Tertiary education costs and other barriers affecting the entry of female students to tertiary education: science, engineering and technology degrees

Report to the National Advisory Council on Innovation

Contact person: Kerri McDonald, Research Manager, SBP
Tel: 011 486 0797, Email: Kerri@sbp.org.za, Date: April 2011
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1. Introduction

SBP was commissioned by NACI to evaluate the barriers faced by female students in entering and staying in the SET streams of study, and factors that contribute to an enabling environment for female students entering and completing SET studies. The project also explored the reasons behind the apparent lack of attraction of certain SET fields to female learners. The key focus was on the throughput of female students from secondary education to tertiary education in SET (thus excluding post-graduate students).

Key research questions and areas of enquiry to be addressed were:
1. Analysis of aggregate data on the gender profile of student applications in SET fields, as well as data on completion and drop out rates by gender.
2. Analysis of aggregate data on the gender profile of uptake in maths and science subjects at the secondary school level and the throughput to tertiary education.
3. Particular barriers to entering and staying in courses in the SET fields for females versus males, including financial barriers (the cost of tuition and other access costs, and lack of access to finance etc) as well as the impact of social norms and cultural values (socialisation by parents, schools and the wider community for example).
4. Factors associated with women successfully entering and completing SET studies.
5. The impact of policies and interventions at secondary and tertiary education levels to improve the up-take and completion of SET studies by women.
6. Opportunities and support for female learners and students to re-enter education institutions after a disruption to their studies.

This report provides the findings of the study, together with recommendations and priorities for policy and practical interventions.

2. Background and context

Studies at the international level have found that, particularly in less developed countries, fewer girls than boys have access to primary education, and even fewer participate in science. This is, however, not the case in South Africa.

National surveys measuring access to education show that equitable access for boys and girls to primary school has effectively been achieved in this country. While there are slightly more boys than girls in primary school, this is as a result of higher rates of repetition for boy learners. In addition, data from the General Household Survey for years 2002 to 2008 show that “South African parents enrol girls and boys without distinction in Early Childhood Development and Grade R programmes”.

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1 StatsSA’s General Household Survey and Community Survey, for example
2 Dept of Basic Education, Education for All (EFA); 2009 Country Report: South Africa, 2010
3 Dept of Basic Education, Education for All (EFA); 2009 Country Report: South Africa, 2010
The statistics show that boys and girls have equal access to maths and science subjects at school in South Africa. Department of Basic Education data shows that an almost equal proportion of male and female candidates sat for the National Senior Certificate (Matric) Mathematics exam in 2009: 53.1 percent of male candidates, and 52.2 percent of female candidates, with a higher number of females than males sitting for the exam (as more young women make it to Matric than young men). On the other hand, a slightly higher number of male learners wrote the Physical Sciences paper (44 106) than female learners (41 250).

Boys and girls at primary school level do equally as well on numeracy and mathematics tests, as shown by results from Grade 3 and 6 learners. In the final Matric exam however, a slightly higher percentage of young men pass the Maths and Physical Science papers than young women.

At the tertiary level, however, certain SET courses remain predominantly the preserve of male students. While industrialised countries, including South Africa, are seeing significant increases in the enrolment of women for higher education degrees, subjects such as engineering and the built environment, and physical, mathematical and computer sciences, remain male-dominated. In such courses, the gender disparity is evident in terms of student enrolments at the undergraduate level, and "becomes a glaring disparity at the postgraduate level." The gender imbalance is not apparent across all SET courses, however. Indeed, many Life Sciences courses attract a higher proportion of female than male students.

The current study examines the obstacles and disincentives facing young women wishing to enter into SET fields of tertiary study, with a particular focus on fields such as engineering, that continue to show high levels of gender disparity in enrolments. It also reviews the challenges facing students in the successful completion of undergraduate studies, and examines the extent to which female students may face particular gender specific obstacles.

3. Methodology

3.1. Project Scope

The project focuses on the throughput of female students from secondary education to tertiary education, and completion of under-graduate courses in SET fields. It excludes post-graduate studies and the workplace.

The original Terms of Reference provided for “representative samples of tertiary education institutions in South Africa.... and high schools that offer science and mathematics subjects...”. However SBP's proposal, as accepted by NACI, noted that in the context of a highly diverse and

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4 For example: SACMEQ II, TIMMS(R), Department of Education Systematic Evaluations
6 Centre for Research on Science and Technology, A monitoring and evaluation framework to benchmark the performance of women in the NSI, Final Report to the SET4W Reference Group, December 2005
disparate education system in South Africa, where the quality of teaching, subjects on offer, conditions of learning, and social and environmental contexts are vastly different from one institution to the next, a truly representative sample of tertiary institutions and schools across the country would need to cover and extremely large and very carefully stratified sample population. SBP therefore proposed that, while a wide-ranging, time-consuming and very expensive survey might indeed yield some interesting results, the core objectives of the study would be better met through targeted qualitative research, enabling investigation of critical issues and challenges using far more in-depth and sensitive research instruments.

SBP also noted that aggregate survey statistics on the uptake and pass rate of subjects such as maths and science at secondary school level are publicly available and that some of the trends and challenges in this area have been usefully analysed and documented. Data on the gender profile of students enrolling in university faculties is also publicly available. In order to avoid reinventing the wheel, SBP’s approach used existing surveys and statistics as a baseline, and focused primary research on targeted qualitative engagements with a spectrum of relevant stakeholders. In order to minimise costs and maximise the use of existing research outputs and intellectual capital, the research consisted of two components:

- Desk review and analysis of existing secondary data
- Qualitative research to obtain depth of insight into the barriers to, and opportunities for, increasing female enrolment and success in the SET fields of study.

A note on terminology
It should be noted that SET fields of study are broad in their scope and include a range of different degrees and diplomas at the higher education level. There is no standard international list of SET studies. Some CESM categories (Classification of Educational Subject Matter), such as ‘Health Professions and Related Clinic Sciences’, include both SET and non-SET studies (for example surgery and hospital administration). Statistical analysis undertaken for the purposes of the project presents data by CESM categories conventionally classified as SET by the Department of Higher Education and Training (even though these categories include some overlap with some non-SET subjects).7

Phase 1: Desk review and analysis of secondary data
Phase 1 comprised a desk review of existing research on the barriers women face in entering SET fields of study, including financial and other barriers. Sources consulted included NACI’s own extensive knowledge archives, comparative research at the international level, and research from a range of academic, government and industry bodies in South Africa on participation and transformation challenges in SET fields and initiatives to increase access to the sector.

This phase also included statistical analysis of existing EMIS and HEMIS data to assess gender representation across SET fields of study, at secondary and tertiary levels, and throughput trends from secondary school to tertiary education. Specifically, it included analysis of:

- Performance in maths and science at school level by gender

7 CESM categories included in SET are: Agricultural and Renewable Resources; Architecture and Environmental Design; Computer Science and Data Processing; Engineering and Engineering Technology; Health Care and Health Sciences; Home Economics; Industrial Arts, Trades and Technology; Life Sciences and Physical Sciences; Mathematical Sciences; and Military Sciences.
• Throughput to SET studies at undergraduate level by gender, and gender and race
• Completion of undergraduate SET studies by gender, and gender and race

Unfortunately, there is very little publicly available data on enrolment in, and completion of, FET college qualifications, and analysis of enrolment in and completion of FET SET studies was thus necessarily limited, as a result of data deficiencies.

The desk review also accessed case study research from a range of South African universities to analyse trends in drop out by gender, and gender and race.

Ideally, throughput from secondary education to tertiary education should be tracked by following a generational group of learners from school to higher education. Given the currently available data from EMIS and HEMIS, however, this is not possible.\(^8\) A proxy for throughput was therefore developed by analysing the gender ratio in undergraduate enrolments within SET for the period 2006 to 2008, and assessing the difference between these statistics and the gender profile of learners with Matric maths and science results which enable them to continue to SET studies at higher education level for the period 2005 to 2007. The assumption was made that students matriculating in the period 2005 to 2007 comprised the pool of students from which higher education enrolments for the period 2006 to 2008 were drawn.\(^9\)

**Phase 2: Primary qualitative research**

Primary research was undertaken in the form of in-depth interviews and focus groups with university and FET college staff (academic and support staff), female undergraduate students in SET fields, maths and science teachers in secondary schools, life orientation teachers, and male and female high school learners taking maths and science for Matric.

It was agreed with NACI that interviews and focus groups would be concentrated in Gauteng and KwaZulu-Natal, on the basis of the relative concentration of higher education and research institutions in these provinces.

**Higher education institutions** were chosen to reflect a spread across geographical location; types of universities (traditional, comprehensive and universities of technology); and historically advantaged and historically disadvantaged universities. Interviews were conducted with academic and support staff, and students, at the following universities:

- Tshwane University of Technology
- University of KwaZulu-Natal, Westville Campus
- University of Limpopo, MEDUNSA campus Gauteng
- University of Pretoria
- University of Zululand (Comprehensive)
- Vaal University of Technology

\(^8\) Discussion with CHE, November 2010 – Tracking of this sort would require all students in the country to be tracked using a unique number which they would carry with them through their educational careers (such as an ID number). Data tracking would need to reflect when a learner leaves the schooling system, whether and when they enter further/higher education, reasons for de-registration, and movements from one institution to another. Information of this sort is not available.

\(^9\) 2008 is the latest year for which HEMIS tables are currently available to the public.
**FET colleges:** The study included one FET college in Gauteng (Ekhurhuleni West College) and one in KwaZulu-Natal (Coastal KZN FET College).

Interviews were undertaken with academic staff in relevant faculties, and staff responsible for student support and academic development programmes.

Interviews at universities and FET colleges gathered information on:
- The gender profiles of students and lecturers in different courses
- Factors influencing students’ choice of particular fields of study
- Factors impacting on female students staying/dropping out of SET courses
- The influence of community/individual backgrounds on choices and performance
- Sources of academic and emotional support for students

**Secondary schools:** The study focused on four secondary schools - two in Gauteng (one of which was a technical school), and two in KwaZulu-Natal. In each province interviews were conducted at one well-resourced former model-C school, and one poorly resourced school drawing students mainly from low income households.

Interviews were conducted with maths and science teachers and life orientation teachers. Small focus groups were undertaken with learners in Grades 11 and 12. Interviews and focus groups probed challenges facing girl learners in taking up maths, science, and geographical sciences at school level, their aspirations for further education, and challenges and barriers to pursuing studies in SET, including in-school factors (organisational culture and attitudes, availability of appropriate career guidance) and out-of school factors (home environment, exposure to science and technology, social constructions of gender and so on).

**Other key informants**
In-depth interviews and group discussions were undertaken with key informants in government, industry and academia. These gathered information on policy and practical interventions (financial and other support mechanisms) to increase retention rates of female students in SET fields, and take-up of maths and science subjects in schools, and sought to identify challenges, successes and lessons. Respondents included:

**Government departments, agencies and other statutory bodies:**
- Council on Higher Education (CHE)
- National Student Financial Aid Scheme (NSFAS)
- SA Agency for Science and Technology Advancement (SAASTA)
- Education and Skills Development Unit, HSRC
- SciBono Careers Centre in Newtown

**Professional bodies and maths and science intervention programmes:**
- Engenius Programme, Engineering Council of South Africa
- SA Wise (Association of South African Women in Science and Engineering)
- GirlEng
- Women in Engineering and the Built Environment (WIEBE)
- Women in Engineering Forum, Vaal University of Technology
- Alexandra Schools Programme
- The Ukuqonda Institute
In addition, SBP undertook interviews with a number of leading young women in SET fields, with a particular focus on engineering, on a case study basis. These women come from a diverse array of backgrounds. Some are from big cities, others from tiny rural communities. Some are from middle class, well-educated families, others were brought up by single mothers with very limited formal education. Their experiences and reflections are included as an annex at the end of the report.

**Phase 3: Analysis and reporting**

Desk research, statistical analysis of existing data, and findings from the in-depth interviews and focus groups were collated to provide a picture of trends in the uptake and completion of SET studies, to provide a comprehensive assessment of the barriers female students face in entering and completing studies in the SET fields, and to outline the factors which encourage female enrolment and successful completion of undergraduate study in these fields. The report includes ‘success stories’ and examples of good practice, and critical challenges and obstacles at various stages along the study path. It identifies common characteristics and sources of support (financial and other) together with lessons for broader application.

4. **Quantitative analysis: trends in uptake and completion of SET studies**

4.1. **Overview**

A significant body of existing data is available to inform quantitative analysis of trends in the uptake and completion of SET studies. The project involved statistical analysis of existing EMIS and HEMIS data, to assess gender representation across SET fields of study at secondary and tertiary levels, and throughput trends from secondary school to tertiary education. This analysis focused in particular on:

- South African learner performance at school level on internationally and locally recognised tests of numeracy and mathematics, by gender
- Uptake of, and performance in, maths and science subjects in the Senior Certificate / National Senior Certificate examination (Matric) by gender  
- Uptake and completion of SET studies at undergraduate level in higher education, specifically reporting on enrolment and graduation in SET studies by gender, and by gender and race.

A recent CHE report makes the very pertinent point that “quantitative measures of throughput fail to reflect the intricacies of social conditions and the teaching and learning process.” Such measures do nonetheless provide an objective indicator of the current status quo, and provide

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10 In 2008 the Senior Certificate examination was replaced by the National Senior Certificate. Significantly, changes included the scrapping of the subjects Maths, offered at Higher and Standard Grade, and its replacement by the subjects Mathematics and Maths Literacy. Physical Science was no longer offered at Higher and Standard Grade: it is replaced by the subject Physical Sciences. An analysis of Matric results which spans the Senior, and National Senior Certificate is very tricky, as Maths Higher Grade and Maths Standard Grade cannot be simply compared with the subjects Mathematics and Maths Literacy.

11 This covers all diplomas, certificates and degrees offered by universities, comprehensive universities and universities of technology up to undergraduate level, i.e. excluding postgraduate level studies.
an important ‘big picture’ against which more localised and nuanced experiences can be assessed. They also provide a barometer against which change can be assessed over time.

It should be noted that students do not follow linear paths through higher education. Students may complete one year of a course and then move to a different course or to a different institution, for example. While these appear as ‘dropouts’ in measures of the course or institution in question, the individuals may go on to be successful graduates elsewhere. Available HEMIS data does not accommodate the tracking of individual students moving between institutions. We draw on case study research to document patterns of female students dropping out and re-entering the higher education.

4.2. Uptake and performance in maths and science at school

*Findings from school numeracy and mathematics tests*

The quality of the maths and science education provided to many learners in South African schools is very poor. The Global Competitiveness Index recently ranked South Africa at 133 out of 139 countries for the quality of its science and maths education. The Trends in International Maths and Science Study (TIMMS) identifies South Africa as the worst performer with regard to average maths and science scores. This reality has major implications for the enrolment and success of students in SET studies in higher education in South Africa, which we explore further in the following section. Here our focus is on indicators of gender parity in maths performance.

TIMSS is an internationally administered mathematics test, conducted on a periodic basis. Results from the 1999 TIMMS test for South Africa showed that boys clearly outperformed girls. Four years later, however, the 2003 results showed that the gap in favour of boys (2 points in both Mathematics and Science) was insignificant.

SACMEQII is another internationally recognised numeracy and literacy test, which was administered to learners in Grade 6 between 2000 and 2003 in 15 countries in the SADC region. In terms of aggregate performance across all participating countries in the SACMEQII test, results show that mean female scores were significantly higher than those of males for both numeracy and literacy.

Reporting on SACMEQ results for South African learners, a Department of Basic Education report notes that female learners (Grade 6) perform better than male learners in SACMEQII, both for numeracy and literacy.
learners in both reading and mathematics.\textsuperscript{18} Analysis of the SACMEQ results for South African learners by Servaas van der Berg however indicates that gender differences in performance were not significant.\textsuperscript{19}

The Department of Education has conducted national numeracy and literacy testing of school learners in Grade 3 and 6 (recently extended to Grade 9). In 2001 and 2007 evaluations were conducted at the end of the Foundation Phase of schooling (Grade 3) in numeracy, literacy and life skills. In 2004, an evaluation of the end of the Intermediate Phase of schooling was conducted (Grade 6) of learning outcomes in the language of learning and teaching, Mathematics and Natural Sciences.\textsuperscript{20}

In the Grade 3 numeracy test, girls outperformed boys in all provinces, with a difference in scores of between one and three percent (see Figure 1). In the Grade 6 Systematic Evaluation (2004), females scored an average of 27.4 percent for mathematics and males 26.7 percent.\textsuperscript{21}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure1.png}
\caption{Average numeracy score by gender and province in the Grade 3 Systematic Evaluation, 2007}
\end{figure}

These results by gender from international, regional and local tests are encouraging – girls and young women in South African schools are performing at least as well, and in some cases marginally better, than their male counterparts in numeracy and mathematics.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline
Province & Male & Female & Male & Female & Male & Female & Male & Female \\
\hline
E. Cape & 35 & 37 & 41 & 44 & 41 & 43 & 35 & 37 \\
Free State & 41 & 43 & 23 & 26 & 30 & 33 & 28 & 29 \\
Gauteng & 35 & 37 & 30 & 33 & 28 & 29 & 30 & 33 \\
KZN & 23 & 26 & 50 & 50 & 48 & 50 & 48 & 50 \\
Limpopo & 30 & 33 & 28 & 29 & 30 & 33 & 28 & 29 \\
Mpumalanga & 28 & 29 & 30 & 33 & 28 & 29 & 30 & 33 \\
N. Cape & 48 & 50 & 48 & 50 & 48 & 50 & 48 & 50 \\
North West & 30 & 33 & 30 & 33 & 30 & 33 & 30 & 33 \\
W. Cape & 50 & 50 & 50 & 50 & 50 & 50 & 50 & 50 \\
\hline
\end{tabular}
\caption{Learner performance on numeracy tests}
\end{table}

\textsuperscript{18} Department of Basic Education, Trends in Education Macro Indicators: South Africa, 2009.


\textsuperscript{20} Department of Basic Education, Trends in Education Macro Indicators: South Africa, 2009.

\textsuperscript{21} Department of Basic Education, Trends in Education Macro Indicators: South Africa, 2009.
Gender differences in maths: findings from international studies

A 2008 study suggested that gender differences in maths performance may be influenced by national culture. It found that girls living in countries where there is more gender equality perform better in math than girls who live in countries with less gender equality. The study examined boys' and girls' test scores worldwide, using data from the 2003 Programme for International Test Assessment, which covered 40 countries. The study found that girls worldwide scored on average 2 percent lower than boys in math, but with noticeable differences per country.\(^{22}\)

The findings were reinforced by a separate study in 2009, which found that girls do just as well at maths as boys if they are given the same opportunities and encouragement. The study reported that gender inequality, rather than lack of innate ability, is the primary reason fewer females than males are identified as excelling in mathematics performance in most countries. The researchers conducted statistical analysis comparing various math scores and contests with the World Economic Forum’s 2007 Gender Gap Index (which ranks countries according to employment and economic opportunities, education and political opportunities and medical status). It assessed how well females relative to males were doing at the average level, at 95th percentile, and at the profoundly gifted level. The study reported that countries with greater gender equity demonstrate a much more equal ratio of girls to boys doing well in maths – including at the highest performance levels. Analysis of data from 15-year-old students participating in the 2003 Program for International Student Assessment indicated that at least as many girls as boys scored above the 99th percentile in Iceland, Thailand and the United Kingdom.\(^{23}\)

Uptake and performance in the Senior Certificate exam (Matric)

South Africa has over half a million Matriculants annually, with an increasing number of candidates sitting the exam. Over the past decade, a higher proportion of the learners sitting the Matric exam have been female than male, as illustrated by Figure 2.


\(^{23}\) Janet Hyde and Janet Mertz, University of Wisconsin, Proceedings of the National Academy of Sciences
On average, the Senior Certificate pass rate for males has been higher than that for females, although females are more likely to feature in the top achievers (i.e. more likely to achieve a pass with Merit or Distinction).\footnote{Perry, H. and Fleisch, B, “Gender and educational achievement in South Africa” in Reddy, V. (ed) \textit{Making Matric: Colloquium Proceedings}, HSRC Press, Pretoria.}

**“Two extremes of female performance”**

Analysis of Senior Certificate results by gender for the period 1996 to 2002 by Perry and Fleisch (2006) shows an interesting pattern. They comment that, “... there are two extremes of female performance – stronger female than male academic achievement amongst the higher performing students, and weaker female performance amongst students performing poorly.”

Analysis by race shows that for Indian, Coloured and white candidates, the average mark for females was higher than for males at all levels (i.e. amongst those that failed, those that passed, and those that passed with endorsement). Among black candidates, however, the average mark for female learners was higher amongst the learners who failed, and amongst those that got an endorsement, but was lower among candidates that passed.\footnote{Perry, H. and Fleisch, B, “Gender and educational achievement in South Africa” in Reddy, V. (ed) \textit{Making Matric: Colloquium Proceedings}, HSRC Press, Pretoria.}

Turning to the data on the gender of students passing with endorsement (a Matriculation Endorsement was the minimum requirement for admission to a bachelor’s degree in a South African university under the Senior Certificate), data shows that...
whilst the number of females who passed the Senior Certificate exam with an endorsement was higher, this was related to the fact that more females than males sat for the Senior Certificate. A slightly higher proportion of males passed with an endorsement in the 2005 to 2007 period than females, as shown in Figure 3.

**Figure 3: Percentage and number of candidates who passed the Senior Certificate with endorsement, 2005 to 2007**

![Figure 3](image)

Source: Department of Education, Education Statistics in South Africa, 2005 to 2007

An endorsement does not guarantee access to SET courses in higher education institutions. Each higher education institution has its own entrance or admissions criteria. Under the Senior Certificate exam system, most higher education institutions required at least a pass (and often higher) on Higher Grade Mathematics, and many required a pass on Higher Grade Physical Science. Admission requirements at many institutions also require minimum language proficiency.

More males than females wrote the Mathematics and Physical Sciences paper at Higher Grade level for the years 2005 to 2007. Figures 4 and 5 show the gender ratio of candidates who wrote the Maths and Physical Science papers at Higher Grade level.
Figure 4: Senior Certificate candidates who wrote Mathematics Higher Grade, 2005 to 2007

![Bar chart showing gender ratio for Mathematics Higher Grade candidates from 2005 to 2007.](chart1)


Figure 5: Senior Certificate candidates who wrote Physical Science HG by gender, 2005 to 2007

![Bar chart showing gender ratio for Physical Science Higher Grade candidates from 2005 to 2007.](chart2)


Looking at the take up of Maths and Physical Science by gender another way: in 2007, 10 percent of male learners who wrote the Senior Certificate exam, wrote the Mathematics Higher Grade paper, while the corresponding proportion for females was seven percent. Fifteen percent of male learners who wrote the Senior Certificate exam, wrote the Physical Science exam at Higher Grade level, compared to 10 percent of female candidates.
Recent results: the National Senior Certificate results by gender (2009)

Under the National Senior Certificate, which replaced the Senior Certificate in 2008, the subjects Mathematics Higher and Standard Grade where replaced by Mathematics and Maths Literacy. A far higher proportion of candidates sat for the Mathematics paper, than the Maths Higher Grade paper in the preceding years. For example, in 2006, while approximately 9 percent of candidates wrote the Maths Higher Grade paper, 53 percent of candidates wrote Mathematics in 2009.

An almost equal number of males and females sat the 2009 National Senior Certificate Mathematics exam: 53.1 percent of male candidates, and 52.2 percent of female candidates. The gender gap was more noticeable in respect of the Physical Sciences paper, which was written by 42.9 percent of male candidates and 37.6 percent of female candidates.


The percentage of females who passed both Mathematics and Physical Science at the Higher Grade level was marginally lower than the percentage of males who passed these subjects for the years 2005 to 2007. On average there was a difference in the percentage of males to females who passed Mathematics Higher Grade of 3.5 percent over the 2005 to 2007 period, and 4.6 percent in the case of Physical Science Higher Grade.

Figure 6: Senior Certificate Pass rate for Mathematics HG by gender, 2005 to 2007

<table>
<thead>
<tr>
<th>Year</th>
<th>Males who passed Maths HG</th>
<th>Females who passed Maths HG</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>17 974</td>
<td>14 138</td>
</tr>
<tr>
<td>2006</td>
<td>18 565</td>
<td>14 547</td>
</tr>
<tr>
<td>2007</td>
<td>17 856</td>
<td>14 927</td>
</tr>
</tbody>
</table>

Recent results: the National Senior Certificate results by gender (2009)

The 2009 National Senior Certificate show that 33 percent of male learners achieved a pass in Mathematics (a pass is 40 percent), while the proportion of female learners was lower at 26.3 percent. Slightly more males (22.8 percent) than females (18.5 percent) achieved a pass in Physical Sciences.


Senior Certificate results for the 2005 to 2007 period by gender and race are not available, but data presented by Perry and Fleisch (2006) for the year 2002 shows that “African men continue to outperform African women in the key subjects of Mathematics and Physical Science both in terms of the number of candidates that enter and the number and percentage that pass.”


The 2002 results for Physical Science Higher Grade show that Coloured, Indian and White females outperformed males. In contrast, Black males outperformed Black females, with a 6.7 percent higher pass rate.


In Maths Higher Grade, a slightly higher proportion of White and Indian females passed than males, and the reverse for Coloured learners. The pass rate for African males was 8.3 percent higher than for females.

**Attrition of learners from the school system**

The completion rate refers to the proportion of learners who complete a given level of the education system. A 2007 Department of Education report used Household Survey data to create a proxy for the completion rate – the number of persons who state that they have completed a given grade or higher grade, as a proportion of all persons of any given age. To prevent the data from being “contaminated” by the low completion rates of older age groups, the age range was restricted to 9-to-23-year-olds.

The report showed a steadily increasing Grade 12 completion rate, from 42 percent in 2001, to 44 percent in 2007. It noted that the main reasons provided by young people for not completing school were, in descending order:

- Financial - problems pertaining to affording the direct costs, or needing to leave school to work
- Problems pertaining to educational relevance and quality
- Illness or pregnancy – in that order.

Lack of opportunity as such was seldom a factor.

Gender differences in completion rates were shown to be marginal, though they slightly favoured females (by a difference of less than one percent).  

The Ministerial Committee on Learner Retention in the South African Schooling System was established by the then Minister of Education, Mrs Naledi Pandor, in April 2007, to investigate the extent of retention and dropping out in the schooling system. The Committee’s analysis indicated that, while the drop out rate below Grade 9 is minimal (less than one percent), the Grade 9 and 10 drop-out rate was over 10 percent, and the Grade 12 drop-out rate was over 20 percent. Between 1997 and 2003, the drop-out rate among Grades 9 to 12 increased for each successive group.

The Household Survey showed that, for the period 2002 to 2007, the most common reason cited by children aged 7-to-18 who were not attending an educational institution was insufficient money for study fees. In 2002, just over 320 000 children fell into this category, but this dropped to 198 296 in 2007, the year in which government introduced its No-fee Schools Policy in 2007, which applies to all Quintile 1 and 2 schools – 40 percent of the poorest schools in the country (learners attending schools in the upper three quintiles who could not afford the fees could apply for a partial or full exemption. In 2010 the no-fee school policy was extended to Quintile 3 schools. This means that learners attending some 60 per cent of state schools in South Africa are exempted from paying fees).

Nonetheless, in 2007 almost one third of all children who were not attending an educational institution cited lack of money as the reason. The proportion of females citing financial constraints was slightly higher, at 34 percent, than males, at 31 percent. (with no significant difference between genders). A further 7.5 percent of respondents said they were not attending an educational institution because they had to work (nine percent among males, six percent among females). Thus, four out of every 10 children of school-going age, who were not attending an educational institution, were doing so for economic reasons. Of the remaining

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29 Trends in Education Macro-Indicators Report South Africa 2009, Department of Education
respondents in 2007, 15 percent said that they were not attending an educational institution because education was useless or uninteresting (21 percent of males, but only nine percent of females – suggesting very different attitude differences across genders), seven percent sited family commitments (11 percent of females compared to only three percent of males). Twelve percent of female respondents were not in school owing to pregnancy.30

**Figure 8: Percentage of 7 to 18 years olds by main reason for currently not attending an educational institution**

4.3. **Enrolment in higher education SET courses**

In 2009, total student enrolments in undergraduate level higher education stood at approximately 650 000 students spread across universities, universities of technology and comprehensive universities.31

**Higher Education in South Africa**

Higher education in South African comprises 23 public institutions, as well as a large number of smaller private higher education institutions. The public institutions are made up of eleven universities, six comprehensive universities and six universities of technology.

Universities offer career-oriented degree and professional programmes, general formative programmes and research masters and doctoral programmes. Universities of technology offer more vocational orientated training, bestowing undergraduate degrees, certificates and diplomas. Comprehensive universities offer a variety of programmes, from vocational and career oriented diplomas to postgraduate research degrees.32

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30 Trends in Education Macro-Indicators Report South Africa 2009, Department of Education
31 Source: HEMIS database, 2008 tables (653 398). Downloaded from www.education.gov.za
The demographics of enrolment have changed markedly over the last ten years. The proportion of black students enrolled in higher education has increased considerably from 43 percent of enrolments in 1998 to 64 percent in 2008. Up until 1994, both universities and technikons enrolled more men than women. However, in 1995 more women than men enrolled in universities (though men remained in the majority in technikons), beginning a consistent trend of greater numbers of females enrolled in these institutions.\(^3^\)

**Enrolment in HE SET courses by gender**

Since 2000, there have been more females enrolled in higher education institutions than males. Female enrolment has increased at a faster rate than male enrolment. Between 2000 and 2007, female enrolment increased by 39 percent, while male enrolment increased by only 23 percent.\(^3^\) Undergraduate enrolment statistics by gender are shown for the 2006 to 2008 period in the figure below.\(^3^\) In 2008 women comprised 56 percent of total undergraduate enrolments.

**Figure 9: Enrolment in undergraduate studies in higher education by gender, 2006 to 2008**


Relatively few students are enrolling in SET courses, however. Between 2006 and 2008, 28 percent of undergraduate enrolments were in SET courses, consistently lower than business/commerce or arts and education faculty enrolments. In the United Kingdom, in contrast, approximately 41% of enrolments are in SET studies.\(^3^\)

**Figure 10: Enrolment in undergraduate studies in higher education by field of study, 2006-8**

\(^3^\) Trends in Education Macro-Indicators Report South Africa 2009, Department of Education
\(^3^\) Data on undergraduate enrolments presented for the 2007 to 2009 period from the HEMIS database includes all students enrolled for undergraduate diplomas, certificates and three and four year bachelor degrees at public higher education institutions in South Africa.
\(^3^\) See table on page 23 in Ramsden, B, Patterns of Higher Education Institutions in the UK, Tenth Report, Universities UK, September 2010, downloaded from: http://www.universitiesuk.ac.uk/Publications/Documents/PatternsOfHigherEducationInstitutionsInTheUK.pdf
More men enrol in SET undergraduate courses – females comprise 43 percent of enrolments in SET.

**Figure 11: Enrolments in SET undergraduate studies by gender, 2006 to 2008**

**Enrolment in HE SET courses by gender and race**

While enrolments by black students in higher education have been increasing, major race imbalances are still evident in enrolment statistics in the different fields of study. Education Faculties continue to attract a far higher proportion of black students, even though black enrolment in education courses has decreased over the last few years.  

Black students continue to be underrepresented in the SET field of study. The white population makes up approximately 9 percent of the population in South Africa, and yet white students make up 23 percent of SET undergraduate enrolments. Enrolments in SET studies by race are shown in the table below.

While enrolments in SET studies by black students remain relatively low, they have been steadily rising. In 2004, 56 percent of enrolments in SET courses comprised black students - by 2008 this has increased to over 60 percent.

<table>
<thead>
<tr>
<th>Race</th>
<th>Percentage of total enrolments</th>
<th>Percentage of the SA population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>64.5%</td>
<td>79.2%</td>
</tr>
<tr>
<td>Coloured</td>
<td>5.9%</td>
<td>9.0%</td>
</tr>
<tr>
<td>Indian</td>
<td>6.5%</td>
<td>2.6%</td>
</tr>
<tr>
<td>White</td>
<td>23.1%</td>
<td>9.2%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Source for enrolment data: HEMIS database 2008; source for population data: StatsSA mid-year population estimate, 2008 (medium variant)

As shown in the table below, white males comprise a disproportionately large segment of SET students (these statistics are heavily influenced by the high proportion of white males in Engineering). Black females are particularly underrepresented. Enrolments in SET courses by black women have been increasing, albeit at a slow pace, rising from 26 percent in 2004 to almost 29 percent in 2008.

The biggest gap between the genders within race groups, is within the white population, where males comprise 60 percent and females 40 percent of enrolments.

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39 It would be more accurate to show the percentage of the adult population in an age range from say 18 to 30, but the relative proportion of the population in each race group does not vary much by age.

40 Source: HEMIS tables, downloaded from www.education.gov.za
### Table 2: Enrolment in undergraduate SET studies by race and gender, 2008

<table>
<thead>
<tr>
<th>Race and gender</th>
<th>Gender ratio within race groups for SET undergraduate enrolments</th>
<th>Percentage of total undergraduate SET enrolments</th>
<th>Percentage of SA population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black male</td>
<td>56</td>
<td>35.8%</td>
<td>38.1%</td>
</tr>
<tr>
<td>Black female</td>
<td>44</td>
<td>28.6%</td>
<td>41.2%</td>
</tr>
<tr>
<td>Coloured male</td>
<td>52</td>
<td>3.1%</td>
<td>4.3%</td>
</tr>
<tr>
<td>Coloured female</td>
<td>48</td>
<td>2.8%</td>
<td>4.7%</td>
</tr>
<tr>
<td>Indian male</td>
<td>56</td>
<td>3.6%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Indian female</td>
<td>44</td>
<td>2.9%</td>
<td>1.3%</td>
</tr>
<tr>
<td>White male</td>
<td>60</td>
<td>13.8%</td>
<td>4.5%</td>
</tr>
<tr>
<td>White female</td>
<td>40</td>
<td>9.3%</td>
<td>4.7%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>-</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source for enrolment data: HEMIS database 2008; source for population data: StatsSA mid-year population estimate, 2008 (medium variant)\(^{41}\)

**Gender ratio within selected HE SET courses**

Within the SET field, the gender ratio in different fields of science and engineering varies widely. Women predominate in both the Health Sciences\(^{42}\), and in the Life and Physical Sciences. The relatively small gender gap in enrolments in Architecture and Environmental Design favours male students, while a large gender gap in favour of males still remains in Computer Sciences and, most notably in Engineering. Only a quarter of undergraduate enrolments in Engineering are female.

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\(^{41}\) It would be more accurate to show the percentage of the adult population in an age range from say 18 to 30, but the relative proportion of the population in each race group does not vary much by age.

\(^{42}\) The CESM categories included in the broad subject category of Health Science include courses which are not strictly SET courses. These include hospital administration and so on. Health Sciences also includes nursing which is disproportionately female.
4.4. Completion of undergraduate HE SET courses

**Completion and drop out in South Africa: an overview**

Available data shows that, in comparison to developed counties, our higher education system is very inefficient. Less than half of those enrolled in bachelors or national diplomas are projected to complete their studies.  

A national cohort study by the Department of Education (2006) highlighted the low student success rates in South Africa as a major problem facing all academic institutions. For those entering the higher education system in 2000, the study found that by 2004, the proportion of students who had graduated ranged from 9 percent at distance education institutions to 68 percent at the former Potchefstroom University (now a campus of the North West University). Drop out rates were high – at UWC, for example, 36 percent of the year 2000 cohort had graduated and 48 percent had dropped out of the university.

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Differences in drop out rates across institutions

Drop out rates differ significantly across different institutions. Recently published research shows that up to 20 percent of undergraduate students in the University of Pretoria’s (UP) contact programmes drop out. Less than 40 percent of students complete within the minimum time allowed for the three- and four-year undergraduate programmes. This is despite the fact that UP attracts many of the best students exiting the school system (more than 30 percent of those who leave the school system with more than six distinctions), and entrance is based on academic merit.45

At Wits, a study of student throughput figures for students enrolling from 1992 to 1998 found that less than 50 percent of students graduate and less than 45 percent graduate in the minimum time. Many degrees exclude more than 20 percent of students for academic or financial reasons.46

A 2009 CHE report notes that an estimated 44 percent of students in the 2000 enrolment cohort will graduate.47 In contrast, the Higher Education Funding Council for England projects that 78 percent of the 2000/2001 cohort in the English higher education system will graduate.48

Statistics from focused studies on drop out show that drop out rates in first year university are particularly high across institutions and faculties, and for both male and female students. A 2008 HSRC study of the 120,000 first-year students in higher education institutions in 2000 found that 36,000, or 30 percent, dropped out in their first year of study, and a further 24,000, or 20 percent, in their second year.49

A University of Witwatersrand Study which tracked a cohort of learners from 1992 to 1998 shows that there are distinct demographic trends in drop out rates. In almost every faculty, in almost every qualification, white students did statistically better than black students for all the variables - average years to graduate, percentage who graduate and percentage excluded. More black than white students drop out and more men and black students are excluded.50 Disaggregating national graduation statistics by race shows that in the human and social sciences (excluding education) and in

45 The admission policies to the Mamelodi campus are set at a somewhat lower level than at the main campus, provided that students entering with lower scores complete extended programmes. A number of foundation programmes are in operation to assist students who enter with weaker school backgrounds.
science, engineering and technology, graduates are still disproportionately white, but there has been a gradual increase in the proportion of African graduates.\textsuperscript{51}

The number of students successfully completing SET degrees has risen over recent years. A 2009 CHE report notes that since 2004 graduations in the health care and health sciences have increased by 13 percent, mathematical sciences by 16 percent, and Life and Physical Sciences by 17 percent. Engineering has shown a huge improvement – the number of graduations in engineering has increased by 39 percent since 2004. In the field of Computer Sciences however, graduations have declined by 14 percent.\textsuperscript{52}

\textit{Completion of undergraduate SET courses by gender}

There is very little statistical data available on drop out by gender, race and field of study. In the following section we rely on HEMIS graduation data to paint a picture of the relative success or failure of female students in completing their SET studies.

Statistics show that, on average, women are more likely to complete their degree than men. In 2009, 40,184 men graduated with a degree, certificate or diploma from South African higher education institutions versus 60,500 women (60 percent of total graduations).\textsuperscript{53} Female graduations increased on average by about eight percent each year between 1995 and 2005.\textsuperscript{54}

Women are proportionately more likely to complete SET courses than men. While more men graduate from SET undergraduate studies, this is because men comprise a greater proportion of the SET student body. As the figure below shows, women account for just under half SET graduates (49 percent), despite comprising about 44 percent of total SET enrolments.\textsuperscript{55}

\begin{footnotes}
\item[53] Source: HEMIS database. Tables downloaded from www.education.gov.za
\item[54] CREST Report, NACI, 2001, Facing the Facts 2009; NACI
\item[55] Technically, we should compare graduations in 2008 with enrolments a number of years prior to 2008. However, year on year changes in the relative proportions of students graduating is very small. Drop out rates from case study research does show us that women are more likely to graduate, hence the smaller gap between men and women in graduation figures than in enrolment figures.
\end{footnotes}
Statistics by race, and race and gender, are shown in the tables below. For the year 2008, an equal number of black men and women graduated with a degree or other qualification in SET, whereas a slightly higher number of Coloured and Indian females graduated than males.

Table 3: Graduation from undergraduate SET studies by race, 2008

<table>
<thead>
<tr>
<th>Race</th>
<th>Percentage of total graduations</th>
<th>Percentage of the SA population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>56%</td>
<td>79%</td>
</tr>
<tr>
<td>Coloured</td>
<td>6%</td>
<td>9%</td>
</tr>
<tr>
<td>Indian</td>
<td>8%</td>
<td>3%</td>
</tr>
<tr>
<td>White</td>
<td>30%</td>
<td>9%</td>
</tr>
</tbody>
</table>

Source for graduation data: HEMIS database 2008; source for population data: StatsSA mid-year population estimate, 2008 (medium variant)
Table 4: Graduation from undergraduate SET studies by race and gender, 2008

<table>
<thead>
<tr>
<th>Race and gender</th>
<th>Gender ratio within race</th>
<th>Percentage of total</th>
<th>Percentage of SA population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>groups for SET graduate</td>
<td>undergraduate SET</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>graduations</td>
<td></td>
</tr>
<tr>
<td>Black male</td>
<td>50</td>
<td>28%</td>
<td>38%</td>
</tr>
<tr>
<td>Black female</td>
<td>50</td>
<td>28%</td>
<td>41%</td>
</tr>
<tr>
<td>Coloured male</td>
<td>46</td>
<td>3%</td>
<td>4%</td>
</tr>
<tr>
<td>Coloured female</td>
<td>54</td>
<td>3%</td>
<td>5%</td>
</tr>
<tr>
<td>Indian male</td>
<td>49</td>
<td>4%</td>
<td>1%</td>
</tr>
<tr>
<td>Indian female</td>
<td>51</td>
<td>4%</td>
<td>1%</td>
</tr>
<tr>
<td>White male</td>
<td>54</td>
<td>16%</td>
<td>5%</td>
</tr>
<tr>
<td>White female</td>
<td>46</td>
<td>14%</td>
<td>5%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>-</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source for graduation data: HEMIS database 2008; source for population data: StatsSA mid-year population estimate, 2008 (medium variant)

As will be explored in the following section, there are multiple hurdles for both young men and women from low income backgrounds to overcome in order to graduate with a degree, and some of these hurdles are disproportionately experienced by women. Nevertheless, women, including those in SET fields, are on average more successful students in most higher education institutions.

Enrolment and graduation from SET at postgraduate level

Literature suggests that the proportion of female students declines over the duration of SET studies. Thus, while the gender profile of undergraduate enrolments and graduations is fairly even across many SET fields (exceptions include Engineering and Computer Sciences), gender differences become more marked at postgraduate level. In South Africa the overall proportion of female SET doctoral enrolments is 41 percent (versus 43 percent at undergraduate level). The gap is however very marked in particular fields - in Engineering, 15 percent of doctoral enrolments are female (versus 25 percent at undergraduate level). In contrast, in the Health Sciences, 64 percent of doctoral enrolments are female.56

4.5. Enrollment in FET SET courses

The National Certificate (Vocational) (NCV) is a qualification offered at NQF levels 2 to 4 (known as the Further Education and Training Band (FET)) and replaces NQF Levels 2 to 4 of the old National Technical Education Programme courses (NATED), though many FET colleges are currently offering both programmes. To enrol for either of these, applicants must have a

minimum of a Grade 9 pass or ABET Level 4, or a NQF Level 1 qualification.\textsuperscript{57} The NCV offers a more practical and less academic alternative to the FET programme (Grades 10 to 12) offered by schools. Students receive practical, industry focused training which enables them to seek work in a range of fields such as business administration, hospitality, and engineering and applied technology.

FET colleges also offer tertiary qualifications in a range of vocational fields, including engineering.

At the policy level, there is currently a strong impetus toward recruiting more learners to skills-focused FET colleges. In 2011, the FET sector received a substantial financial boost, with significant funding increases to FET colleges, SETAs, NSFAS and the National Skills Fund (NSF). Targeted interventions by DHET have improved learner performance in the sector, and raised pass rates from 23 percent of those who wrote in 2007 to 59.7 percent in 2009. Interventions in the FET sector are a key component of the DHET’s broader strategy to reduce drop out rates from education after Grade 9.\textsuperscript{58}

Table 5: Levels of education and qualifications in South Africa

<table>
<thead>
<tr>
<th>Band</th>
<th>School Grades</th>
<th>NQF Level</th>
<th>Qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIGHER / TERTIARY EDUCATION</td>
<td>8</td>
<td>8</td>
<td>Doctoral degree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7</td>
<td>Masters degree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
<td>Honours degree</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>Postgraduate diploma</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>General first degree</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>4</td>
<td>Professional first degree postgraduate</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>3</td>
<td>Bachelors degree</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>2</td>
<td>First diploma</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Higher certificate</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Certificate</td>
</tr>
<tr>
<td>FURTHER EDUCATION AND TRAINING</td>
<td>9</td>
<td>1</td>
<td>National Senior Certificate/ Diploma / National Certificate (Vocational) Level 3</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
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</tr>
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</tr>
<tr>
<td></td>
<td>R</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{57} Ekurhuleni West College (EWC) for Further Education and Training website: http://www.ewc.edu.za/courses_ncv_overview.htm

\textsuperscript{58} Discussion Paper for public Comment: Confronting youth unemployment: policy options for South Africa, National Treasury, February 2011
However, there remain strong social perceptions in many communities that a vocational qualification, at school or tertiary level, is inferior to an academic qualification and that anything less than a university degree is a second-best option.

This is born out by the relatively low levels of enrolments in the FET sector. In 2007, 320,679 students were enrolled in public FET and training colleges. In contrast, 761,087 students enrolled in higher education institutions across South Africa, and about 2.5 million learners were enrolled in Grades 10 to 12 at public and independent schools.  

A 2007 Department of Education Report shows that as many as 80 percent of 16 to 18-year-olds were enrolled at school (about 2,4 million learners), whereas only one percent were enrolled at FET colleges (23,689 learners). The report indicates that this pattern was consistent from 2002 to 2006. It does however note, importantly, that the discrepancy in the participation rate of the 16-18-year-old age group between schools and FET colleges must be viewed in the context of the availability of the two options – while South Africa had 5,466 public ordinary secondary schools in 2006, it had only 50 public FET colleges.  

Nonetheless, the FET sector has not to date been as effective as it could be in providing learners and their parents with adequate information about post school options and financing. Given the Government’s commitment to increasing participation rates in vocational education as alternative to Matric, and increasing the number of artisans in South Africa, a much more effective campaign is needed to persuade young people and care-givers of the value of an FET qualification.

### FET qualifications do secure good jobs

Learnerships are vocational and educational training programmes with a theoretical and work-based component which are aligned to the national qualification system. In 2009, there were 51,607 learners enrolled on learnership programmes. A tax allowance is paid to employers that use learnerships or apprenticeships. Research by the National Treasury has found that the salaries of unemployed learners who find a job after completing a learnership are relatively high, with approximately half earning a salary of between R3000 and R5000 per month in 2005-06. Most learners enrol for intermediate skills development. Approximately 70 percent enrol for NQF level 4, with the majority being matriculants.

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60 Trends in Education Macro-Indicators Report South Africa 2009, Department of Education
63 Discussion Paper for public Comment: Confronting youth unemployment: policy options for South Africa, National Treasury, February 2011
Enrolment in FET SET courses by gender

There is very little publicly available data on enrolment in, and completion of, FET college qualifications. The Department of Higher Education and Training collects data on enrolment of students by gender and race in FET public colleges via an annual survey. However, despite repeated requests to the Department for access to this data, over a period of several months, the researchers were unable to access enrolment statistics. The Department did not provide reasons as to why the data could not be made available.

Limited data is available from other public sources. Data presented in a 2002 report by the National Business Initiative on the FET College sector shows that in 2000, 42 percent of enrolments in public FET Colleges were female. Only 18 percent of students enrolled in Engineering Studies were female, however. The report notes that there was a slight increase in the proportion of females enrolled in Engineering Studies in the period 1998 to 2000.  

Anecdotal evidence based on interviews for this research with lecturers and Department Heads at two FET colleges in KZN and Gauteng respectively, suggest that in 2010, the gender ratio in student enrolments in civil, mechanical and civil engineering courses (the primary SET course offered at FET colleges) is significantly skewed towards males.

Completion of FET SET courses by gender

There is currently no publicly available information on completion and drop out from the FET sector. SBP was advised that this information would need to be sourced independently directly from the colleges, as no national data set is available. This was beyond the scope or the study, which specifically excluded the collection of new statistical data (quantitative data analysis was explicitly limited to the availability of existing data sets, as per the project agreement).

4.6. Summary of quantitative analysis

The picture painted by the statistics above can be summarised as follows:

At the school level

- Boys and girls have equitable access to primary school, and to maths and science subjects at school. However, the quality of the maths and science education provided to many learners in South African schools is very poor
- Boys and girls perform equally as well on a range of numeracy and mathematics tests at school level
- A slightly higher proportion of boys write Matric Maths and Physical Science Higher Grade than girls, and more boys pass these key subjects. The ratio of the number of male to females who passed the Maths HG paper was 56:44, and Physical Science HG paper 57:43, over the period 2005 to 2007.
- Thus while access to maths and science education can be assumed to be equal for boys and girls in South Africa, take-up of these subjects at FET level (Grades 10 to 12) is not yet equal – there is clearly some ‘leakage’ of young women from the potential group of young scientists and technicians at the secondary school level.

• These statistics primarily represent the reality amongst black learners. There is very little gap between boys and girls amongst the other race groups.\textsuperscript{65}
• Encouragingly, the gap between male and female uptake of, and performance in, these subjects has decreased over the last decade in terms of both the number and proportion of girls sitting for these exams.

**Throughput to tertiary SET studies**

• Since 1995, women have enrolled in greater numbers than men in universities, while men remained in the majority in technikons.
• Just under a quarter of all undergraduate enrolments are in SET courses. Females comprise 43 percent of enrolments in SET (In first year, the proportion of male to enrollments is more skewed toward males, but as more male than female students drop out over the duration of the degree, the gap narrows to 57:43.\textsuperscript{66})
• It is possible that the gender ratio in SET courses in FET colleges (which straddles FET and Tertiary Education) is even more skewed towards males, representing another leakage of young women from the SET system.

**Refining the analysis: enrolment results by gender and race**

• Statistics from 2002 show that the largest gap in the gender ratio within race groups at the school level is amongst the black population, with far more young men taking and passing Maths and Science HG papers than young women. Encouragingly, this gap narrows at tertiary undergraduate level. While black men still outnumber black women in SET studies, the gap is far smaller.
• While female Indian learners outnumbered male learners in Maths and Science HG passes at school (2002 data), this is reversed at tertiary level, with more Indian males taking SET studies than females.
• Results within the Coloured population show that a slightly higher proportion of young men passed Maths and Science HG and school, and, consistent with this, a slightly higher percentage are enrolled in SET studies at undergraduate level.
• The biggest gender gap at tertiary level is within the white population. Statistics for 2008 show that amongst white students, 60 percent of SET enrolments were men, and 40 percent women.
• The group that is the least well represented in SET undergraduate studies is black women, when assessed relative to the percentage of young women in the South African population. The group best represented is white males, followed by white females.

**Enrolment results by gender within different fields of SET studies**

• The starkest gender gaps are within SET studies at tertiary level. 2008 statistics show that while 54 percent of enrolments in undergraduate Life Sciences were women, women comprise only a quarter of undergraduate enrolments in Engineering.


\textsuperscript{66} The HEMIS tables available for public download do not present statistics by the year of enrolment, but only for the type of degree / diploma, e.g. masters versus bachelors.
Completion of undergraduate SET studies by gender

- Undergraduate drop out rates across South African higher education institutions, are very high. Less than half of those enrolled in bachelors or national diplomas are projected to complete their studies.
- Women are more likely to complete their degree than men, including in SET fields.

5. Factors influencing entry to SET study

Existing research in South Africa and internationally identifies a number of key factors that encourage women to enter a career in SET, including:

- Individual preferences and aptitudes
- Being exposed to SET education, activities and career information
- Encouragement from a mentor figure, especially a parent
- Real or perceived incentives such as bursaries, employment opportunities and earning potential.67

Critical barriers include:

- Gender stereotyping regarding the types of subject, at school and tertiary level, that are appropriate for girls versus boys
- Lack of exposure to information about possible study and career options, particularly in black communities, as a result of parents being less likely to have attended university or work in professional careers compared to the parents of white and Indian students68
- Financial constraints (although the available research does not indicate that this is a gender-specific problem).

The study confirmed the critical importance of these enabling factors and barriers, in encouraging or inhibiting students’ entry into tertiary study in SET fields.

It should however be noted that barriers such as limited exposure to information about study and career options, and financial constraints, are not specific only to female students – male students are also affected.

The study also clearly shows that the single biggest barrier to entry and achievement in SET fields – which overrides gender issues and applies across the board – is inadequate educational preparation at primary and high school levels. Deficiencies in the school system severely limit male and female learners’ opportunities to access SET courses at tertiary level, and their capacity to successfully complete these courses.

A range of additional barriers, affecting both female and male learners, are closely linked to inter-generational deprivation, impacting most severely on black learners. These include

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68 Cited in Centre for Research on Science and Technology, A monitoring and evaluation framework to benchmark the performance of women in the NSI, Final Report to the SET4W Reference Group, December 2005
financial constraints, geographical location (particularly for learners living in remote rural areas), and language proficiency.

### 5.1. Individual preferences and aptitudes

In focus groups with female learners and students conducted for the project, individuals reported that their good marks in maths and science at school, and their enjoyment of the subjects, were their primary motivator in taking maths and science for Matric, and pursuing SET related fields of study at tertiary level.

Focus group discussions with Grade 11 learners in schools indicated that girls who had selected maths and science in Grade 9 did so because they believed this would make it easier for them to get into university, and would open more job opportunities to them.

Interviews indicated that learners that achieve well at school, and are perceived by their parents and teachers as being clever, are often strongly encouraged by their parents and teachers to take maths and science subjects in Grades 10 to 12, in order to provide a good grounding for future study.

Many of these grade 11 learners already had very strong ideas about the careers they wanted to pursue, and expressed their desires to be vets, doctors, architects, engineers, marine biologists and pilots.

Interviews revealed some cases of individual learners pursuing their interest in maths and science at school level despite the odds being very much against them. A Chemistry lecturer and PhD student from a rural community in KZN, for example, related how she had developed a love and aptitude for science at her rural primary school. However, her local high school did not offer science subjects. At age 12, with the encouragement of her parents, she moved several hours drive away from home, to live with her aunt in a township, in order to attend a secondary school were she was able to take science through to Matric.

Learners and first years often lacked a clear understanding of the different courses on offer at university or what career they might pursue with a science degree. They know however that they want to do a science degree – and often only start to think about areas of specialisation and possible career direction in their second year of tertiary study.

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**Learners pursue subjects they are good at**

Existing research has demonstrated the importance of aptitude on career choices. A study examining the career preferences of accounting students at the University of Pretoria, for example, highlights aptitude, together with the influence of families and teachers, as key determinants of students’ career decisions. The study, of 480 students, identified the following as the most important influences affecting students’ career choice:
- Their performance in accounting at school
- Advice from friends and relatives
- School teachers’ influence
- Association with others in the field of accounting
The study found that over half the students had decided on their career as a CA between Grades 8 and 11, while a third had decided during their Matric year.⁶⁹

5.2. Exposure to SET education, activities and career information

The sources of information available to individuals, and their exposure to activities and individuals who might encourage them to think beyond societal norms, have a very significant impact on the choices they make – including the extent to which they are willing to question or challenge received cultural stereotypes and enter into ‘non-traditional’ fields of study and work. Key sources of information identified by learners and students include parents, teachers, university open days and science events, and the internet. Individuals’ access to information is however heavily influenced by their personal circumstances, including their parents’ socio-economic status and educational levels, their geographical location, and the school they attend.

Parents

Interviews with learners and students indicate that parents and relatives provide an important source of information – but only in so far as their own exposure allows. Students from low-income and rural communities note that there are limits to how much guidance their parents could provide, as many are unemployed and/or poorly educated. A focus group with 11 high achieving girl learners in a KZN school revealed that only one learner had a parent who had completed a degree. Learners reported that their parents generally had little understanding of universities and the courses on offer or how they are structured, despite being generally supportive of them going to university.

Poverty and child-headed households severely limit further education options for male and female students

The support offered by parents was notably absent at one of the study sites, a no-fee technical high school on the fringes of Gauteng. Teachers at the school reported that, among the thirty learners who participated in focus group discussions, ninety percent will not further their studies. The large majority live separately to their parents (parents are often based in rural areas in other provinces), or have lost their parents and live with relatives or in child-headed households. According to teachers, the pressure on these learners to find work immediately after school is likely to prevent most – boys and girls - from pursuing any further studies.

Teachers noted that in their interactions with parents, they see a tendency for parents to encourage certain careers, particularly medicine and accounting, and perceive that parents often have very little awareness of SET related career options (for young men or women). Teachers noted that parents tend to express concern about the earning potential of particular degrees and fields of study, and that science (though not engineering) is generally considered less appealing in this regard. There were however suggestions that girls may in fact have more leeway to pursue science related studies for the love of the subject, whereas parents may be

⁶⁹ JE Myburgh, An empirical analysis of career choice factors that influence first-year Accounting students at the University of Pretoria: A cross-racial study, Department of Accounting, University of Pretoria
more likely to encourage boys to pursue a ‘traditional’ profession in order to ensure his earning capacity and status.

**Teachers**

Science teachers have a critical role to play in terms of making science real to learners, and drawing the links between SET fields of study and their daily lives. Teachers’ ability to achieve this is however determined not just by their individual levels of enthusiasm and depth of understanding of the subject, but also their access to resources to enable practical application. Learners in disadvantaged communities in particular are likely to have very little exposure to applied side of science, and little or no experience of experiments. Students from rural high schools report that their schools did not have resources to undertake practicals, with the result that their exposure to chemistry and physics in school was purely theoretical. This severely limits the meaning and value of the subject for the learners, and damages the link between what children do in school and how it might apply in ‘real life.’

The value of life orientation in guiding learners’ subject choices at Grade 9 level and their choices in respect of tertiary study appears to be highly dependent on the enthusiasm and experience of the individual Life Orientation teacher.

Some learners interviewed for the project described Life Orientation classes as useful in terms of learning how to construct their CVs, and doing research projects into their future career. Life Orientation teachers may also provide information on NSFAS and bursaries. Other learners however described life orientation as a waste of time, and expressed frustration about the lack of practical information, including information about different types of careers, bursary options and so on.

Industry representatives suggest that career guidance at schools is seldom offered in a way that “wows children” and taps into their hopes and dreams of making the world a better place. Life Orientation teachers are unlikely to be equipped with the knowledge and contacts to encourage a big shift of girl learners’ into non-traditional occupations. The extent to which Life Orientation teachers are capacitated to provide effective career guidance is partially dependent on their own exposure to a range of possible careers, and their willingness to proactively engage with tertiary institutions and professional organisations to gather information and facilitate links. Life Orientation is not yet standardised across schools, there is no final Matric exam, and there appears to be limited external moderation – with the result that much is dependent on the individual teacher.

**Lack of awareness of FET college qualifications**

Ekurhuleni West College, located in Germiston, Gauteng offers courses in Engineering, Business Studies, Utility Studies and Occupational Programmes. The College raises awareness amongst schools in the surrounding area about its course offerings through open days on campus, visits to the schools, and engagements with local community leaders.

Despite these efforts, FET college staff report that few young people are aware of the kinds of industry specific and vocational training offered by the colleges, which are available to learners.

70 Tina James (ed), Women in the Information and Communication Technology Sector in South Africa, July 2006
following completion of Grade 9. Staff report that there is a common misconception amongst both school teachers and learners that FET colleges are equivalent to the old trade schools for those with learning difficulties. Few teachers thus encourage young people to enter the vocational training offered at the colleges.

Interviews conducted amongst female learners in Grades 11 and 12 confirmed a bias against FET colleges. None of the learners interviewed had considered attending an FET college, and a number noted that their parents would not wish them to attend a college (versus a university), due to low status associated with vocational training, as well as the perception that higher education degrees are more likely to ensure their children obtained employment.

Key informant interviews highlighted the degree to which vocational training continues to be seen as a last resort option – educators noted that learners want “white collar” rather than “blue collar” jobs, and therefore aspire to academic qualifications rather than vocational.

**Science events and university open days**

Learners and students indicate that events such as science/ engineering weeks and open days at their local universities are a very effective source of information about study options and possible careers, and in many cases helped to shape their decisions. This was confirmed by interviews with teachers.

University staff acknowledge however that such events tend to attract learners who are already passionate about science, and generally those who attend better resourced and better achieving schools, and are less effective at reaching those with more limited access to information.

The likelihood of learners attending university open days also appears to be very dependent on their physical location and the extent to which their school proactively engages in such events. Interviews with top female science learners at a KZN school about an hour from UKZN, for example, revealed that none of the respondents had attended university open days or events, because the campus is perceived as being far away. There is a private higher education institution relatively close to the school, but learners and their parents preferred the option of a traditional university, and had thus not accessed information, or free aptitude tests, from the local college. These learners expressed some confusion about the differences between degrees (between a BCom and BSc for example). They appeared to have far less information, and less sense of agency in terms of their ability to engage with sources of information, than learners in other focus groups at other schools.
The South African Agency for Science and Technology Advancement (SAASTA) implements a number of projects on behalf of other agencies, including DST. One of these is the National Science Week event which aims to excite youth about science from an early age and to encourage them to develop an interest in studying maths and science subjects. Key activities include interactive exhibitions, science shows, workshops, theatres, and career information sessions hosted at provincial level. Schools are encouraged to take their learners on excursions to participate. SAASTA also coordinates the National Science Olympiad. The Olympiad aims to promote the participation of Grade 10-12 learners in the sciences and encourage them to pursue careers in SET fields.

SAWISE undertakes outreach work with learners. The aim is to raise an awareness of science amongst girl learners and to alert them to the range of careers they could pursue in science and engineering. SAWISE organises a major event every year, for which it invites female learners to a careers day at UCT or UWC. The event targets a range of schools, including well resourced and poorly resourced schools, schools that specialise in science and technology subjects, and schools that don’t specialise. SAWISE works with learners to inform them about the kinds of careers they can pursue with a science or engineering degree, and what they would have to study at university level for these careers. They also get women with experience in the sector to engage with learners about their career choices and their experiences. They target Grade 8s, in order to influence their choice of subjects, and Grade 11 maths and science learners.

**Broader sources of exposure**

Students from schools in low income areas and rural communities are much less likely to have had exposure to broader sources of information. Interviews revealed that many of these students had never worked on a computer or used the internet prior to arriving at university. Their exposure to the world of work tends to be limited to professions such as doctors, teachers and social workers – making it difficult for them to imagine opportunities for themselves beyond these parameters. While this is true for both male and female learners, it is often compounded by community expectations that women should become wives and mothers – further limiting the extent to which young women from such backgrounds might explore alternative options that challenge social norms. This is particularly the case in rural communities.

Interviews with grade 11 girl learners in well-resourced, urban schools, in contrast, indicated that they have access to extensive information about possible career options. Learners report that they rely on the Internet to find out more about specific careers, and about what subjects universities require for specific courses.

**Professional career guidance**

A well-resourced school reports that it brings in a career guidance psychologist in Grade 9 to provide guidance to the learners in terms of their subject choices for Grade 10 (parents pay for this as an extra service). Learners may also access aptitude testing outside of school, to get guidance on future careers.
Teachers note however that these tests tend to be very specific, and are not grounded in ability. The test results are quite prescriptive, in that they recommend specific careers, rather than broad fields of study. They also provide no guidance about possible alternatives. Teachers express concern that some learners are simply choosing to study a subject because the aptitude test recommended it, without finding out what kinds of careers they might follow or whether those careers interest them.

5.3. Gender stereotypes regarding school subjects and tertiary study

NACI reports have identified the significant influence of socialisation and gender stereotyping as a key barrier to females entering SET fields of study.\textsuperscript{71} The literature identifies three major influences in this regard, namely parents, teachers, and the media. It suggests that, as a result of societal influences, there is a tendency for certain careers to be associated with a particular gender. Research conducted for NACI has shown that career guidance and selection processes for study courses tend to perpetuate these stereotypes, further discouraging young women from entering SET fields.\textsuperscript{72}

As noted above, the extent to which social norms and cultural values determine the decisions individual girl learners make, and the options that are open to them, in terms of school subjects, tertiary education and career paths, is dependent on a number of variables, but most importantly on the individual learner’s level of exposure to information about career options and professions – including information from sources other than their immediate communities, and exposure to adult professionals, and role models who break conventional moulds. This exposure is in turn influenced by the individual’s background, including the poverty or affluence of her family and her parents’ educational levels, the school she attends, and whether she lives in an urban or rural area.

\textit{Parents’ expectations and influence}

Prior research has shown that the socialising role played by parents has a significant impact on the study and career choices of young women. Reports suggest that parents tend to display certain expectations about gender roles and gender-related abilities, which shape children’s understanding of how they should behave. A 2009 NACI report found that parents appear to be especially influential in guiding the career choices of young women, and particularly young black women, and parents and other caregivers tend to encourage children to take up subjects and careers associated with specific genders. This socialisation begins from a very early age. The study suggested that, even in the earliest grades of formal schooling, young girls may already have deeply entrenched doubts or assumptions about their abilities in science and maths. This is reinforced in multiple ways, including pre-school play groups and crèches, as well as community institutions such as churches, via media constructions of gender.\textsuperscript{73} Even the toys that are designated as appropriate for boys versus girls (toy trucks and hammers versus mini...

\textsuperscript{71} Women in SET: Exploring the Facts, A report prepared for The South African Reference Group for Women of The National Advisory Council on Innovation, under the auspices of the Department of Science and Technology, Tara Research and Equity Consultants, Feedback

\textsuperscript{72} Women in SET: Exploring the Facts, A report prepared for The South African Reference Group for Women of The National Advisory Council on Innovation, under the auspices of the Department of Science and Technology, Tara Research and Equity Consultants, Feedback

ironing boards and cooking sets) start to provide fairly clear messages about stereotypical gender behaviour, from as young as two or three years of age.

**Culture and religion**

Interviews with learners and lecturers indicated that an individual’s culture and religion, and the level of conservatism at home, may create significant differences in opportunity for boys and girls in the same family. A number of learners reported that they come from quite conservative Indian families, where their parents have a significant say over what and where they will study. While medicine is often a preferred career choice for boys and girls, one girl learner reported that her parents are very concerned about her interest in engineering, as they fear she will not have time to raise a family. It was also reported that conservative Muslim parents would strongly discourage their daughters from leaving home in order to attend university.

Female learners interviewed for the project for the most part described their parents as being very supportive of their choices in respect of subjects and possible careers. Many suggested that their parents’ primary concern was that they should go to university and get a degree, without too much concern about which degree they choose. Several female students did however report that their families were ‘surprised,’ and in some cases disconcerted, at the idea of them pursuing SET fields of study and potentially becoming scientists and engineers.

Interviews with female learners and students from rural villages in KZN in particular indicated that, while their parents were generally supportive of respondents’ decisions to study a BSc, they were concerned about their job prospects, and had expected them to study teaching or nursing instead. Students also suggested that while their own families were supportive, friends and other people in their communities often expressed scepticism about their ability to complete the course, and find work. They also reported that friends in other courses question their choice of BSc degrees, and suggest that it is a waste of money as there are so few jobs available in the field. Friends also tell them that they will not have time to raise a family with a career in science.

At the University of Pretoria, engineering lecturers report that they are regularly contacted by parents whose daughters wish to pursue an engineering degree – seeking reassurance that this is an appropriate choice of study and career for a young woman. Their concerns appear to be motivated mainly by concerns about safety at work and the perception that the work place will be a male-dominated and very masculine environment.

**Perceptions of ability**

DST research has noted the prevalence of science anxiety, or a negative bias towards science, at the school level – among boy and girl learners. The DST report notes that deficiencies in the quality of education received by learners in maths and science fields tends to contribute to learners’ science anxiety, exacerbating the disinclination towards studying SET related disciplines.⁷⁴

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Existing research shows that teachers are very influential in shaping individual learners’ perceptions of their different aptitudes and abilities. NACI reports show that teachers may reinforce assumptions that boys have more ability than girls in math and science, and allow these views to impact on classroom interactions by focusing on boy learners when choosing individuals to answer questions and participate in demonstrations. The research also suggests that teachers may tacitly discourage science studies for girls as a result of their own views about appropriate gender roles.  

Female learners interviewed for the current study for the most part indicated that their teachers had been important in encouraging their love for science and maths, and had in many cases provided them with advice on possible fields of study and future career options. This was not always the case however, and some respondents from rural backgrounds reported that learners in rural schools were sometimes discouraged from taking science and maths as high school subjects. This was not necessarily gender specific – both subjects are perceived as difficult and learners are advised that their chances of passing are better if they choose other subjects.

Interviews with teachers and lecturers suggested that high levels of maths and science anxiety are prevalent across both genders. Teachers generally did not discern significant differences in terms of boy and girl learners’ attitudes to or ability in maths and science at school level, and reported that female learners are often top of the class in both subjects.

While South Africa’s school performance statistics show that boys and girls do equally as well on numeracy and mathematics tests in the years up to Matric, results for final Matric exams do show a slightly higher percentage of male learners passing the maths and physical science papers than female learners. Interviews with teachers working in disadvantaged schools suggested that, while girls tend to work harder and do better than boys in the early years of high school, male learners pull ahead in Matric. The teachers suggested that the girls are less driven to succeed in their final exams, because many expect to get married rather than pursue a career, are less inclined to see themselves as “income-earners” and are more passive about their life choices.

**Gender stereotypes associated with particular subjects**

Learners and students interviewed for the current study indicated awareness of traditional views and attitudes toward male-oriented versus female-oriented fields of study – although these views did not necessarily have a significant impact on their own decisions about subject choices at school and tertiary level. In a focus group discussion with male and female maths and science learners in a technical school, females asserted that they are just as able to do well in these subjects as boys. Opinions of their male classmates varied however – some claimed that boys have a natural aptitude for maths and science subjects, whilst other noted that they had

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76 For example: SACMEQ II, TIMMS(R), Department of Education Systematic Evaluations.

seen how their female peers were clearly able to succeed as well as males in maths, as well as in practical hands-on technical subjects.

As noted in section 4, maths and science subjects at school level attract relatively even numbers of male and female students. A small number of school subjects are however strongly associated with a particular gender. Whilst Maths and Physical Science appear to be less likely to be perceived as “boy’s” subjects, this is not the case for technology related subjects. Technical drawing is a clear example. The composition of technical drawing classes is mainly male. Girls taking the subject report that they are frequently questioned by other learners about why they are doing so. Other examples include Engineering Graphics and Design (EGD) and mechanical technology – hands-on subjects that require working with machinery and materials. An EGD teacher at one of the schools interviewed for the study noted that only three girls in the school were taking Matric EGD in 2010. Likewise, interviews with teachers at a technical school in Gauteng revealed that, while many female learners are taking maths and science subjects, there is only one girl in the Grade 12 Technology class.

Interviews with students and lecturers in industrial design and engineering courses highlight the importance of technical drawing as a foundation for tertiary study in these fields - female students who have not taken the subject at school are at a significant disadvantage in first year. Female engineering students interviewed for the study expressed frustration that they had never realised, while at school, how important technical drawing would be for the types of courses they are now engaged in.
Technical schools in South Africa

Moses Maren Mission Technical School is situated just south of Kibler Park in Gauteng. The school is attended by students from the surrounding area, most of whom come from very low income households. The school is a no-fee school, and a public bus service provides free transport to school.

Despite the challenges to teaching posed by lack of resources in both the surrounding community and the school, Moses Maren Mission obtained a 76 percent Matric pass rate in 2010.

As a technical school, Moses Maren Mission offers a far wider range of technical subjects than most other public schools – these include Civil, Electrical and Mechanical Technology, as well as Engineering Graphs and Design. All these subjects include a practical component, but due to limited funding, the school increasingly struggles to provide the relevant hands on training. Teaching technical subjects is particularly resource intensive – expenses include technical equipment, workshop maintenance, materials such as steel and wood, and high electricity bills.

A formal distinction between technical and ordinary schools does not exist in South Africa (technical schools are classified as ‘public ordinary schools’ (POS)). They receive the same annual funding as other ordinary schools, despite the higher costs of providing technical education. Anecdotal evidence suggests that given resource constraints, as well as difficulties in finding teachers qualified to teach technical subjects, many technical schools across the country are struggling to survive. In 2009, the Minister of Basic Education announced the allocation of R5 million to the recapitalisation of technical schools across the country.  

Gender stereotypes associated with particular careers

Gender stereotypes about particular careers are apparent even in well resourced schools. Teachers in a high-achieving, middle-income school suggested that there is a strong sense among the learners that boys do engineering, law, and accounting, while female top achievers in science subjects tend to go into medicine. Teachers note that girls are however beginning to show more interest in engineering and BSc degrees, as well as the health sciences, including medical technology.

At tertiary level, there continue to be marked gender differences in certain SET fields. The life sciences, for example, attract a higher proportion of female undergraduate students than male students. Biological Sciences, for example, shows an average gender ratio of 60:40 in favour of females, while Chemistry is 55:45 in favour of females.

Courses such as engineering and computer science, in contrast, continue to be dominated by male students. As noted above, male students comprised 75 percent of engineering enrolments at undergraduate level in 2008 and 62 percent of undergraduate enrolments in computer

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78 Minister of Basic Education, Angie Motshekga, Member of Parliament 2009/10 Education Budget Speech, June 30 2009
science and data processing. Lecturers and academic support staff interviewed for the project acknowledge that while there is a strong focus on drawing students from previously disadvantaged communities and under-resourced schools into these faculties, there tends to be much less focus on addressing gender disparities.

**Standing out from the crowd**

A 2009 survey among male and female students in the construction faculties of University of Johannesburg and the Cape Peninsula University of Technology found that male and female respondents displayed very different perceptions of the influences behind their choice of a career in construction. Among female students, 23 percent said that their primary reason for choosing construction was to ‘challenge the perception that construction is for males,’ while a further 20 percent had chosen the sector because ‘there were so few women.’ While 27 percent of male students were motivated by ‘opportunities in the industry,’ among female students the figure was only 12 percent. Sixty percent of female respondents agreed that, ‘because of discrimination, women tend to avoid construction and stick to conventional careers such as nursing.’

SBP’s interviews with lecturers and students revealed a tendency among some female students to select particular courses precisely because of their reputation as being male dominated. University students in various focus groups indicated that they had chosen their degree (particularly engineering) because they perceived it as a challenge, and it was an unusual course for a girl to do. They indicated that they were proud of themselves for doing something that is perceived as difficult, and different to the norm, rather than following more traditional paths like many of their peers.

The image of what one will ‘look like’ in a particular career also appears to be a significant influence on young women. Chemistry and microbiology students interviewed for the project said that at school they had “pictured themselves working in lab coats.” Print media and television offers images of attractive young women, with impeccable make-up, dressed in lab coats and high heels and appearing very glamorous. Research has shown that careers in ICT, on the other hand, are negatively associated with images of anti-social behaviour – nerdy boys glued to their computer screens to the exclusion of all else - and that this detracts from young women’s interest in the ICT field. Female engineers in industry and academia report that the biggest barrier to getting more females enrolling in engineering is the image of the profession as unglamorous and unfeminine. They suggest that powerful media stereotypes about femininity and female attractiveness create important markers of identity for girls and young women, and that engineering is perceived to be at odds with these, precluding femininity and stylish clothes. Respondents also note that young women who have successfully completed their SET degrees are very often lured into other fields directly after graduation – the corporate world of banks and financial consultancies offers opportunities to be glamorous and stylish, which might be more appealing than getting dirty on site. Efforts to address perceptual barriers will thus have to

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79 Influences on Women’s Choices of Careers in Construction: A South African study, Kolosa Madikizela, Cape Peninsula University of Technology, South Africa, and Professor Theo Haupt, Director Building and Construction Science, Mississippi State University, USA, 2009

80 Tina James (ed), Women in the Information and Communication Technology Sector in South Africa, July 2006
acknowledge that for some young women, the message needs to be not just that engineering is for girls, but that it can also be for feminine girls who care about high heels and make-up.

SA Women in Engineering (SAWomEng) was started in 2005 by two undergraduate engineering students who noticed that many female engineering graduates were going on to work in other fields, particularly commerce, and that industry seemed to be doing little to make engineering attractive to female graduates (international studies show only 60 percent of female engineering graduates work in the engineering sector after completing their studies). Recruitment sessions run by large auditing and consulting firms for third and fourth year students promised high salaries and a glamorous career – and saw female engineering students signing up in high numbers. Engineering companies, in contrast, did very little outreach, and for many third and fourth year students the image of the industry was one of a harsh, dirty working environment, with everyone dressed in boiler suits.

SAWomEng aims to change the image of engineering and to market engineering to young women as a glamorous profession. Its work is underpinned by five pillars:

- Target students with information about exciting and innovative work taking place in the engineering industry;
- Link female students to female engineers in industry, who act as mentors and share their knowledge and skills;
- Showcase the technical aptitude of young bright women in engineering at conferences and workshops
- Bring together new young engineers and experienced older engineers to enable the industry to better understand the needs and priorities of the younger generation
- Promote the femininity of female engineers.81

The organisation has established GirlEng to focus on schools. High potential girl learners in Grades 10 to 12 are selected to attend targeted workshops, providing them with information about different engineering fields and careers. GirlEng also runs a targeted Mentorship Programme for learners and first year engineering students. GirlEng reports that Grade 11 is an ideal time to engage with learners, as they are starting to think seriously about what they would like to study, and still have time to improve their marks and apply for bursaries.

Women in Engineering and the Built Environment (WIBE) covers the fields of engineering, construction, town and regional planning and architecture. The forum was started about five years ago. Two years ago WIBE partnered with Group 5, which provides much of the funding. Funding is also provided by UJ, the Engineering Council and the Department of Mining. The forum has three primary strands – learners, students, professionals. It works to attract school learners into studies in engineering, technology and the built environment, and to change the perception that engineering involves working in a ‘dirty’ and unfeminine’ environment.

81 http://www.sawomeng.org.za/page-pillars.htm
5.4. Role models

The media can potentially play a key role in shaping notions of appropriate gender-role behaviour. This role can be a very positive one. In interviews conducted with students and lecturers, the popular TV programme CSI (crime scene investigation) was repeatedly mentioned as a motivator for young women to pursue studies in forensic sciences. Young people who would not otherwise have considered the career have been persuaded by the programme that it is glamorous and challenging, and have opted to study BSc courses as a result. Interviews also revealed that local programme Isidingo has a character who is a geologist, and that this has seen a surge in interest among learners in geology as a potential career.

Respondents highlighted the importance of role models, as mechanisms to improve exposure SET fields, and to improve understanding at a very practical level of what individuals can do with a degree/ career in these fields. Role models should be someone who the young person can relate to and identify with. Respondents identified two types of role models:

- Those that are personally known to the individual, including parents, relatives, teachers and lecturers, as well as professionals such as vets, doctors, physiotherapists and so on that a young person may come into contact with in daily life
- High-profile individuals who provide a public face for a particular activity or field of work.

In both cases, the role model is important in terms of making careers in SET fields real, relevant and attractive to young people. The gender of the role model is perhaps less important than the practical demonstration of the particular career. However, in respect of public, high-profile role models (as opposed to individuals known to the learner), successful female role models are very important in terms of breaking down societal stereotypes and cultural barriers, and demonstrating that young women can excel in what have traditionally been considered male-dominated fields of study and work.

There is however a limited number of high-profile and successful females in traditionally male-dominated occupations. Black South Africans have historically had extremely limited opportunities to gain tertiary qualifications and excel in the SET fields, partly as a direct result of discriminatory policies and practices, and partly as a result of the poor quality education provided to them. SET4W research indicates that this legacy translates into a severe under-representation of black women in SET fields, resulting in a shortage of role models who could attract young women into SET fields of study.\(^2\)

5.5. Incentives (employment opportunities, earning potential, bursaries)

Interviews with lecturers, students, and teachers highlighted the extent to which perceptions about career opportunities, and particularly earning potential, shape male and female students’ course choices and preferred career options.

The strong focus on the earning potential associated with a particular career tends to dissuade many learners from pursuing SET studies, particularly non-engineering degrees, because

career paths are not very clear, and salaries are likely to be lower relative to professions in commerce and law for example. This dissuades both young men and young women from pursuing careers in science fields.

Interviews with students suggest that earning capacity is a particularly important consideration for those who are the first to go to university in their family, as there is an expectation that they will provide for the family once they have completed their studies.

Students’ perceptions about high earning careers are however not always linked to industry realities. Lecturers report that learners express genuine surprise at the idea that it is possible to get a high-earning job in the financial sector with a Maths degree, for example – their frame of reference tends to be very limited to ‘professions,’ such as medicine, law and accounting.

Nonetheless, academics acknowledge that how to make money as a scientist is ‘not self-evident.’ They note that while pursuing an interest in science and getting a non-professional degree equips students with skills and expertise that may be applicable across a range of different industries, to understand this requires a broader understanding of the world of work than many first year students, or their parents, have. The lack of definite career paths may thus act as a disincentive to SET studies. Academics and industry experts also acknowledge that jobs in highly specialised SET fields, such as computational physics for example, are indeed few and far between.

The availability of bursaries at the undergraduate level, particularly in engineering fields, appears to act as a significant driver in attracting women into SET courses. A significant number of female students and graduates interviewed for the study noted that they had embarked on BSc engineering degrees primarily because they had been able to secure bursaries to do so. Several respondents noted that they had not had any clear idea about what field of study they should pursue, but that on the basis of their good marks in science and/or maths at school they had applied for bursaries in the engineering sector, and were now engaged in engineering studies/ careers as a result of securing this funding. One young woman noted that she had been among a group of 20 students to secure a bursary from Eskom for studies in electrical engineering – and that only two of her fellow bursary holders had been male.

5.6. Schooling and educational preparedness

A critical barrier for both boy and girl learners entering SET fields of study is the extent to which the school system has left them academically under-prepared for tertiary study in this field. As noted in section 4, learner performance on tests of maths and science ability is very poor. Relatively few South African schools are producing the kinds of maths and sciences results that would secure learners entrance into BSc degrees.

Learner performance placed South Africa last in the list of participating counties in maths in the TIMM(R) study, with a mean of 275 out of a possible 800, well below the international mean of 487. Mean attainment in science was even lower.\(^{83}\) SACMEQII results for South Africa saw less

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than half of learners reach competency levels higher than Level 2, ‘Emergent Numeracy’ (Level 4 shows that learners are ‘beginning to problem solve’).\(^{84}\)

The Department of Education systematic evaluations results are shown in the table below. Overall learner performance is very poor. For Mathematics (Grade 6), only 12 percent of learners managed to reach the ‘Achieved Level’ (50 to 69 percent) or higher.

**Table 6: Average percentage scores achieved by learners in the DoE’s Systematic Evaluations**

<table>
<thead>
<tr>
<th>Test</th>
<th>Average learner score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 3 (2001): Numeracy</td>
<td>30%</td>
</tr>
<tr>
<td>Grade 3 (2007): Numeracy</td>
<td>35%</td>
</tr>
<tr>
<td>Grade 6 (2004): Mathematics</td>
<td>27%</td>
</tr>
</tbody>
</table>


Recently published research shows that maths and science passes at what compares to the old higher grade level are heavily concentrated in independent schools and the top quintile of public schools. In 2004, 6.6 percent of all schools entering candidates for the Senior Certificate (414 schools) accounted for 66 percent of maths passes, while 5.5 percent of schools produced 50 percent of science passes.\(^{85}\)

The research found that the variables exerting the largest effect on maths scores were:

- Population group (race)
- Whether the candidates wrote English home language (an advantage of 11 percent)
- Whether they attended a top quintile public school or independent school (advantage of 7 percent)
- Whether they attended a Dinaledi school (advantage of 6 percent)
- Which school district they belonged to
- School infrastructure
- Gender (males had a 3 percent advantage over females)
- School’s human capital score

The variables were similar in science scores – but here females were less than one percent behind males.\(^{86}\)


\(^{85}\) The Maths and science performance of South Africa’s public schools: some lessons from the past decade, CDE, September 2010

\(^{86}\) The Maths and science performance of South Africa’s public schools: some lessons from the past decade, CDE, September 2010
A low proportion of learners complete Matric

The 2007 General Household Survey data shows that only 38 per cent of 19- to 24-year-olds had completed Matric or an equivalent FET college level qualification (although a proportion of this age group are still in school). Recent research suggests that school fees are now seldom a reason for school drop out, although other access costs (such as uniforms and transport costs) are still a barrier to completion, when combined with the cumulative impact of household poverty on learners. Teenage pregnancy is one of the most common contributors to females leaving school before completion. Other common reasons for school drop out include: lack of interest or disengagement from schooling, and having failed grades a number of times, or having learning difficulties.

Research conducted on behalf of NACI has identified deficits in education and training facilities at schools servicing disadvantaged communities, which result in learners developing inferior language, mathematics and science skills. This limits learners’ course options at tertiary level. Similarly, schools in rural areas tend to be significantly more under-resourced than their urban counterparts, in terms of access to facilities and equipment, and the quality and standards of teaching. In analysing the South African SACMEQII data, van der Berg argues that the extent of inequality in educational outcomes between schools in South African is far larger than in any of the other countries participating in SACMEQ, and that it is “much higher than for most other studies worldwide.”

Teachers identify maths and science curricula as key challenges. They note that the science curriculum expects learners to think on fairly high level, and incorporates aspects of economics and social perspectives, which learners are ill equipped to handle. The science curriculum calls on learners to be able to grasp certain maths concepts, which are not covered in the maths literacy syllabus, such as simultaneous equations and ratios. According to one science teacher, the average learner’s science marks drop by ten to 20 percent when they switch from maths to maths literacy.

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Closing doors

Teachers play a significant role in influencing learners’ future prospects in relation to decisions around maths versus maths literacy. Teachers and lecturers interviewed for the project complained that maths teachers where too quick to move learners onto maths literacy – and that their ability to cope with school science is seriously diminished as a result. There also appears to be a limited understanding among teachers and learners about the extent to which maths literacy limits prospects for tertiary education in SET fields. Respondents report that learners – including those in well resourced schools – are given very little advice about what a switch to maths literacy means in the longer term. Respondents emphasised that learners who achieve an A in maths literacy are not able to apply for a BSc degree.

Teachers note that the science syllabus is too long, making it very difficult to cover the whole syllabus in the school year. The extensive syllabus results in students losing confidence in their ability to do science, with significant numbers (of both male and female learners) switching to other subjects in Grade 10 as a result. This sentiment is echoed by university lecturers, who report that the school curriculum tries to cover too many topics in maths and science, with the result that learners cover subjects in insufficient depth and have limited understanding.

Teachers themselves often lack appropriate depth of understanding of their subjects. In some schools, teachers get moved around from one subject to the next – with no apparent recognition that teaching at high school level requires subject-specific knowledge and experience.

Interviews with students revealed that many, particularly those from rural areas, felt they had suffered considerable disadvantage in their first year as a result of their inadequate schooling. They also reported that teachers in rural schools are limited in their experience, and are unable to provide much guidance or preparation for further study. Whilst these issues affect both genders, they contribute substantially to the underrepresentation of young black women in SET studies, as it is black children who are more likely to attend poorly resourced, underperforming schools.

The Student Support Programme (SSP) SSP enables academically distinguished, low-income students to flourish through attending South Africa's top high schools. It achieves this through financial assistance, mentoring and leadership development. SSP finances five years of high school education at schools in Gauteng and the Eastern Cape in South Africa. Students are recruited from primary schools based on academic excellence, financial need and leadership potential. SSP reports that more than 90 percent of SSP students complete their studies with the programme's partner schools, while 95 percent of SSP graduates go to university. In 2008, SSP achieved a 100 percent matriculation pass rate and 97 percent attendance at tertiary level institutions.

Possibilities for registering at university with an FET qualification
At a 2009 colloquium on the FET-HE interface, JJ Mbana, Chairperson of the South African College Principals’ Organisation (SACPO) described the existing boundaries between FET and HE as rigid, impregnable and unnecessary.

It was hoped that the NQF-based qualifications and unit standards which were to have fully replaced the NATED system would have addressed this disjunction – but this has proven not to be the case. As a result, the DHET is currently reviewing the FET curriculum and structure.

At present, individual universities determine entry levels to their courses, and whether or not FET qualifications are acceptable. Many universities require students to write National Benchmark Tests, which are used to inform student placement decisions, curriculum development and academic support programmes.

The National Benchmark Tests are an assessment for prospective first year entry students into Higher Education. The assessment is designed to measure a writer’s levels of proficiency in Academic Literacy, Quantitative Literacy and Mathematics as related to the demands of tertiary study. The NBT also provides information to assist in the placement of students in appropriate curricular routes (e.g. regular, augmented, extended, bridging or foundation programmes) and with the development of curriculum for Higher Education programmes. In addition, it assists Higher Education to interpret school-leaving results, such as those of the National Senior Certificate (NSC). There are two tests. The Academic Literacy and Quantitative Literacy domains (AQL) are combined into one multiple-choice test. The AQL Test is written by applicants to all programmes. The second test is Mathematics (MAT), which is written by applicants to programmes for which Mathematics is a requirement, and is also multiple choice.

The National Skills Development Strategy III proposes a review of programme entry levels and the balance between academic knowledge and practical experience, in order to ensure that FET qualifications can offer access to university programmes. The DHET’s 2010 strategic plan aims to address the current disconnect between FET colleges and universities. This includes developing “a highly articulated system of qualifications between the FET and university programmes.”

Entering University through FET

A partnership between INSETA, UWC’s School of Business and Finance, and the Financial Planning Institute (FPI) aims to offer new opportunities for young people seeking a career in the financial sector. The initiative offers a “seamless articulation” between FET and HE, and aims to make it easier and more affordable for students to gain the right accreditation and qualifications. It allows FET Colleges to offer the equivalent of a first-year university course. UWC will recognize the NQF level 5 Certificate in Wealth Management as the first year of a B.Com Degree. The NQF level 5 qualification will therefore be a bridge to a higher qualification at UWC.

A pilot programme is being funded by INSETA, and will allow 100 learners at five Western Cape public FET Colleges to undertake the NQF level 5 Certificate in Wealth Management as the first step toward university qualification. The FET training is being provided on a no fee basis, as
INSETA is using discretionary funds to fund the 100 learners. The initiative will also allow companies to claim back portions of their skills levy for placing employees on accredited training.

5.7. Financial constraints

South African learners have access to free education on a means tested basis

In 2007 all government schools in South African in Quintiles 1 and 2 (i.e. schools in poor and relatively less wealthy areas) were made 'no-fee schools' which meant that learners attending these schools no longer had to pay for school fees. Those learners who attended schools in Quintiles 3 to 5 (schools in relatively better resourced areas) but who could not afford school fees, could apply for a partial or full fees exemption, based on a means test. In 2010, no-fees schools were extended to include all those in Quintile 3. Approximately 60 percent of South African schools are now fee-free.\(^9^0\)

Financial barriers affect both male and female students in enrolling and completing studies in any field. However, financial barriers disproportionately affect black students, and aspirant black students – as they are more likely to come from poor or low income households. Any initiative which specifically aims to increase the proportion of black females undertaking studies in SET must give consideration to financial barriers to access, even though this do not appear, in the South African case, to affect women more than men.

Previous research on barriers to higher education indicates that access, particularly for Black students, is related foremost to:

- the impact of discrimination under Apartheid
- financial resources available\(^9^1\)

Education is relatively expensive in South Africa. The annual fees for an undergraduate degree range from R15,000 to R35,000. This is well in excess of the average annual income of a Black African household, which the Stats SA Income and Expenditure Survey 2005/06 calculates as R37,711. Studies have shown that lack of access to funds is one of the main disincentives to entering higher education, for male and female students.\(^9^2\)

Plans to widen access to higher and further education

The Department of Higher Education and Training has acknowledged that available funding for higher and further education and training does not provide for the estimated 42 percent of young people between the ages of 18 and 24 who are not in employment, education or training, a significant proportion of whom have completed Matric and some of whom have university exemption. The new policy framework for higher education and further education and training


\(^9^2\) Cosser & du Toit 2002:14
aims to extend the right of access to education by providing free higher and further education to students from poor and working class communities, and to greatly increase the number of students enrolled at FET colleges.93

**Funding options**

Students wishing to enter higher education have three funding possibilities:

- Self-funding, often through student loans or loans taken by parents/care-givers
- A loan from the NSFAS, a government agency which provides funds for capable students who might otherwise be financially excluded from higher education.
- Bursaries and scholarships, from tertiary institutions, government and the private sector.

**Self-funding**

Commercial banks offer student loans. Repayment terms vary, depending on the bank’s terms and conditions. The loan usually covers fees, books, equipment, and accommodation for students who study full-time and do not live with their parents.

Private companies also offer student finance. EduLoan for example provides funding to overcome financial barriers to access higher education in South Africa. Support mainly includes finance for registration fees and student’s tuition fees. Eduloan mainly funds students from historically disadvantaged communities, who are not able to meet the criteria for formal banking sector loans or government, and do not qualify for NSAFS loans.

**NSFAS**

A significant proportion of undergraduates are reliant on NSFAS funding, particularly in historically disadvantaged institutions. In 2004, 13 percent of the students enrolled in public higher education benefitted from NSFAS grants. By 2008 this had risen to 17 percent. HEMIS data shows that the number of students who apply for but do not receive NSFAS awards is increasing.94 Selection criteria include annual gross family income, family size, number of siblings at higher education institutions, and distance from home.

Women account for **56 percent** of NSFAS beneficiaries. The large majority of NSFAS funding to date has been allocated to HE rather than FET. Female beneficiaries outnumber male beneficiaries in respect of both HE and FET across all nine provinces.

Over 90 percent of NSFAS funding goes to African students. NSFAS has become a significant source of income for historically disadvantaged universities, improving cash flow and reducing student debt.95

The table below shows the NSFAS allocations per province in 2009, based on data in the NSFAS 2010 Annual Report.

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93 Report of the Ministerial Committee on the Review of the National Student Financial Aid Scheme, Department of Higher Education and Training, 2010
NSFAS distributes funds to tertiary institutions, which act as the disbursing agency and are also responsible for processing applications. The assessment model takes into account the financial need of the applicant, and academic eligibility. A means test is used to determine eligibility for a loan, and to calculate what amount, if any, the student is required to pay toward their studies each year.

University applicants are required to submit the following documents:

- Grade 12 certificate
- A certified copy of applicant’s bar-coded ID
- Proof of latest income of parents (e.g. pay slip, pension, grant or an affidavit stating that the parent is unemployed)
- Proof of registration of siblings within the same household
- The ID books or birth certificates of other people, such as brothers and sisters, whom are regarded as members of the family and who are also supported by means of the household income
- In case of disabled student, a letter from medical doctor providing proof of permanent disability
- Letter of acceptance from the institution.

Students interviewed for the study report that the application process for NSFAS loans is administratively complex, and providing the necessary supporting documentation is a considerable challenge. Students note that much of the documentation has to come from their families back home, which requires them travelling home to collect it or arranging for certified copies to be sent to them at university.

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Documentation challenges

One student interviewed for the project, who comes from a township outside Pretoria, noted that she had applied for NSFAS funds but been rejected. It appeared that part of the problem was the difficulty her family had encountered in completing the documentation, because her father is self-employed, and was unable to show a specific income, because his income changes all the time, and they were also unable to prove that her mother is unemployed.

Students have to be accepted by a university before they are able to begin the process of applying for funding. Universities generally require students to make an upfront payment before registration, to secure admission to the university (Wits University for example requires an upfront payment of R5,000).\(^97\) The balance of the tuition fees must be paid during the course of the year (in some universities fees must be settled by the end of March). NSFAS funds are however only disbursed later in the year - students therefore have to fund the initial payment from their own pockets. NSFAS does transfer some funds (up to 30 percent of the total allocation) in advance of the financial year end to cover student costs associated with registration and accommodation (this is only applicable to students who qualify for full NSFAS awards, where expected family contribution is zero or close to zero). It is however up to the tertiary institution whether or not such advance payments are made available. Students and support staff at one university reported that while the university used to make upfront funds available for registration, they no longer do so.\(^98\)

NSFAS beneficiaries are required to re-apply for loans every year. The loss of a NSFAS loan, generally as a result of poor academic performance, is a major contributor to student drop-out, as discussed in section six.

Bursaries and scholarships

Academic Merit Awards are financial rewards that are allocated by higher education institutions to students with excellent academic results. Institutions typically allocate two categories of merit awards:

- first year students who excel in Grade 12
- undergraduate students who excel in their field of study.

Merit awards are usually not paid out to students. Instead, the amount of the award is deducted from the student's fee account. Awards are used to attract the best students to the institution.

Bursaries and scholarships are generally based on learner performance, but limited numbers are available. Bursaries and scholarships may be funded by government departments and institutions, as well as organizations, companies and international donors. Several companies in the SET sector provide bursaries to previously disadvantaged students, partly in an effort to influence the demographic profile of particular industries. Students who are awarded bursaries by private sector companies or parastatals are often required to work for the company for a period of time after completing their studies (this is called a contract bursary).


\(^98\) https://www.nsfas.org.za/web/view/students/prospective/FAQS18
6. Factors influencing completion of SET studies

The study identified the primary reasons for drop out from SET courses as inability to cope academically, and financial constraints. For the most part, respondents to the study did not believe that these key challenges would be any greater for female students undertaking studies in SET than for their male peers.

Respondents also identified a number of additional challenges, including lack of understanding of what courses will cover, family responsibilities, limited capacity to cope with the responsibilities and freedom offered by university life, and living arrangements that are not conducive to studying. These challenges were also perceived as being largely applicable to both genders.

A number of gender specific challenges were however identified, which may have a particular impact on female students’ performance, and their chances of successfully completing their undergraduate degrees. These include concerns about personal safety that prevent women accessing libraries and laboratories in the evenings, social pressure to switch to a less demanding and time-consuming course, concern about career opportunities and potential discrimination in hiring practices in industry, and negative experiences during practical placements for courses such as engineering.

Despite high rates of student pregnancy at most campuses, pregnancy and child-rearing do not appear to be major barriers to successful completion of undergraduate studies. Pregnancy may however contribute to financial pressures if the student takes longer to complete her degree as a result of the pregnancy.

6.1. The context

As noted in section 4.7, less than half the students currently enrolled in bachelors or national diplomas in South Africa are projected to complete their studies. Statistics show that drop out rates in first year university are high across institutions and faculties, and for both male and female students. Women are however, on average, more likely to complete their degree than men, including in SET fields of study.

6.2. Academic preparedness

Interviews undertaken for the current study, with academic support staff and lecturers at universities across Gauteng and KZN, repeatedly highlighted academic unpreparedness as one of the biggest challenges facing both male and female students, and a critical contributor to failure and drop out. Lecturers and academic support staff emphasised that students are not academically ready for university, and lack the necessary skills to tackle SET subjects. Many students drop out within the first month as a result.

Lecturers report that drop out in first year is very high, as borne out by national statistics. Performance in second year is generally better, as weaker students have changed courses or

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dropped out, students are specialising in their chosen subjects, and classes are smaller and allow more individual attention.

Staff at FET colleges report similar trends. They note that drop out from NQF Level 2 (the first year at FET colleges) is high, and reduces substantially in Levels 3 and 4, once weaker students have left the system and remaining students have a clearer sense of direction.

Lecturers and academic support staff interviewed at FET colleges highlight lack of academic preparedness as the major reason for low graduation rates. An FET College reports that it had originally intended for students applying for enrolment at the college to write a preparedness test, which would have acted as a filter to assess students’ ability to undertake the course. However, the test suggested that as many as 90 percent of students should not be accepted. The test could thus not be used as a filter, and is now used merely as a competency indicator.

University lecturers report that students with Matric reports reflecting 80 percent for maths, when independently tested at university, actually have competency levels around 50 to 60 percent. A key informant who works for an organisation specialising in maths and science education support programmes notes that some of the students they have worked with who scored 75 percent or higher in Matric exams, obtain ten to 15 percent in first year exams. School marks appear highly inflated, with the result that students fail first year, with devastating consequences for their confidence and enthusiasm.

University lecturers report that even in well resourced schools, learners are not being taught to think independently and logically, and that teachers pursue a system of rote learning. They note that there is a lot of pressure to push learners through the schooling system, teaching them in a way that spoon-feeds them the answers, rather than developing key skills. As a result, students reach university unable to do basic arithmetic, and are completely reliant on calculators even for simple sums.

Students are also unprepared for the type of study they need to undertake at university and college. Many come from schools where textbooks have been few and far between, and are thus not used to using textbooks as a tool for study. Textbooks are also expensive, and many students are unable to pay for them. They thus rely on shared access to the few reference books available from the library.

Both university and FET college lecturers report that many students struggle to communicate in English. Discussions with students revealed that many students find studying and completing assignments in English very challenging.

These challenges are particularly problematic for students from schools in poorly resourced communities, including townships and rural areas, were performance rates tend to be lower and resources such as science equipment and textbooks scarcer. The high levels at which these learners drop out of first year as a result of academic unpreparedness thus perpetuates the under-representation of black students from low income households in tertiary education.
Curriculum issues in FET

The new FET curriculum, introduced in 2007, is identified as a critical challenge by lecturers in FET colleges. The entrance qualification for NCV level 2 is Grade 9 – but the syllabus content requires knowledge well in advance of this level. Lecturers report that Grade 9 learners are not equipped to cope with the syllabus – and that students are thus effectively set up for failure. Lecturers report that, since the introduction of the new curriculum, there has been a steep decline in student performance. Practical time has been greatly reduced. Classes are big, with 30 students to a class, even in the workshop environment.

Under the old NQF courses, students took four subjects, and had to pass two in order to proceed to the next level. However students are now required to take seven subjects. They are allowed to proceed to the next level with only three passes, but have to carry the four failed subjects into second year. Students are unable to cope.

Lecturers did however note that the new curriculum has introduced English language as a subject - students do 5 hours a week of English language classes – and that this had led to a marked improvement in English proficiency.

Most universities offer support programmes aimed to facilitate university entry for students who have been disadvantaged by their school education. Foundation programmes offer students an alternative access route to university if they do not meet entry requirements on the strength of their school-leaving results. These programmes focus on developing knowledge and skills in core subjects (such as maths and science) and academic competencies (such as language proficiency, critical thinking and problem-solving skills). They also help students adapt to the university environment and prepare them for university study.

Foundation and bridging programmes

Foundation programmes are designed to assist learners from disadvantaged schools, particularly in rural areas, to access a university education despite having in sufficient points to be accepted for a mainstream BSc degree programme. The programmes target schools in South Africa’s ten most disadvantaged quintiles, with a particular focus on rural schools.

The BSc Foundation programme is a one-year stand-alone support programme, which covers chemistry, physics, biology and English literacy. Students who successfully complete the programme are able to enter the mainstream three-year BSc degree at first year level (students may also choose to enter an alternative degree outside of the SET fields).

The BSc Augmented programme targets students with slightly better application scores. The students attend the mainstream BSc classes, but receive extra tuition from the support programme, and complete the degree over four years rather than three years.
6.3. Access to finance

Respondents identified financial constraints as a critical challenge in terms of students’ ability to complete their undergraduate courses, and a major factor in students dropping out (although this is not specific to gender).

**NSFAS**

The recipients of NSFAS funds have to reapply for funding every year. The loss of NSFAS funding once a student has embarked on their undergraduate degree appears to be a major driver of drop-out. There appear to be a number of challenges associated with the administration of NSFAS loans, which contribute to students dropping out.

**Timing of funding allocations:**
Students who enrol at the beginning of the year only find out during the course of the year whether they have been awarded a NSFAS loan. If they find out that they have not qualified, they often have to drop out.

When students are informed about the outcome of their NSFAS applications varies from one institution to the next. Some are informed as late as September of the year the loan was intended to cover (the final claim date for higher education institutions is the 15 December of the same year). This results in some students, who have attended lectures for months, having to drop out if they cannot source other funds. These students are then in debt to the university.

**Loss of funding due to academic underperformance:**
Applicants must achieve a minimum pass rate in order to re-apply for NSFAS funding for their next year of study. Each university may set its own standards in this regard – some universities require students to pass all their subjects, others require that they pass a minimum number of subjects or attain a particular level of achievement (NSFAS has recently tabled a recommendation that students should pass major subjects with 60 percent, and other subjects with 50 percent). Loss of funding as a result of academic under-performance appears to be a major contributor to student drop out.

According to a manager from the Ukuqonda Institute, which runs programmes aimed at developing learners and students skills in maths and science, the situation appears to be compounded by the lack of correlation between students’ Matric results and their functional numeracy and mathematics skill at the level required for success in SET higher education courses. Students who are ill equipped for SET courses may nonetheless be provided with loans or bursaries on the basis of their good Matric marks. Inability to cope academically may result in such students dropping out – and being saddled with large student debt as a result of non-completion.
High drop out rates for NSFAS funded students

The report of the *Ministerial Committee on the Review of the National Student Financial Aid Scheme* notes that only 19 percent of NSFAS students have graduated, while 48 percent have dropped out or otherwise not completed their studies. The remaining 33 percent are still studying. The report notes that while poor students being enabled to enter the higher education system, they are unable to complete their studies, and so revert to poverty.\(^{100}\)

Adequacy of funding:

Ideally NSFAS funds are intended to cover the full costs of accessing education: covering tuition and registration, providing an allowance for transport, accommodation, and textbooks, a stipend to cover costs associated with internships or work placements, and targeted funds for certain students such as the disabled in need of technical aids.

How the results of the means test are used to allocate funding is however up the disbursing institution, and varies from one university to another. A university may decide to award a large number of loans that cover only a portion of fees, while another may offer larger loans to a smaller number of students. Where NSFAS loans cover only a portion of student fees and expenses, students report considerable difficulties in coming up with the balance of money needed. Some students report that textbooks are prohibitively expensive and are not covered by their loans. Some blame low levels of attendance on transport costs to university/college.

Tabled changes to NSFAS process (from 2011)

NSFAS is in the process of reconceptualising its business model on the basis of the recommendations of the *Ministerial Committee on the Review of the National Student Financial Aid Scheme*. The organisation is reviewing ways to make the application process more streamlined, efficient and transparent, and to reduce the paperwork required. There are plans to introduce a tracking system, which will allow students to be kept informed about the status of their application.

The institution recognises inefficiencies and costs associated with the current process, particularly in terms of how long it takes to publicise the results of funding applications, and the implications of this for students who are not successful but have already invested considerable time at university and run up substantial debt.

NSFAS have tabled a number of recommended changes to how student applications are processed, and how financial aid should be awarded (including a preference for providing a smaller number of students with funds to cover the full costs of study, versus providing a larger number of students with funds to cover only part of access costs).\(^{101}\)

\(^{100}\) Report of the Ministerial Committee on the Review of the National Student Financial Aid Scheme, Department of Higher Education and Training, 2010

\(^{101}\) Report of the Ministerial Committee on the Review of the National Student Financial Aid Scheme, Department of Higher Education and Training, 2010
Other sources of funding

While scholarships and bursaries from industry appear to be quite limited at the undergraduate level, there are some available, particularly in fields such as engineering, some of which are specifically for female students. The conditions attached to these bursaries vary according to the requirements of the particular industry sponsor. Poor academic performance would however generally result in loss of funding, and thus potentially in drop out. As these are private sector funds, however, there is no readily available public information regarding completion / drop-out rates of industry-funded bursary students.

6.4. Expectations of the course

Interviews with academic support staff and counselling staff indicate that students often have a very limited understanding of courses on offer or what types of careers they might be able to pursue with majors in particular subjects. They suggest that this may make it difficult for students to stay focused on their courses and to find the necessary motivation to succeed, given that the next step, after achieving the undergraduate degree, is not necessarily clear.

Lecturers and industry professionals undertaking community outreach report that learners from both well resourced and poorly schools tend to be equally ignorant of what the day to day work of an engineer entails, for example. Learners who express an interest in engineering tend to have very little understanding of what it is, what it involves, or how many branches there are. Focus groups with students confirm that their course choices were often based on very limited information. Students acknowledged that they had very little understanding when they arrived at university of different faculties and schools and possible career options. In extreme cases, students had switched from one SET course to another because queues were shorter. Respondents admitted that students are generally quite lazy about finding out about their options – and several students expressed regret regarding their own course selection. Reasons included the realisation that lab work is not what they want to do, or that it will not be easy to get a job with their degree.

Research undertaken by Wits University indicates that many of the university’s BSc students are doing the course as a ‘second best’ option, having been refused entry to Health Sciences or to Engineering and the Built Environment.

The current study showed a similar pattern. Academic staff noted that students with a scientific inclination often want to study medicine or engineering, but very often lack the necessary marks – so they end up doing a degree that they didn’t really choose. Many of the University of Pretoria’s first year BSc students, for example, are hoping to switch to medicine or veterinary science in second year if they do well enough – but few will get in. Lecturers report that if students find after first year that they still can not get into these courses, they often drop out or switch to a completely different course of study. Lecturers suggested that science faculties need to become much better at providing students with a ‘plan B’ within a similar field, rather than losing them to other faculties.
High levels of course switching is a common trend internationally

Switching between courses, particularly in first year, is a common trend internationally. Longitudinal studies conducted in Australia have found that course change is fairly common in higher education – five to seven percent of students change course by mid-year in their first year of study, while 20 percent of students indicate that they hope to change to a different course after their first year of study. A five-year tracer study of a sample of school leavers discovered that one in four higher education entrants underwent a course change.

6.5. Course structure and family responsibilities

BSc students emphasise that theirs is a difficult and demanding course. Many BSc subjects require students to attend practicals up to five afternoons per week – meaning that they have far less free time than students in other courses. Student interviews suggest that there is very little understanding among students, prior to starting their course, about the extent to which afternoons will be taken up with practicals.

The need to miss lectures and practicals in order to fulfil family responsibilities is a challenge for both male and female students, but is likely to fall more heavily on female students. Respondents report that when things go wrong at home, such as a family member falling ill or younger siblings requiring care, the burden generally falls to the females in the household. The burden of South Africa’s HIV epidemic and child-headed households appears to fall particularly heavily on female students from rural areas, who face challenges staying at university when they also need to be mothers to their families.

Respondents report that girls are more likely to leave university as a result of family responsibilities than boys (respondents suggested that boys were more likely to drop out for reasons related to academic failure or substance abuse, for example).

There were also some suggestions that female students may be under more pressure on a daily basis to get home early and fulfil family responsibilities, such as caring for younger siblings or children, and preparing dinner, which may be problematic in SET courses requiring attendance at afternoon practicals several times a week.

Interviews with staff and students across various universities and FET colleges indicate that pregnancy on campus tends to be high. However, for the most part, pregnancy, perhaps surprisingly, does not appear to have a significant impact on female students’ performance or completion. Staff and students report that students tend to be away from class for a relatively short period when they have a baby, and then to return and continue their course. It appears

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that very few students drop out because of pregnancy. In most instances, families step in to assist in raising the child.

Difficulties arise when births take place close to exams and students have to get permission to write at a later date, which can impact on their NSFAS funding. Students may also lose their funding if they are away from the course for a significant length of time. Staff members note that most of the students who lose their funding as a result of pregnancy do not come back.

Empowerment

The UKZN Centre for Science Access programme is currently piloting a series of relationship workshops with students, which aim to reduce unplanned pregnancies. The workshops deal with issues such as conflict management, communication, budgeting, and sex. Workshops are mixed gender, and aim to encourage negotiation skills in a non-threatening environment, thereby empowering female students and building their self-confidence. The workshops are run as part of the programme’s life orientation course.
6.6. Personal resources to cope with campus life

Lecturers and support staff report that students arrive at university with extremely limited personal resources – this applies to both male and female students. Academically, they expect to be spoon-fed, and they expect to be able to get by without much self-study, because this has been their experience of school. On arrival at university they have to take responsibility not only for their academic progress, for also for paying rent and budgeting for food – big responsibilities for which they often have little preparation.

At FET colleges, students enter the NC(V) Programme (or old NATED courses) after having completed Grade 9 – some of the students are thus as young as 14. Staff from FET colleges report that many of these young students struggle to adapt to the lecturing format used in the colleges, which represents a big jump from the style of teaching used in schools. Students have to learn to manage their time, and take responsibility for being in class. Staff report that partly as a result of this, absenteeism levels are high.

University students acknowledge that it can be difficult to cope with increased levels of freedom and responsibility at university. For many, campus represents a big, intimidating environment, away from family and friends. Students from disadvantaged backgrounds in rural communities have a particularly big adjustment to make in entering university. A 2008 report summarises the experience of a group of rural students on their arrival at university: rural students attending urban universities are less likely to have friends at the university than urban students, they may experience ‘cultural shock’ in adjusting from village life, in which people knew each other and lived a relatively homogenous life, to diversity and pace of urban living. They may also have less social currency in ‘youth sub-culture’ than their urban counterparts. These issues may be amplified by language issues – in the difference between dialects of the same language between rural and urban students, and urban students’ generally better proficiency in English.  

Interestingly, females appear to be more successful in adapting to university life than males. A key informant interviewed for the study who runs a post-Matric programme aimed at preparing individuals from low income, rural backgrounds both academically and socially for entry into higher education, notes that in contrast to the young men who enter the post-Matric programme, many of the young women have been socialised from a young age to take responsibility for managing basic daily routines – buying and preparing food, doing laundry and other domestic tasks. Young women arrive at university more adept at taking responsibility for their lives and managing their time. He suggests that this is one of the primary reasons that young women are more successful than young men in completing their degrees.

University staff report that counselling services offered at universities, in terms of both personal counselling and academic counselling services, tend to be very over-subscribed. Despite the high demand for these services on many campuses, some respondents suggest that there is still a stigma attached to using counselling services amongst some students, exacerbated, according to a recent report by the Rural Education Access Programme (REAP) by the fact that

104 Jones, B, Coetzee, G. and Bailey T, Factors that facilitate successes for disadvantaged higher education students: An investigation into approaches used by REAP, NSFAS and selected higher education institutions, Rural Education Access Programme, June 2008.
105 University Preparedness & Support Programme (Post-Matric) run by the Ukuqonda Institute. Interview with Andrew Hofmeyr, General Manager of Ukuqonda, January 2011.
these services are not always offered in students’ home language, making the articulation of complex and sensitive issues particularly hard.\textsuperscript{106}

6.7. Living arrangements

**Accommodation**

Living arrangements can add to students’ academic and social challenges, particularly where students lack quiet and privacy.

BSc students interviewed for the project note that it can be hard to study when living with students who are studying other courses and who have less strenuous demands on their time. This can be particularly problematic for female students. Residences often group together students doing similar courses. Most of the students in a male hostel might be engineering students, for example. Female engineering students, because of their considerably smaller numbers, are much more likely to be sharing accommodation with students in less demanding courses, who have a lot more time for socialising.

**Personal safety**

Respondents at UKZN, the University of Zululand and Medunsa highlighted concerns about female students’ safety on campus, and the extent to which this hinders them from accessing lab and library facilities after dark.

6.8. Peer pressure and course structure

Lecturers interviewed for the study note that the long hours of practical and lab work required by most SET degrees may put some students off taking certain subjects into second and third year. They suggest that the realisation of how hard one needs to work, and the long hours spent on practicals in the afternoon, only become clear in second year, and that a lot of students change to less time-consuming subjects as a result. There were also suggestions that female students enrolled in ‘hard science’ courses may be under pressure from their female friends in other courses, to switch to less time consuming courses in life science subjects.

6.9. Career opportunities

Academic staff report that many students are disinclined to take particular SET courses, or switch out of such courses, owing to perceptions about career opportunities and earning potential. Few students take theoretical subjects like maths and physics to third year, because career opportunities in these fields are perceived to be limited. Lecturers note that for someone with a BSc undergraduate degree and no further qualifications, career options beyond teaching are somewhat limited. Jobs as technicians are very poorly paid. A BSc graduate in forensics in the police service, for example, earns approximately R5,000 a month as a new entrant.

In several SET disciplines one requires post-graduate qualification – and even a PhD - in order to secure a position in the field. Lecturers suggest that it can be very de-motivating for students knowing that they have years of study ahead of them before you can hope for a decent job.

\textsuperscript{106}Jones, B., Coetzee, G. and Bailey T, Factors that facilitate successes for disadvantaged higher education students: An investigation into approaches used by REAP, NSFAS and selected higher education institutions, Rural Education Access Programme, June 2008.
Students tend to be more willing to commit to six or seven years of study to become a medical doctor or an engineer – whereas committing to course of study in order to become someone with a PhD in science who still does not have a clear career path, is much more problematic. Lecturers suggest that significant numbers of BSc students switch to other paths as these realities become apparent in second year.

Interviews with Matric learners indicated some concern about the limitations of job opportunities for ‘scientists’ – jobs are perceived to be scarce and not particularly well paid. Learners also expressed perceptions that people with scientific degrees are more likely to be well respected and have good jobs in highly developed economies – while opportunities in South Africa are perceived to be quite limited.

6.10. Practical placements

In vocational courses, particularly engineering diplomas offered at universities of technology, students face significant challenges completing work integrated learning/in-service training as part of their course.

The national diploma requires students to complete two years theory and one year practical. If students are unable to access in-service training they are unable to qualify. Industry experts describe this as a huge challenge. Companies lack the time and resources to provide student placements in which students are properly mentored and gain meaningful industry experience. Furthermore, if students in placements underperform, companies become much less willing to take on students in the future.

Academics and industry experts report that industry is reluctant to take on students for in-service training and students are struggling to complete their diplomas as a result. They also note that industry is extremely reluctant to provide placement opportunities to students that have taken longer than the minimum two years to complete the theory component of their diploma.

These challenges apply to male and female students, and difficulty securing placement is described by academic staff as a key factor in drop out from diploma courses. The challenge may be somewhat greater for male students – academic staff report that it may be easier to place female students because it helps industry to meet equity targets.

SETA’s have a critical role to play in engaging with industry and colleges/universities in order to facilitate placements. Their performance in this regard has however been uneven. A 2008 review by the DPRU at the University of Cape Town found that the skills development system suffers from weak reporting requirements, underdeveloped capacity, lack of effective management, and inadequate monitoring and evaluation, that limit the ability of SETAs to serve as primary vehicles for skills development.

The SETAs now fall under the authority of the Department of Higher Education and Training (DHET), who have announced reforms to the system to make it more effective and accountable. Policies proposals to extend learnership and tax incentives aim to support improved
performance in this area. The DHET has expressed its expectation that SETAs will assist students with placements where work experience is required to complete FET courses.

### SETAs to partner with colleges

DHET intends that partnerships will be established between SETAs, FET colleges and employers. Under the service level agreement (SLA) framework for 2010/11, SETAs are required to partner with FET colleges and work toward providing more work-based learning opportunities. SETA activities include placing interns in colleges, improving the capacity of college lecturers, funding internships for college students and conducting audits to establish the readiness of colleges to offer approved courses. The NSDS3 framework provides for pivotal programmes and strategic programmes. Pivotal programmes involve professional, vocational, technical and academic learning programmes that address critical needs for economic growth and social development. Learners are exposed to courses at various institutions and structured learning at work.

Under the NSD3, colleges must commit themselves to developing strong linkages with industry that support workplace opportunities for students to gain necessary work experience as part of their qualification requirements. Employers who give placements for workplace learning are given a grant per learner for the duration of the placement.

Working groups comprising SETAs, colleges and representatives of professional bodies will be set up for each occupation. The groups will develop curricula for the various occupations, review and develop curricula for the different components and assess college facilities. The SETAs should also be providing colleges with information on demand trends in industry, to ensure that resources are steered toward areas offering highest employment potential.

University engineering students also have to complete industry placements as part of their degrees, although these are of much shorter duration.

For students undertaking degrees or diplomas, a bad experience at site may result in failure to complete the course. The site environment can be very harsh, characterised by dust and dirt, physical danger, and unpleasant locations. For female students in particular, site can be a very negative experience, especially if they are in the minority in a very male dominated workplace. Lecturers of both degree students and diploma students note that some have such a bad experience of industry that they don’t complete their studies, switch direction, or move into an office-based role as soon as they qualify.

At a more general, gender-neutral level, students and lecturers report that placement work is very often a wasted opportunity. Companies often use placement students to do basic administrative tasks. The students have to write a report on their workplace experience – but very often they were doing secretarial work. One young engineer interviewed for the project noted that she plans to work with her company to develop a structured student development

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programme, so that both the company and the students can actually get something out of the placement.

6.11. Gender attitudes among students

At a subtle level, the idea that men are more technically inclined and better able to manage problem-solving tasks persists, and appears to have a significant impact on females’ confidence and willingness to take a lead in certain areas.

Interviews with students and lecturers revealed that in hands-on activities in areas such working with machinery in engineering workshops, or computer programming, female students tend to be less confident and more cautious, whereas male students are more likely to take a hands-on approach and not worry too much about making mistakes.

Interviews also indicate that female students, particularly when they are the minority in class, may be less likely to volunteer to respond to lecturers’ questions, or to ask questions of their own – possibly out of concern about getting things wrong in a class with mostly male peers. Female students in courses where women are in the minority note that it is difficult being one of the few women in a class of men, and that you have to “up your game” and constantly prove that you are good at the subject. It was suggested that male students often think they’re cleverer than women. These attitudes discourage female students from seeking advice and asking questions. Some female students report that some gender discrimination is ‘just life – boys are used to being first and girls being second.’

Lecturers in universities and FET colleges noted that male students do sometimes discourage female students, particularly in the workshop environment, where male students try to monopolise access to machinery, and often leave the task of cleaning up to the female students. Interviews with female industrial design students, who are the very small minority in their class, revealed that the male students in the class don’t want the girls to do anything in the workshop environment because they want to be in charge (in class the genders are quite equal, but in the workshop the males want to dominate). Interviews with female students in mechanical engineering courses revealed that in group projects, male students tend to monopolise the practical components of the project and instruct the female students to work on components like posters and business plans. Some female students indicated that they simply go along with it, because there are so few of them in class.

Academic staff also report that while male students don’t necessarily have any preconceived attitudes against females doing science degrees, some students, particularly those from rural areas, do exhibit very stereotyped, patriarchal attitudes toward women in general.

Lecturers suggested that black female students from rural backgrounds may be very shy about presenting papers in front of males, as a result of cultural attitudes about appropriate gender behaviour. It was noted that in rural Zulu culture women are expected to talk softly in front of men, and that gender differences may be a significant part of the identity of more students from traditional Zulu communities.
7. Summary: factors affecting the entry and completion of SET studies for women

7.1. Entering SET studies

Statistics presented in Section 4 showed that there is a small amount of leakage’ of young women from the potential group of young scientists and technicians at the secondary school level - fewer young women are sitting for Matric maths and science exams than young men, despite higher overall number of females undertaking Matric, and despite equal aptitude for maths and science subjects. The statistical gap in key subjects such as Maths and Physical Science is not large, however.

Females appear particularly underrepresented in technology subjects, though data in this area is scant. Whilst these subjects are not a prequisite for entry into SET courses at tertiary education level, they provide students with an advantage for undertaking certain SET courses, and, it appears likely that they open up the possibilities of undertaking further studies in technology and engineering related fields. The reasons for the underrepresentation of young female learners appear to be primarily related to gender stereotyping of technology subjects as being physically demanding and unfeminine (learners have to get dirty with dust and grease).

Data in Section 4 also demonstrated that a slightly higher proportion of young men who qualified to undertake courses in SET enroll for these courses than women, representing a second (albeit small) ‘leakage’ of women from the system. The gender profile within SET courses varies widely however, with more females enrolled in Health and Life Sciences, and more men enrolled in Engineering and Computer Sciences, for example.

There are a set of disincentives to individuals of both genders entering studies in SET. These primarily relate to the perception that careers in science (though not engineering) do not pay well, and a lack of exposure to the possibilities of degrees in SET fields.

The research shows that barriers specific to young women enrolling in SET courses (particularly in engineering courses) were primarily related to gender stereotyping around certain careers, and more specifically, to perceptions of certain careers in SET as unfeminine (particularly engineering and technology related fields). In some cases learners are provided with overt messages from parents and other household members that they should enter professions traditionally associated with women (teaching and social work for example). However, qualitative research undertaken for the project indicates that for the most part the messages are far more subtle. In many cases it appears that girls do not consciously reject the option of studying engineering, but that the option simply does not occur to them or those who might influence them. Female engineers in industry and academia suggest that powerful media stereotypes about femininity and female attractiveness create important markers of identity for girls and young women, and that engineering is perceived to be at odds with these. In cases
where female learners are exposed to the possibilities of careers in engineering (via career days, science competitions and so forth), these perceptions are more likely to shift.

Lastly, there are remaining barriers to entry into SET studies which affect both females and males, but which disproportionately affect disadvantaged aspirant students, contributing to the particular underrepresentation of black women in SET studies. These include:

- Financial constraints
- Inadequate maths and science results to enter SET studies given continuing racially skewed access to quality education
- Lack of exposure to the range of SET studies and careers particularly for disadvantaged individuals from rural backgrounds. This is related to poor career information provided in under resourced schools, compounded by the low educational attainment of caregivers.

7.2. Completing SET studies

Once enrolled in SET undergraduate courses, women are more likely to graduate than men (though data varies by field of study within SET). The reasons for this are no doubt complex, but anecdotal evidence suggests that women are socialized to better manage their time and daily routines, which contributes to academic success.

Enormous challenges to graduation exist for both men and women in South Africa, chief amongst them (and affecting both genders) are financial constraints and inability to cope academically with the demands of relevant higher education courses, particularly the often tough demands of SET courses. These barriers disproportionately affect students from disadvantaged backgrounds. Another major challenge primarily facing students from disadvantaged backgrounds, and particularly those from rural areas, is having to adjust to a campus life which relies on forms of social currency that middle class students are more likely to possess.

Despite the fact that women are slightly more likely to complete their courses than men, many young women are faced by a set of challenges or hurdles to overcome in completing their degree which are specific to their gender. Anecdotal evidence from this research suggests that girls are more likely to leave university as a result of family responsibilities than boys (respondents suggested that boys were more likely to drop out for reasons related to academic failure or substance abuse, for example). There were also some suggestions that female students may be under more pressure on a daily basis to get home early and fulfil family responsibilities, which may be problematic in SET courses requiring attendance at afternoon practicals.

Whilst respondents for the study suggest that pregnancy is not a major contributor to females dropping out of undergraduate studies, this is very dependent on the individual circumstances of the student and the willingness of her family to share her child rearing responsibilities.
Many young women enrolled in SET courses interviewed for the study, or those who had successfully completed them, noted that they did not feel singled out or differently treated as women in classes dominated by men, and taught primarily by men. However, the idea that men are more technically inclined and better able to manage problem-solving tasks does persist. This appears to have an impact on females’ confidence and willingness to take a lead in certain aspects of student’s course work, such as hands-on activities in areas such working with machinery, or computer programming.
8. Recommendations

8.1. Entry into SET fields

**Overview**

International research identifies various strategies aimed at encouraging women to enter SET fields and removing barriers to their participation. These include:

- Special training/coaching for women with high SET potential
- Identification of women role models in SET to promote society’s awareness of women’s potential to excel in the highest ranks
- Partnerships between industry and schools and universities to:
  - channel promising candidates into SET fields of study
  - support them financially
  - provide mentoring through industry
  - provide links to job placements for graduates in participating SET companies.\(^{109}\)

In South Africa, a number of government and private sector led initiatives respond directly to these priorities – and progress is being made in certain respects. The project findings nonetheless highlight that more needs to be done, particularly in terms of addressing specific South African realities, namely:

- Improving the quality of teaching, particularly in maths, science and technology subjects, at school
- Improving access to appropriate facilities and equipment to enable effective teaching of science subjects at school
- Increasing learners’ exposure to information about SET study options and possible careers at FET colleges and universities
- Improving the quality and substance of career guidance available to learners in schools, and improving links between schools and tertiary education facilities
- Shifting the perception of certain SET fields as unfeminine
- Improving awareness and efficient administration of student financing schemes such as NSFAS, in order to improve access for all eligible prospective students.\(^{110}\)

In addition, it is critical to examine what completion of a BSc degree/ SET diploma actually means for a student, male or female, in terms of job opportunities, earning potential, and ability to balance work and family life.

*Improve the quality of teaching, and access to appropriate facilities and equipment*

Prior NACI research has highlighted the need to ensure all learners have access to the appropriate education facilities, including appropriate lab facilities, learning materials, text books

\(^{109}\) NACI, An assessment of the participation of women in SET industry, October 2008

\(^{110}\) Several respondents reported that they had arrived at university not knowing how they were going to fund their studies, and only then found out about and successfully applied for NSFAS funding
and qualified educators. The key recommendation emerging from this study is the need to improve the quality of school education.

Critical challenges that need to be addressed include:

- Improving teachers’ competency in and attitudes toward maths and science subjects, from primary school level
- Ensuring adequate provision of facilities and equipment to enable practical application in science subjects
- Encouraging partnerships between schools and universities, aimed at capacitating maths and science teachers and enhancing their subject knowledge, and making tertiary institutions’ lab facilities/workshops available to schools during holiday periods
- Addressing disconnects between the maths and science curricula
- Moving away from rote learning and use of calculators, focusing instead on developing an understanding of core concepts
- Focusing the curriculum more narrowly to enable subjects to be covered in greater depth and detail
- Providing learners with comprehensive information about the implications of subject choices and course options and careers from Grade 8 – learners need to understand the implications of taking maths literacy over maths, or choosing not to take geometry or technical drawing
- Providing learners with access to technology, including computers and internet access.

### Training the educators

A number of universities run training programmes for maths and science teachers in disadvantaged schools. The School for Mathematical Studies at UKZN, for example, has introduced a programme to improve the skills of maths teachers in SA. The School is supporting a group of teachers from the Northern Cape to obtain a degree with a maths major. The programme is funded by a mining company in the Northern Cape. Teachers take the degree over five years, taking classes over the weekends. The programme has been very successful to date. Twenty of the 25 participants have graduated. Participants apply to the DoE in the Northern Cape for inclusion in the programme. Teachers have to work for the department for a number of years following completion of the training.

The Ukuqonda Institute is an NGO which runs a range of programmes aimed at improving maths and science education and performance at school and tertiary level. One of these programmes focuses on teacher development: the Institute currently supports the development of maths and science teachers in 45 high schools and 59 primary schools in rural and semi-rural areas of the Northwest, Limpopo and Mpumalanga provinces. The training focuses on subject area content knowledge, as well as improving teachers’ ability to identify learners’ area of weakness and misinterpretation in maths and science.

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Another critical message is the need for teachers to consistently demonstrate the everyday relevance of maths and science to learners, in relation to their own lives and aspirations, and as a tool for use in solving every-day problems. Examples should be used to demonstrate how maths and science knowledge can make a difference to learners’ communities (in relation to food security; water quality; climate change; soccer stadiums and so on) – making science relevant rather than remote. Industry representatives emphasise the importance of the ‘wow factor’ – demonstrating the role of engineers and scientists in making the world a better place through real examples. Industry and schools need to work together to convey this message to learners.

**Exposure to information, career guidance, and links between schools and tertiary facilities**

Prior NACI research has identified the importance of providing life orientation, maths and science educators with the necessary information to encourage further study in SET and support learners to make informed career decisions.

Children find it difficult to anticipate what they might do with a maths or science education. Educators and parents need to work with them to explore possible options, beyond the obvious. An interest in one particular career should not close doors to other opportunities. A learner who is good at life sciences but has not been accepted into medicine needs access to information about other options. Educators and parents need to be proactive in finding out more about SET industries, through the internet and engagement with industry and tertiary institutions.

The current study indicates that the quality of career guidance is highly dependent on the resourcefulness and contacts of individual teachers. Closer links between schools, tertiary institutions and industry are needed to enable teachers to provide effective guidance. Life Orientation appears to be under-developed as a dynamic and interactive resource for learners in many schools. A comprehensive review of the LO curriculum and its implementation, inclusive of teacher and student perspectives in this regard, could be a useful area of future research for the DHET.

It is important to facilitate learners’ participation in university open days, particularly in Grade 11 and 12, and provide opportunities for learners to participate in visits to university departments and laboratories and to meet academic staff and current students in various fields. This is particularly challenging in remote rural areas, where the expense associated with travel to the nearest tertiary institution may place such visits out of reach of schools and individual learners. Targeted schemes to assist rural learners to participate in university and FET open days, including free bus travel, would assist this regard.

Online information portals could also be useful means of providing information on possible SET career paths. These should be advertised through accessible media, including television, social networking sites and radio, to alert young people to the kinds of information available to them. Relevant websites should be easily navigable via cell-phone, as this medium of internet access is often more accessible to young people than laptops or PCs.

Learners need to be encouraged to apply their knowledge, from a very early age, in order to grow their understanding of what a career in SET might actually mean. Inter-school competitions are effective in encouraging the practical application of knowledge. Examples
include the Eskom science expo and the SA Institute of Engineering BKS Bridge Building Competition. Awards could include funding for the winning school to build/equip a science laboratory, or a sponsorship from industry which might include a field trip for learners to see SET activities in action.

Career days, science competitions, science camps and workshops, expose young people to the possibilities and nature of science and engineering careers and can have a major impact on shifting their perceptions of SET fields, and opening them to the idea of undertaking studies in these fields. While a plethora of different interventions of this kind exist, organised by government agencies such as SAASTA and professional organisations such as SAWISE, many respondents were unaware of such programmes – suggesting a need for better coordination across the various public and private sector initiatives, in order to increase reach and impact.

**Gender perceptions**

Teachers need to consistently reinforce the message that maths, science and technology are subjects for both girls and boys – using examples, experiments, tools and images that appeal to both genders. The prevalent perception that subjects such as technical drawing and EGD are “boys’ subjects” creates a disadvantage for female students pursuing engineering and architecture and needs to be corrected.

Role models can play an important role in addressing gender stereotypes, and improving understanding at a very practical level of what individuals can do with a degree/ career in these fields. Role models may be personally known to the individual, or high-profile individuals who provide a public face for a particular activity or field of work. In both cases, the role model is important in terms of making careers in SET fields real, relevant and attractive to young people. Successful female role models are particularly important in breaking down societal stereotypes and cultural barriers, and demonstrating that young women can excel in what have traditionally been considered male-dominated fields of study and work.

The study showed the importance of the media in influencing young people’s ideas about the world of work. Young people enrol for the courses and plan for the careers that they have heard about – they can only begin to imagine a broader range of options when they have the information to do so. Various forms of media, including television programmes, radio and magazines that appeal to young people, could play a role in creatively transmitting information about possible SET careers.

Student respondents warned against glossy marketing aimed at ‘women in science’ that sometimes comes across as patronising, however. They suggest that the real issue is about young graduates being able to get jobs and develop their skill. News stories about women winning top awards and excelling in their field are inspiring – publicity pamphlets are not.

**Job opportunities, earning potential, and work-life balance**

Universities and FET colleges need to do much more in terms of proactive marketing of courses and subjects, making it clear that the possibilities are open to everyone, and providing clear and accessible information about the financial support that is available and how to apply.
SET faculties need to think creatively about how to market their subjects in career terms. A BSc could for example allow the inclusion of certain subjects from other faculties, to facilitate career paths such as science journalism, or patent law, for example.

The study indicates that government needs to be more proactive in engaging with schools and learners in smaller towns and rural areas, marketing higher education options and providing information about financial aid. There appears to be very low levels of awareness of the kinds of qualifications (in engineering and technology fields and others) that FET colleges offer, and how entry into these colleges may be funded.

### Building links between schools, tertiary institutions and government

The University of Zululand has established a Science Centre in Richards Bay, which reaches up to 30 000 high school learners each year. Government departments could make use of Centres such as this to distribute information to and engage with learners, particularly those who do not have easy access to open days at local universities.

The need for learners and students to be much more exposed to SET in practice, in order to develop their awareness the day to day activities involved in working in various SET fields and of possible career paths, is a key theme emerging from the study.

Field trips to businesses and project sites such as power stations and mines are an effective mechanism to provide learners with an interest in SET fields with an understanding of career possibilities in particular fields, and day to day activities associated with particular jobs.

SET industries need to promote careers in the sector, marketing themselves in a way that inspires excitement and enthusiasm in young people. This should include drawing clear links between exciting projects such as the SKA telescope, for example, and careers in SET fields. SETAs also have an important role to play in this regard, and should consider partnering with schools, in addition to tertiary institutions, in terms of promoting awareness of industry careers and steering young people in the direction of employer skill needs.

Industry needs to tap in to young people’s dreams and aspirations about wanting to make the world a better place, and to demonstrate that engineers and scientists make a positive difference in the world. International studies have found that while girls in particular are not attracted by hard engineering, if they are persuaded that engineering can be about improving the world in which they live, they tend to find it a more attractive prospect. Industry players who do good work need to capitalise on that to build the appeal of the profession. The Chilean miners were rescued by engineers – such examples can inspire more young people toward SET professions.

Industry could also be more proactive in supporting students with financial constraints to access work-study opportunities. Respondents note that industry and research institutions such as ARC and CSIR used to offer students the opportunity to work and study part-time (students would

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113 Changing the Conversation: Messages for improving public understanding of engineering, Committee on Public Understanding of Engineering Messages, National Academy of Engineering, USA, 2008
undertake research on an aspect of their work at the institution, but that these opportunities are increasingly scarce. The model offers a valuable route into tertiary qualification for students who are struggling financially. For government funded agencies in particular, this could be a useful means of supporting academic training for potential employees.

**Engenius** is ‘a national campaign to grow and transform the engineering profession,’ initiated by the Engineering Council of South Africa. The key objectives are to: Promote national collaboration, coordination and support amongst organisations involved in advancing the engineering profession; Promote the engineering profession to primary and high school learners in order to attract sufficient numbers of suitably educated learners that represent the demographics of SA; Identify new programmes required to support the purpose. The Engenius Campaign also aims to provide learners with an understanding of the role of the engineering profession in their lives and to enthuse learners to make engineering a career of choice. Professionals from engineering voluntary associations and industry and engineering students are trained to inform and educate learners.

**Narrowing the field: a focus on engineering and technology**

Disaggregated statistics show that there is a world of difference between the gender profile of enrolments and graduations in different SET fields. More women than men enrol and complete undergraduate studies in Life and Health Sciences, while only 23 percent of graduations in Engineering and related fields are female. Rather than a broad focus on ‘SET studies’, energy needs to be targeted into increasing the participation of:

- Girl learners in technical subjects at school
- Young women in engineering and technology and related artisanship in FET colleges
- Young women in engineering, maths and computer related fields in higher education institutions.

**8.2. Completion of SET studies**

The current study identified poor academic preparedness, and inadequate access to funds, as the primary drivers of drop out at the under-graduate level. It also identified a number of contributing factors, which might result in students switching to non-SET courses, or to dropping out. These include:

- Poor understanding of what SET studies would involve/ what content would be covered
- Difficulty coping with course structure, including attendance at afternoon practicals up to five times a week
- Under-developed personal resources to deal with university life
- Living arrangements not conducive to study
- Peer pressure to switch to less demanding courses
- Challenges associated with securing industry placements as part of in-service training requirements.
- Concerns about the potential benefits of a BSc degree, in terms of employability and earning potential, versus the effort and time involved in completing the degree.

Most of these challenges were identified as effecting both male and female students, although certain gender specific issues were identified. These included:
• Concerns about personal safety, which limit students’ access to labs and libraries after dark
• Family responsibilities which may interfere with students’ attendance at practicals
• Gender attitudes among students, which may undermine female students’ confidence and willingness to actively engage in class.

Existing NACI research has identified a number of key factors that support women to complete their undergraduate degrees, including supportive lecturers, the company of female classmates, knowledge of female role models active in the field of study, and an academic culture perceived to be, on the whole, free of gender discrimination.\textsuperscript{114}

The current study identified three key mechanisms to improve retention and success of female students in SET courses:
• Provide access to mentors, including at undergraduate level
• Develop a broader understanding of how students can use a BSc degree in the working world
• Develop partnerships between government, industry and tertiary education providers to ensure effective provision of placements/in-service training.

The issue of gender inequality in the workplace is also pertinent to the current study, to the extent that concerns about gender isolation, and possible gender discrimination, may act as a disincentive to completion of SET degrees for female students.

\textit{Mentors}

Respondents in the current study reiterated the importance of mentors, at undergraduate and postgraduate levels. Lecturers noted that young black women in particular often lack the confidence to engage with academic staff, and are thus less likely to raise questions or seek clarification or support. Mentoring systems can be very effective in enhancing these students’ confidence and sense of agency. Mentors do not necessarily need to be women – as long as they are perceived by the students as a sympathetic figure with whom the student can relate and trust.

Students and graduates emphasised how useful it would be to be able to telephone or email a mentor figure, on an occasional basis, for support and encouragement – and to remind them that someone like themselves has been through these challenges before and succeeded in overcoming them. Interviews with young women in industry revealed a keen appetite among several respondents to become involved in mentoring schemes, in order to provide help and encouragement to female students from similar backgrounds to themselves.

\textit{Diverse career options}

The limited career options offered in certain SET fields is a clear concern emerging from the study. SET faculties within tertiary institutions need to develop a better sense of where their students go after graduating, in order to better understand the range of career opportunities offered by their degree, and identify opportunities to build relationships with relevant industry

\textsuperscript{114} Women in SET: Exploring the Facts, A report prepared for The South African Reference Group for Women of The National Advisory Council on Innovation, under the auspices of the Department of Science and Technology, Tara Research and Equity Consultants, Feedback
bodies. This requires universities to develop creative mechanisms to keep track of students once they enter their career paths, in administratively effective ways.

Universities also need to demonstrate to learners, parents and students the value of a BSc degree in developing logical analytical skills - which are in high demand in the labour market. Universities and students themselves need to avoid thinking that their degrees have been wasted if they don't end up working in their particular SET field.

**Placements**

Tertiary institutions and industry need to work more closely together to ensure that students in FET colleges and university courses are able to secure placement opportunities in relevant companies, as per the requirements of their degrees and diplomas. Once they have secured a placement, students need to have opportunities to engage in meaningful activities, which test and extend the skills that they should be acquiring in terms of their course.

This requires a significant time commitment from tertiary institutions and participating companies, with proactive engagement and communication by both parties. Government – and particularly the DST - needs to engage with tertiary institutions and industry, at the level of SETAs, industry bodies and individual companies, in order to explore the kinds of administrative requirements, incentives and support structures that would be needed to make the in-service training system more effective, meaningful and efficient from the perspective of industry, education bodies and students themselves.

One of the eight goals of the National Skills Development Strategy III is to create a credible institutional mechanism for skills planning and for improving the work of SETAs and the DHET – closer relationships between tertiary institutions, DHET and industry is a critical priority in this regard. As noted above, the DHET has expressed its expectation that SETAs will assist students with placements where work experience is required to complete FET courses.

The NSD III also provides that employers willing to accept placement of newly qualified people will be able to supplement the cost of the programme with a grant from their SETA. If implemented effectively, this could make a significant contribution to securing placements for FET students.

**Gender equality in the workplace**

The study clearly indicated gender discrimination within industry remains a concern for prospective entrants to the workplace. While levels of gender discrimination have declined markedly over the past few decades – very real challenges continue to inhibit women's progression in SET fields, in industry and academia. Respondents emphasised the need to ensure:

- Salary parity for women and men in the same job (in industry and in academia)
- A review of promotion criteria to remove any bias in favour men, including perceptions about appropriate leadership styles
- Mentoring programmes for young female graduates in the early years of their careers.
9. Annex 1: Selected Case Studies

Philisiwe Shange, Research Technician, Agricultural Research Council, Stellenbosch

Philisiwe studied BSc Agriculture at the University of Stellenbosch, with majors in viticulture and soil science. She completed Matric in 1998, at a government school in a poorly resourced rural community. Her school offered learners a choice of two streams when it came to selecting subjects for Grade 10 – a science stream or an accounting stream. Philisiwe didn’t like accounting, so she chose the science stream.

Three factors shaped her decision to study BSc Agriculture:
• She took agriculture at school and did well in the subject
• Her older sister had completed a BSc Agriculture degree at Stellenbosch
• A teacher had obtained two application forms from the University of Stellenbosch for a bursary to do a BSc Agriculture – one of which she gave to Philisiwe

Philisiwe secured the bursary and enrolled for her degree. Her classes comprised more male students than female, although the gender mix was not particularly skewed. For Philisiwe, gender was not an issue – the real challenge was that she was one of very few black people in her course, and that all classes were taught in Afrikaans, a language with which she struggled.

Philisiwe believes that a lack of understanding of career options associated with a BSc Agriculture is a major barrier to attracting more women into the degree. She stresses the need to create understanding of the broader possibilities – such as working in research, laboratories and industry – making it clear that it is not just about driving a ‘bakkie’ and being a farmer.

She suggests that exposure to people who are already working in the field is the most valuable way of breaking down preconceptions and generating a better understanding of career options. This exposure needs to happen from the early years of secondary school.

Limited earning potential in the science field is a critical challenge. While this wasn’t really a concern for Philisiwe while she was still studying, once she started working she began to seriously question why she had spent so much time and energy getting her postgraduate science degree, when friends and peers with ‘easier’ degrees in other fields are earning so much more at the outset of their careers.

Philisiwe suggests developing a system of ambassadors in specific SET fields, with a particular focus on fields where women are under-represented. These ambassadors could visit high schools in their local area on an annual basis, and also be available to informally mentor and monitor selected high school students who show an aptitude and interest in science. She suggests that the ambassadors should be easily reachable by students through emails or sms, to allow students to ask questions and get quick feedback. The ambassadors could also make available to students relevant university application forms and assist them with the application process, as well as being able to provide them with in-depth information about university level courses and subjects, which learners would otherwise not have access to. Ambassadors could
also have meetings with lectures and gather specific information to assist potential students and new students.

Ambassadors would also play an important role in supporting first year students, especially those who are far away from home, by providing practical advice on things like how to study a specific subject, how to handle tutorials and so on. Philisiwe suggests that personal assistance on this level with be a great support, assuring students that they are not alone, that others like them have succeeded and so can they.

**Faith Oyomno, Integration Engineer in the aeronautical industry**

Faith is an integration engineer at an engineering company specialising in aeronautical engineering.

She credits her parents - a teacher and a university lecturer - with providing herself and her brothers with a clear understanding of the importance of education, and notes that, given her family’s strong focus on academic achievement, it would have been very hard for her not to do well at school.

Faith’s preferred school subjects were maths and science, and on this basis she decided to pursue a science degree at university. She notes that her parents placed a strong emphasis on the importance of having a profession, be it a doctor, a lawyer, an accountant or an engineer, for example. Faith decided on engineering, because it was in the science field, because it required a very high number of points, which she had, and because she thought an engineer would probably make good money. She wasn’t particularly aware of what engineers did on an everyday basis however.

She notes that the electrical engineering faculty at the university offered a scholarship to anyone achieving over 36 points. As a result, there were a lot of people in the course, including herself, who were these because of the bursary rather than because electrical engineering had been their first choice. The bursary covered fees for first year, and attracted large numbers of female as well as male students. Faith reports that engineering courses attract a lot of bursaries from the private sector, and that there is no shortage of girls taking up such bursaries.

Faith describes the gap between school and university in terms of course content as huge. She came to university with distinctions in science and maths, and found herself scraping through first and second year with 50 percent. This was a big blow to her confidence, particularly since she had attended good schools and had a good education. Other students, who had attended private schools, had a considerable edge over their classmates, because they had done computer science and additional maths at school and were thus well ahead in practical electronics. Students who had done technical drawing and had attended technical high schools also enjoyed an edge over their peers.

Faith estimates that females comprised about 30 percent of her first year class of about 300 students. However, by the time she graduated at the end of fourth year, she was the only female student. Large numbers of both male and female students left the course during second year, largely as a result of academic failures in what the class termed the ‘filter courses’ - namely software, and signals and systems. As many as three quarters of students were ‘filtered
out' by these two subjects, which most found extremely challenging. Software, in particular, required students to spend a great deal of time in front of the computer, and included a requirement to design a computer game. Many of the students, particularly female students, had not been exposed to software previously, and many had very little experience of playing computer games, never mind designing them. A lot of the female students in particular had spent very little time working on computers, and many had no access to computers at home.

Faith says that her strategy, which worked for her throughout her studies, was to team up with the students who very clearly knew what they were doing. She sought to team up on projects with top students in the class, who were usually male, because she knew she would benefit from their experience and knowledge. This association with other conscientious students was a significant source of support throughout her studies.

Faith suggests that while there were no particular issues around gender within her class, there was a tendency for the guys to express surprise if a female student achieved the highest mark on a particular project. She also notes that there were girls in the class who ‘went all helpless’ and asked male students to help them with projects – but that they didn’t last very long, since that strategy isn’t very helpful when it comes to exams.

Faith insists that to succeed in an engineering degree it’s not enough to be smart, one also has to be dedicated and to work extremely hard. She believes that while career evenings at high school are very useful, learners could benefit a great deal from more exposure to campus – spending a day visiting different faculties and sitting in on classes, for example. She would also encourage learners to do much more background investigation into possible career options, and necessary skills. She notes for example that she had no idea her course would involve working with software until she had already registered.

Faith has recently signed up for a programme to mentor several female learners. She notes that she would loved to have had a mentor at university – someone to help keep her focused on her studies and her future career, and provide guidance on what to expect as her studies progressed.

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**Nombuso Sibeko, Electrical engineer at Eskom**

Nombuso is an electrical engineer at Eskom. Her decision to study engineering at Wits University was based almost entirely on the fact that she enjoyed maths and science at school, and her father, who is an advocate, suggested electrical engineering as a course that would allow her to pursue her interest in those subjects. She had very little understanding of what the course would involve when she signed up for it.

Nombuso found the first two years of the course fine – subjects such as maths, physics electronics and circuit boards built on the foundation she had from school. Third year however represented a huge jump. Subjects become more specialised, and some new and very abstract concepts were introduced. Having done additional maths at school helped a lot. The few students who had done software programming at school enjoyed a considerable advantage.

Nombuso suggests that if the male students had an advantage, it is that they had a better idea of what engineering involved, before they began the course. She also notes that many of them
had attended technical high schools, and were able to grasp concepts and subjects because they had been previously exposed to these. Many of the female students, in contrast, had chosen engineering because they had qualified for a bursary, without having had any real desire to become an engineer.

Signals and systems was a particularly challenging subject, along with software programming – for both male and female students. In these two subjects, perhaps 30 percent of the class actually grasped the concepts and were able to follow the lectures – while the rest were left floundering. She feels that lecturers focused on the 30 percent of the class who were coping with the subject, and appeared not to be too bothered about the rest. This was not a gender specific challenge - several students of both genders dropped out as a result of repeatedly failing these subjects.

Nombuso describes a number of challenges specific to the course:
- If students were unable to pass signals and systems, it was not possible to switch to another module in order to get the necessary credits to complete the degree
- Students who had failed one or more subjects were unable to carry subjects into the following year if they clashed with the course structure (students were unable to restructure their timetables to accommodate extra subjects) – so a student would have to spend a whole year re-doing just one or two subjects, and would thus take longer to finish the degree
- Her university allowed students to write a maximum of two supplementary exams – other universities apparently allow students to write more supplementary exams if required. This also increases the length of time required to complete a degree.

Unathi Mahola, IT Solutions Architect at Ericsson

Unathi grew up in Mtanzani, near East London in the Eastern Cape, where she attended a school she describes as “not well resourced.” Her teachers were very supportive of both young men and women taking up studies in higher education, and particularly supportive of both genders in taking up studies in engineering or science. Unathi felt that in contrast to the attitude of her teachers, there was a broader community mindset which socialized young women into being less ambitious than young men – women “did not have to achieve as much.”

Unathi noted that whilst in the final few years of her schooling she did not know what her future held and had certainly not thought that she would be going to university. Her sights were set on passing Matric – and didn’t go much further than that. However, Unathi was one of the school’s top performers in maths. When Eskom visited her school in search of bright young scholars to whom they could award bursaries for courses in Engineering, her teachers put her forward as a candidate. She was awarded an Engineering bursary at the University of the Witwatersrand and became one of the few people in her school to go to university. Unathi’s parents were very proud of her achievement and particularly proud that she would be studying engineering, as this was considered a difficult degree to study, “much more challenging than social work or teaching.”
University was a whole new world for Unathi, and her first few months were tough. She had to adjust to the sudden freedom of campus life, and not having her parents around, as well as having to deal with the big jump in the curriculum from school. She felt that the schooling she had received has not prepared her adequately, despite having what she saw as a good maths teacher. She notes that the majority of her engineering classmates “where lost along the way”, primarily as a result of academic failure, which then lead to loss of funding to continue their studies.

Despite being the top student in her school, she arrived at university to find herself in class with students who had managed to obtain substantially higher marks at school than she had. Initially she found this experience very intimidating, but she noted that she soon realized “she was not too different” from the other students in her class: if she worked hard she could get as good, even better grades than her peers. She soon realized however, that her biggest disadvantage was not having the competency in English that many of her fellow students had. Improving her English was the area in which she worked the hardest at university.

Unathi was first introduced to working on a computer in her first year of university, but she took to programming relatively easily. She went on to major in Information Engineering.

Unathi describes financial worries and constraints as a big issue for many students, and a challenge for her in completing her studies. In her first year she was given a stipend of R11,000 for food. She was living in university residence at the time, where students needed R23,000 per year for food – her allowance therefore covered one meal per day of residence food. Fortunately Unathi had a friend in residence who was on a larger bursary and who generously shared one of her daily meals with her. In order to cover other expenses like toiletries, she relied on money from family and friends.

While Unathi’s family was proud of the fact that she was undertaking an engineering degree, and supportive of her studies, she was also keenly aware that “she was the only hope” for her family and that she could not afford to let them down. The fact that she did not “want to go back to where [she] came from” was also a motivating factor in her hard work at university.

Her identity as a woman was not an important marker in her experience of her engineering studies. The fact that there were so many more males in her university classes than she had experienced in maths and science classes at school was “an adjustment” but she noted that she did not find this at all intimidating and that she found neither her male peers nor lecturers biased in any way. She did note however that, on average, the female students had to work twice as hard as their male classmates to pass the course. The male students in her class always seemed to be
out partying – engaging in a more varied campus life – and yet got the same marks as the female students.

Unathi has found that “gender issues” are more visible in the workplace than they were on campus. She feels that sometimes women have to work harder to be awarded more challenging projects. Some of her male peers are earning more than she is.

Unathi notes that many of the students from low income backgrounds who fail their degree have had to deal with an enormous emotional and social load – such as a death in the family, the weight of an family expectations on the first generation of students to get to higher education, not having enough money to go home on holidays to visit family members who could provide support and so on. She personally knows of a few cases where these pressures led to students committing suicide. While universities provide counselling services, few students who needed them seem to use them. She stresses that students need to be told that it is acceptable to have problems in their academic, social and family life, and that is acceptable to “offload” these problems.

Seponono Kekana, Turbine Senior Engineer, Control and Instrumentation Department, Kendal Power Station

Seponono “stumbled into engineering.” Her mother was a single parent and a domestic worker, with no money to send her daughter to university. She was however determined that her daughter should receive a university education, so she went out and looked for companies that would sponsor Seponono’s studies. A friend recommended that she try to access Eskom’s bursary scheme for electrical engineering. Seponono’s mother obtained the necessary information, and encouraged Seponono to apply.

Seponono applied to Wits for an electrical engineering degree, and was accepted, with an Eskom bursary to cover her studies. As a student from a disadvantaged background, Seponono was enrolled into the one year foundation programme. She describes the programme as being similar to school – all the students were together in one class, taking a large number of different subjects. Many of Seponono’s classmates were female – of the 20 Eskom bursaries awarded that year, 18 went to female candidates. An initial filtering process in June saw many students excluded for academic under-achievement. At the end of the year, only a very small number of the bursary students progressed to first year.

Seponono notes that for those who have a bursary and fail a course, the bursary is withdrawn and the student has to pay for herself. Few students can afford to do so, and many drop out as a result. Students struggle to make the change from school to university – they are not used to being independent and thinking for themselves, and many struggle to follow lectures in English. There is also a great deal of individual stress – worries about money and about the whole new situation one finds oneself in, which all makes getting through a big challenge. For Seponono, however, gender was not an issue – particularly since she feels that electrical engineering is about mind power, rather than physical strength, so the issue of gender differences never really came up.

Seponono notes that for her, her bursary took a great weight off her mind, as she never had to worry about finance. She was never embarrassed to ask questions in class – even if someone
might have thought a question stupid, her concern was about making sure she understood what she needed to.

At work, Seponono finds the absence of women in her field very noticeable. She is aware that there are societies for women in engineering – but she doesn’t know much about them or what they do. She notes that the Institute for Electrical Engineers, the professional body, encourages students on campus to register, and feels that professional bodies for women engineers could be similarly proactive.
10. Annex 2: List of respondents

University of KwaZulu Natal
- Asok Rajh, Centre Liaison Officer, Science and Technology Education Centre
- Tanja Reinhardt, Coordinator, Science and Technology Education Centre
- Thandeka Mtshali, Schools Liaison Officer, Career Counselling and Student Employment Centre
- Ashay Nathoo, Schools Liaison Officer, Career Counselling and Student Employment Centre
- Dr Neil Koorbanally, Centre for Science Access, Faculty of Science and Agriculture
- Candice McCain, Psychologist, Centre for Science Access, Faculty of Science and Agriculture
- Professor Dhamanand Baboolal, Senior Lecturer, School of Mathematical Sciences
- Professor Sreekantha Jonnalagadda, Senior Lecturer, School of Chemistry
- Dr Alan Matthews, Senior Lecturer, Department of Computational Space Physics
- Dr Deshendran Moodley, Head of School, School of Computer Science
- Focus group discussion with female postgraduate Microbiology students, Faculty of Science and Agriculture

University of Pretoria
- Paulette Bloomer, Head of Department, Department of Genetics
- Lucille Herman, Lecturer, Department of Genetics
- Professor Elsabe Kearsley, Head of Department, Department of Civil Engineering
- Christine Maritz-Olivier, Lecturer, Department of Genetics
- Magdaleen Snyman, Lecturer, Department of Electrical Engineering and coordinator for Women in Engineering, Faculty of Engineering, Build Environment and Information Technology
- Focus group discussion with female 3rd year students, Department of Genetics
- Focus group discussion with female postgraduate students, Department of Genetics

Medunsa (University of Limpopo)
- Sebolaishi Doris Kolobe, Department of Chemistry, Biochemistry and Biotechnology
- Emelinah Hluphekile Mathe, Lecturer, Department of Chemistry, Biochemistry and Biotechnology

Tshwane University of Technology
- Michael Wythe, Lecturer, Department of Industrial Design, Faculty of Engineering and the Build Environment
- Focus group discussion with 1st and 2nd year female Industrial Design students
- Focus group discussion with 1st and 2nd year female Mechanical Engineering students

Vaal University of Technology
- Theresa Joubert, Lecturer, Department of Power Engineering
• Dr Trudy Sutherland, Lecturer, Department of Electronic Engineering and Chairperson of the Women in Engineering Forum

Coastal KZN College, Durban
• Marius Calitz, EAP Practitioner
• Sheryl Venter, Assistant Manager, Student Admin Services
• Focus group discussion with male and female lecturers of National Certificate (Vocational) courses (lecturers of Mathematics, Electronics, Practical Motors and Theory, Electrical Engineering and Civil Engineering)

Ekurhuleni West Public FET College
• Focus group discussion with male and female Heads of Departments (Engineering courses)
• Mr Smit, Deputy Principal: Academic

Empangeni High School, Empangeni, KZN
• Focus group discussion with female Grade 11, Mathematics, Physical Sciences and Life Sciences learners

Stanger Secondary School, Stanger, KZN
• Physical Sciences Teacher, senior grades
• Focus group discussion with female Grade 11 Mathematics and Physical Sciences learners

Moses Maren Mission Technical School, Eikenhof, Gauteng
• Teachers of maths, science, engineering and technology subjects, senior grades
• Focus group discussion with male and female Grade 12 learners taking maths, engineering and science subjects

Northcliff High, Johannesburg, Gauteng
• Tracy Fairless, Physical Sciences Teacher
• Ms Odendaal, Life Orientation Teacher
• Focus group discussion with female and male Grade 11 and 12 learners

Other key informants
Support and interventions in schools:
• Caroline Duncan, Mathematics and Geography Teacher, Parktown High School for Girls
• Linda Giuricich, Director of Community Affairs, St Mary’s School: Coordinator of the Alexandra High Schools Programme (providing maths and science education support to learners from schools in Alexandra high schools)
• Andrew Murray, General Manager, Ukuqonda Trust (which runs a maths and science schools intervention programme, and post-Matric for potential Science and Engineering students)
• Phelelia Sekele, Manager, Careers Centre, Sci Bono

Statutory bodies:
• Ntokozo Bhengu, Researcher, Council on Higher Education
• Michael Gordon, Data Administrator, Council on Higher Education
• Fiona Lewis, Policy and Research Officer, National Student Financial Aid Scheme (NSFAS)
• Beata Mtyingizana, Research Manager, Council on Higher Education
• Jabu Nukeri, Science Education Manager, South African Agency for Science and Technology Advancement (SAASTA)
• Angelique Wildschut, Researcher, Education and Skills Development Unit, Human Sciences Research Council

Industry Associations and organisations in support of women and girls in SET:
• Liesel Kirsten, Engenius Programme, Engineering Council of South Africa
• Hannelie Nel, Director, Women in Engineering & the Built Environment and Strategy Manager Metal Casting Technology Station at the University of Johannesburg
• Lara Roden, Education Portfolio, Association of South African Women in Science and Engineering (SA WISE)
• Hema Vallabh, Director, GirlEng
• Diane Wilcox, Executive Committee Member, Association of South African Women in Science and Engineering (SA WISE)

Successful young women working in SET fields:
• Seponono Kekana, Senior Engineering Advisor, Eskom
• Fionah Khathi, Environmental Scientist, South African Nuclear Energy Corporation
• Unathi Mahola, IT Solutions Architect, Ericsson
• Faith Oyomno, Aerospace Junior Integration Engineer / Manager, Advanced Technologies & Engineering
• Mmadisime Phetoe, Nuclear Facility Manager & Chemical Engineering Technician, South African Nuclear Energy Corporation
• Philisiwe Shange, Research Technician, Agricultural Research Council
• Nombuso Sibeko, Electrical Engineer, Eskom
• Janelle van Vasbeek, Pilot, 1time Airlines
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