The association of matriculation English scores with the performance of Information Systems majors at the University of Cape Town

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by

Jane Nash

Student number CLYJAN001

Supervisor: Prof M Hart

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Preface

I confirm that this research report is my own unassisted work. The Harvard style of referencing has been used to provide detailed citations of all sources that were consulted during this research project.

I would like to thank the following friends and colleagues for their contributions:

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Jane Nash

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Abstract

The important contribution that can be made by information systems (IS) towards social and economic development within South Africa is hampered by a shortage of skilled IS professionals. The implementation of employment equity practices has also led to increased demand for black IS graduates. However, many university students take longer than the prescribed period to complete their studies, or do not graduate at all, at considerable expense to their families, academic institutions and the state. In order to improve student retention and graduation rates, it would be useful to examine whether university admissions criteria should be reviewed, or additional support provided as part of the teaching process.

Research has suggested that lack of proficiency in academic English could have a significant negative impact on academic performance at tertiary level. If so, this would be particularly relevant to black university entrants, the majority of whom are second (or even third) language speakers of English.

This study examines the role of language proficiency in the performance of university students within the specialised field of IS, with particular focus on second language speakers. Quantitative analysis is used to investigate the association between academic performance and matriculation results (particularly English), as well as a number of demographic factors, based on a cohort of 241 undergraduate students following an IS major curriculum at the University of Cape Town over a four year period.

Student data was analysed in terms of performance at the level of individual IS courses, average IS results for each academic year, and the time taken to complete all of the IS major

courses. Although a consistent positive relationship was demonstrated between matriculation English results and IS performance, the association of other matriculation subjects with IS performance was far more significant. It would thus appear that while language proficiency contributes positively to academic success, overall matriculation scores remain the best available criterion for university admission.

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Terms used in this report

Academic Development Programme (ADP) / Academic Support Programme (ASP): extended degree curriculum providing additional teaching support for under-prepared students

Alternative Admissions Research Programme (AARP): project implemented at the University of Cape Town to assess student potential based on criteria other than the standard matriculation examination

Analysis of Variance (ANOVA) / Analysis of Covariance (ANCOVA): statistical methods used to quantify the degree of variation in a dependent variable that can be explained by a set of independent variables.

Bachelor of Commerce (BCom) degree: undergraduate degree offered in the Commerce Faculty at UCT, requiring a minimum of three years of study, directed towards a specific major subject such as Information Systems.

Bachelor of Business Science (BBusSci) degree: undergraduate degree offered in the Commerce Faculty at UCT, requiring a minimum of four years of study, and with higher entrance requirements than a BCom degree.

Basic Interpersonal Communication Skills (BICS): linguistic skills needed for conversation interaction within a shared context.

Cognitive-Academic Language Proficiency (CALP): linguistic skills needed for critical analysis and exposition of academic material, often at a conceptual level.

Department of Education (DE): body responsible for the administration of white education under the apartheid government in South Africa.

Department of Education and Training (DET): body responsible for the administration of black education under the apartheid government in South Africa.

INF: prefix used to identify Information Systems courses offered at UCT

Information Systems (IS): Combination of technology, people and processes used to produce appropriate business information within an organisational context.

Information Technology (IT): the technological infrastructure (hardware, software and communications) used to support IS. The term IT is sometimes used interchangeably with IS.

Matriculation examination: the highest examination passed at secondary school level in South Africa (Grade 12).

P-level: the p-value of a test is the probability of observing a test statistic at least as extreme as the one computed given that the null hypothesis is true.

Previously disadvantaged students: students who are under-prepared for admission to tertiary studies because of the inadequate school education provided under apartheid.

Race group: classification system used by the apartheid government in South Africa, in terms of which all citizens were classified as either white, black, coloured or Indian.

$\mathbf{R^2}$ – the degree of correlation observed between two continuous variables; or the level of variation that is explained by the independent variables in a regression equation.

Test of English as a Foreign Language (TOEFL): English language test written by foreign students in order to assess their English language proficiency for purposes of university admission.

1. Introduction

1.1 Research background

The role of information systems (IS) has become increasingly pervasive within the global economy (Baskerville & Myers, 2002), and tertiary education has become the leading credential for obtaining employment within this field (ITAA, 2002). In South Africa, an insufficient supply of skilled IS graduates has been exacerbated by the exodus of those seeking employment overseas, and by the limited pool of qualified black candidates who are available to meet organisational employment equity requirements (Conradie, 2000; SAITIS, 2000).

Many black school leavers lack basic computer literacy skills, making it difficult to overcome the "digital divide" between those who are able to benefit from access to information and communication technologies (ICTs), and those who are excluded (Miller & Day, 2000). At the same time, tertiary institutions are under pressure to provide access to education for those who were previously disadvantaged (Rossouw, 2001). In most cases, admission is based on matriculation results, which are not always a reliable predictor of academic success, and several studies have suggested that language proficiency may be an important contributing factor in English-medium education (Miller et al, 1998; Nash et al, 2002; Thesen et al, 1997).

Academic Development Programmes (ADPs) have been established at a number of universities to provide additional support for under-prepared students, but limited resources make it essential that their efforts should be directed where they will be most effective. The majority of ADP students are second-language English speakers (Cele, 2001), as are an

increasing number of mainstream students, and problems of second-language acquisition and use may significantly affect students' ability to cope with academic language requirements. Although a number of alternative tests have been developed for the assessment of English proficiency, the matriculation English examination remains the most readily available and widely used criterion of language proficiency in respect of university admissions.

At the University of Cape Town (UCT), the degree programme for IS majors includes a number of general commerce courses, in subjects such as accounting, economics, statistics and law, together with ten undergraduate IS courses which can be completed in a minimum period of three years. Language plays an important role in these courses, from the understanding of technical jargon and the syntax of programming languages, to the unambiguous description of business models and the writing of system documentation.

Despite consistent ratios of black, coloured, Indian and white students in the Commerce Faculty intake from 2000 to 2002, an increasing proportion of white students is found in each successive year of the IS major: in 2002, 62% of the third year class was white, compared with 43% of the first year class (Nash et al, 2003). In order to meet the equity requirements of both tertiary education and industry, it is essential that the progression rates of black students should be improved. The first step towards doing so is to identify factors affecting student performance, particularly those who have been previously disadvantaged, so that positive interventions can be provided. Linguistic competence in English may be one of these factors.

1.2 The research topic

This research study was undertaken in order to investigate **the relationship between English language skills and student performance in the IS major curriculum at UCT**. The existence of such a relationship could indicate a need for the provision of additional language support for previously disadvantaged students entering tertiary education, many of whom are second-language English speakers.

For the purposes of this study, "English language skills" were assessed in terms of the scores achieved by students in the higher grade English matriculation examination, and "student performance" in terms of the results obtained in each of the undergraduate IS major courses offered at UCT, the average result achieved by students for each academic year of study, and the time taken to complete all of the undergraduate IS courses.

Demographic and academic data were collected and analysed for a cohort of 241 IS major students who registered at UCT for the first time in 1999. Statistical tests were used to examine the relationship between matriculation English score and the number of years taken to complete all of the undergraduate IS courses, as well as the relationship between matriculation English score and student performance in individual IS courses. Further analyses compared the effect of English proficiency on IS performance for first- and second-language English speakers. The implications of these results were then examined in the light of previous research in the area of language and academic performance, and opportunities for future research identified.

1.3 Structure of the report

The next three chapters of this report present a literature review of previous studies related to various aspects of the research topic. **Chapter 2** examines IS as an academic discipline and its role in the economy. **Chapter 3** describes tertiary education in South Africa within both past and current political contexts. **Chapter 4** reviews the role of language in tertiary education (including IS), and issues of second-language acquisition and assessment. **Chapter 5** provides background information about the IS major curriculum at UCT.

Chapter 6 explains the aims of this research project and the development of the research hypotheses, while **Chapter 7** describes the research method and data sample that were used. **Chapter 8** presents the statistical analysis of the data, and **Chapter 9** discusses the research results in the light of the literature review. **Chapter 10** presents the conclusions drawn from the study and suggests opportunities for further research in this area.

Bibliographic references are provided for the source material cited in the research report (**Chapter 11**), and a number of appendices provide details of the statistical analyses on which the research results were based (**Chapter 12**).

2. The Field of Information Systems

This chapter describes the relationship between Information Systems and other academic disciplines. Because of the important role played by IS in the development of both national and global economies, it is vital that the gap should be bridged between those who have access to technology and those who do not.

2.1 Information Systems as an academic subject

The field of information systems explores the relationships between information, technology, people, organisations and society, based on a foundation that includes fundamental theory (for example systems science), underlying disciplines such as psychology and sociology, and related applied disciplines such as computer science and business management (Gupta, 2000; Baskerville & Myers, 2002). Although the term "information systems" is frequently used interchangeably with "information technology", the scope of IS is generally considered to be broader than that of IT, extending beyond the implementation of technologies to encompass a variety of business, organisational and social issues.

Scholars in the field of information systems assert that it should not simply be viewed as a hybrid of other disciplines, despite an historical lack of consensus regarding a cohesive underlying conceptual framework (Avison & Fitzgerald, 1991; Benbasat & Weber, 1996). The editor-in-chief of MIS Quarterly, Allen S. Lee, commenting on the current state of IS research, states that "the information systems field examines more than just the technological system, or just the social system, or even the two side by side; in addition, it investigates the phenomena that emerge when the two interact" (Lee, 2001, p.iii).

As information systems play an increasingly pervasive role in areas as diverse as agriculture, education and government, so the importance of the field has gained recognition (Baskerville & Myers, 2002). Researchers and practitioners are involved in an ongoing debate as to whether it has yet achieved the status of an independent discipline (Avison & Fitzgerald, 1991; Watson et al, 1999; Baskerville & Myers, 2002). But regardless of nomenclature, the development of this field has been accompanied by the growth of barriers separating it from other disciplines: technical jargon, cultural and philosophical assumptions, and shared values among information systems professionals all serve to restrict access to a specialised body of knowledge (Baskerville & Myers, 2002). Effective communication with practitioners in other fields has thus become an essential element in the development and implementation of information systems.

As an academic subject, information systems presents a challenge to educators because collaboration is typically needed between a number of different departments in order to teach soft skills such as teamwork, communications and problem solving, along with business management and technical material (Rada, 1999; Bailey & Stefaniak, 2000). Students need to be immersed in practices as much as concepts and principles, and because they are likely to be asked to carry out tasks for which they have not specifically been educated, it is essential that students develop the ability to find their own solutions to business problems (Dawson & Newman, 2002).

Information systems also differs from other more traditional disciplines in terms of the rate of growth of its body of knowledge, changes in technology and terminology, and the wide range of approaches to its application that is found in industry (Dawson & Newman, 2002).

The impact of new knowledge on existing practices also means that information systems professionals must have the ability to continuously develop their knowledge base throughout their professional careers (Westfall, 1998).

A comprehensive survey of the IT workforce in the United States conducted during 2002 found that across all jobs, education followed specific job experience as the leading credential needed to obtain employment in the IT industry (ITAA, 2002). Within the job category *Programming and Software Engineering*, a college degree was the single highest determinant for new appointments: "Software engineers must not only have a depth of technical skills, including working knowledge of programming languages and software development methods, but they must also have a larger conceptual understanding of complex problem solving requiring advanced mathematics and modelling. Hiring managers are saying that there is little substitute for a four-year college degree in this field." (ITAA, 2002, p.30).

Thus at the same time as students in the field of information systems are developing a broad range of analytical and technical skills, they must also develop the capacity to keep up to date with a constantly changing body of knowledge, and gain the management and communication skills that are needed to implement and manage technologies within a volatile business environment.

2.2 The role of IS in the economy

The unprecedented development of information and communication technologies has put knowledge at the centre of the new global economy (Department of Education, 2002). The impact of IT on organisations has led to the disappearance of jobs and the creation of new

forms of employment, not necessarily limited by geographic distance and time; more work is being performed by collaborative consortia, and financial markets are increasingly transcending national boundaries (SAITIS, 2000).

A comprehensive report produced by the US Department of Commerce (2002) shows that the number of jobs in the IT industry within the United States grew twice as fast as the national average during the period 1992-2000; during 1996-2000, when the economy grew by an average 4% annually, the IT-producing sector grew by 21% a year; and wages paid to IT workers in 2000 were roughly twice the average private industry wage. Despite a downturn in the American economy during 2001, the number of IT positions remaining unfilled due to a lack of qualified workers remained consistently around 50% of total demand during the period 2000-2002, resulting in approximately 578 000 unfilled IT positions in the United States alone in 2002 (ITAA, 2002).

Not only are IT professionals increasingly in demand, but basic computer literacy is needed to compete for 21st century jobs. Individuals need skills to evaluate technologies and economic factors and trends, so that they can make informed judgements about the future prospects of technologies and products, bearing in mind that literacy is not just knowledge about information technologies, but must also include knowledge of how to use specific technologies, usually in organisational settings (Westfall, 1998). In South Africa, although large organisations within the financial and retailing sectors have implemented world-class IT facilities, the use of IT in manufacturing and by small, medium and micro-enterprises (SMMEs) lags significantly behind Europe and the United States (SAITIS, 2000).

The shortage of skilled IT workers has become a global issue resulting in increased costs and missed business opportunities (Bailey & Stefaniak, 2000). The skills shortage problem in South Africa has been exacerbated by the "brain drain", as both newly-qualified and more experienced IT professionals leave the country in search of opportunity, financial reward and improved quality of life (Conradie, 2000). A survey of IT systems staff conducted in 1998 indicated that approximately 30% of those employed at management level who voluntarily changed jobs, left the country (SAITIS, 2000).

Despite continued high growth in demand for IT services in South Africa, much of this in the "information systems" areas of systems development and IS management, there has been significant under-investment in appropriate training. As a result organisations compete for a limited pool of qualified professionals, encouraging the "job-hopping" characteristic of the IT industry (SAITIS, 2000). Attempts to meet employment equity requirements have also been hampered by a shortage of qualified black professionals. The national IT Jobs and Skills survey conducted as part of the SAITIS project found that 70% of IT staff employed by 456 organisations were white, and only 27% female (SAITIS, 2000).

The national Information Systems, Electronics and Telecommunications (ISETT) skills development report has indicated a massive shortage of ICT skills in South Africa, while in Cape Town itself, an overall lack of high-level ICT skills is a major problem among organisations ranging from businesses and government agencies to academic institutions and community organisations (ISETT, 2001; City of Cape Town, 2002).

The increasing reliance of organisations on information technology at all levels, and a continuing shortage of adequately qualified professionals to develop and use IT-based

systems, means that tertiary education has an important role to play in providing the skills needed for the growth of an increasingly knowledge-based economy (Bailey & Stefaniak, 2000).

2.3 The digital divide

The "digital divide" refers to the concept that people can be divided into two groups: those who have access to (and the ability to use) modern information technology, and those who do not. This dichotomy is apparent between the educated and uneducated, between economic classes, and globally, between more and less industrialised countries (TechTarget, 2003). In recent years, the idea that minority groups are falling further behind in their ability to participate in a modern economy has seized the popular imagination (Attewell, 2001). "In the Information Age, being on the wrong side of the digital divide can limit significantly a person's life" (Butler, 2002).

This problem is clearly evident in South Africa, which is a developing country with wide inequities between different groups, a literacy rate of only 61%, and significant levels of unemployment (SAITIS, 2000). Internet access is generally limited to educated city dwellers, marginalizing over 70% of the population in terms of access to training and employment (SAITIS, 2000). As increasing numbers of people make use of Information and Communication Technologies (ICT) to conduct their daily activities, so people who lack access to these tools are at an increasing disadvantage (Herselman & Britton, 2002). Restricting factors that make it difficult to overcome the digital divide include the lack of physical infrastructures and appliances; insufficient economic capacity among potential users; the absence of skilled resources within the community; and inadequate exposure to appropriate content at the level of school curricula (Herselman & Britton, 2002).

A recent assessment of the implications of the digital divide in the City of Cape Town stated that the effective use of information and communication technologies "offers huge potential to empower people in developing countries to overcome development obstacles, to address the most important social problems they face, and to strengthen communities, democratic institutions, a free press and local economies" (City of Cape Town, 2002, p.12). In general, the standard of ICT skills needed for employment is rising. The existing shortage of high-end skills is likely to worsen as demand increases, and a severe lack of participation is apparent among disadvantaged individuals within the ICT economy (City of Cape Town, 2002).

However, one should view with caution overly simplistic approaches to this dilemma such as that offered by Tyson (1999): "In an age when 60 percent of all new jobs require some technology skills, many low-wage Americans also are recognizing that, with a little training and a few mouse clicks, they can leap beyond poverty, prejudice, and isolation of the ghetto". Olsen (2000) considers that students need more than computer literacy to succeed in their educational, professional, social and personal lives, and suggests that colleges should aim instead to teach "computer fluency", a deeper understanding of information technology that encompasses skills, concepts, and logical reasoning. Furthermore, differences in gender, race, ethnicity, language skills, culture, and economic background all affect students' abilities to benefit educationally from their access to technology and to knowledge (Natriello, 2001).

In South Africa, continuing inequality in the standard of school education means that most black school-leavers have not been taught basic computer literacy skills. Miller and Day

(2000) report that in 1996, only 7.5% of South African schools were equipped with adequate facilities to be able to offer courses in computer literacy. Among a class of educationally disadvantaged first-year students enrolled for an introductory course in information systems at the University of Cape Town in 2001, 41% had never previously used a computer (Nash et al, 2002); while Herselman & Britton (2002) found that only 11% of Grade 12 learners from resource-deprived schools in the Port Elizabeth area had regular access to a personal computer.

The Global Digital Divide Initiative of the World Economic Forum (2002) recognises that "now more than ever, ICT solutions offer powerful tools for poverty alleviation and the advancement of sustainable development". However, technological disadvantage cannot be addressed separately from the larger educational and economic context (Attewell, 2001). Poor matriculation results and depressed socio-economic conditions make access to further education a continuing problem for black South Africans. The solution to this problem does not simply lie in the provision of computer technology and internet access in rural areas, since current low levels of computer literacy mean that students must first familiarise themselves with technology before they will be able to benefit from the educational opportunities that it offers (Odendaal, 2001).

Tertiary education can contribute to the effort to reduce the extent to which South Africans become marginalised by the digital divide, by ensuring that an increasing number of graduates emerging from disadvantaged backgrounds develop the ability to use technology effectively and to enhance the role that it can play within a range of organisational contexts.

2.4 Summary

Information technology has played an increasingly important role in national and global economies over the last decade, accompanied by continuing growth in demand for qualified professionals. The field of information systems, which explores the interaction between information, technology and society, draws on a variety of disciplines, and IS practitioners need to develop a broad range of abilities. Through the development of IS skills, especially among previously disadvantaged communities, tertiary education could make a significant contribution to economic and social transformation in South Africa.

3. Tertiary Education in South Africa

This chapter presents the political background to the current state of tertiary education in South Africa, and identifies a number of factors influencing the selection and retention of university students. The provision of special academic programmes intended to support previously disadvantaged students is also discussed.

3.1 Political context

In South Africa, apartheid policies became enshrined in legislation and public administration following the rise to power of the National Party in 1948. The school system was divided on the basis of race (white, Indian, coloured and black) and administered through four different departments providing an unequal allocation of resources; for example, in 1989, government spent R3600 per year on each white student as opposed to R750 per black student at secondary school level (Naidoo et al, 1998). Further statistics for the same year show that 32% of teachers employed at schools run by the (black) Department of Education and Training (DET) had not even matriculated, and only 5% held university degrees, while all teachers employed at white schools had matriculated, and 32% held degrees (Huysamen, 2000). Underqualified teachers, high student-teacher ratios, and the lack of facilities such as classrooms, desks and textbooks, promoted the rote learning of information and resulted in poor examination performance for blacks, thus limiting access to higher education (Nyamapfene & Letseka, 1995; Naidoo et al, 1998).

The South African constitution of 1984 entrenched the apartheid divisions in public higher education through the designation of 11 universities for the exclusive use of whites, one each for coloureds and Indians, and four for blacks (Bunting, 2002a). Although the

University of South Africa (Unisa) was controlled by the white House of Assembly, as a distance-learning institution it was allowed to enrol applicants of any race who qualified for admission to its programmes. Other white universities could apply for permits to enrol students from other race groups if the proposed programme of study was not available at the racially designated institution, and by 1990 28% of students registered at the more liberal English-medium white universities (and 4% of students at Afrikaans-medium universities) were either black, coloured or Indian (Bunting, 2002a). Between 1990 and 1994, when it became apparent that the apartheid era was drawing to a close, university enrolments grew by a further 38 000, mainly at historically black universities (Bunting, 2002b). Nevertheless, in 1993 only 9% of black 20-24 year olds were enrolled in the higher education system (both universities and technikons), compared with 70% of whites (Bunting, 2002b).

The Bill of Rights that was included in the new South African constitution, following the democratic elections of 1994, stated that all learners have a right to basic education including adult basic education and further education (Lomofsky & Lazarus, 2001). The White Paper for higher education transformation promised increased access for previously disadvantaged students within an enabling institutional environment, so as to redress historical inequalities (Department of Education, 1997). "At a national level, the post-apartheid context demands that South African higher education addresses not only the challenges raised by globalisation, but also those arising from the developmental imperatives of equity, redress and reconstruction which derived from the country's history" (Council on Higher Education, 2000).

In 1993, Michael Sarakinsky, anticipating the need for the implementation of affirmative action in higher education, claimed that apart from the moral argument for eliminating inequality, it was essential to equip previously disadvantaged students with the skills needed to promote economic growth in a rapidly industrialising developing country. He considered that this could only be achieved through a combination of meaningful university admission criteria based on appropriate measures of ability, and the provision of academic support programmes to address the problems of students who did not speak English as a first language and had received inadequate tuition at school (Sarakinsky, 1993).

These concerns appear to have been justified. Although inequalities in education are being addressed post-apartheid, the aftermath of oppression has brought with it numerous educational problems, particularly for students from disadvantaged backgrounds, who have not been adequately prepared to cope with the demands of tertiary education (Miller et al, 1998; Huysamen & Raubenheimer, 1999). About 125 000 students drop out of South Africa's higher education institutions each year, most of them black; a trend which is likely to continue unless there is adequate government spending on foundation courses to help students bridge the gap between secondary and higher education (Rossouw, 2001).

Universities are under pressure from the Department of Education not only to maintain student enrolments, but also to become more demographically representative, and as a result they admit underprepared students (Rossouw, 2001). Many students do not acquire language skills at school that are adequate for coping with the linguistic demands of tertiary education, and for the majority of 'under-prepared' students, the common denominator is that they are studying in a language that is not their mother tongue (Miller et al, 1998). Nyamapfene and Letseka (1995) suggest that the dominance of Afrikaner nationalism

served to diminish the influence of English among black South Africans, since under apartheid there was little opportunity for Africans to mix with English speakers, either socially or in business.

The academic policy that has been developed by the current Department of Education is intended to

- contribute to the goal of equity and social redress by facilitating increased access to tertiary education;
- ensure that the student body reflects the demographic realities of the broader society;
- support previously disadvantaged students through the provision of academic development programmes and extended curricula.

(Department of Education, 2002).

However, although education has been perceived as an agent for constructive change, a new set of inequalities appears to be emerging: historically white English universities remain elite, Afrikaans universities have become more entrepreneurial, and historically black universities are increasingly faced with financial and academic crises as the growing demand for student places has been offset by the reality of an educationally less skilled intake and constrained budgets for education (Gultig, 2000). Students who receive inferior training at high school remain underprepared for the demands of university, and are often further disadvantaged by the inadequacy of their financial resources (Huysamen, 2000). Other non-academic factors that have been considered likely to affect student performance include perceptions of racism, feelings of alienation, socio-political influences, and problems of finance, transport and accommodation (Bokhorst et al, 1990).

If the right of access to further education is to be translated into significantly increased numbers of black graduates, then a number of broader issues need to be addressed. Miller et al (1998) point out that the cognitive demands of university study may not match the approach to understanding that has been inculcated in students from a predominantly oral culture, who tend to engage in tasks as if they require a single unequivocal solution. In addition, exposure to a different set of cultural and social customs, beliefs and values complicates the adjustment to a new physical environment (Huysamen, 2000).

If we are to succeed in enhancing the academic performance of previously disadvantaged students, then we need to recognise the multivariate nature of the problem (Berry & Asamen, 1989), and the findings of this thesis should be viewed within the broader social and political problem context of academic achievement and social transformation.

3.2 University admission practices

The Higher Education Act of 1997 does not specify a minimum admission requirement for study in higher education. Institutions have the right to determine entrance requirements for particular programmes, student numbers and the manner of student selection. However, the act requires that "the admissions policy of a public higher education institution must provide for the redress of past inequalities" (Council on Higher Education, 2000).

In the endeavour to widen access and at the same time improve graduation rates, it is important that higher education institutions should ensure that admission, selection and placement is carried out in a responsible manner (Council on Higher Education, 2000). Some universities have instituted institution-specific entrance tests for prospective students,

and in many cases, students with matriculation results below a certain aggregate are required to write these tests in order to assist university administrators in making alternative admissions and placement decisions (Skuy et al, 1996; Blunt & Goodier, 2000). This development is due largely to "the now widely accepted fact that the Senior Certificate is only a good predictor of academic performance for those students within the top range of scores" (Council on Higher Education, 2000). Admissions based solely on Senior Certificate results for those with lower range scores are therefore believed to exclude unfairly many students with academic potential (Skuy et al, 1996; Huysamen, 2000; Miller et al, 2001). In fact, well before the release of the Council on Higher Education report in 2000, Miller (1992) had already demonstrated that the assumption of equitable student selection based on matriculation points becomes false when extended to include the DET school system, since DET matriculation scores do not correlate with first-year university results and should not be used as an index of probable success.

Alternative selection procedures that have been used at South African universities to assess the academic potential of disadvantaged students include the Teach-Test-Teach programme at the University of Natal at Durban, and the Alternative Admissions project at the University of Cape Town (Skuy et al, 1996). Gultig (2000) suggests that as an increasing number of black middle class students emerge from historically white schools with acceptable academic qualifications, it will no longer be necessary for universities to apply alternative admissions strategies, and he suggests that a move back to conventional admissions is likely. An opposing view has been presented by Yeld & Hartman (1992), who make a strong argument for diagnostic entry testing of all students, particularly as the range of under-preparedness across the student body increases.

Experience at the Port Elizabeth Technikon has shown that even when students have obtained sufficient matriculation points for admission to the Technikon, in many instances their inability to cope with academic English has severely hampered their progress at tertiary level (Blunt & Goodier, 2000). At the University of the Western Cape, Switzer (1999) recommended that to avoid admitting students who do not have a reasonable chance of success, all incoming students should be evaluated in terms of language and mathematical skills and overall academic potential. He proposed that academic development programmes should provide additional English teaching for all first-year students, as well as upgrading numeracy and mathematical skills.

Alternative admissions tests can play an important role in identifying students who will benefit from academic support, as well as assisting in the selection of appropriate courses (Huysamen, 1997). In the United States, admissions testing is considered to have a democratising role, in that it allows students with inequitable high-school backgrounds to reveal their true potential, and it is commonly used in conjunction with high school results in determining college admissions (Huysamen, 1997). However, since achievement in aptitude tests is affected by educational experience, South African students emerging from inadequate schools are likely to be disadvantaged as far as both matriculation scores and performance on existing aptitude tests are concerned (Griesel, 1992; Miller, 1992).

In discussing the validity of admissions testing, Miller (1992) argues that if appropriate educational intervention within degree programmes is able to alter the initial probability of student success, then the value of the entrance test diminishes concomitantly. This implies that the more we improve our education system, the worse our predictions based on

entrance tests are likely to become; in which case the greatest value of admissions testing lies in the ability to determine the type of intervention that is needed (Miller, 1992).

However, the implementation of alternative admissions policies is only one aspect of the campaign to achieve equity in higher education. While the revision of admissions criteria to admit a limited number of disadvantaged students is better than the alternative of excluding them, it still does not address the legacy of problems created by inferior education at school level, and efforts to develop the academic potential of students continue to be undermined by weak language, mathematical and analytical skills, and poor study habits (Switzer, 1999; Thompson & Tobias, 2000).

Furthermore, although the enrolment of black students at South African universities has increased rapidly since 1993, the proportion following courses in science, engineering and technology, and business remains low (Council on Higher Education, 2000). Strong concern regarding this situation has been expressed by Professor Martin Hall of the University of Cape Town: "In a developing economy with low levels of direct foreign investment, massive disparities in access to housing and basic education, substantial unemployment and a growing public health crisis spearheaded by the escalating AIDS pandemic, low and inequitable access to higher education will severely limit the potential for economic development and political stability" (Hall, 2001).

3.3 Academic development programmes

In planning for post-apartheid education, the National Education Policy Investigation of 1992 emphasised that support services should be allocated to those most in need, with priority being given to marginalised youth, 'learners with special needs', those affected by

violence and those to whom a quality education has previously been denied (Lomofsky & Lazarus, 2001).

Academic Development Programmes (ADP) - also referred to as Academic Support Programmes (ASP) - were implemented at a number of South African universities during the 1980s; many of these are now integrated into mainstream curricula in the form of extended programmes linked to "alternative access" entry (Department of Education, 2002). The 1997 White Paper published by the Department of Education promoted the increased provision of ADP support in the hope that this would lead to improved graduation rates, especially for black and female students. However, five years later the Department expressed its concern that dropout rates were still unacceptably high (25% for first-time entering students), and reiterated that: "Higher education institutions have a moral and educational responsibility to ensure that they have effective programmes in place to meet the teaching and learning needs of the students they admit" (Department of Education, 2002).

The provision of additional support for students has engendered a further debate as to the meaning of the term 'disadvantaged'. For example, a significant proportion of underprepared black students at the University of the Western Cape stem from a growing black middle class and would be excluded from assessment practices targeting students from the lowest ranks of the economically disadvantaged (Switzer, 1999). Furthermore, although all of the historically White universities, with standards that are perceived to be high, have instituted testing procedures and academic support programmes for their disadvantaged students, so-called 'black' universities, with entrance standards that are

perceived to be lower, have virtually no testing facilities, and academic support remains little more than a pilot project (Switzer, 1999).

Despite the provision of support programmes, only a small percentage of underprepared students who are admitted to university show continuing academic improvement. At the University of Natal, first-year psychology students were tested for English language and mathematics competence at the start of the course; the majority of those who were identified as being underprepared declined academically during their first year and failed by their third (Miller et al, 2001). This could indicate a deficiency in either the admissions policies used, or the forms of intervention that are provided. Moll & Slonimsky (1989) point out that ADP students are expected to compete within an unfamiliar context and in terms of unfamiliar ground-rules, in order to succeed. Although these students do not necessarily lack the requisite cognitive abilities, they may find it difficult to mobilise these skills in a university context. According to Moll & Slonimsky (1989), the previous Department of Education and Training homogenised educational activity into a single ground-rule: replicate what is given. As a result, students tend to learn a text as a totality and fail to identify the salient features that can subsequently be used to construct a logical argument (Moll & Slonimsky, 1989).

The lack of cognitive academic development at school level and excessive reliance on rote learning, make concept development an important element of ADP support (Kilfoil, 1997). Kilfoil (1997) positions the need for cognitive development within a set of three other factors: proficiency in the language of learning and instruction; introduction to the discourse of the discipline being studied; and provision of interpersonal support.

Cele (2001) points out that the common characteristic of students in tertiary education who need special intervention is that they are second language speakers accessing their education in English, and suggests that there is an imperative need for special attention to be paid to the acquisition and development of English competence among learners. This reinforces the view of Moll & Slonimsky (1989) that students from an educationally disadvantaged background find it difficult to translate abstract understanding into another language. The combined effect of insufficient academic English and a cultural background which may approach problem solving differently from the Western standard presents a double obstacle for linguistically and culturally diverse learners (Garaway, 1994).

This problem of academic disadvantage is viewed from a different perspective by Miller et al (1998), who suggest that the critical variable is not whether students are first or second language speakers, but whether or not they are adequately prepared. They posit that students are disadvantaged to the extent that the quality of their prior education limits their subsequent academic performance, and feel that increased fluency in English may not be sufficient to reverse this handicap. Intervention programmes, in addition to emphasising second language problems, should thus focus on the more general problem of under-preparedness (Miller et al, 1998).

Although language skills might be expected to improve with exposure to tertiary education, cognitive deficiencies may become apparent only at more advanced levels of study. The long term effects of under-preparedness could thus help to explain why, although ADP programmes may show an improved pass rate at the end of the first year, disproportionately few students actually graduate (Agar, 1990). One approach that has been used successfully for teaching both the content and method of university discourses, is that of "scaffolding",

based on the principle that a scaffold serves to function during the initial stages of building, but once a solid framework is in place then the scaffolding can be removed and the rest of the construction proceeds on an independent basis (Kilfoil, 1997). In order for students to successfully acquire the discourse of an academic discipline, foundation courses must enable them to process information selectively and integrate it with their existing knowledge frameworks; ongoing interpersonal support is also essential for maintaining the self-esteem of students accustomed to different frames of reference (Kilfoil, 1997).

The role of academic support programmes within tertiary institutions is a complex one, encompassing the assessment of student potential before admission, the development of cognitive skills required at tertiary level, and the ongoing provision of educational and psychological support to students; and their contribution to student success should not be underestimated. Unfortunately, only a small number of students can be accommodated within these programmes. Many other students from disadvantaged backgrounds who face similar problems of under-preparedness are accepted into the mainstream student body, and it is important that obstacles to their academic success should be identified and addressed.

3.4 Predicting academic success

Even before the changes in education that followed the 1994 elections, there was concern about the high failure rate of students in tertiary education in South Africa, especially in their first year (Stoker et al, 1985; Bokhorst et al, 1990). Since quality of schooling is a prime determinant of access and success in higher education, it is hardly surprising to find high failure rates at tertiary level among black pupils emerging from an apartheid context of differential spending on black and white education, political opposition resulting in boycotts by both teachers and pupils, bureaucratic inefficiency and corruption and under-

prepared teachers (Hall, 2001). Inappropriate student selection may lead to increased education costs, waste of limited teaching resources, and the demoralising effects of failure following unsuitable career choices (Bokhorst et al, 1990).

The important role of admissions policy has led a number of researchers to investigate the relationship between academic factors and university achievement. However, attempts to predict academic success within the South African context are complicated by the presence of psycho-sociological factors, especially for black students attending historically white universities, who must adapt to a different set of social customs, are more likely to suffer financial difficulties, and may find that their cultural customs conflict with the spirit of enquiry and independent thought that is required of them (Huysamen, 2000). Although research in the United States has found no difference in the achievement needs of different racial groups or in their perception of individual responsibility for outcomes, low ability cues received from teachers may influence student self-perception and negatively affect performance (Graham, 1989). The interaction between personal attributes and background, experiences with overt and covert racism in their interactions with faculty and peers, and the development of maladaptive coping styles all confer an additional risk for early attrition, poor academic performance, and psychological distress in a large percentage of black students (Prillerman et al, 1989).

A survey commissioned by the Committee of University Principals in 1982, based on a sample of 6527 students drawn from 16 South African universities, showed that school aggregate was the strongest single predictor of university performance (Stoker, 1985). For non-language BA majors, first language was found to be the second most important variable, while other "race-related" factors such as university and school examining body

also played a role. The value of the matriculation examination was supported by Van Wyk and Crawford (1984), who found that in the sciences, school aggregate remained the best predictor of university performance.

Bokhorst et al (1990) examined the performance of first year psychology students at the University of Cape Town during the period 1984-1987, in terms of school aggregate, home language, population group and matriculation authority. School aggregate was found to have an almost perfect positive correlation with first year psychology results, while home language and population group were linked to academic success (with English language and White population group predicting fewer failures). Although school aggregate appeared to be a significant predictor across all population groups, the high entrance requirement for this course meant that the black students included in the sample were not representative of the general population - illustrated by the fact that there were only 45 black students among the 1974 cases that were analysed. (Despite the fact that by 1990, 32% of total South African university enrolment was black, most of these students were studying at racially segregated universities (Bunting, 2002b).)

Researchers such as Shochet (1986, cited in Huysamen,1997) have cast doubts on the usefulness of matriculation score as a predictor, claiming that it is only valid in the case of "advantaged" students. However, Huysamen (1999) counters this stance by observing that the correlation between predictor and criterion will be reduced by a restriction in range of either variable. In studies based on samples that include a smaller percentage of students from disadvantaged communities, one would thus expect to find a lower correlation.

The increasing diversity of students in tertiary education in South Africa, although indicative of success in the pursuit of equity, has affected both the problem of student retention and the complexity of predicting academic success. Between 1994 and 2000, retention rates have decreased further within the public higher education system (Bunting, 2002b). The Shape and Size of Higher Education Task Team, commissioned in 2000 to provide a framework for enabling significant improvements in quality and equity of higher education, considered the number of students dropping out of the system each year to be unacceptably high; in the case of first time entering undergraduates, at least 25% drop out by the end of their first year of study (Council on Higher Education, 2000).

Huysamen (2000) notes that especially in the first year of study, the academic performance of South African black students compares unfavourably with that of whites. At the same time, matric results show a weaker correlation with tertiary academic performance for disadvantaged students (Huysamen, 2000). Similar findings have been reported by American researchers; for example Linn (1990, cited in Huysamen & Raubenheimer, 1999) found that the regression equation for white students overpredicted the grade-point average for black students irrespective of level of performance. In examining the relationship between overall matric scores and results in the first year accounting course at the University of Durban-Westville, Samkin (1996) found that not only were significantly higher results achieved by students who had attended schools controlled by the "coloured" House of Delegates (HOD) than those emerging from the black Department of Education and Training (DET), but there was also a stronger correlation between matric scores and accounting results for HOD than DET students.

Skuy et al (1996) compared the predictability of academic performance for educationally advantaged and disadvantaged students entering a pre-university bridging year at the University of the Witwatersrand, and found no significant correlation with matric score for either group. However, the validity of these results is likely to have been diminished by the small sample size (a total of 26 students).

In a similar study based on a sample of 1585 first-year students at the University of the Orange Free State, Huysamen and Raubenheimer (1999) investigated whether the correlation of matric scores with university performance differed for students from the DET and from the "white" Department of Education (DE). However, since students from weak school backgrounds are often advised to register for fewer than the standard number of courses, mean first-year results were weighted in terms of the number of courses for which students had registered. This adjustment resulted in highly significant correlations between matric score and first-year performance for both groups of students. By adding gender and matriculation authority to the regression equation, there was no appreciable over- or under-prediction of academic performance for any particular demographic group.

However, Huysamen (1999) points out that in many cases, the predictor and criterion variables are being measured in a language in which students are not adequately proficient, and he suggests that one would expect the correlation to be higher when students have an adequate command of English. This may explain the results of the study by Nash et al (2002), who found that the first-year results of previously disadvantaged students studying Information Systems at the University of Cape Town, had a stronger correlation with matric English marks than with either mathematics or overall matric scores.

In contrast, Ayaya (1996) found a significant negative relationship between school English and first-year academic performance at the National University of Lesotho. At the same institution, Seelen (2002) found overall school aggregate to be the best predictor of academic performance, and found no evidence to support the hypothesis that school English was positively related to first-year results. He notes however that because of the existence of admission criteria based on school English scores, a limited range of sample values was available for analysis, and suggests that a certain threshold of English proficiency is essential to be successful at university, above which better knowledge of English does not increase the chances of success. Another possible explanation presented by Seelen (2002) is that since all school subjects except Sesotho would have been written in English, the overall school aggregate in fact reflects a student's ability to use the English language in order to communicate academic content.

A survey carried out at the University of the Orange Free State between 1996 and 1998, using 1088 students with equivalent curriculum loads, found that for both white and black students, first-year performance had higher validity than matric points as predictor of subsequent performance (Huysamen 2000). Predictive correlations for black students continued to improve over time, which Huysamen (2000) considers may be the result of increasing facility with the language of instruction, although the significance of this finding is diminished by the large proportion of educationally disadvantaged students who fell by the wayside. The improved correlations may also be linked to Wilson's (1980) "late bloomer hypothesis", which suggests that academic performance of minority students improves as semesters accumulate. In terms of this argument, as disadvantaged South African students adapt to the tertiary education environment, and are exposed to lecturers with better command of language, receive better support services and develop improved

study methods, one could expect an increasing overlap of performance with that of previously advantaged students (Huysamen, 2000).

At the University of Natal, Durban, Miller et al (2001) evaluated the association of English and mathematics competence on admission with third year psychology results, and found that students who scored high on both English and mathematics at the start of the course, improved their tutorial performance during first year and performed better in third year than in the previous two years, while students who performed badly at the outset, did not show improvement on tutorial assignments and performed relatively worse in third year than in the other two years. However, it was not reported whether or not the students who were weaker on admission, were predominantly second language English speakers. This reinforces the findings of an earlier study by Miller et al (1998), which revealed clear differences in academic performance between students who were more or less prepared (in terms of basic mathematics and English competence), irrespective of whether they were first or second language students. Nevertheless, even if second language education is not a direct cause of under-preparedness, it is likely to compound or exacerbate any educational or cognitive problems (Miller et al, 1998).

These studies suggest that while matriculation performance is probably the best generally available predictor of success at tertiary level, students with poor English proficiency, who are most likely to be second language speakers, can be expected to encounter additional difficulties in coping with the academic demands placed upon them at university, especially during the first two years of study.

3.5 Summary

Black and coloured students entering tertiary education are still negatively affected by the policy of segregation that was applied to education in South Africa prior to 1994. The transformation of higher education requires the provision of structures that will facilitate the admission and retention of previously disadvantaged students, achieved mainly through the establishment of academic development programmes. Successful performance of under-prepared students is likely to depend on the identification of appropriate admissions criteria linked to academic achievement, and the provision of intervention programmes to improve their cognitive academic skills, including language proficiency.

4. Language in Tertiary Education

The majority of previously disadvantaged students entering tertiary education are also second language English speakers. This section of the thesis provides an overview of theories related to second language acquisition and use, and discusses the role of language proficiency in tertiary education, particularly within the field of information systems.

4.1 Second language acquisition

Almost all African nations resort to a foreign language as the medium of instruction (Silue, 2000), perhaps due to the perception that African languages are not adequately developed to meet the demands of modern education concomitant with global trends (Cele, 2001). However, students for whom English is an additional or foreign language are presented with a double burden when required to grapple with complex academic content in a language to which they have had very limited exposure (Thesen et al, 1997). Language and communication blocks have been identified by the National Commission on Special Needs in Education and Training as key barriers to learning when the medium of instruction is not the first language of the learners (Department of Education, 1997).

Textbook language presents serious problems of comprehension to most students for whom English is a second language (Jiya, 1993). Decoding of texts is slower in a second language, which increases mental fatigue, impairs short-term memory, and increases levels of stress; problems that are exacerbated when the subject matter and vocabulary are unfamiliar to the student ((Dornic, 1980; Rosenthal, 1996). Translation from one language to another is also never simply a substitution of one word for another, since the more the cultures differ, the more the thoughts conveyed by the words will differ, and the more

complex the translation will be (McKinley et al, 1992). Translation can be further complicated by the fact that traditional African languages do not always provide an equivalent of the linguistic structures used in Western science to express analytical and logical thought, as such things as logico-grammatical connectors or articles may not even exist (Rutherford & Nkopodi, 1990).

Important theories of cognition and second language acquisition have been developed by Cummins (1980, 1996) and Krashen (1982).

Cummins (1980) claims that even when students are fluent in everyday conversation, academic proficiency is a more complex requirement. He hypothesises the existence of two types of linguistic proficiency, basic interpersonal communication skills (BICS) and cognitive-academic language proficiency (CALP). As illustrated in Figure 1, these represent the extremes of two intersecting continua, in which BICS is context embedded and not cognitively demanding (quadrant A), as opposed to CALP which is both context reduced and cognitively demanding (quadrant D).

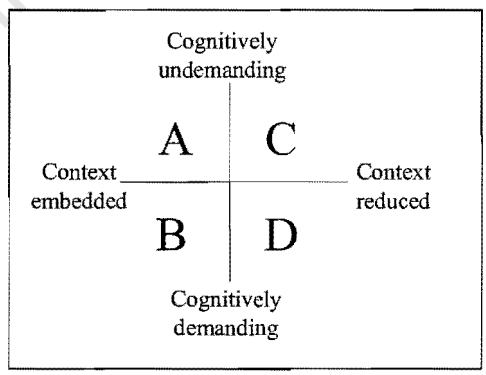

Figure 1. Contextual support and degree of cognitive involvement in communicative activities (Cummins, 1996, p.57)

For second language speakers, BICS takes about two years to achieve, whereas CALP takes from five to seven years (Cummins, 1980). Because of the length of time needed for the development of academic language proficiency, English second language programmes are not likely to prepare students adequately for the rigours of the academic classroom (Rosenthal, 1996). This theory was subsequently extended by Cummins & Swain (1986) to suggest that after acquisition, CALP is transferable from one language to another.

Torres and Zeidler (2002) provide a clear overview of Cummins' theories, and describe how Hispanic English language learners, although quite proficient in English grammar, vocabulary and sentence structures, lack the CALP skills needed to understand abstract information that is unrelated to the students' life experience. Thesen et al (1997) agree that if students have had little exposure to tasks in a context-reduced/cognitively demanding area, they are likely to struggle with decontextualised academic tasks at university, particularly if they have to be performed in a foreign or additional language.

The gap between BICS and CALP further disadvantages second-language students in tertiary study because there is a layer of academic vocabulary that students have to learn, understand and apply appropriately in order to become part of the academic discourse community (Kilfoil, 1999). Bohlmann and Pretorius (2002) refer to the distinction commonly made in vocabulary studies between three main categories of words: high-frequency words occurring in everyday conversation; low-frequency words occurring in academic discourse but which are not discipline specific; and low-frequency technical words that are seldom used outside of a particular discipline. Research has shown that knowledge of low-frequency words is positively associated with academic success (Bohlmann & Pretorius, 2002). However, students with smaller vocabularies or those

emerging from predominantly oral contexts typically know a higher percentage of high-frequency words, and in South Africa, second language students studying in English have been found to display alarmingly low levels of low-frequency words (Cooper, 1996). Nevertheless, students are often resentful because they believe that they are sufficiently fluent in English and that lecturers are being discriminatory when they consider their English inadequate for academic purposes (Kilfoil, 1999).

Krashen (1982) distinguishes between language acquisition and language learning. Language acquisition is described as an unconscious process that develops through exposure to comprehensible input over a long period of time; whereas language learning involves the conscious self-monitoring of language practices, which does not usually occur sufficiently within a conversational context for adequate learning to occur (Krashen, 1982). This frequently presents an obstacle to second language students in South Africa, who are expected to accomplish complex academic tasks such as comprehension, analysis, synthesis, summarisation, evaluation and the writing of essays, for which they need to be familiar with the "rules" and constraints of the genres of scholarly discourse (Von Gruenewaldt, 1999).

In attempting to explain the apparent success or failure of second language acquisition, Boughey (1998) advocates the use of the historical-structural approach, which examines the socio-economic and cultural contexts within which individuals seek to learn language and in which language is used. For example, when investigating the high failure rates of Maori students learning science, McKinley et al (1992) found that the cultural preconceptions of students influence the explanations for the natural world that they bring to the task of learning science. Social values also play an important role in the educational process: in

cultures where it is considered disrespectful to question authority, students are likely to remain passive and dependent on their teacher (McKinley et al, 1992). At the same time, exposure to multiple discourses may affect the significance attached to linguistic structures, such as when a student's home discourse attaches no social value to the use of tense or gender (Boughey, 1998).

Second-language speakers of English in a tertiary education environment are thus faced with problems of vocabulary, translation, comprehension and communication, often while having to operate within an unfamiliar academic discourse and social milieu.

4.2 The importance of language proficiency in tertiary education

Because the majority of South African higher learning institutions make their programmes available through the medium of English, Black learners emerging from historically disadvantaged schools with a poor command of the English language will have restricted access to these institutions (Cele, 2001). Nevertheless, many English second-language students choose to study through the medium of English because they perceive that it will have advantages for them in terms of future study and employment opportunities: "most third-world countries see English as a key that will give them access to science, technology and world culture" (Gueye, 1990, p31).

Thesen et al (1997), discussing the importance of language skills within academic programmes at the University of Cape Town, claims that many students come from schools which have failed to equip them adequately for engaging with the highly abstract concepts, theories and methods of enquiry that are characteristic of reading and writing academic texts. This perception is supported by Switzer (1999), who reports that at the University of

the Western Cape, only two out of 20 History honours students in 1994 managed to pass a standardised English test usually administered to second-year students at the University of Houston, despite being given double the usual length of time. Balfour (1995) notes that although second-language speakers might be articulate in social contexts, they often do not participate significantly in tutorials and find that the linguistic register used in classroom interaction falls beyond their immediate scope of competence. Furthermore, the problem of linguistic competence is not restricted to second-language speakers, and even first-language users of English frequently arrive at university with inadequate reading and writing skills (Kilfoil, 1997). Bohlmann and Pretorius (2002) claim that weak readers are only achieving comprehension levels of 50% or less, with dire consequences for their academic performance, and advise higher education institutions to focus on reading as a fundamental skill underlying academic competence.

The subject of language proficiency has been addressed by a number of researchers. Light et al (1987), while acknowledging the difficulty of measuring language proficiency among international students, suggest that four major components of the communication process must be mastered for successful university study: grammatical competence, sociolinguistic competence, discourse competence and strategic competence. However, skill requirements within these categories are likely to differ across campuses or within different majors. Cummins (1996) emphasised the distinction between conversational and academic aspects of language proficiency. Conversational proficiency typically involves "context-embedded" communication, which is supported by a wide range of meaningful interpersonal and situational cues, whereas the "context-reduced" communication of the academic environment relies primarily on linguistic cues to meaning, and interpretation of the message depends heavily on knowledge of the language itself. Academic language

proficiency thus requires high levels of cognitive involvement which is only minimally supported by contextual or interpersonal cues (Cummins, 1996).

Kilfoil (1997) suggests that discipline-specific language is a third aspect of language proficiency that needs to be developed in addition to BICS and CALP if students are to succeed in their studies. Bohlmann and Pretorius (2002) claim that textual coherence is derived from four basic types of conceptual relation: additive (X *and* Y), temporal (X *then* Y), causal (X, *as a result* Y) and contrastive (X. *However*, Y), and that students' perception of these relations is fundamental to their construction of meaning. The causal and contrastive relations are especially important in academic discourse, and comprehension failure on the part of less skilled readers may easily result from the high levels of abstraction, conceptual density and lack of redundancy found in academic texts (Bohlmann & Pretorius, 2002).

Gultig (2000) points out that the goal of higher education is to achieve deep understanding of higher order concepts and perspectives through the rigorous evaluation and reconstitution of ideas. In the process of constructing knowledge, students must be able to verbalise, explain, question, discuss, hypothesise and synthesise (Cele, 2001). Instead of assuming the role of a "mere receiver of knowledge", the learner must interact with the material, giving it order and structure in order to discover and express its meaning (Garaway, 1994). A lack of competence in English is thus likely to encourage rote learning (Agar, 1990).

Miller et al (1997) found that second-language students in a first-year Psychology class had higher pass rates for the MCQ section of the examination than for the essay section, and

hypothesised that MCQ questions test rote memory, while essay questions assess higher cognitive functions. Although Ayaya (1996) reports that among Chinese students at University of Hong Kong, where English is the medium of instruction, English language proficiency was found to be the most important determinant of successful performance, Miller et al (1997) propose that student performance is not directly linked to language but rather to overall academic preparedness. Rollnick (1998) encompasses both these perspectives in identifying how language proficiency affects the academic performance of second-language students in terms of a number of factors: mastery of syntax and vocabulary; comprehension of content; resolution of ambiguities and integration of material; and the overall level of academic preparedness.

Within any academic discipline, a lack of language proficiency is likely to have a negative impact on student achievement. In South African universities, this problem is obviously not limited only to those who were previously disadvantaged by apartheid education; however, the negative impact of inadequate English competence is particularly likely to be felt by second language students.

4.3 Assessing language proficiency for tertiary education

The primary motive for assessing English language proficiency is to facilitate the provision of equal education to language minority students, since without this information it is difficult to plan for student needs or to measure student progress (Navarrete, 1992). However, the assessment task is frequently hampered by practical constraints such as availability of facilities, materials and personnel, as well as the limitations of the instruments used in standardised tests.

American universities admitting international students are required to verify that every non-native English speaking student has sufficient English proficiency to cope with academic studies. The Test of English as a Foreign Language (TOEFL) is commonly used for this purpose, by evaluating a combination of listening comprehension, grammar identification and reading comprehension skills. It has however been criticised on the grounds that because it is a multiple choice test, it measures recognition rather than production, and in some cases the Test of Written English (TWE) is also required (Washington University, 2001).

Saville-Troike (1991) argues that although vocabulary knowledge is representative of a larger body of concepts and schemata, and remains an important determinant of academic achievement, the assessment of English competence at the time of entering college may be an overly simplistic basis for applying remediation, since university achievement is heavily dependent on interactional competence, and background knowledge may be crucial to the interpretation of meaning. Furthermore, the predictive value of aptitude tests written by students with weak English language skills is unreliable because students' language abilities generally improve over time (Geisinger & Carlson, 1992).

Torres & Zeidler (2002) examined the effect of English language proficiency on the acquisition of science content knowledge by Hispanic students in the United States. The language proficiency of the students was measured using the Test of English as a Foreign Language (TOEFL) instrument. The results of this study showed English language proficiency to be a significant contributor to the students' performance on a standardised science test. However, an alternative point of view has been expressed by Light et al

(1987), who suggest that students who are admitted to tertiary institutions with weak English skills would have had to perform well above average on other subjects to meet the entry criteria, and could therefore be regarded as unusually promising.

The existence of weak correlations between English language test scores and academic performance in the United States may also be influenced by the fact that students with low proficiency in English are not usually admitted to university studies. Graham (1987) suggests there may be a minimum level varying with institution and program, below which lack of proficiency in English contributes significantly to lack of academic success.

Research has suggested that English scores obtained in the South African matriculation examinations are not a good indicator of academic English proficiency, especially for second-language students (Huysamen, 2000; Miller et al, 2001). Although a variety of other tests have been used to evaluate language proficiency at South African universities, these are mainly intended to assess the academic potential of previously disadvantaged students. For example, students applying for admission to the University of Cape Town (UCT) under the Alternative Admissions Programme, write the Placement Test in English for Educational Purposes (PTEEP), which presents tasks requiring students to manipulate text in order to demonstrate their construction of understanding (Blunt & Goodier, 2000). However, students who qualify for admission to UCT in terms of the standard admission criteria are not required to write the PTEEP test, making it difficult to assess the general predictive value of the test.

At South African tertiary institutions, matriculation results tend to remain the sole criterion of academic and linguistic proficiency for the majority of applicants entering mainstream

university studies, and no useful research results are yet available to evaluate the reliability of alternative methods of assessing academic potential.

4.4 Language in Information Systems

Although the language of science and technology in South Africa is English, many students believe that language skills are needed only in arts and humanities courses (Nyamapfene & Letseka, 1995). In the same vein, while the importance of reading proficiency in the language, social and human sciences seems undisputed, it has often been assumed that success in mathematics and science requires primarily logico-deductive and numerical skills, and consequently the role that reading plays in constructing and understanding complex concepts and in problem solving in these disciplines is often underestimated or overlooked (Bohlmann & Pretorius, 2002). Research into the performance of undergraduate students in mathematics has shown that while good reading ability does not guarantee success, poor reading ability can function as a barrier to effective mathematics performance (Bohlmann & Pretorius, 2002).

Within any academic discipline, verbal comprehension is an important determinant in the cognitive process. Many words that have specific meanings within an academic field are also used in everyday conversational language, but with different connotations, and for students whose first language is not English there may be problems with linguistic transfer (Jiya, 1993). Since the words which cause most trouble in conceptualising scientific ideas are those which occur in normal English usage, it is important to teach English within a specific discipline, and not as a standard course (Johnstone & Cassels, 1978).

In emphasising the need for education to empower individuals to become active participants in a technologically based world economy, Garaway (1994) acknowledges the problems caused by differences between everyday language use of terms and the mathematical or scientific use of the same terms. Furthermore, a student's native tongue may lack words for specific concepts, adding to the learning difficulties of second-language speakers (Garaway, 1994). Rutherford & Nkopodi (1990) suggest that problems in expressing scientific ideas in African languages arise because of differences in vocabulary, the use of articles ("a solution" vs "the solution"), the absence of logical connectors and the existence of multiple meaning of words (for example "power"). At the University of Fort Hare, where all science courses are taught in English, students not only found language to be an obstacle to their academic performance in these courses, but also reported difficulty in articulating ideas in their mother tongue (Jiya, 1993).

Computer skills are more mixed with conceptual and language abilities than the common idea of computer literacy envisions (Attewell, 2001). In a survey of students attending a computer literacy course at the University of the Western Cape, 65% experienced problems with language and terminology (Venter & Blignaut, 1995). Black students achieved significantly lower marks for the theory component of the course, although there was no difference in results for the practical section. Nash et al (2002), analysing the results of first-year ADP students studying IS at the University of Cape Town, also found a greater positive correlation between English matriculation scores and the theory component of the course than the practical component of the course.

Within any practice, the primary role of language is to articulate the principles, rules and goals which are pertinent to that practice and to facilitate communication amongst its

practitioners (Frowe, 2001). Information Systems professionals in particular are required to communicate difficult technical concepts in a clear, concise manner to people with varying levels of technological expertise and interest; confusion resulting from the use of technical terms almost guarantees that others will not understand the issues at stake (Gupta, 2000).

Silue (2000) emphasises the importance of literacy in establishing the science and technology skills necessary for modern economic development, a view that is reinforced in an appeal to the Thai government by Waltham (2003): "The 'number one' difficulty we face is the lack of English language competency among Thai IT professionals. It is not 'language chauvinism' but simply a fact of life that the language of IT worldwide is English. Given the long-standing goal of improving Thailand's IT readiness and preparing for competition in a global economy, this is an issue which can not be over-emphasised".

4.5 Summary

Students for whom English is a second language are likely to encounter difficulties with the academic use of English at tertiary level, a problem that is exacerbated by the presence of discipline-specific vocabulary. While there is some difference of opinion regarding the degree to which language proficiency affects academic performance, there appears to be consensus that inadequate linguistic skills present a barrier to learning. Although alternative tests of English proficiency are being administered at some institutions, the matriculation examination remains the most common assessment of English proficiency for students entering South African universities.

5. Studying Information Systems at UCT

The section of the thesis describes the structure and content of the undergraduate Information Systems programme offered at UCT, which is the origin of much of the research data used to describe and analyse student performance in the following three chapters. Issues related to student demographics, equity strategies and retention rates are also discussed.

5.1 Curriculum and objectives

The South African Qualifications Authority was established in 1995 to oversee the development and implementation of a National Qualifications Framework, which is essentially a quality assurance system responsible for the registration and moderation of standards and qualifications. For any university programme to be accepted as a qualification, its learning outcomes must include "using science and technology effectively and critically" (Department of Education, 2002).

Students majoring in Information Systems (IS) at UCT must complete ten IS undergraduate semester courses, together with a number of other business-related courses such as Accounting, Economics, Statistics and Law. (The curriculum of students registered for the Bachelor of Business Science degree includes an additional year at Honours level.) The content and structure of the IS major courses is based on the IS2002 model curriculum developed by the Association for Information Systems (AIS), which provides a broad introduction to IS concepts during the first year, and then revisits them at greater depth in subsequent years (Gorgone et al, 2002). The IS major programme is intended to equip students with an appropriate mix of technical, organisational and management knowledge

and skills to be able to meet international standards within the IS profession (Nash et al, 2003). Together with the efficient use of information technology, key objectives of the programme include the development of quantitative, written and presentation skills; problem-solving and life-long learning; teamwork and project management; and ethics and professionalism.

Undergraduate courses included in the IS major programme during the period of this study were as follows:

1st year:	INF102	Foundations of Information Systems
	INF103	Commercial Programming
2nd year:	INF205	IS Theory & Practice (until 2000)
	INF206	IT Architectures (from 2001)
	INF212	Systems Analysis & Design
	INF213	Data communications
	INF214	Systems Implementation in a Database Environment
3rd year:	INF311	IT Management
	INF312	IT Applications (from 2002)
	INF313	Group Systems Development Project
	INF314	Electronic Commerce
	INF316	IT Architectures (until 2001)

Note that students who successfully completed their first year courses in 1999 would have attended the INF205 course in 2000. Students who attended INF206 had thus either failed one of the first-year IS courses, or else were following the ADP extended curriculum. A similar situation applies to INF312 and INF316: students who had successfully completed IS1 and IS2 within two years, would have attended INF316 in 2001, while those who took three years to complete IS1 and IS2 would have attended INF312 in 2002.

The acquisition of practical computer programming skills is only one element of the IS curriculum. Students must also master the theoretical concepts underlying the different technologies used within information systems, so as to enable them to select the most appropriate components to be used within a particular business environment. They must learn to elicit, document and interpret the requirements specifications for a proposed information system, on which development and implementation will be based. With increasing emphasis on electronic commerce, students must understand the implications of different business models and their impact on the supply chain. They must also be equipped to manage system development projects, including IS staff, users and vendors, and to liaise with senior management in order to align the information systems function with organisational goals.

These various aspects of an IS education involve a broad range of language skills: programming relates to formal grammatical and syntactic structures; the description of theoretical concepts in information systems depends heavily on the use of technical jargon; the eliciting of system specifications requires accurate verbal comprehension and the unambiguous use of language; business models are described in terms of logical abstractions; while interpersonal communication skills are essential for effective management. Thus students who are linguistically under-prepared, are likely to encounter difficulties throughout the IS curriculum.

5.2 Equity issues

The report on Transformation and Reconstruction of the Higher Education System includes among its key objectives the need to increase access to tertiary education and produce

graduates with the skills needed to meet our country's human resource needs, while redressing past inequalities and promoting equity among students and staff so as to reflect the demographic composition of society (Department of Education, 2002). The target set by the Department of Education aims at increasing the participation rate of black students in higher education from 15% to 20% (an additional 200 000 students) over the next 10 to 15 years; while at the same time increasing graduation rates from 15% to 30% of enrolled students per annum.

In line with this requirement, the Faculty of Commerce at UCT intends admitting a significantly increased number of students under the existing Academic Development Programme (ADP) during 2004 and 2005. However, new teaching strategies are likely to be needed if the simultaneous objectives of increasing the number of educationally disadvantaged students being admitted to the faculty, while raising throughput and graduation rates, are to be achieved. This may be an opportune time to re-assess the importance of language skills in the curriculum.

The ADP programme provides an alternative route for the admission of students from previously disadvantaged backgrounds, who have failed to meet the standard admission requirements (in terms of matriculation points) for study within the Faculty of Commerce. Alternative Admissions Tests can be written at a number of centres around the country, and students who are able to demonstrate academic potential are then admitted into special courses (Nash et al, 2002). ADP students follow an extended curriculum in which the content of the first IS semester course is instead taught over a whole year, with special attention being paid to the acquisition of computer literacy, extra opportunities for practical work, and the provision of additional explanation and examples in the teaching of

theoretical concepts. However, based on the experience of the writer, many students still rely on rote learning of the material that is presented to them, and the scope of the course content does not necessarily force students to extend their logical and linguistic skills. In subsequent years, when the content of courses increases in volume and complexity, and students are expected to be able to explore, evaluate and apply information independently, many of them encounter serious difficulties with their academic work.

Until now the ADP class has been relatively small, with an intake of about 70 students per year, of whom typically fewer than 10 intend majoring in Information Systems. However, the number of students entering the ADP programme is expected to triple by 2005. At the same time, many more black students enter the mainstream Information Systems major programme each year, virtually all of them second language English speakers and many of whom have emerged from educationally limited backgrounds. All of these students must cope with their studies at UCT within an English medium environment, mastering the same curriculum content and achieving the same examination standard as their first-language English speaking counterparts. If language skills have a significant role to play in the performance of IS majors, then appropriate teaching interventions could provide useful support for all of these students.

5.3 Student admission and retention rates

In general, the admission of students to the University of Cape Town depends on the total number of points achieved in the matriculation examination. A score is calculated for each of a student's six best subjects: on the higher grade, an A symbol carries 8 points, a B symbol 7 points, and so on; standard grade subjects and English second language carry 6 points for an A symbol, 5 points for a B symbol, etc. In some faculties, additional

weightings are applied, for example in the Faculty of Commerce, the scores for English and mathematics are doubled. However, students who are admitted under the Academic Development Programme have usually failed to meet the standard entrance criteria, and are selected on the basis of their performance in the alternative admissions tests, which are intended to identify academic potential as well as current skills in mathematics and English.

Since English is used as the medium of instruction and examination at UCT, all students must have attained an acceptable level of proficiency before being admitted to the university. In most faculties, the minimum standard is an E-symbol for English at the Higher Grade (First or Second Language) in the South African senior certificate examination. Previously disadvantaged students applying to enter UCT under the Academic Development Programme usually write the Placement Test in English for Education Purposes (PTEEP) test, while foreign students must have an O-level pass in English Language, or else must achieve a prescribed minimum standard in either the TOEFL or PTEEP tests.

The racial composition of new students entering the Faculty of Commerce has been relatively consistent over the period 2000-2002, as shown in Table 1.

	African		**Coloured**		**Indian**		**White**		**Total**
2000	241	*22%*	130	*12%*	110	*10%*	604	*54%*	1085
2001	288	*25%*	159	*14%*	87	*8%*	622	*54%*	1156
2002	246	*23%*	137	*13%*	99	*9%*	574	*54%*	1056

Table 1. New undergraduates entering the Faculty of Commerce 2000-2002 (Nash et al, 2003)

However, as at 2002, race distribution within the IS major programme appeared to show a steady decline from approximately 43% white at the end of the first year, to 62% white in the third year (illustrated in Figure 2).

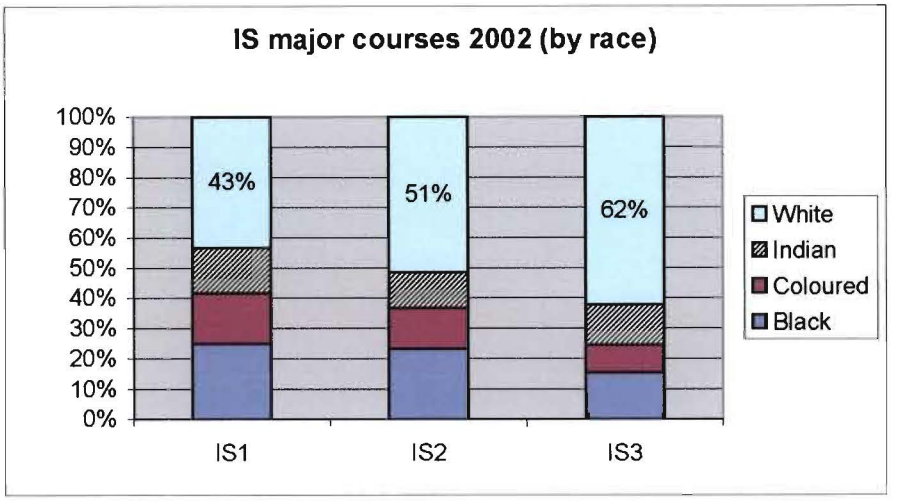

Figure 2. Race distribution across years of study for IS majors (Nash et al, 2003)

The progress of ADP students is closely monitored and their graduation rates are generally considered to be higher than those of other African students at UCT who are not in the ADP programme (Switzer, 1999). However, black students as a group (both ADP and mainstream) generally take longer than their white counterparts to complete the degree programme as a whole. Lower throughput rates for black students negatively impact the implementation of employment equity policies intended to redress previous discrimination in the workplace. The report of the Commission on Employment Equity showed that as at July 2002, white employees still held 80% and men 82% of senior management positions (Department of Labour, 2003). Barriers to the implementation of employment equity that were cited in this report included a lack of people from designated groups with appropriate skills, and high mobility of people from designated groups once appointed.

5.4 Summary

Strategies for achieving student equity, together with the demands of affirmative action in the workplace, have resulted in increasing numbers of under-prepared students entering both mainstream and academic support programmes at UCT. Students majoring in

Information Systems must complete ten undergraduate IS courses over a minimum of three academic years, which are intended to equip them with a variety of different skills and which rely on a range of linguistic abilities. English proficiency could thus have a significant impact on student throughput and graduation rates.

6. Aims of this research

In this chapter, the hypotheses to be tested are explicitly stated. Some practical applications of the research results are suggested, and a number of limitations identified during the course of the study are identified.

6.1 Development of hypotheses

The purpose of this study is to investigate the association of English language skills with the performance of students majoring in information systems at the University of Cape Town. Previous research has suggested that language proficiency may be an important factor in achieving academic success at tertiary level, and seems to support the claim that this is particularly relevant in the case of students with weak language skills. No research appears to have been undertaken to investigate the association between English language skills and academic performance within the field of information systems, but since IS as an academic subject has strong communication and syntactic components, it seems likely that language skills could play an important role in student performance.

In addition to the matriculation examination, a number of alternative tests, such as the TOEFL and PTEEP tests, are available for assessing the English language skills of university applicants. However, these tests are not written by the majority of students entering UCT. Since matriculation results, including English, are available for all UCT entrants other than those educated in foreign countries, the matriculation English score provides a readily available measure of linguistic ability. Although some doubt has previously been cast upon the reliability of the matriculation examination in assessing academic English proficiency, the result obtained in the matriculation English examination

forms part of the current UCT admissions criteria, and it has therefore been used to represent language proficiency for the purposes of this study.

In the most general sense, performance in IS can be measured in terms of the time taken to complete all ten undergraduate IS courses. However, since students are required to complete both first-year IS courses before proceeding to any of the second-year courses, and to complete all four second-year courses before proceeding to any of the third year courses, any course which a student fails is likely to extend the overall period of the degree. It would therefore seem justified to examine student performance at the course level rather than simply in terms of the time taken to complete all of the IS courses.

The findings reported in the preceding literature review, current admission and progression practices at UCT, and the need to provide increased support for disadvantaged students entering tertiary education, were used as the basis for developing the following research hypotheses:

H1: There is a significant positive association between matriculation English scores and student performance in the individual IS major courses offered at UCT.

H2: There is a significant positive association between matriculation English scores and the average IS course results obtained in each academic year by students majoring in IS at UCT.

H3: There is a significant negative association between matriculation English scores and the time taken to complete an IS major at UCT.

H4: The association between matriculation English score and IS performance is significantly stronger for students whose home language is not English, than for students whose home language is English.

6.2 Value of the research

Linguistic proficiency is one of a number of factors that could affect student performance in IS and thus influence progression rates through the undergraduate degree curriculum. If this is indeed the case, then early intervention programmes based on English language admissions criteria could be of benefit to under-prepared students. This would be of value not only to ADP students, but also to the many second-language English speakers who are admitted into mainstream programmes.

Since IS as a discipline has links with a number of other academic subjects, these findings could also be of value within other degree programmes. According to the University of Queensland (1998), problems of English language proficiency are not isolated to any one cohort of students, and as such deserve University-wide attention. However, the potential impact on IS graduation rates would be particularly valuable in view of the local need for employment equity skills and the importance of IS within the global economy.

6.3 Limitations of the study

This study addresses only one of many factors that may affect student performance in IS and within tertiary education in general. It does not attempt to examine the relationship between language proficiency and factors such as previous educational environment, social and economic background. Other universities and other faculties within UCT are likely to apply different admission criteria, and as a result the findings of this study may not be

applicable outside of the Commerce Faculty at UCT. In addition, data relating only to a single cohort of students has been collected and analysed, and changes in course content or teaching methods could affect the generalisability of these findings.

Of greater concern is the question of how best English proficiency and student performance can be measured. Several studies have indicated that the matriculation examinations are not a good predictor of student performance, especially for those with lower range scores (Miller et al, 2001), and a number of tertiary institutions require applicants to write alternative admissions tests in order to assess language proficiency. Since no alternative data sources was available for the purposes of this study, matriculation English results were used as the basis for determining English language skills. The extent to which this variable in fact measures language proficiency will affect the validity of the research results. In addition, the assessment of student performance has been based on the academic results achieved in undergraduate IS courses, and may have been affected (although to a limited extent) by the assessment methods used, such as the proportion of multiple choice questions or group work incorporated in the final result.

6.4 Summary

Four hypotheses have been developed, which use matriculation English score as the basis for examining the relationship between English language proficiency and undergraduate performance in Information Systems. The finding of a positive association could provide motivation for additional language support for under-prepared students.

7. Research method

This section of the report describes the data collection process, including the selection of the sample, details of the variables included in the study, a description of the methods used to obtain and verify student data, and the manipulations applied in order to derive additional calculated variables for the purposes of statistical analysis.

7.1 Methodology

This research project is based primarily on a survey of undergraduate student data collected at the University of Cape Town over a four year period, and is thus quantitative in nature. Quantitative research is concerned with the collection and analysis of representative sets of structured data, obtained in such a way as to be representative of a defined population; the aggregation of individual responses is used to produce results that apply to the sample as a whole, and that can then be generalised to the underlying population (Blaxter et al, 1996).

According to Bulmer (1984), analytical surveys provide the most appropriate means of testing hypotheses about the relationships between variables in order to understand and explain a particular social phenomenon. However, the discovery of a relationship does not necessarily imply causality, unless some mechanism can be identified that links the variables in question (Blaxter et al, 1996). Associational or correlational research thus studies the relationship among two or more variables without any attempt to influence them, and is carried out for one of two basic purposes: either to help explain behaviour or to predict future outcomes (Fraenkel & Wallen, 2000). Variables that are found to be strongly related often serve as the focus of further research based on experimental design, in order to ascertain whether the relationships are causal (Fraenkel & Wallen, 2000). However, even

without evidence of causality, if a relationship of sufficient magnitude exists between variables, then it becomes possible through the use of multiple regression techniques to calculate a predicted value for the criterion variable under examination (Fraenkel & Wallen, 2000).

In this study, a single cohort of students has been used to investigate the relationship between English language proficiency and performance in Information Systems. The reliability and accuracy of the data have been assured through the use of institutional records rather than personal recollection, and since the entire cohort of students has been included, representativeness within the sample is not a cause of concern. There could however be significant effects of time or context when comparing the performance of these students with other cohorts, due to differences in admissions criteria, curricula, lecturers, teaching and assessment methods, which affects the generalisability of the present findings across other courses or with regard to other institutions.

External validity is an issue of greater concern, since in the areas of both linguistic ability and academic performance there is some uncertainty about the extent to which the methods used actually measure what the study sets out to explore. This issue has been addressed in further detail under the sections relating to the variables being analysed (7.3) and the limitations of the study (6.3).

7.2 Data sample

The sample used for this study consisted of all students intending to major in Information Systems at the University of Cape Town, who registered for the first time in 1999. This particular group was selected because they were the first group to follow the new

semesterised curriculum; academic results based on earlier years might not have been generalisable to students following the present IS degree programme. Since the ten undergraduate IS major courses can be completed in a minimum of three years, a number of students could have been expected to do so by the end of 2001, while those following an extended four-year programme would have completed there is studies by the end of 2002. The use of this cohort thus ensured that data across all years of the IS major programme would be available even for those students who took longer than the minimum period to complete their degrees.

Since all students in the Faculty of Commerce are required to complete the introductory IS course INF102, whether or not they intend to major in IS, the sample was based on those students who had entered UCT in 1999 and who registered for the commercial programming course, INF103, which follows INF102 and is the first component of the IS curriculum that is specific to IS majors. Class lists were obtained from the central student records system for three groups of students:

- those who registered for INF103 in the second semester of 1999 (intending IS majors who had completed INF102 during the first semester of 1999)
- those who attended the INF103 "summer term" intensive course during the December vacation of 1999 (mainly students who had only completed INF102 during the second semester of 1999, but who wished to proceed to the second year IS courses in 2000)
- those who registered for INF103 in the first semester of 2000 (students who had completed INF102 in 1999, either during the second semester or over the whole academic year).

The second two categories allow for the inclusion of students who transferred to an IS major from another academic programme during the course of their first year, those who repeated one of their first-year IS semester courses, and those who were admitted under the Academic Development Programme.

Out of a total of 335 students included in the class lists, 72 were not intending to major in IS, but had taken INF103 as an elective course while intending to major in another subject; a further 22 student records were duplicated in more than one list as a result of repeating the INF103 course. Records for non-IS majors and for repeating students were excluded from the data set, and academic records for the remaining 241 students, for the period from 1999 to the end of 2002, were downloaded from the central university database by the researcher. Results for each of the ten courses contributing towards the IS major were entered into an Access database on the researcher's home computer. The total number of courses for which the student had registered during each academic year was also captured, to allow for the subsequent weighting of student results based on course load. Where the same course was repeated in more than one semester, it was considered to be a full course the first time that it was attempted, and thereafter was allocated half the weight of a standard semester course.

Matriculation results and demographic data for the same students were obtained from the central university administration, and linked to the corresponding student academic records by means of the unique student number. The correctness of the final data set was checked by comparing a random sample of combined electronic records against the source data for those students, and no errors were found. Thereafter the student numbers were replaced by an alternative unique numeric identifier to ensure confidentiality and to remove any possibility of personal bias on the part of the researcher. The data set thus obtained was

subsequently analysed using the Statistica ™ package to provide descriptive statistics of the sample under investigation, and to test the hypotheses under investigation by means of various correlational analyses, as well as performing Analyses of Covariance using the General Linear Model in order to assess the degree of interaction between the variables included in the study.

7.3 Variables included in the study

In order to assess student performance in Information Systems, the following academic data was collected for each student:

- the final mark obtained for the first attempt at each of the undergraduate IS courses;
- the total number of semester courses for which the student had registered during each academic year.

This allowed for the calculation of weighted course results based on an expected course load of eight semester courses per academic year. Huysamen (1999) has suggested that since disadvantaged students are likely to register for fewer courses per year, it is preferable to use a weighted result when comparing academic performance.

The researcher also calculated for each student

- the average result obtained for all of the IS courses required at each academic year level within the IS curriculum

  i.e. year 1: INF102 and INF103

  year 2: INF205 or INF206, INF212, INF213, INF214

  year 3: INF311, INF312 or INF316, INF313, INF314

(The average result for each academic year provides a more reliable indicator of overall student performance, since the effect of a single poor examination result is reduced. Clashes in the examination timetable, ill-health or personal problems could contribute towards a unrepresentative examination result for an individual course.)

- the total number of years taken to complete all 10 IS undergraduate semester courses. Students following a standard IS major curriculum are expected to complete the 10 undergraduate IS courses within a period of 3 years, although many students take four years to do so. A contributing factor to this phenomenon is that students must pass both of the first-year IS courses before progressing to IS2, and must pass all four of the second-year courses before progressing to IS3. Thus failure in any one IS course is likely to add a year to the degree period. In addition to negatively affecting student throughput rates at UCT, the need for an additional undergraduate year has severe financial implications for many students.

Additional data relating to student admissions criteria that was obtained from the central UCT database included:

- type of matriculation English examination that was written
- matriculation English result (symbol)
- total unweighted matriculation score
- whether the student had been accepted in terms of the Academic Development Programme

The type of English examination written and the symbol obtained allow the calculation of the *English score* which is used by the faculty to determine whether minimum language requirements have been met, and provides a measure of linguistic proficiency that is

consistent across the sample. Prior studies have questioned the validity of using the matriculation English score as a measure of English proficiency. Unfortunately, since Alternative Admissions Tests are written only by students entering the Academic Development Programme, no alternative measure of English proficiency was available for the majority of students included in the study.

Since total matriculation score forms the current basis for admission to the University of Cape Town, any correlation between academic performance and English results would need to be considered relative to the equivalent correlation between academic performance and the matriculation score excluding English. In order to do so, the *Net matriculation score* was calculated by subtracting the English score from the total unweighted matriculation score. (An explanation of the basis used to calculate matriculation scores is provided in section 5.3.)

A number of demographic variables (*Race*, *Sex*, and *Home language*) were included in the data that was collected, in order to investigate their possible influence on the association between English proficiency and academic performance. Based on the literature review, it appeared possible that both *Race* and *Home language* could be associated with English proficiency. There was no reason to expect a significant relationship between *Sex* and either English proficiency or IS performance. However, students accepted in terms of the ADP programme could be expected to have lower matriculation and English scores and take longer to complete the IS courses.

7.4 Summary

A survey was conducted based on a cohort of students majoring in Information Systems, who registered at UCT for the first time in 1999. The data that was collected included demographic variables, matriculation scores and IS course results recorded over a four-year period. In keeping with similar published research, a number of additional weighted variables were derived. The following chapter presents the analysis of the validated data set.

8. Statistical analysis

This chapter of the thesis describes how a variety of statistical techniques were used to describe the distribution of the data, to understand the profile of the sample as a whole and when comparing various subgroups, and to test the hypotheses defined in Chapter 6. The statistical methods that were employed, include:

- Frequency counts for each value of the categorical variables;
- Descriptive statistics (mean, standard deviation, etc) for each of the continuous variables;
- Plotting of histograms to assess the distribution of the data;
- Comparison of raw course results with results weighted by the total number of courses taken per year;
- Chi-squared tests to compare the performance of different race groups and of different home language speakers;
- Correlations to measure the association between matriculation English scores and IS results;
- T-tests to compare the English scores and IS performance of different race and language groups;
- Analyses of variance and of covariance to assess the relative contribution made by each of a number of independent variables to student performance in IS.

8.1 Preliminary analysis

Frequency counts were produced for each of the categorical variables (see Appendix A), and used as the basis for redefining some variables in order to eliminate low response counts. Final categories used for these variables were as follows:

Sex:	male / female
Race:	black / coloured / Indian / white
Home language:	English / other
ADP student:	Yes / No

The collapsing of *Home language* into two alternatives, "English" or "other", was necessitated by the fact that altogether 16 different home languages were spoken by the students included in the study, with all of these languages except English having a frequency of less than 5% of the total sample. An additional variable, *Race group,* with values of "white" and "other", was derived from *Race* to cater for multidimensional analyses which otherwise would have resulted in inadequate cell frequencies. The matriculation *English score* was calculated based on the type of examination written and symbol obtained, and the *Net matriculation score* (excluding English) was also derived. In keeping with the findings of Huysamen (1999), weighted results were calculated for each of the IS courses, based on the number of courses for which a student had registered per year.

Descriptive statistics (number of valid responses, mean, minimum, maximum, standard deviation, standard error, skewness and kurtosis) were calculated for each of the numerical variables: total unweighted *matriculation score*, *English score*, *Net matriculation score* (excluding English), unweighted and weighted *course results*. A summary of these values is included as Appendix B. Since *English score* had a very limited range (minimum 4,

maximum 8), it was treated as an ordinal variable for subsequent analyses and the three students who had a score of 4 were grouped together with those having a score of 5.

Histograms were plotted for each the continuous variables and compared to the expected distribution under the normal curve. In the case of the unweighted results for two courses, INF102 and INF205, the Kolmogorov-Smirnov d-statistic reflected a significant deviation from the normal curve ($p < 0.10$). This appeared to be due to an increased number of students falling into the 45%-49% range, within which supplementary examinations are awarded, and in both cases the weighted course result did not show any significant deviation from the normal curve. It is also noticeable that the weighting of IS results by the number of courses taken, resulted in an increase in both standard deviation and standard error of the mean for every course.

Statistical analysis and testing of hypotheses was based on three separate subsets of the data:

- Dataset A: demographic data plus weighted and unweighted **results for the individual IS courses**; consisting of all 241 valid records included in the data sample.
- Dataset B: demographic data plus **average** weighted and unweighted results for the first-year, second-year and third-year IS courses; consisting of records for those students who had completed the total number of IS courses required for **each academic year**.
- Dataset C: demographic data plus a variable indicating the **number of years** taken for the student to complete **all 10** undergraduate IS courses; consisting of records for only those students who had completed the IS major within the four years of the study.

8.2 Analysis of Dataset A: Results for individual courses

Demographic data

The complete data sample of 241 students reflected the following characteristics:

Sex: Female 33%; male 67%

Race: Black 16%; Coloured 8%; Indian 11%; White 65%

Home language: English 80%; Other 20%

ADP student: No 96%; Yes 4%

(Because of the small number of ADP students present in the sample, this variable was not included in subsequent analyses.)

Since the matriculation English score reflected a very limited range of values, chi-square statistics were used to determine the degree of independence between *English score* and the other categorical or ordinal variables included in the study. A highly significant relationship was found between *English score* and *Home language* ($p<.001$); mean English scores for the two language groups are shown in Table 2.

Home language	***Mean English score***	***N***
English	6.45	193
Other	5.96	48
All groups	6.35	241

Table 2. Mean English score for Home language: English / other

No significant relationship was found between *English score* and any one of *Sex, Race* or *Race group* (white / other). The association between *Home language* and *Race* could not be measured statistically because of the large proportion of empty cells, but the relationship between *Home Language* and *Race group* was highly significant ($p=0.000$); frequency counts are shown in Table 3.

	Home language			
Race group	***English***		***Other***	
White	142	*74%*	14	*29%*
Other	51	*26%*	34	*71%*
Total	193		48	

Table 3. Home language vs. Race group

Chi-square statistics were used to ascertain the degree of dependence between *English score* and the proportion of students who passed or failed each course (see Appendix C). Significant associations occurred only in the case of INF102 (the first-year foundation course) and INF205 (discontinued after 2000). This outcome could have resulted from the fact that all the other IS courses had a failure rate of less than 10% of the class, resulting in low cell frequencies, whereas for INF102 and INF205 the failure rate was approximately 20%.

Further chi-squared statistics were calculated to determine the association between *Home language* (English / other) and whether students passed or failed each of the IS courses (Appendix D). Significant associations ($p < 0.05$) occurred for all courses except INF102, INF206, INF312, INF313 and INF316; inspection of the data shows that the pass rate for English speaking students was consistently higher than for non-English speakers.

Product-moment correlations (Pearson's r-statistic) were calculated between each of the unweighted and weighted IS course results and *English score*, as well as between the unweighted and weighted IS course results and *Net matriculation score* (see Appendix E). Significant positive correlations ($p<0.05$) were found between weighted IS results and *English score* for all of the IS courses except INF206, INF312 and INF313. It is relevant to note that INF206 and INF312 were only taken by students who had previously failed at

least one IS course, or else were following the four-year ADP programme, while the result for INF313 was based largely on group work. However, in every case but one (INF312), the correlation obtained between weighted IS results and *Net matriculation score* was considerably higher than that obtained between weighted IS results and *English score* (see Table 4). It could also be observed that the strength of the correlations of both *Net matriculation score* and *English score* with weighted IS results generally decreased as students progressed to more senior IS courses.

Course	***Net Matric Score***	***English score***
INF102 wtd	0.61	0.39
INF103 wtd	0.61	0.24
INF205 wtd	0.52	0.32
INF206 wtd	0.24	0.06 ($p > 0.05$)
INF212 wtd	0.57	0.26
INF213 wtd	0.61	0.27
INF214 wtd	0.57	0.35
INF311 wtd	0.45	0.21
INF312 wtd	0.10 ($p > 0.05$)	0.10 ($p > 0.05$)
INF313 wtd	0.23	0.14 ($p > 0.05$)
INF314 wtd	0.35	0.23
INF316 wtd	0.37	0.23

Table 4. Correlation of weighted IS course results with matric and English score
(Note: $p < .05$ except where indicated)

The weaker correlation between weighted IS course results and matriculation English points could perhaps have been influenced by the restricted range of values assumed by the *English score* variable. Huysamen (1999) emphasises that any restriction on the range of scores of a predictor and/or criterion variable will have the effect of decreasing the correlation between the predictor and criterion. Nevertheless, these results do appear to support the weighting of results by course load advised by Huysamen and Raubenheimer (1999), since in every case except INF312, the corresponding correlation of unweighted course results with *Net matriculation score* and *English score* yielded a lower value.

The overall correlation between *Net matriculation score* and *English score* was 0.446 ($p < 0.05$). However, when the data set was divided into two subgroups on the basis of *Home language* (English / non-English), it was interesting to note that the correlation coefficient between *Net matriculation score* and *English score* was 0.524 for English home language students, and –0.036 for non-English language students.

There was also a highly significant difference, equivalent to approximately 2 ½ matriculation symbols, between the *Net matriculation score* of English first and second language students ($F=17.957$, $df=1,239$, $p=0.0000$), illustrated in Table 5.

Home language	***Mean Net matric score***	***N***
English	31.3	193
Other	28.6	48
All groups	30.8	241

Table 5. Mean Net matriculation score for Home language: English / other

Analysis of variance (ANOVA) calculations were performed to compare the course results of students entering the university with differing English scores, and in most cases, significant differences were found (see Table 6).

Course	***F statistic***	***P value***
INF102 wtd	$F(3, 229) = 14.749$	0.00000
INF103 wtd	$F(3, 198) = 5.4098$	0.00135
INF205 wtd	$F(3, 152) = 7.2163$	0.00015
INF206 wtd	$F(3, 69) = 0.22335$	0.87986
INF212 wtd	$F(3, 219) = 6.0847$	0.00054
INF213 wtd	$F(3, 222) = 6.3304$	0.00039
INF214 wtd	$F(3, 221) = 11.319$	0.00000
INF311 wtd	$F(3, 201) = 3.8228$	0.01079
INF312 wtd	$F(3, 65) = 0.63398$	0.59578
INF313 wtd	$F(3, 200) = 3.8785$	0.01003
INF314 wtd	$F(3, 201) = 4.0405$	0.00810
INF316 wtd	$F(3, 134) = 2.9939$	0.03317

Table 6. ANOVA for weighted IS course results and English score

No significant difference based on English score was found in the results for INF206 and INF312, both of which were attended only by students following a four-year program, which is in line with the results obtained in the previous set of correlations. Inspection of the mean course results showed that for almost all courses, there was a clear trend towards higher course results for those students having higher English scores (see Table 7).

	English score			
Course	***4/5***	***6***	***7***	***8***
INF102 wtd	56.4	60.6	70.2	79.1
INF103 wtd	58.0	64.0	63.3	73.8
INF205 wtd	58.4	65.1	66.0	77.2
INF206 wtd	52.7	53.8	54.7	57.7
INF212 wtd	70.9	74.8	78.1	88.0
INF213 wtd	62.3	66.3	69.5	76.6
INF214 wtd	61.1	65.1	71.0	81.4
INF311 wtd	59.2	59.6	64.4	71.4
INF312 wtd	55.5	54.5	59.1	60.2
INF313 wtd	71.1	65.8	76.0	75.3
INF314 wtd	61.5	62.5	67.5	71.6
INF316 wtd	67.7	70.0	72.0	78.8

Table 7. Mean course result per English score

One-way ANOVAs were performed to examine the effect of *Sex, Race* and *Home language* on weighted course results as the dependent variable. *Sex* was significant only in the case of INF313, where females had a mean result of 54.2, compared with 57.0 for males. The effect of *Race* was significant for every course except INF312; the pattern in all cases was for white or coloured students to have higher marks than Indian or black students. The *Race group* variable, which categorised race as White or Other, showed White students to have a higher mean result for every course, the difference being significant in all cases except INF312. A similar result was observed for *Home language*, where English speakers had a higher mean result for every course, the difference again being significant in all cases except INF312.

The General Linear Model was then used to compute the Analysis of Covariance (ANCOVA), using each weighted course result in turn as the dependent variable, with *Home language* and *Race group* as categorical predictor variables and *English score* as a continuous predictor variable (Table 8).

Course	***R^2***	***Eng Score***	***Race group***	***Home Lang***	***RaceGp x HomeLang***
INF102 wtd	0.249	p<0.01	p<0.01	n/s	p<0.05
INF103 wtd	0.191	p<0.01	p<0.01	n/s	p<0.01
INF205 wtd	0.196	p<0.01	p<0.01	n/s	p<0.01
INF206 wtd	0.066	n/s	n/s	n/s	n/s
INF212 wtd	0.154	p<0.01	p<0.01	n/s	p<0.01
INF213 wtd	0.171	p<0.01	p<0.01	n/s	p<0.01
INF214 wtd	0.226	p<0.01	p<0.01	n/s	p<0.01
INF311 wtd	0.151	p<0.05	p<0.01	p<0.01	n/s
INF312 wtd	0.076	n/s	n/s	n/s	n/s
INF313 wtd	0.145	n/s	p<0.01	p<0.05	n/s
INF314 wtd	0.214	p<0.05	p<0.01	p<0.01	n/s
INF316 wtd	0.146	p<0.05	p<0.01	n/s	n/s

Table 8. Overall fit of parameters in the General Linear Model (between effects test)
(n/s = not significant)

The results indicated that in almost all cases both English score and Race group were significantly associated with course level performance, while a fairly significant degree of interaction existed between *Race group* and *Home language*, particularly at the level of first- and second-year courses.

However, the impact of *English score* on course performance needs to be considered relative to the impact of other matriculation subjects. Table 9 shows the effect on the ANCOVA model when *Net matriculation score* is introduced as a second continuous predictor. Not only does *Net matriculation score* play a considerably more important role than *English score* in the model, but the value of R^2 increases substantially for those courses where results are associated with *Net matriculation score.*

Course	R^2	*Net Matr. score*	*Eng score*	*Race group*	*Home lang*	*RaceGp x HomeLang*
INF102	0.417	p<0.01	p<0.01	n/s	n/s	n/s
INF103	0.397	p<0.01	n/s	p<0.05	n/s	n/s
INF205	0.299	p<0.01	n/s	p<0.05	n/s	p<0.05
INF206	0.100	n/s	n/s	n/s	n/s	n/s
INF212	0.348	p<0.01	n/s	n/s	n/s	n/s
INF213	0.391	p<0.01	n/s	p<0.05	n/s	p<0.05
INF214	0.368	p<0.01	p<0.05	p<0.01	n/s	n/s
INF311	0.253	p<0.01	n/s	n/s	p<0.01	n/s
INF312	0.076	n/s	n/s	n/s	n/s	n/s
INF313	0.155	n/s	n/s	p<0.01	p<0.05	n/s
INF314	0.242	p<0.01	n/s	p<0.01	p<0.01	n/s
INF316	0.161	p<0.01	n/s	p<0.05	n/s	n/s

Table 9. Overall fit of parameters in the General Linear Model (incl *net matric score*)
(n/s = not significant)

8.3 Analysis of Dataset B: Average results per academic year

Demographic data

The following tables illustrate the distribution of demographic characteristics across the three academic years of the IS major. (Section 7.3 provides details as to which courses are studied in each year.)

Sex	*Year 1*		*Year 2*		*Year 3*	
Female	76	*34%*	70	32%	64	32%
Male	149	66%	150	68%	139	68%
Total	225		220		203	

Table 10. Sex by Year of Study

Race group	*Year 1*		*Year 2*		*Year 3*	
White	146	*65%*	147	*67%*	140	*69%*
Other	79	*35%*	73	*33%*	63	*31%*
Total	225		220		203	

Table 11. Race Group by Year of Study

Home language	***Year 1***		***Year 2***		***Year 3***	
English	181	*80%*	177	*80%*	169	*83%*
Other	44	*20%*	43	*20%*	34	*17%*
Total	225		220		203	

Table 12. Home Language by Year of Study

Note: the apparent increase in the number of white males between Year 1 and Year 2 can be attributed to the fact that students who have successfully completed the first year of a Computer Science degree are allowed to enter the IS major programme at second-year level.

The correlations of individual course results within each year of study were all highly significant ($p<0.001$), apart from the combinations of INF205 / INF206 and INF312 / INF316, which had no data because students took only one out of each pair of courses (either INF205 followed by INF316, or else INF206 followed by INF312). However, the analysis of average student performance across all the IS courses within a single academic year was intended to provide a single value representative of overall student performance. Correlations between all three year averages were also highly significant ($p<0.001$), although the correlation between IS1 and IS2 was stronger than that between IS2 and IS3.

Table 13 below reflects the correlation of both *English score* and *Net matriculation score* with the average weighted result obtained in each year of study, all of which were highly significant ($p<0.01$). Since the year average is derived from the individual courses which were analysed in the previous section, it is not surprising that *Net matriculation score* has a higher correlation than *English score* in all years, and that both correlations decrease at third year level.

Year of study	*Net Matric Score*	*English score*
IS1 average	0.646	0.315
IS2 average	0.616	0.327
IS3 average	0.382	0.215

Table 13. Correlation of English and matric scores with year average

T-tests were used to determine the effect of *Sex*, *Race group* and *Home language* on the average result for each year. No significant effect was found in the case of *Sex*, but *Race Group* and *Home Language* both demonstrated highly significant effects across all three years ($p < 0.0001$); dependence between *Race group* and *Home language* was in turn highly significant for all three years ($p<0.0001$). Tables 14 and 15 demonstrate that significantly higher average scores were achieved in each year by white and by English-speaking students.

Year of study	*White*	*Other*
IS1 average	67.2 %	58.0 %
IS2 average	71.8 %	63.0 %
IS3 average	69.7 %	58.4 %

Table 14. Mean year average by Race Group

Year	*English*	*Other*
IS1 average	66.2 %	54.8 %
IS2 average	70.6 %	61.6 %
IS3 average	68.4 %	55.4 %

Table 15. Mean year average by Home Language

Analysis of variance (ANOVA) calculations were performed to compare the average year results of students entering the university with differing English scores, and as in the previous section of this report, highly significant differences were found (see Table 16). Again, inspection of the mean year results showed an apparent trend towards higher course

results for those students having higher English scores, which corresponds to the pattern that was evident in the analysis of individual courses.

			English score			
Year of study	***F statistic***	***P value***	***4/5***	***6***	***7***	***8***
IS1 average	F(3, 221) = 9.0855	0.00001	60.8	62.4	64.9	68.8
IS2 average	F(3, 216) = 9.9582	0.00000	60.9	63.6	65.7	68.6
IS3 average	F(3, 199) = 4.1840	0.00672	63.9	63.2	69.2	73.2

Table 16. ANOVA for average year results and English score

An Analysis of Covariance was computed using the General Linear Model, with each average year result being considered in turn as the dependent variable, *Home language* and *Race group* as categorical predictor variables, and *English score* as a continuous predictor variable (Table 17). The results again showed *English score* and *Race group* to be significantly associated with average performance within each academic year, and also indicated the presence of a significant degree of interaction between *Race group* and *Home language* at the level of first- and second-year courses.

Year of study	***R^2***	***Eng Score***	***Race group***	***Home Lang***	***RaceGp x HomeLang***
IS1 average	0.224	p<0.01	p<0.01	n/s	p<0.01
IS2 average	0.222	p<0.01	p<0.01	n/s	p<0.01
IS3 average	0.195	p<0.05	p<0.01	p<0.01	n/s

Table 17. Overall fit of parameters in the General Linear Model (between effects test)
(n/s = not significant)

Table 18 again shows that the introduction of *Net matriculation score* as a second continuous predictor overshadows the association with *English score* at all levels while substantially increasing the value of R^2. The role played by other factors in explaining the variance generally decreased in significance with the inclusion of *Net matriculation score.*

Year of study	R^2	*Net Matr. Score*	*Eng Score*	*Race group*	*Home Lang*	*RaceGp x HomeLang*
IS1 average	0.443	p<0.01	n/s	n/s	n/s	n/s
IS2 average	0.407	p<0.01	n/s	p<0.05	n/s	n/s
IS3 average	0.246	p<0.01	n/s	p<0.01	p<0.01	n/s

Table 18. Overall fit of parameters in the General Linear Model (incl. net matric score)

(n/s = not significant)

8.4 Analysis of Dataset C: Years taken to complete IS3

Of the total sample size of 241, 193 students completed all 10 undergraduate IS courses within the four years of the study. Their demographic characteristics were as follows:

Sex: Female 32%; male 68%

Race: Black 11%; Coloured 8%; Indian 11%; White 70%

Home language: English 84%; Other 16%

ADP student: No 98%; Yes 2%

When comparing students who completed IS3 with those who failed to do so, a chi-squared test showed significant differences between the two groups in respect of all the above variables except for sex. Fewer black students and more white students completed the IS courses; more English speakers completed the courses; and fewer ADP students completed the courses (although low numbers of ADP students make this result statistically unreliable).

The results of a t-test showed that students who completed the IS major curriculum differed significantly from those who did not in terms of their *English score* (6.4 vs. 6.1, p=0.033) and their *Net matriculation score* (31.4 vs. 28.4, p=0.000). In view of the limited range of the *English score* variable, a chi-square test was also used to measure its association with completion of IS3, and gave a similar result (p=0.038).

The focus of this area of the analysis was to identify differences between those students who completed their undergraduate IS courses within the minimum period of three years compared to those students who tool four years to do so, with particular interest in the role played by matriculation English scores. The following tables compare the demographic characteristics of the two groups.

Sex	***3 Years***		***4 Years***	
Female	43	*34%*	19	*29%*
Male	85	*66%*	46	*71%*
Total	128		65	

Table 19. Sex by Years Taken to Complete IS3

Race group	***3 Years***		***4 Years***	
White	100	*78%*	35	*54%*
Other	28	*22%*	30	*46%*
Total	128		65	

Table 20. Race Group by Years Taken to Complete IS3

Home language	***3 Years***		***4 Years***	
English	115	*90%*	47	*72%*
Other	13	*10%*	18	*28%*
Total	128		65	

Table 21. Home Language by Years Taken to Complete IS3

Chi-squared tests showed significant differences between the two groups in the case of both *Race group* and *Home language* ($p<0.01$), but not in the case of *Sex* ($p=0.54$). The association between *Race group* and *Home language* was highly significant for the complete group of students who completed IS3; however, this association was considerably weaker within the group who took four years to do so ($p=0.04$), than for those who took three years ($p<0.001$).

A one-way ANOVA showed that although the relationship between English score and the average period taken to complete IS3 was statistically significant (F=3.402, p=0.018), in practical terms the difference between the minimum and maximum group means was slightly less than three months (Table 22).

			English score			
	F statistic	***P value***	***4/5***	***6***	***7***	***8***
Yrs to IS3	F(3, 189) = 3.402	0.018	3.5	3.4	3.3	3.2
N			27	84	57	25

Table 22. ANOVA for Years taken to complete IS3 and English score

T-tests demonstrated significant differences in the value of English score and net matriculation score for the two groups (Table 23).

Variable	***Mean (3 Yrs)***	***Mean (4 Yrs)***	***t-value***	***p***
English score	6.55	6.12	-3.13	0.002
Net matric score	32.4	29.4	-5.43	0.000

Table 23. Matric scores by Years Taken to Complete IS3

Although for this subset of the data sample as a whole, the correlation between *English score* and *Net matriculation score* was 0.466 ($p<0.001$), it was slightly higher for those who completed the IS courses within 3 years ($r=0.484$), and considerably less significant for those who took four years ($r=0.261$, $p<0.05$).

An ANCOVA computing the effect of *English score*, *Race group* and *Home language* on the years taken to complete IS3, found that both *English score* and *Race group* had a significant impact ($p<0.05$), although the low value of R^2 (0.120) makes this of little practical value. When *Net matriculation score* was added to the model, it became the only variable to make a significant contribution, while increasing the value of R^2 to 0.185.

8.5 Summary

Univariate statistics were used to inspect cell frequencies for categorical variables and data distributions for continuous variables, and to transform data values where appropriate. Multivariate techniques were then applied to examine the relationship between demographic variables, matriculation scores, and each of the following:

- final results for individual IS courses;
- the average result obtained for each year;
- the number of years taken to complete the IS major.

The results of these analyses will be discussed in the following chapter.

9. Discussion of results

In this chapter, the implications of the statistical analyses described in the previous section are discussed in terms of each of the research hypotheses, and areas for future research are identified.

9.1 Hypothesis 1:

There is a significant positive association between matriculation English scores and student performance in the individual IS major courses offered at UCT.

In comparing unweighted course results with results weighted by the total number of courses taken by a student each year, the distribution of weighted results approximated the normal curve more closely and showed higher correlations with both *English score* and *Net matriculation score*. As a result, weighted results were used for most of the statistical analyses, in line with the recommendation of Huysamen and Raubenheimer (1999), and form the basis for the following discussion.

The relationship between *English score* and weighted results for each of the undergraduate IS courses was investigated using Pearson's correlation coefficient; in view of the limited range of values for *English score*, one-way analyses of variance were also performed using *English score* as an ordinal variable. The results for all courses except for INF206 and INF312 showed a significant positive correlation with *English score*, which was confirmed by the ANOVA results. (Note that INF206 and INF312 were attended only by weak students who had already taken longer than the minimum period to pass the previous IS courses, as explained in section 5.1.) The strongest correlation between *English score* and weighted course result occurred for INF102 (Foundations of Information Systems), which

is the first-year introductory semester course covering both theoretical concepts and practical computer skills. Because INF102 is directed towards breadth rather than depth of conceptual content, students may need to place less reliance on cognitive academic skills than in more advanced courses (Rosenthal, 1996; Kilfoil, 1999), resulting in a closer relationship between INF102 performance and school results.

Since failure of any one course will prevent the progression of a student to the next academic year, course results in terms of pass / fail will significantly affect student throughput rates and the time taken to complete the IS major. For this reason, chi-squared tests were used to measure the independence of *English score* against the pass/fail outcome for each course. The only significant association between *English score* and a pass/fail course outcome occurred in the case of INF102. The weaker correlation between *English score* and weighted results that was found in subsequent courses may be partly due to the fact that some of the 34 students who failed the introductory INF102 course and were excluded from the analysis of subsequent courses, could have had English skills below a critical threshold for success in tertiary education (Seelen, 2002); the mean value of *English score* for those who failed INF102 was 5.9, which is below a C symbol, compared with 6.4 for those who passed ($p = 0.005$).

Wilson's (1980) "late bloomer" hypothesis may also be relevant in explaining the weaker association of English score with IS results at more senior levels. This suggests that through continued exposure to academic English, weak students are likely to improve their linguistic skills and reduce the disadvantage of their lower proficiency on admission.

When Analysis of Covariance was used to explain the influence of *English score* as well as the categorical factors *Sex* and *Race group* on course results, *English score* again made a significant contribution to all courses except INF206 and INF312, which had been attended by weaker students, and the system development project INF313 which is based primarily on group work. In all cases where English score was involved, *Race group* also made a significant contribution to course results: in general, white or coloured students fared better than black or Indian. At the level of first- and second-year courses, significant interaction was apparent between *Race group* and *Home language.*

However, across all of the IS courses, stronger correlations were found between weighted course results and *Net matriculation score* (excluding English) than between weighted course results and *English score* alone. This supports the findings reported by Bokhorst et al (1990), Huysamen and Raubenheimer (1999) and Seelen (2002). The correlation between *Net matriculation score* and *English score* was also highly significant, which is to be expected since students who obtain above-average results for the range of matric subjects can generally be expected to also perform well in English; while students whose overall matric results are poor are also likely to have lower English scores. In addition, the majority of students would have written all of their matriculation examinations through the medium of English, and thus the results obtained for examinations in other subjects would indicate their ability to use English language within an academic context (Seelen, 2002). However, the inclusion of *Net matriculation score* in the Analysis of Covariance calculation reduced the contribution of *English score* to non-significance for all courses except INF102 and INF214, while substantially increasing the value of R^2.

Thus although statistical tests appeared to support **Hypothesis 1**, the overall outcome of these analyses indicates that in practice, *Net matriculation score* makes a more useful contribution than *English score* to student selection and the prediction of student performance.

9.2 Hypothesis 2:

There is a significant positive association between matriculation English scores and the average IS course results obtained in each academic year by students majoring in IS at UCT.

Because the individual IS courses that must be completed within any one academic year are likely to differ in their focus on conceptual or technical material, analyses based on the average result for each year will smooth variation across individual courses and provide a more reliable indicator of overall student performance. At the same time, since the average result for the year is based on the individual courses that have been completed, these analyses are likely to confirm rather than deviate from the findings related to the previous hypothesis (particularly since the within-year course results showed a strong positive correlation).

One-way analyses of variance indicated that a higher *English score* was positively associated with higher average results in all academic years. The increase in average course result for students with an English score of 8 when compared with those having an English score of 4-5, was approximately 8% in the first and second years, reaching almost 10% in the third year. While first- and second-year results showed a clear trend towards an increase in course average for each additional point in the English score, the pattern was slightly different at third-year level. Here there appeared to be no significant difference in average

course performance within the range of 4 to 6 English points, while students who achieved an English score of 7 or 8 fared significantly better than their class mates.

Analysis of Covariance calculations revealed that average course results were significantly associated with *English score* and *Race group* across all years, with white English speakers generally performing better. The average result of white students was approximately 9% higher than for other students; average results for English speakers were between 9% and 12% higher than for non-English speakers, with the lower difference occurring in the more technical second year. The strength of the association of *English score* with average course results decreased somewhat at the third year level, as did the interaction between *Race group* and *Home language*.

However, despite the positive association of *English score* with average IS course results, similar calculations involving *Net matriculation score* demonstrated that the contribution of *Net matriculation score* as a predictor of academic performance remained statistically more significant at all levels. As was the case with the previous hypothesis, this suggests that the statistical support observed in favour of **Hypothesis 2** is of limited practical value.

9.3 Hypothesis 3:

There is a significant negative association between matriculation English scores and the time taken to complete an IS major at UCT.

Since the failure of any IS course will usually add a year to the time taken to complete the IS major, factors influencing performance in individual courses can be expected to have a similar effect on the *Years to IS3* variable. (However, failure of an IS course does not always result in an additional year, because students who obtain a mark of at least 45% are

given the opportunity to write a supplementary examination which may still enable them to pass the course.)

Within the period of this study, students could have completed an IS major within the minimum period of three years, or within an extended period of four years. In fact, 20% of the initial cohort of 241 students had not completed the IS major by the end of 2002, and were excluded from the following analyses.

A chi-squared test revealed a significant association between the value of *English score* and the number of years taken to complete IS3 (p=0.009), while a t-test comparing the *English score* of those who completed IS3 within 3 years as opposed to 4 years resulted in a value of p=0.002. The mean *English score* for those completing IS3 within 3 years was 6.55, compared with a mean *English score* of 6.12 for those taking 4 years (implying a difference of half a matriculation symbol).

In assessing the impact of other demographic variables on the time taken to complete IS3, *Race group* and *Home language* both played significant roles. The interaction between these two variables was also highly significant for those who completed IS3 within 3 years (mainly white English speakers), while the weaker association between *Race group* and *Home language* within the 4 year group suggested greater demographic diversity.

Once again, the contribution of *English score* in determining the time taken to complete IS3 was overshadowed by the stronger association with *Net matriculation score.* In practical terms, students completing IS3 within 3 years scored on average only half a matric symbol higher than the 4 year group in the English examination (6.6 points vs. 6.1). In contrast, the

mean *Net matriculation score* for students completing IS3 within 3 years was 32.4, and mean *Net matriculation score* for the 4 year group was 29.4, implying a difference of three symbols across the five matriculation subjects excluding English. In the light of this result, support for **Hypothesis 3** must be regarded as limited.

It could also prove useful to examine the characteristics of those students who did not complete an IS major during the four years of this study, since student throughput rates are an issue of concern for students, parents, the university administration and the Department of Education. Students who failed to complete IS3 differed significantly from those who succeeded in terms of both *Race group* and *Home language*, with black students and non-English speakers less likely to complete the full IS curriculum within four years. They also differed slightly on the basis of *English score* (completers scoring on average about 3½ % more than non-completers), but much more significantly on the basis of *Net matriculation score*, with a difference of three symbols across the five subjects excluding English. Once again this suggests that for weak students in particular, matriculation English results are not a reliable predictor of academic performance (Huysamen, 2000; Miller et al, 2001).

When comparing the demographic characteristics of IS majors with Faculty admission figures, it is apparent that in 1999 the IS major programme attracted a high proportion of white students: 65% of the IS1 intake was white, compared with 54% of first-years across the Faculty as a whole. The retention rate of black students within this cohort seemed more promising than had previously been reported, with the proportion of non-white students decreasing only slightly from 35% in first year to 31% by third year. One must however bear in mind that the cohort under investigation entered UCT in 1999, a period of substantial growth in the IT industry. More recent admission figures reflect a lower

proportion of white students entering the IS major programme (43% in 2002, see section 5.3), and it is possible that the admission of increasing numbers of under-prepared black students could negatively affect retention rates.

9.4 Hypothesis 4:

The association between matriculation English score and IS performance is significantly stronger for students whose home language is not English, than for students whose home language is English.

This hypothesis was investigated by comparing the performance of students whose home language was English with those who were non-English speakers, in terms of the time taken to complete IS3 and performance in each of the individual IS undergraduate courses.

ADP students were excluded from this section of the analysis, since 80% of the ADP students in the study are not English first-language speakers. As they have not met the standard entrance requirements for admission to mainstream courses in terms of matriculation results, they could be expected to bias the outcome of the analysis through weaker academic achievement.

Further justification for the exclusion of ADP students is apparent when using the chi-squared statistic to evaluate the independence of *Home language* and *Years to IS3*. For the complete data set, the resulting probability of 0.001 indicated a highly significant relationship between the two variables. However, when ADP students were excluded from the calculation, the strength of the association decreased ($p = 0.01$); this change is hardly surprising since ADP students are accepted into UCT on the basis of a four-year degree program rather than the three years intended for mainstream students. Nevertheless, a

significant relationship between *Home language* and *Years to IS3* is still indicated for non-ADP students, with 60% of English home language students completing their IS courses within 3 years, compared with only 33% of non-English speakers.

At the individual course level, chi-square tests showed significant associations between *Home language* and pass / fail rates only for courses INF205, INF212, INF213 and INF214. At both first and third year levels, a pass/fail outcome appears to be independent of home language. In general however, low failure rates for most of the IS courses would make the detection of dependence difficult without a larger sample size.

The analysis of weighted course results by *Home language* showed that in every case the mean result for English-speakers was higher than that for non-English speakers. These differences were highly significant (based on t-tests) for all courses except INF205 and INF206, particularly in the case of third-year courses where mean results differed between the two groups by as much as 15%. However, students whose home language is English generally enter UCT with significantly higher matriculation points than non-English speakers (37.9 vs 35.3, $p=0.001$). It is interesting to note that while there is a significant positive correlation of *Net matriculation score* with *English score* for English speakers (0.524, $p<0.05$), non-English speakers showed a slight negative correlation between the two scores (-0.036, not significant). This result is not as surprising as it might first appear, since students who perform badly in the matriculation English examination would have to do unusually well in their other subjects to achieve the total score needed for university admission (Ayaya, 1996).

In view of the fact that second-language English speakers enter UCT with significantly lower matriculation scores than English speakers, there would appear to be no direct evidence to support **Hypothesis 4**. Nevertheless, second-language speakers seem to find themselves at an increasing academic disadvantage throughout their undergraduate education, with the influence of *Home language* having a particularly noticeable effect at 3rd year level.

9.5 Areas for future research

Data relating to only a single cohort of IS majors at UCT has been analysed, and different results might be obtained based on a different group of students or different lecturers. This study also does not take into account the effect of changes to the IS curriculum or to UCT admissions criteria, or different practices in the teaching of IS at other tertiary institutions.

- Further research carried out over a longer time period and encompassing a range of different institutions would be useful in ascertaining the extent to which English proficiency is related to IS achievement within the discipline as a whole.
- It would also be useful to examine more closely the role of language skills within specific areas of IS, such as business analysis, system development and IT management.
- By assessing English proficiency in terms of the actual percentage obtained in the matriculation examination, rather than in terms of a symbol, a more accurate measure of linguistic skill across a wider range of values would be obtained, which would increase the power of the calculated correlation statistics.

A potential weakness of this study is the reliance on English matriculation score as an indicator of language proficiency. Several researchers have previously cast doubt on the

reliability of the matriculation examination as a predictor of student academic ability, particularly for underprepared and second language students. Alternative admissions tests are already being used at a number of tertiary institutions to provide an independent assessment of language and mathematical ability, and as from 2004 all students entering the Faculty of Commerce at UCT will be expected to write these tests.

- Future studies based on the data emerging from the alternative testing process could provide additional insight into the nature of the relationship being investigated here.

Finally, the research methods used in this study have been exclusively quantitative in nature.

- A qualitative investigation into student perceptions and experiences of the role of English language within the IS curriculum would make a valuable contribution to our understanding of this relationship.
- Since student performance is a complex and multivariate phenomenon, research is also needed to understand the contribution of other factors affecting IS performance; for example social background, levels of self-discipline and the ability to co-operate within groups.

Equity in education is a vital element in the quest for social transformation in South Africa. Further investigation into issues affecting student performance is essential if we are to translate affirmative admissions practices into increased numbers of black graduates.

9.6 Summary

Each of the hypotheses defined in chapter 6 was examined in the light of the data analysis reported in chapter 8. While matriculation English score was found to be positively associated with performance in individual IS courses (Hypothesis 1), the association with average results was significant only at first- and second-year level (Hypothesis 2). As expected, English score was negatively associated with the time taken to complete the IS major (Hypothesis 3). However, the strength of the association between English score and IS performance did not appear to differ between first and second language speakers (Hypothesis 4).

The chapter concludes with a number of suggestions for future research which could extend the generalisability and value of this study.

10. Conclusion

Tertiary institutions are under pressure to meet the demand for IS specialists within both local and global economies. At the same time, social transformation within South Africa depends on increased numbers of black graduates. If students emerging from academically disadvantaged backgrounds are to succeed within the field of information systems, then research is needed to identify problem areas and ways of redressing them.

This study investigated the relationship between English language skills and the performance of IS majors at UCT, based on demographic and academic data for a cohort of students following the IS curriculum between 1999 and 2002. Statistical analysis at the course level showed a significant positive correlation between matriculation English score and course results for most of the ten undergraduate IS courses, although the degree of correlation decreased at the third year level. However, in all cases the net matriculation score excluding English was far more strongly associated with academic performance than was the English score.

Analyses based on demographic data found that white students had consistently better results across all years, while English speakers performed significantly better in both first and second year. A similar outcome was obtained for analyses based on average results for each academic year rather than individual courses: white students averaged about 9% higher than other students, and English speakers as much as 12% more than non-English speakers.

The time period within which students completed all ten undergraduate IS courses was relatively shorter for those with higher English scores; however, in practical terms this difference translated into only a few months. Once again, net matriculation score was more strongly associated than English score with the time taken to complete IS3.

Although the home language of students appeared to play a significant role in IS performance, with higher results being obtained by English speakers for every course, this outcome was clearly influenced by the fact that English speakers enter UCT with a significantly higher matriculation score than do non-English speakers. Nevertheless, the gap in performance between English speakers and non-English speakers appears to increase at the third year level, suggesting that many second language English speakers remain at a disadvantage throughout their tertiary education.

Since the results for all six matriculation subjects form the basis for the current admissions policy at UCT, there would appear to be no justification for a change in policy. The significant positive correlation between English score and net matriculation score suggests that students who achieve good results in the English examination are likely to also achieve good results in their other subjects, and perform better in their IS major courses. However, it is interesting to note that the correlation of English score and net matriculation score decreased for weaker students, and was slightly negative for non-English speakers. This suggests that second language English speakers who have achieved sufficient points for admission to UCT, are likely to have weak language skills relative to their performance in their other subjects, and would probably benefit from support programs aimed at improving their linguistic proficiency.

11. References

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12. Appendices

A. Frequency counts for categorical variables

Category	Frequency table: **Sex** (AllCourses.sta)			
	Count	Cumulative Count	Percent	Cumulative Percent
F	79	79	32.78008	32.7801
M	162	241	67.21992	100.0000
Missing	0	241	0.00000	100.0000

Category	Frequency table: **Race** (AllCourses.sta)			
	Count	Cumulative Count	Percent	Cumulative Percent
I	27	27	11.20332	11.2033
W	156	183	64.73029	75.9336
C	20	203	8.29876	84.2324
B	38	241	15.76763	100.0000
Missing	0	241	0.00000	100.0000

Category	Frequency table: RaceGroup (AllCourses.sta)			
	Count	Cumulative Count	Percent	Cumulative Percent
O	85	85	35.26971	35.2697
W	156	241	64.73029	100.0000
Missing	0	241	0.00000	100.0000

Category	Frequency table: **Language** (AllCourses.sta)			
	Count	Cumulative Count	Percent	Cumulative Percent
EN	164	164	68.04979	68.0498
EA	3	167	1.24481	69.2946
E	26	193	10.78838	80.0830
TG	1	194	0.41494	80.4979
CH	7	201	2.90456	83.4025
NS	1	202	0.41494	83.8174
AF	2	204	0.82988	84.6473
O	12	216	4.97925	89.6266
ZU	5	221	2.07469	91.7012
XH	11	232	4.56432	96.2656
GR	2	234	0.82988	97.0954
VE	1	235	0.41494	97.5104
SX	1	236	0.41494	97.9253
TW	2	238	0.82988	98.7552
ND	1	239	0.41494	99.1701
MA	1	240	0.41494	99.5851
RU	1	241	0.41494	100.0000
Missing	0	241	0.00000	100.0000

Category	Frequency table: **HomeLanguage** (AllCourses.sta)			
	Count	Cumulative Count	Percent	Cumulative Percent
E	193	193	80.08299	80.0830
O	48	241	19.91701	100.0000
Missing	0	241	0.00000	100.0000

Category	Frequency table: **ADP** (AllCourses.sta)			
	Count	Cumulative Count	Percent	Cumulative Percent
No	231	231	95.85062	95.8506
Yes	10	241	4.14938	100.0000
Missing	0	241	0.00000	100.0000

Category	Frequency table: **RawEnglishScore** (AllCourses.sta)			
	Count	Cumulative Count	Percent	Cumulative Percent
4	3	3	1.24481	1.2448
5	37	40	15.35270	16.5975
6	107	147	44.39834	60.9959
7	63	210	26.14108	87.1369
8	31	241	12.86307	100.0000
Missing	0	241	0.00000	100.0000

Category	Frequency table: EnglishScore (AllCourses.sta)			
	Count	Cumulative Count	Percent	Cumulative Percent
5	40	40	16.59751	16.5975
6	107	147	44.39834	60.9959
7	63	210	26.14108	87.1369
8	31	241	12.86307	100.0000
Missing	0	241	0.00000	100.0000

B. Descriptive statistics for quantitative variables

Variable	Descriptive Statistics (AllCourses.sta)							
	Valid N	Mean	Minimum	Maximum	Std.Dev.	Standard Error	Skewness	Kurtosis
NetMatricScore	241	30.79253	15.00000	40.0000	4.09757	0.263948	0.072931	0.40670
EnglishScore	241	6.35270	5.00000	8.0000	0.90605	0.058364	0.293515	-0.66115
INF102 result	233	64.96137	41.00000	89.0000	10.80243	0.707691	-0.176098	-0.64505
INF102 wtd	233	64.88224	30.00000	106.2500	18.18237	1.191167	0.103388	-1.04355
INF103 result	232	62.18966	36.00000	91.0000	9.70688	0.637288	0.191786	-0.25022
INF103 wtd	202	64.04146	27.50000	102.5000	15.31651	1.077666	0.040116	-0.60584
INF205 result	156	59.42308	34.00000	80.0000	8.38973	0.671716	-0.279211	-0.07495
INF205 wtd	156	65.96194	34.00000	117.0000	14.47831	1.159193	0.222895	0.36787
INF206 result	73	55.75342	30.00000	78.0000	11.21108	1.312158	-0.221521	-0.19302
INF206 wtd	73	54.04966	28.00000	87.7500	13.58017	1.589439	0.159677	-0.48161
INF212 result	223	71.72646	40.00000	95.0000	10.65687	0.713637	-0.279525	-0.24728
INF212 wtd	223	76.74524	35.06250	139.7500	17.89013	1.198011	0.192054	0.01326
INF213 result	226	63.54425	25.00000	84.0000	9.36472	0.622932	-0.674763	0.85537
INF213 wtd	226	67.76576	20.31250	118.6250	14.62636	0.972931	0.258362	0.39204
INF214 result	225	63.61333	30.00000	90.0000	10.21321	0.680881	-0.167813	-0.01103
INF214 wtd	225	68.03306	29.56250	117.0000	16.59260	1.106173	0.258610	-0.01443
INF311 result	205	60.97073	26.00000	87.0000	12.27740	0.857490	-0.293689	0.01390
INF311 wtd	205	62.30640	24.37500	105.8750	17.37846	1.213764	0.080613	-0.66699
INF312 result	69	61.94203	37.00000	78.0000	7.79873	0.938856	-0.486376	0.59710
INF312 wtd	69	56.20471	17.75000	81.9375	13.06216	1.572499	-0.126658	-0.09735
INF313 result	204	69.00980	50.00000	95.0000	10.21444	0.715154	-0.089361	-0.48719
INF313 wtd	204	70.65533	8.87500	134.8750	19.55627	1.369213	0.105130	0.50686
INF314 result	205	63.38049	41.00000	84.0000	7.17373	0.501035	-0.312008	0.37973
INF314 wtd	205	64.82293	29.00000	107.2500	14.58699	1.018800	0.044920	-0.11335
INF316 result	138	67.11594	46.00000	87.0000	7.49703	0.638189	-0.201515	0.52938
INF316 wtd	138	71.45969	28.50000	97.8750	13.00655	1.107191	-0.431272	0.15041

Note:

1. Students in their second academic year attended either INF205 (in 2000) or INF206 (in 2001), hence the smaller number of data values for each of these classes.

2. Students in their third academic year attended either INF316 (in 2001) or INF312 (in 2002), hence the smaller number of data values for each of these classes.

C. English score vs. Number of students passing / failing each course

		English score					
Course		**4 / 5**	**6**	**7**	**8**	**Pearson chi-square (df=3)**	**p**
INF102	Pass	31	81	57	30	12.0466	.007227
	Fail	6	23	5	0		
INF103	Pass	32	96	60	37	3.32493	.344193
	Fail	5	6	3	3		
INF205	Pass	14	51	44	19	11.4811	.009392
	Fail	10	10	6	2		
INF206	Pass	11	30	7	5	.049583	.997107
	Fail	4	11	3	2		
INF212	Pass	35	96	58	29	2.45296	.483855
	Fail	2	2	1	0		
INF213	Pass	34	95	56	27	1.62227	.654351
	Fail	4	5	3	2		
INF214	Pass	33	93	56	27	3.00319	.391138
	Fail	5	7	3	1		
INF311	Pass	27	74	54	24	8.63416	.034577
	Fail	8	14	3	1		
INF312	Pass	11	33	15	6	8.06412	.044711
	Fail	3	1	0	0		
INF314	Pass	30	84	57	25	11.9352	.007611
	Fail	5	4	0	0		
INF316	Pass	21	54	41	19	1.04523	.790309
	Fail	1	1	1	0		

Note:

1. In most cases the probabilities shown above may be unreliable as a result of low cell frequencies.

2. No chi-square analysis was produced in respect of pass/fail for INF313 since all students in this cohort passed the course.

D. Home language vs. Number of students passing / failing each course

Home language

Course		English	Other	Pearson chi-square (df=3)	p
INF102	Pass	162	37	2.11074	.146272
	Fail	24	10		
INF103	Pass	177	38	5.56587	.018316
	Fail	10	7		
INF205	Pass	115	13	9.16815	.002463
	Fail	19	9		
INF206	Pass	38	15	.920794	.337269
	Fail	12	8		
INF212	Pass	179	39	12.1148	.000500
	Fail	1	4		
INF213	Pass	175	37	12.9731	.000316
	Fail	6	8		
INF214	Pass	172	37	9.68900	.001854
	Fail	8	8		
INF311	Pass	152	27	5.98227	.014452
	Fail	17	9		
INF312	Pass	47	18	.013688	.906863
	Fail	3	1		
INF314	Pass	166	30	15.6791	.000075
	Fail	3	6		
INF316	Pass	119	16	1.25380	.262831
	Fail	2	1		

Note:

1. In some cases the probabilities shown above may be unreliable as a result of low cell frequencies.

2. No chi-square analysis was produced in respect of pass/fail for INF313 since all students in this cohort passed the course.

E. Correlation between Course results and Matric / English score

Variable	Correlations (AllCourses.sta) Marked correlations are significant at p < .05000 NetMatricScore	EnglishScore
INF102 result	.4840	.3445
	N=233	N=233
	p=.000	p=.000
INF102 wtd	.6145	.3948
	N=233	N=233
	p=0.00	0
INF103 result	.4425	.1402
	N=232	N=232
	0	p=.033
INF103 wtd	.6056	.2305
	N=202	N=202
	0	p=.001
INF205 result	.4340	.3010
	N=156	N=156
	0	0
INF205 wtd	.5161	.3180
	N=156	N=156
	0	0
INF206 result	.2453	.0105
	N=73	N=73
	p=.036	p=.930
INF206 wtd	.2420	.0940
	N=73	N=73
	p=.039	p=.429
INF212 result	.4890	.1814
	N=223	N=223
	0	p=.007
INF212 wtd	.5736	.2645
	N=223	N=223
	0	0
INF213 result	.4600	.1631
	N=226	N=226
	0	p=.014
INF213 wtd	.6110	.2749
	N=226	N=226
	0	0
INF214 result	.4766	.2981
	N=225	N=225
	0	0
INF214 wtd	.5727	.3546
	N=225	N=225
	0	0

Variable	Correlations (AllCourses.sta) Marked correlations are significant at p < .05000 NetMatricScore	EnglishScore
INF311 result	.4335	.2200
	N=205	N=205
	p=.000	p=.002
INF311 wtd	.4470	.2137
	N=205	N=205
	0	0
INF312 result	.2730	.2597
	N=69	N=69
	p=.023	p=.031
INF312 wtd	.1024	.1320
	N=69	N=69
	p=.403	p=.280
INF313 result	.2349	.1357
	N=204	N=204
	p=.001	p=.053
INF313 wtd	.2333	.1447
	N=204	N=204
	0	p=.039
INF314 result	.3999	.3157
	N=205	N=205
	0	p=.000
INF314 wtd	.3519	.2278
	N=205	N=205
	0	p=.001
INF316 result	.3301	.2059
	N=138	N=138
	0	p=.015
INF316 wtd	.3651	.2347
	N=138	N=138
	0	p=.006