Cape Town (UCT) and in his paper quoted one of the undergraduate students.

Xoliswa mentioned, after attending the first Women in Engineering Conference held at UCT, “I was affected by Jeff Jawitz’s talk on the subject ‘Exploring the reasons South African students give for studying engineering,’ When he mentioned social identity, I was immediately transported into my first year. However, in the five years that I have been here I have lost the drive I had for initially doing Engineering.” Jawitz’s comments to his colleagues with regards to Xoliswa’s remarks was that the task of engineering educators is to ensure that, despite the odds stacked up against her and other female engineering students, that someone like Xoliswa can develop a strong basis from which to achieve her goals as an engineer.

For engineering educators the task ahead is a difficult and challenging one. Their role is to produce engineering graduates with the basic abilities required to enter the engineering profession and the commitment to help steer the industrial development of South Africa. This task requires much more than simply preparing and delivering lectures, it requires them to serve as role models and also keep abreast and contribute to the developments in higher engineering education. What then is the role of engineering educators as mentors and how has mentoring programmes been successful or have they in achieving the overall goal of producing more female engineering graduates and more women in the postgraduate engineering sector?

A discussion follows of an interesting perspective on mentoring in the higher education sector in the United States by Chesler (2002:49-54). The focus of the study was based on the premise that improved mentoring of women graduate students and young academics is one strategy for increasing the presence, retention and advancement of women scholars in engineering. The study looked at various mentoring models and its impact.

Chesler mentions that socialization of women as compared to men is particularly relevant to their success in the sciences and engineering, because women are less confident and more alienated by the culture of fields that do not fit in with their own learned styles. Chesler found evidence which suggests that many men find women in engineering either "unnatural" or unfeminine, marginalizing them through the use of pejoratives such as ugly, sexually deviant, or suggesting that they were too smart or too busy to be attractive. These perceptions and related behaviours, when acted out in the classroom, are reinforced in the lives of both men and women.

These barriers prevent many women from succeeding in Science, Manufacturing and Engineering fields (SME) fields and contribute to the "leaky pipeline" of women in engineering in both the masters and doctoral levels. Women must enter and find their way through a "chilly" climate. Once in these environments, the care-taking roles expected of women as wives and mothers compete with academic demands.

The purpose of the mentoring strategy is to increase the number of women scholars that enter, stay and advance in engineering by creating a supportive research, teaching and service environment with approachable, access to senior faculty of either gender. Chesler (2002:50) defines mentoring as "a developmental relationship in which an experienced person provides both technical and psycho-social support to a less experienced person. In return the mentor gains personal satisfaction; respect from colleagues for successfully developing younger talent and in the best case grows intellectually as well."

Traditional mentoring models are categorized into the Heroic Journey and Cross-Gender Mentoring. With regards to the Heroic Journey, two major components typify this approach to mentoring. The first is the priority of informational and technical conversation, relationships and guidance over psycho-social issues. The second is the actual commitment to the heroic journey.

The heroic journey is defined by Broome (1999:52) as the stressing of independence. The student is challenged with difficult tasks that are posed in order to weed out those who can not rise to the challenge. The hero's journey is therefore a separation from dependency, including the abandonment by former helpers, solely engaging in the challenge and then returning the triumphant hero. The denial of nurturing in the midst of stressful situations is presumed to lead to healthy independence and stems from the traditional “tests of manhood” present in military and sporting arena’s.

The second traditional mentoring method is cross-gender mentoring. The dominant mentoring style within the Science and Engineering sector is based on traditional model of male socialization. In these male-dominated fields, there are few senior female faculty staff available to act as mentors and models. Chesler (2002: 51) also found that even when there were senior women present and available, junior women might not develop mentoring relationships with them for several reasons. Firstly, when senior women are perceived as being outside the departmental norm, they will be less appealing mentors to young women attempting to construct their own personal and professional personae. In the same study, graduate students perceive their senior female faculty as wielding less power and having less influence both inside and outside their department. Therefore, they are seen as being less effective on providing the types of instrumental assistance graduate students need. Thirdly, some senior women may not wish to take on the role of mentoring junior women in particular, seeing this as a stereotypic role that adds to an already overloaded agenda.

Hence, Chesler concludes that, “traditional mentoring models do not prove to be effective. Both male and female senior faculty either consciously or unconsciously adopts aspects of the “heroic male journey” as their mentoring model and hence they are likely to ill-serve female graduates and young faculty. Young women may be more comfortable responding to praise than to challenge, perform better when supported rather than tested, seek peer collaboration rather than competition and may wish to construct their careers around different priorities than their male counterparts. Hence, this motivates the search for alternative mentoring models” (chesler, 2002:52).

According to Tierney and Bensimon (1996:43) the notion of a single experienced faculty member being willing and able to play the all-inclusive role of mentor is wishful thinking. They ascertain that a variety of individuals are required to help meet a mentee’s diverse needs. One alternative model is that of multiple mentoring which encourages the protégé to construct a mentoring community based on a diverse set of helpers instead of relying on a single mentor. This can be accomplished by establishing a climate of trust quite early on in the student’s career so that the trust lays the foundation for a more engaging mentoring relationship. The disadvantage of this approach, according to Chesler (2002: 51) is that it lays the responsibility of creating a mentoring community with the protégé. Also finding a diverse set of helpers who meet the various and changing needs of the protégé in a new institution is not a trivial task.

The second type of alternative mentoring model is peer mentoring. Female friendship and study groups may help women engineering students learn material and support one another while avoiding openly competitive or negative interactions with men. This model is also more flexible in time and level of commitment that women experience with the traditional mentoring model. These include unpredictable family and child-care responsibilities and career interruptions. However, this model also has its shortfalls. Namely, the fact that peers have a lack of experience and difficulties may arise if their careers advance at different rates. Also a complication with this model is whose needs are met.

The third type of alternative mentoring model is that of collective mentoring which involves senior colleagues in the department taking responsibility for constructing and maintaining a mentoring team. Hence, one can draw upon the knowledge of senior female staff on how the cultures of engineering departments work. Collective mentoring is a formal and collective organizational task, part of the organization's ability to orient and socialize its new members.

On the 23 August 2008, the non-profit organization SA WomEng held its annual conference which included female engineering students and academics from the Universities of Witswatersrand, Cape Town, Stellenbosch, KwaZulu-Natal and Pretoria as well as female engineers from industry. "The whole idea is to have a support system in place for female engineering students in third and fourth year", said Moosajee who is one of the co-founders of SA WomEng (The Star, 2008:8). She went on to state that, "A significant number of women students enrol for engineering studies at tertiary institutions only to drop out or change their course by the end of their first or second year. We want to ensure that those who make it through to final year are given assistance when the going gets tough".

Hence, mentoring is an important component of efforts to improve the presence, retention and advancement of women faculty and graduate students in engineering. However, successful mentoring of women in the Engineering sector must recognize the different cultural styles, backgrounds and the needs of women for supportive and nurturing relationships amidst the highly stressful and competitive profession, the different experiences of men and women in the scientific enterprise and the socially-constructed and institutionally supported dynamics of gender privilege that affect cross-gender relationships. However, mentoring is only one approach that is needed for women to overcome career barriers and disadvantages experienced in the Engineering sector. Another important element is that of the contribution of the employment sector to the initiative of encouraging and retaining more women in engineering.

5.4 Role of Industry in Encouraging More Women into Engineering

There are many challenges that confront women, which make it difficult for them to advance in an engineering career. Some of these challenges involve the issues they face within the industry sector.

In 2008 the European Commission published the findings of a study conducted by academics from the University of Sussex, the UK Institute for Employment Studies, and the Mihajlo Pupin Institute (Research eu: 2008). The main aim of the study was to analyze the policies of countries, their mentoring schemes, exchange of knowledge, all in the effort to increase and retain the number of women engineers and scientists in the labour market. The participating countries in the study covers all European Union states, Iceland, Israel, Norway, Croatia, Switzerland, Turkey, Albania, Bosnia and Herzegovina, former Yugoslav Republic of Macedonia, Montenegro and Serbia.

“Data from the findings indicated that the cause of women’s under-representation in science is often located on the demand side, that is derived from employer policies and/or strategies, and therefore in many cases the solution is related to changing the culture and organisation of the science sector overall and this relates directly to industrial research and in the business enterprise sector” (Potocnik, 2008:37).

Hence, in the countries studied, it was found that the domestic division of labour is unequally distributed and that women carry out most of the child-rearing and household tasks. In light of this women tend to take a career break due to child-care responsibilities and tend to work part-time in order to balance work and their home life. Hence, the study found that public policies concerning child care, parental leave, and measures to reintegrate mothers into their careers all play an important role in influencing a woman's decision to work or not.

There are many ways in which employers can contribute to the goal of encouraging more women into engineering careers. Employers can give talks at schools, host workplace visits, donate materials and surplus equipment and help children with project work. A study by Sturge (1996:4) found that some companies had initiated successful projects in this regard. She mentions British Airways, which devised a programme in which it designed curriculum materials with local teachers on the key business themes of People at Work, Customer Service and Planning Journeys.

Another company that she mentions is Northampton Engineering Firm which sends engineering apprentices into a local primary school to work with children and science teachers on science-based projects. The company says that the experience provides useful training and development for apprentices who are responsible for securing raw materials in the firm. Another example is that of car manufacturer, Toyota, which invested 1.2 million pounds in science education in the UK by setting up a fund to finance science and technology projects in primary and secondary schools. Each project features a teacher placement with a local business.

Similarly, Unilever are looking to develop more women as they move towards a culture in which diversity is valued. Companies believe that a more diverse workforce is a more creative workforce capable of challenging old attitudes and practices and bringing fresh thinking and greater innovation to product development.

In a study in the United States as found in Professional Engineering (2003:14) carmaker Ford was recognized for their efforts to address equality in the workplace. The company won an award for its success in attracting more women into engineering. Ford had been running an initiative to retain and recruit more women at all levels, but specifically in non-traditional roles like Engineering. This was aimed at better reflecting its customer base where women make up 60% of the purchasing decisions. The strategy worked because it recognized different needs of women in the workplace. New initiatives were implemented throughout the company, including 52 weeks maternity leave including full pay, career breaks and home and flexible working.

Their results was that there were more women in top management, women working part-time on the shop floor and an employee promoted to director level upon her return from maternity leave. In a single year, the number of women working in the company increased from 6.5 to 7.3% and 96% of women on maternity leave return to work. Thus these initiatives by companies indicate that if the needs of women are understood and met, retention of women within the industry sector is no longer an issue.

In South Africa Siemens plays a huge role in mentoring female engineering students in higher education institutions. Nicolette Barnard of Siemens said, “We will continue to partner with higher education institutions in order to ignite the engineering flame, to facilitate mentorship, to embrace the femininity of the engineering women and to incubate an engineering mind (siemens, 13 February 2009).

Volkswagen (VW) South Africa has embarked on a number of initiatives to bolster the employment of women in engineering related jobs at its Uitenhage car plant. Below some of these initiatives are described by Heidi Bantam of VW (www.vw.co.za, 16 February 2009). Bantam mentions that of the 823 women who work in VW of South Africa, 27 are employed as engineers, while 60% work in technical positions throughout the country.

The first initiative VW embarked on was to expose tertiary students to the process of automotive engineering and manufacturing through in-depth presentations by top VW executives. Secondly, VW has sponsored over three years the SAWomEng Conference which it uses as a platform to source top engineering talent. Bantam also mentions that another initiative was supplying the company’s top female engineer as a mentor to a group of tertiary female engineering students namely Terri-Ann Terblanche.

Through her years of experience in the Engineering field and working with prospective female engineers at higher education institutions, Terblanche had this to say, “I always say that women as a resource are vastly underutilized. Volkswagen has said it wants to employ women. If you can think analytically and are a problem solver by nature, why not pursue a career in engineering?” (Vw, 16 February 2009).

Let's now look a few examples of successful female engineers.

5.5 Successful Role Models

In Connecting Education and Careers (2004:1) an article entitled "Women at the Top of Engineering" quoted some successful women in the engineering sector. Patricia Galloway became the President of American Society of Civil Engineers and she was the first woman in the organization's 150-year history to hold the office. Galloway is quoted, "I don't view my election as a milestone, but instead a validation on how far we have come in accepting people for their abilities and skills."

Another example is of LeEarl Byrant who became the President of the Institute of Electrical and Electronic Engineers in the United States in 2002. In 2003, Diane Dorland was elected as the president of the American Institute of Chemical Engineers. Also in 2003, Susan Skemp became the president of the American Society of Mechanical Engineers International. These are all remarkable achievements for these women as US Census Bureau in 2003 found that women represent only 9.5% of civil engineers, 7.1% of mechanical engineers, 10.1% of electrical engineers, 11.5% of aeronautical engineers, 16.3% of chemical engineers and 16.8% of industrial engineers (www.acteonline.org: 27 February 2007). As we've seen women have still managed to break down very significant barriers when it comes to leadership in the field.

Another very successful female engineer is Barb Samardzich (design news, 27 February 2008) who is the Executive Director of Ford Motor Company, Small Front and Rear Wheel Drive Vehicles. Samardzich mentioned that had she listened to her mother she would not have been the Executive Director of the World's second largest car company. However, she chose to listen to her brother who said, "Go into Engineering, You will be sure to get a job." Since joining Ford, she has managed to work her way up the ranks garnering respect, and a list of achievements that includes a complete overhaul of Ford's Automatic Transmission Line.

Jude Garzolini who is the President of the Society of Women Engineers in the United States is quoted in Electronic Design (Garzolini 2006:41); "Engineering is an outstanding career path for women. The research from the Extraordinary Women Engineers project identified that career motivators for high school girls align with the realities of engineering careers. Engineering is about creativity, design, and innovation. Both the overall demand for people with the technical expertise and the value placed on diversity in engineering offers women a lucrative career.

Mary Ellen Randall who's the Chair of the International Electrical, Electronic Engineering, Women in Engineering Committee, had this to say to all prospective female engineers, "Stay with it. Women who work in this industry tend to do very well. Build a strong network of women and men who will help and support you. Relationships will add to your success. Be sure to find good mentors and utilize them to help you understand corporate culture, keep you up to date on what is happening in the workplace and make introductions for you and open doors" (Bell, 2006:42).

In South Africa, a very successful role model is civil engineering Allyson Lawless who formed the Allyson Lawless Company which pioneered the development of affordable, desktop civil engineering software. Lawless is a graduate of the University of KwaZulu-Natal and information has been extracted from the University's Alumni database (UKZN, 16 February 2009). Lawless was the recipient of several awards including being named Business Woman of the Year finalist, winner of the SAICE IT Project of the Centenary Award during the SAICE Centenary celebrations, Shoprite-Checkers/SABC2 Woman of the Year in Science and Technology and the recipient of a NSTF Award for individuals who have made outstanding contributions to science, engineering and technology in South Africa.

5.6 Conclusion

The status quo in the Faculty of Engineering at the University of KwaZulu-Natal indicates a huge shortage of female academics. As at the 18 December 2008, there were 99 male academic members of staff in the faculty as opposed to 9 female academics. The breakdown of academic ranking is as follows:

Rank	**Male**	**Female**
Professor	18	Nil
Associate Professor	10	1
Senior Lecturer	25	1
Lecturer	45	7
Tutor	1	Nil
Total	99	9

The female complement of only 9% of the total number of academics within the faculty clearly indicates a severe shortage. It is therefore essential that the female academics play a huge role in providing both mentorship and guidance to the female students. The study indicates that 44.8% of the students believe that the female complement of academics is insufficient. What can the faculty do to improve this complement?

One suggestion as indicated in the recommendations is that of pedagogy change which has indicated an increase in the number of females entering the engineering field globally.

When one compares the statistics of final year female and male students from 2004-2007, one is able to notice the huge difference in postgraduate enrolments between the two genders.

Year	**Females**	**Males**
2004	83	342
2005	102	386
2006	101	410
2007	112	418

The percentage of postgraduate enrolments as distributed between the two genders is as follows over the four year period. The table indicates the distribution as progressing from the final year of study to the postgraduate year. Hence, from the 2004 final year class, 69% of the females and 82% of the males enrolled for a postgraduate degree in 2005 and so on.

Year	**Female**	**Male**
2005	69%	82%
2006	54%	70%
2007	41%	55%
2008	46%	65%

The statistics is a clear indication that the number of males enrolling for a postgraduate degree from their final year of study is higher than their female counterparts.

However the researcher could not conclude that a lack of exposure to postgraduate research and social contact with postgraduates would deter female students from pursuing a postgraduate education as all respondents mentioned that they did not receive any exposure to research within the faculty. Hence, the question still remains what are the factors that contribute to a higher proportion of males pursuing a postgraduate degree in engineering than their female classmates? Could it be extraneous variables such as family responsibilities as mentioned by two of the female academic respondents which prevent female graduates from staying on at university? The fewer numbers of female postgraduates lends itself directly to fewer female academics in higher education institutions within Faculties of Engineering.

Certainly at the University of KwaZulu-Natal equal opportunities are provided to both genders and the students also perform similarly. Hence, the only factors which could deter female graduates would be extraneous factors such as family responsibilities or stereotyping of society.

CHAPTER 6
CONCLUSION

The research problem indicated that the numbers of female postgraduate engineers and academics was extremely lower than their male counterparts. In order to understand why this difference occurs, the researchers established three research objectives.

Firstly, the primary aim of this research study was to describe the social and academic environment within the Faculty of Engineering at the University of KwaZulu-Natal in 2008 as perceived by the final year classes. The researcher believed that an understanding of the environment would provide an explanation for the decreased number of females in postgraduate education and academia at the University of KwaZulu-Natal, South Africa.

The second objective was to illustrate the performance at the undergraduate level of study between female and male engineering students over a 3-year period. The aim was to ascertain whether there is a significant difference in the end of year results between female and male students that could be one of the factors that prevented female students from enrolling for postgraduate study.

The third objective of the study was to establish whether there is a marked difference in the perception of the final year students and the female academics in the Faculty with regards to issues around gender socialization such as whether the number of female academics is an important issue for both groups?, do the groups perceive the social and academic climate as being conducive to academic progression?, are male and female students perceived to be different in their relationships with both technicians and academic staff?, whether gender bias is perceived to exist in the Faculty, etc..

The researcher disseminated a descriptive survey to a stratified sample of undergraduate final year students in the disciplines of Chemical, Civil, Mechanical, Electrical, Electronic, Computer and Bioresources Engineering. The students are studying through the University of KwaZulu-Natal across the cities of both Durban and Pietermaritzburg. An online survey was also sent to the nine female academics within the Faculty in order to compare the academics perceptions and experiences with that of the students.

The aim of the survey was to determine the social and academic environment within the faculty and how this would either encourage or deter female graduates from studying further. The survey focussed on the classroom dynamics, experiences in the workshops, perceptions of academics and the faculty in general. It also looked at whether enough information and exposure is provided on research opportunities within the faculty.

The survey on female academics indicated that both the female groups, students and academics had similar experiences and perceptions of the faculty. Both groups felt that there was an insufficient complement of female academics; both groups mentioned that the male students dominated discussions in class; both groups were against having separate classes along gender lines. Both groups also mentioned that performance was not related to gender. It is interesting to note that the gender disparity of the academic staff was not an issue of concern to the male students.

The study indicated that the social and academic environment within the Faculty of Engineering at the University of KwaZulu-Natal was not a deterrent to female graduates studying further and entering academia. Although an issue of concern to both the student and academic group was the low numbers of female academics which is an issue that would need to be corrected by the Faculty.

The exam performance of both male and female students was similar and neither the drop-out rate nor failure was due to gender but rather to the choice of degree. Hence, the study indicated that factors such as family responsibility and gender stereotyping seem to prevent female graduates from studying further. This off course results in low numbers of female academics.

The Faculty of Engineering at the University of KwaZulu-Natal has implemented pedagogy change over the past 5 years which has seen the undergraduate numbers of female students increase. However, the manner in which the course is taught still remains conservative.
As indicated in the study by Alha and Gibson (2002: 219) at the Open University in the UK when the university introduced an interdisciplinary approach to course content and included computer-mediated communication and resource-based learning, the course appealed to a greater number of students and the drop-out rate was reduced.

Three courses were introduced as teaching mechanisms. These were Your Computer and The Net, Communicating Technology and Digital Communications. The study found that gender differences emerged which saw that 82% of women were positive about computer referencing as compared to 58% of men. In the use of the World Wide Web, there were 91% women that were positive about the content as opposed to only 50% of men. Certainly in this digital age and with female students preferring the World Wide Web, the Faculty of Engineering at the University of KwaZulu-Natal should consider offering online courses.

The second recommendation is that of gender informed mentoring strategies. The University of KwaZulu-Natal has adopted the Women in Leadership Leverage (WILL) programme across all faculties which encourage all senior female academics to volunteer to mentor junior staff. However, for engineering educators the task ahead is a difficult and challenging one. Their role is to produce engineering graduates with the basic abilities required to enter the engineering profession and the commitment to help steer the industrial development of South Africa. This task requires much more than simply preparing and delivering lectures, it requires them to serve as role models and also keep abreast and contribute to the developments in higher engineering education.
Hence, the mentoring begins in the classroom level with the students before junior academics can be mentored. It is hoped that the Faculty of Engineering will adapt their WILL programme to the needs of their specific faculty.

The third recommendation is the role that industry plays in encouraging more women into postgraduate engineering. There are many ways in which employers can contribute to the goal of encouraging more women into engineering careers. Employers can give talks at schools, host workplace visits, donate materials and surplus equipment and help children with project work. A study by Sturge (1996:4) found that some companies had initiated successful projects in this regard.

In South Africa, many companies are making a significant contribution to this objective. As mentioned in the study the programmes offered by Siemens South Africa and Volkswagen. However, at the University of KwaZulu-Natal apart from presentations by industry partners, very little is done by the industry sector to mentor and encourage more women engineers. In fact, personal experience has indicated that the majority of presentations to the students are made by male engineers. The Faculty of Engineering has significant links with the

Engineering Industry Sector and this relationship needs to be expanded to achieve the objective of increasing the number of female postgraduates.

Unfortunately, the number of successful role models in South Africa that are women is very limited. However, the Faculty of Engineering should embark on promoting the success of its own female academic staff. All the academic participants in this study are internationally renowned for their contributions to the engineering field. However, unless you're part of the discipline, very little is known about the work they have and are engaged in.

The results are a clear indication that further research in this field is imperative. A suggestion would be to enhance the study to include other institutions and then do a comparison to note the social and academic environment in Faculties of Engineering at other institutions and whether these influence the postgraduate enrolments of female students. Different Faculties offer different syllabi and this may also be seen as a contributing factor as indicated by the study conducted by Beraud (2004:435) in relation to pedagogies. As indicated earlier on in the study, the University of Cape Town (UCT) has a significantly higher number of both female postgraduates and academics. A comparison between UCT's course content, academic environment and exam performance to that of the University of KwaZulu-Natal will provide a more enlightened perspective on the way forward.

CHAPTER 7

BIBLIOGRAPHY

1. Aikman, S., Unterhalter, E. and Challender, C. 2004. The Education MDG's: achieving gender equality through curriculum and pedagogy change, paper based on the *Beyond Access Project Seminars 1 and 2* and presented at the World Congress of Comparative Education Societies Congress, Havana, November 2004.

2. Alha, K. and Gibson, IS. 2002. Using ICT to improve the Gender Balance in Engineering Education. *European Journal of Engineering Education* 28(2).

3. Autumn, S. 1993. *Mothers and Daughters of Invention: Notes for a revised history of Technology*. London: The Scarecrow Press Ltd.

4. Beraud, A. 2003. A European Research on Women and Engineering Education (2001-2002). *European Journal of Engineering Education* 28(4).

5. Bystdzienski, JJ. 2002. *Gendering Science Fields: Transforming Academic Science and Engineering*. Indiana: Indiana University Press.

6. Carter, R. and Kirkup, G. 1990. *Women in Engineering: A Good Place to be*. London: Macmillan Education Ltd.

7. Chanana, K. 1988. *Socialisation, Education and Women*. New Delhi: Orient Longman Limited.

8. Chen, J.C., Owusu-Ofori, S., Pai, D., Toca-McDowell, E., Wang, S and Waters K. 1995. *A Study of Female Academic Performance in Mechanical Engineering*. North Carolina: A & T State University Press.

9. Chesler, NC. And Chesler, MA. 2002. Gender Informed Mentoring Strategies For Women Engineering Scholars: On Establishing a Caring Community. *Journal of Engineering Education*, January: 49-54.

10. Clausen, John A. (ed.) 1968 *Socialization and Society*. Boston: Little Brown and Company.

11. Darwin, C. 1859. *The Origin of Species*. London: John Murray.

12. Electronic Design, October 2006. *Women in Engineering: Disparities remain despite progress*. Diane Matt. Penton Publishing. United States.

13. Ford Scoops Gender Awards. 2003. *Professional Engineering*, November: 14.

14. Gender mainstreaming in poverty eradication and the millennium development goals. (2003). *A Handbook for policy makers and other stakeholders*, London: Commonwealth Secretariat.

15. Grabucker, M. 1988. *There's a Good Girl: Gender Stereotyping in the First 3 Years of Life*. London: The Women's Press Ltd.

16. Gray, D. 2004. *Doing Research in the Real World*. London: Sage Publishers.

17. Henes, R., Bland, M.M. and Darby, J. 1995. *Improving the Academic Environment for Women Engineering Students through Faculty Workshops*, *J. Engr. Education* 84:59-67.

18. McDonald, K. Humphreys, S. 1995. *The Role of Women Graduate Students. Bridging the Gender Gap in Engineering and Science*. Pittsburgh: Carnegie Mellon University Press.

19. Jawitz, J. 1999. It Takes More Than Just Lecturing: developing engineering education in South Africa. *For Engineering Educators* 4(1).

20. Kanhere, U. 1987. *Women in Socialisation*. India: Mittal.

21. Kitetu, CW. 2006. Which Way Forward? Gender Theories, Debates and Practice after the Nairobi and Beijing Conferences. *CODESRIA Bulletin*. No's 1 and 2.

22. Kirkup, G. and Keller, L.S. 1992. *Inventing Women: Science, Technology and Gender*. London: Polity Press.

23. Kothari, CR. 1985. *Research Methodology: Methods and Techniques*. New Delhi: New Age International Publishers.

24. Kristen, T. 2002. *The Millennium Development Goals: Gendered Pathways/Dimensions.* Background paper for the World Bank Workshop on Poverty and gender: National Council for Research on Women.

25. Lang, M. 2004. A Driving Force. *Design News*, 23 February: 72.

26. LeCompte, M. D., & Preissle, J. 1993. *Ethnography and qualitative design in educational research*, 2nd ed. San Diego, Cal.: Academic Press.

27. Lippa, Richard A. 2005. *Gender, Nature and Nurture*. London: Taylor and Francis.

28. Malcolm, SM. 2004. Science and Technology: Meeting Human Needs. *Science, Engineering and Technology for Women.* Pretoria: National Advisory Council on Innovation.

29. Matt, D. 2006. *Women In Engineering: Disparities Remain Despite Progress*. Electronic Design, 20 October: 36.

30. Michel, J. 1988. *Women in Engineering Education*. Paris: United Nations.

31. Mitter, S. and Rowbotham, S. 1995. *Women Encounter Technology: Changing Patterns of Employment in the Third World*. London: Routledge.

32. Minister Mosibudi Mangena. 2006. Keynote Address at the 2006 South African Women in Science Awards. www.dst.gov.za/media/speeches.htm Downloaded 27 March 2007.

33. Mouton, J. 2001. *How to Succeed In Your Masters and Doctoral Studies*. Pretoria: Van Schaik Publishers.

34. Mouton, J. 2006. *Understanding Social Research*. Pretoria: Van Schaik Publishers.

35. Naila, K. 2003.Gender Mainstreaming, Poverty Eradication and the Millennium Development Goals: *A Handbook for Policy Makers and Other Stakeholders* (London, Commonwealth Secretariat, CIDA and IDRC, Canada).

36. Osborn, M. 1999. Facts and Figures still Show Little Room at the Top for Women in Science in Most EU Countries. *Women and Science*. Luxemburg: European Commission.

37. Patton, M. Q. 1990. *Qualitative evaluation and research methods*, 2nd. ed. Newbury Park, Cal.: Sage Publications.

38. Protocnik, J. 2008. *Memorandum of Understanding on Association of Bosnia and Herzegovina to the Seventh Framework Programme.* The European Community. Brussels. 24 November 2008.

39. Punch, K. F. 2003. *Survey Research: The Basics*. London: Sage Publications Ltd.

40. Rosser, SV. 2003. *Attracting and Retaining Women in Science and Engineering*. *Academe* 89(4).

41. SET4WOMEN 2005. *Promoting Women in Science, Engineering and Technology in Africa, 10th Annual Women in Leadership Summit*, Sandton, South Africa. 26 January 2005. Presentation by Luci Abrahams.

42. South Africa. 2004. Facing The Facts: Women's Participation in Science, Engineering and Technology. *Science, Engineering and Technology for Women*. Pretoria: National Advisory Council on Innovation and the Department of Science and Technology.

43. Spelke, ES. 2005. Sex Differences in Intrinsic Aptitude for Mathematics and Science? *American Psychologist* 60 (9).

44. Sturge L. 1996. The Business Case for Encouraging girls into Science and Engineering. www.lboro.ac.uk/orgs. Accessed 27 March 2008.

45. Synthesis report: *Women's Participation in Science, Engineering and Technology (2004).* Department on Science and Technology.

46. The Star Classifieds, 23 August 2008. page 8

47. Thompson, K. 1982. *Emile Durkheim*. London: Tavistock Publications.

48. Tierney, W. and Bensimon, E. 1996. *Promoting and Tenure: Community and Socialization in Academe*. New York: State University of New York Press.

49. Timothy, K. 2002. The Millennium Development Goals: Gendered Pathways and Dimensions. *Poverty and Gender: New Perspectives*, 7 May: 3-19.

50. European Commission. 2000. *Science Policies in the European Union: Promoting Excellence through Mainstreaming Gender Equality*. Brussels: European Commission.

51. Women at the Top of Engineering. 2004. *Connecting Education and Careers*, January: 8.

52. www.dmi.ac.za (accessed on 18 December 2008)

53. www.dst.org.za (accessed on 20 November 2007)

54. www.ewh.ieee.org (accessed on 11 November 2008)

55. www.sarg.org.za (accessed 12 November 2007)

56. www.sawomeng.org.za (accessed on 12 February 2009)

57. www.ukzn.ac.za (accessed on 8 June 2008)

58. www.unmilleniumproject.org (accessed on 10 March 2008)

59. www.unicef.org (accessed on 10 March 2008)

60. www.vw.co.za (accessed on 16 February 2009)

61. www.womensciencenet.org (accessed on 13 February 2009)

62. www.siemens.co.za (accessed on 16 February 2009)

63. Wyer, M., Barbercheck, M., Geisman, D., Ozturk, H. and Wayne, M. (2001). *Women, Science and Technology*. New York: Routledge.

64. Zywno, M., Gilbride, K., Hiscocks, P., Waalen, J. and Kennedy, M. (May, 1998) *Attracting women into Engineering*: A Case Study presented at the "Discover Engineering Summer Camp for High School Girls at Ryerson Polytechnic University - a Recruitment Strategy that Works", Proceedings of the 8th Annual CCWEST Conference, Vancouver.

ANNEXURE ONE

FACULTY OF ENGINEERING STUDENT SURVEY

This survey is part of a Master's Thesis in Development Studies, entitled "**WOMEN IN ENGINEERING: THE IDENTIFICATION AND ANALYSIS OF GENDER SOCIALIZATION IN THE FACULTY OF ENGINEERING AT THE UNIVERSITY OF KWAZULU-NATAL"** by MaryAnn Francis.

Students and staff from the Disciplines of Bioresources Engineering & Environmental Hydrology, Civil, Electrical, Electronic, Computer, Mechanical and Chemical Engineering will form part of this research project. A sample of students and staff has been chosen randomly from the Staff and Student Database managed by the University's Management Information System. Permission has been obtained from the relevant authorities at the University. I will appreciate it if you can complete and return the questionnaire. The information will be used to analyze gender trends within the Faculty and is solely for the purposes of research. **You anonymity is guaranteed and your participation entirely voluntary**. You may send the completed questionnaire to francism@ukzn.ac.za by 15 MAY 2008.

GENERAL INFORMATION

Name:	Gender:
Year of Study:	E-mail address:

1. Was Engineering your first choice of study? Please tick (√) relevant box.

Yes ☐ No ☐

2. When did you first develop an interest in Engineering? Please tick (√) relevant box.

Ages 3-6	
Ages 6-12	
Ages 12-18	
Can't remember	

3. What/Who triggered your interest in Engineering as a career? Please tick (√) relevant box.

Educator	
Parent/Guardian	
Friends	
Guidance Counsellor	
University/Technikon Marketing Days	
University/Technikon Staff	
A qualified Engineer	
The Media	
Television/ Movies	
Can't remember	

Other: Please expand

4. What programme are you enrolled for? Please tick (√) relevant box

Bioresources Engineering and Environmental Hydrology

Electrical Engineering

Electronic Engineering

Computer Engineering

Chemical Engineering

Civil Engineering

Mechanical Engineering

FACULTY-SPECIFIC QUESTIONS: Please tick the relevant box.

Question	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. The number of female lecturers within the Faculty is sufficient					
2. The School/Faculty provides opportunities for social contact with lecturers					
3. I am exposed to the research undertaken by Postgraduates					
4. The Faculty should offer tutorials with male-only and female-only classes					
5. Female students perform better than male students in their specific programmes					
6. The School/Faculty provides opportunities for social contact with Postgraduates					
7. Male students dominate discussions in the laboratories/workshops					
8. Male students are offered more opportunities to pursue postgraduate studies than their female counterparts					
9. Female students are unable to cope with the workload in the workshops/laboratories					
10. The School/Faculty provides good access to research opportunities					
11. Gender differences do not hinder the learning process					
12. Lecturers prefer teaching male students					
13. Male students dominate discussions in class					
14. Technical staff discriminate against female students					
15. Gender bias exists in the Academic and Administration of the Faculty					

FACULTY INFORMATION

1. Describe your experiences within the Faculty of Engineering during the course of your studies.

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2. Is there any aspect of your Faculty, with regards to Teaching, that you would like to see changed? If yes, please explain.

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3. Describe your interaction with your Lecturers?

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4. Will you continue with Postgraduate Studies in Engineering? If yes/no, why?

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Thank you for your time and your co-operation. Please email to MaryAnn Francis: francism@ukzn.ac.za

ANNEXURE TWO

FACULTY OF ENGINEERING: STAFF SURVEY

This survey is part of a Master's Thesis in Development Studies, entitled "**WOMEN IN ENGINEERING: THE IDENTIFICATION AND ANALYSIS OF GENDER SOCIALIZATION IN THE FACULTY OF ENGINEERING AT THE UNIVERSITY OF KWAZULU-NATAL"** by MaryAnn Francis.

Students and staff from the Disciplines of Bioresources Engineering & Environmental Hydrology, Civil, Electrical, Electronic, Computer, Mechanical and Chemical Engineering will form part of this research project. A sample of students and staff has been chosen randomly from the Staff and Student Database managed by the University's Management Information System. Permission has been obtained from the relevant authorities at the University. I would appreciate it if you could complete and return the questionnaire. The information will be used to analyze gender trends within the Faculty and is solely for the purposes of research. **You anonymity is guaranteed and your participation entirely voluntary**. You may send the completed questionnaire to francism@ukzn.ac.za by 20 August 2008.

GENERAL INFORMATION:

Name:	Gender:
Programme:	E-mail address:

FACULTY-SPECIFIC QUESTIONS: Please mark the relevant box using an X.

Question	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
1. The number of female lecturers within the Faculty is sufficient					
2. The School/Faculty provides opportunities for social contact with Undergraduate students					
3. I expose my undergrads to the research undertaken by postgraduates					
4. The Faculty should offer tutorials with male-only and female-only classes					
5. Female students perform better than male students in their specific programmes					
6. The School/Faculty provides opportunities for social contact with Postgraduates					
7. Male students dominate discussions in the laboratories/workshops					
8. Female students are unable to cope with the workload in the workshops/laboratories					
9. Gender differences do not hinder the learning process					
10. Male students dominate discussions in class					
11. Gender bias exists in the Faculty					
12. I would like to mentor a female-only class					
13. Gender discrimination is an issue within Industry					
14. Females can't cope with the workload in Industry					
15. Management is male-dominated in the Faculty					
16. Female lecturers are not provided with adequate support in the Faculty					
17. Gender should not be an issue in a field like Engineering					

1. Do you find it easier working with male students as opposed to female students? Please explain

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2. Is it easier to recruit and retain male students into postgraduate programmes? Please explain.

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3. Do male students perform better than female students academically? Please explain

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4. Do male students perform better than female students technically? Please expand

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Thank you for your time and your co-operation. Please email to MaryAnn Francis: francism@ukzn.ac.za