CHAPTER 1
INTRODUCTION TO THE STUDY AND ITS CONTEXT

1.1 AN OVERVIEW OF THE STUDY AND CHAPTER

This study identified factors perceived to be essential for academic success in first-year biological sciences at the University of the Witwatersrand, South Africa, and investigated the effects of a computer-based programme which was developed to help students increase their awareness of appropriate attitudes, metacognitive knowledge and work-habits which contribute to achieving academic success.

The study had two main phases, similar to the "diagnostic" and "therapeutic" phases used in action research. The aim of the diagnostic phase was to identify factors which stakeholders perceived to be essential for academic success in first-year biological sciences. During the diagnostic phase interviews were used to elicit stakeholders' perceptions (10 lecturers teaching first-year university biology courses, 8 Honours students, and 17 undergraduates). These perceptions provided insights for the development of a questionnaire to diagnose and capture the views of a larger sample of first-year biology students (n=277).

The aim of the therapeutic phase was to investigate the effects of a computer-based instructional programme, designed for the study. Computers were used because they provide individualized instruction (Ismail, 1997; Corbett, 2001) and they allow users to work at their own pace, which is an advantage for students who are embarrassed to show their lack of knowledge and skills in group situations like large classes (see Chapter 5). The computer programme focussed on the impact of affective variables, work-habits, and metacognition on learning; because these factors were identified by the stakeholders in the diagnostic phase as factors which they believe influence academic success. Based on theories of attitude and behaviour change (Ajzen & Madden, 1986; Prochaska & DiClemente, 1983), the programme explained to students the importance of working on their attitudes, intrinsic motivation, and behaviours, in order to achieve their academic goals. During the therapeutic phase formative evaluation of the programme was conducted in two stages: the first involved 61 first-year College of Science students in a usability testing of the package. In the second stage, 14 Introductory Life Sciences student volunteers worked through the completed programme and a case study approach was used to explore the viewpoints of eight participants on the effectiveness of the package.

The purpose of this chapter is to provide arguments, bolstered by the literature, to motivate for the study. In order to do this I have explained the importance to the economy and to the well-being of people, of having a skilled workforce in the biological sciences and hence the need to address the national problem of first-year students at universities failing to perform well in the biological sciences. Focussing on the institution at which the study was conducted, the chapter presents data on student performance to demonstrate the extent of the problem, and reviews the university's efforts during the last three decades, to support students at risk of failure. A section on the purpose of the study (section 1.7) and the key research questions the study addressed is then presented (section 1.8), followed by an outline of the rest of the chapters in the thesis (section 1.9), to orientate the reader to the study as a whole.

1.2 THE IMPORTANCE OF TERTIARY-LEVEL BIOLOGICAL SCIENCES COURSES

Successful tertiary-level studies in biology are crucially important in a number of careers. Many governments, including that of South Africa, have for a long time realized the strong positive correlation that exists between the viability of the economy, the well-being of its people and the availability of scientific and technical human resources (Department of Education, 2001a; Ministry[1] of Education, 2001). Biological sciences form a core part of careers in the health sciences, agriculture and food sciences, microbiology, biotechnology, education, environmental conservation and management, among others.

One area where a large number of skilled personnel is required is the health system. According to SouthAfrica.info (2007) the demand for health service workers in South Africa is great, with the public health sector under pressure to provide services to about 80% of a population of over 49 million[2] individuals. There is demand for laboratory technicians, medical doctors, nurses, and other health specialists such as physiotherapists, who are needed to work in hospitals, clinics and other health outlets. Personnel in all these positions would have studied biology at the tertiary level.

The field of agriculture is important in providing sufficient safe and nutritious food to the estimated 49 million South Africans and contributes to improve the economy. Individuals in the agricultural sector require a basic knowledge of biology as it determines their success at growing crops, raising animals, overseeing farms of various sizes and managing other agric-businesses in the country. The Department of Agriculture spearheads the drive to feed the nation, by supporting sustainable agriculture and rural development, encouraging growth, income generation and ensuring knowledge and information management (Department of Agriculture, 2007). Achieving these goals requires an appropriately educated and skilled labour force, which is mainly recruited from post-secondary institutions.

One of the fields of biology that has created jobs for many and brought wealth[3] to various countries in this century is biotechnology (Ministry of Arts, Culture, Science and Technology[4], 2001). So economically competitive is this field in generating capital that the first century of the second millennium has been labeled the century of *information technology and biotechnology* (Ministry of Arts, Culture, Science and Technology, 2001; Hall, 2002). Knowledge in the field of biotechnology leads to the manufacture of drugs, hormones, bulk foodstuffs, and skills at cleaning up of crude oil spills using microbes or biological substances. It is important for South African institutions to train personnel in this field to help sustain the country's economy through the accrual of the needed capital

[1] The words "department" and "ministry" are often used interchangeably in the South African context.

[2] Figure based on 2007 (estimates). Source Worldfacts. http:// www.worldfacts.us/South-Africa.htm/

[3] In the USA, for example, biotechnology companies have a market capital of $353 billion and an annual turnover of $22 billion p.a.

[4] This department has, since 2002, been divided into two departments (Min. of Science and Technology, 2002)

(Ministry of Arts, Culture, Science and Technology, 2001; Science in Africa, 2004; Potgieter & Davidowitz, 2010).

The global environment is faced with increasing pressures from industries for natural resources, and from meeting the needs of an increasing human population. These challenges, together with global climate change, are set to have major consequences on global biodiversity. Because of these challenges, countries need scientists who understand the theory of ecological processes and how these theories can be applied in meeting the challenges posed by current biodiversity crises (Okhee & Luykx, 2006; University College of London, 2008). Large numbers of graduates are needed with strong backgrounds in conservation and environmental biology to take part in informed debates on environment issues with people, government agencies, industries, and urban planners.

In order to sustain high levels of biology students at tertiary level the role of competent biology teachers must not be overlooked. Biology teachers, in addition to teaching the requisite skills and knowledge, need to be able to enthuse students to take their study of biology into tertiary level, so that they contribute to meet the human-power needs of the country. Equipping teachers for the needed tasks requires improved levels of training in science mathematics and engineering (Kahn, 2006; University of the Witwatersrand, 2009; 2011).

It can be seen that biologically-based careers have high "economic responsiveness" (Moll, 2004) and as such, knowledge of this subject is crucial to meet the needs of the populace and the economy. Any study which looks at ways of improving biology success rates at tertiary level, as this one does, is therefore important.

1.3 THE PROBLEMS WHICH MOTIVATED THIS STUDY

If current trends in university pass rates are used as a yardstick, supplying sufficient trained 'biologists' to meet the manpower needs of the country is not likely to happen, even if the government admission policies (Ntshoe, 2002) are implemented. In the Faculty of Science at the University of the Witwatersrand the problem has exhibited itself in four different ways, as discussed below.

1.3.1 Cancellations of registrations during the year

Cancellations of registrations occur when registered students withdraw voluntarily from a course before the end of the academic year. Two types of cancellations may be identified. There are those who cancel registrations in order to take up late offers in courses they really want. If this happens within the first two weeks of the year, these figures do not get included in the withdrawal statistics. Changes in registrations, even after the first two weeks, are relatively common either because students go to competing institutions or move to the Faculty of Health Sciences or Commerce at this University. The School of Biology[5] in the Faculty of Science admits over 500 applicants per annum to first-year biology courses. For a number of these candidates, studying for a career in the School of

[5] This is an administrative unit, chaired by a senior academic, that oversees first-year biology courses taught by the two schools in the Faculty of Science.

Biology is their second choice. Most would prefer careers in the Health Sciences. Others cancel their registration for financial or social reasons. Although the figures have been variable over the last 10 years, records from the Faculty of Science put the cancellation figure for first-year biological sciences at about five percent of students who initially register (see Figure 1.1).

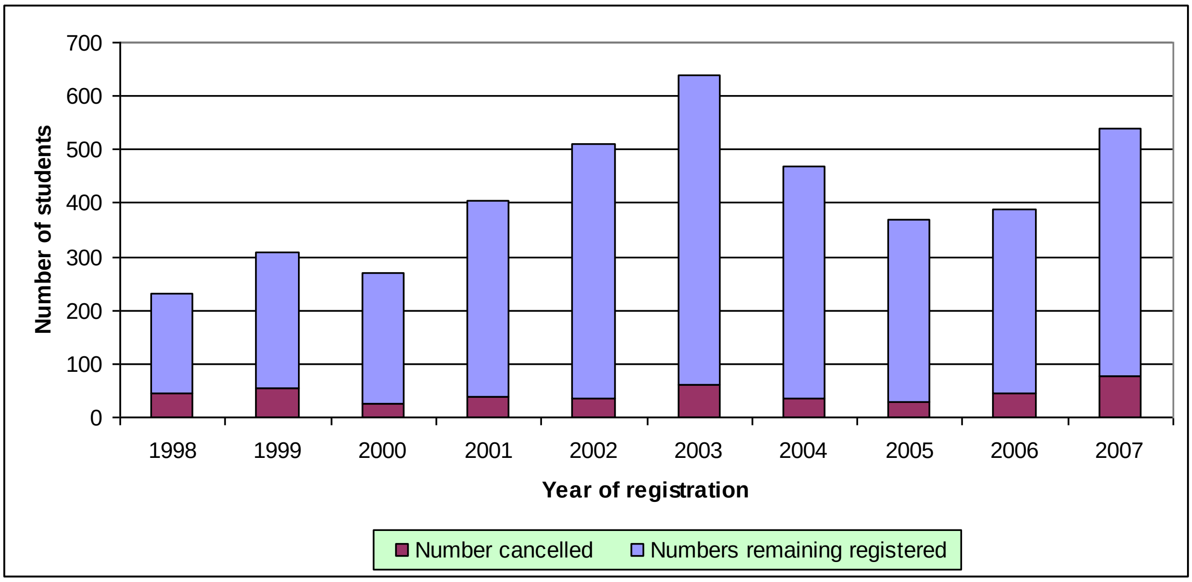

Figure 1.1 Number of first-year biology students cancelling their registrations in the Faculty of Science (Source: University of the Witwatersrand, 2008)

1.3.2 Inability to meet assessment criteria

The award of a Bachelor of Science degree is based on a point system for units and courses passed that form components of a qualification for each of the three years of study (Faculty of Science, 2009). The rules governing the award are complex but basically, students who accrue 108 points or more at first year level are deemed to have completed their first level of study (Faculty of Science, 2009). Non-progression to the next academic level of study occurs when students fail one or more of their courses (or do not register for a required course) and as a result do not meet the minimum assessment requirements. Failing a unit at the first-year level does not imply that such students would be excluded. Generally, such students will have to spend additional time at the university to complete the necessary units and acquire the points. The university's rules are clear that:

> *...a student may not be admitted to a [subsequent] year of study until s/he has completed the units prescribed for any preceding year of study and satisfied such further requirements, if any, as are prescribed by the rules* (Faculty of Science, 2009, p. 20).

Not all students who fail a course or courses drop out of the university, although students who do not meet the minimum requirements of study may be refused permission to re-register. Until 2005 approximately one in three students failed (Figure 1.2). From 2005 the proportion of students failing declined, but increased again in 2009[6]. The increase in numbers of failures could possibly have been

[6] Putting the data into a historical perspective, it should be noted that in 1998 a new school curriculum was introduced which was underpinned by the Outcomes Based Education philosophy (Reddy, 2006). The Grade 12 cohort of 2008 was the first

influenced by the introduction of the new school level curriculum introduced incrementally from 1998. The first cohort of students from the new curriculum matriculated in 2008, and entered universities in 2009. It has widely been publicized that the curriculum has not met expectations (Potgieter & Davidowitz, 2010). Contributing to the failure rate are two groups of students: those students, often a minority, who did not study biology at matriculation level, and students coming from educationally disadvantaged backgrounds.

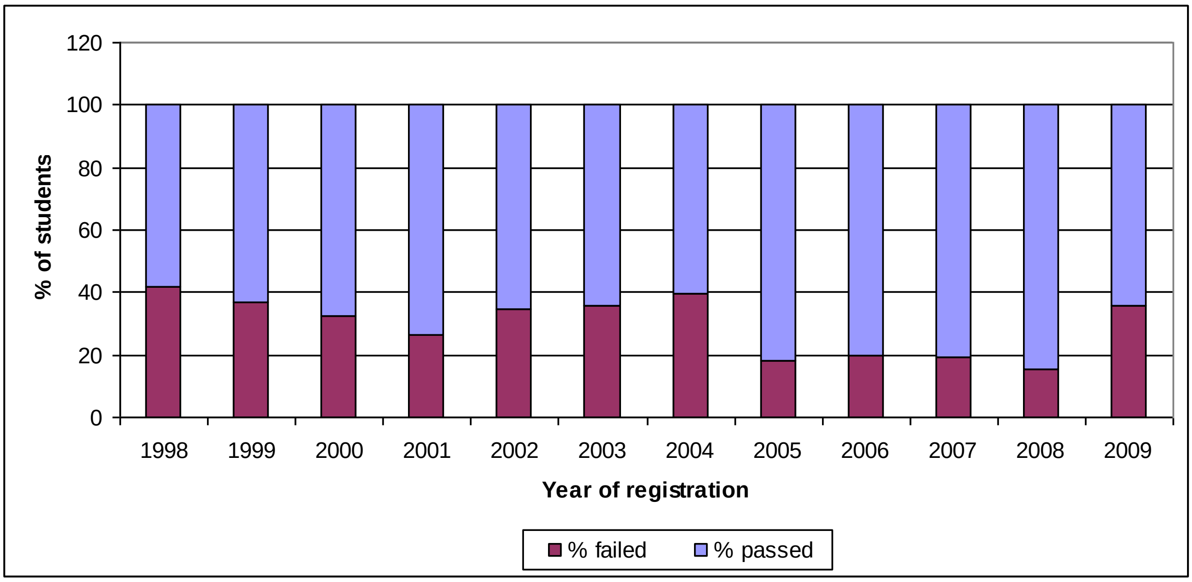

Figure 1.2 Percentage passes in a first-year biology course (Source: University of the Witwatersrand, 2010)

Together these two groups constitute a significant number of students who often are not able to cope with the academic demands of the biological sciences courses, and are described as being "at-risk" because they are literally at risk of failing (Sanders, 1986; Rutherford & Donald 1993). Whilst students may pass biology, they do not necessarily pass all subjects. Therefore the throughput rate declines (see Section 1.3.4).

1.3.3 The low pass rates in university education

The problem of low pass rates, especially in the first year at tertiary level, is not peculiar to the University of the Witwatersrand, or even to South Africa: it is a global phenomenon (see Kobrak, 1992; Pargetter, McInnis, James, Evans, Peel & Dobson, 1998, Greene, 2002). The problem is also not recent. From the United States of America and South Africa come a number of studies (e.g. Kulik, Kulik & Schwalb, 1983; Stanton, 1987; Kobrak, 1992; Grayson, 1996; Gandara & Maxwell-Jolly, 1999; Perry, Hladkyi, Pekrun, Clifton & Chipperfield, 2005) focusing on various factors affecting pass rates, such as race, academic preparedness, and motivation. Several of the authors point out that educators have been grappling with the problem for over a century. Gous, in a South Africa study cited by Stoker, Engelbrecht, Crowther, du Toit & Herbst (1985), found that for the 8000 first-year South African university students registered in 1930 a forty percent failure rate was reported at the

group to follow all years of the new curriculum. Successful applicants were admitted into tertiary institutions. The performance of this cohort of students was first assessed at the University in 2009.

end of the year. Low pass rates impact adversely on throughput rates of institutions and constitute a drain on national and institutional resources (Astin & Oseguera, 2002; University of the Witwatersrand, 2003), as is discussed in the next section.

1.3.4 Low throughput rates to complete degrees

Throughput is defined as the percentage of an initial cohort of students who successfully progress through their studies and complete their degrees within the stipulated minimum period. The problem of low throughput is disturbingly extensive, as indicated by studies from America, Britain and South Africa (Astin & Oseguera, 2002; University of the Witwatersrand, 2003; 2007).

Pantages & Creedon (1978) reported that in 1971, of the estimated 7.6 million USA undergraduate students enrolled, roughly 2.3 million students □ about a third of the "starters" □ dropped out of higher education completely. The situation does not seem to have improved since then. According to a United States national survey in 1994, based on 56,818 students who were admitted to 262 four-year colleges and universities, and whose degree attainment and enrollment statuses were reviewed in 2000, *"... only 36 percent were able to complete their bachelors degrees within four years"* (Astin & Oseguera, 2002, p. 2). A further 22 percent completed after an additional two years of study, putting the completion rate after six years at 59 percent (Astin & Oseguera, 2002). In South Africa, the average throughput for a three-year BSc degree for the period 1992-1997 per cohort of students was 45% (University of the Witwatersrand, 2003). According to the report, about 55% of the initial intake of students could not complete their degrees after six years, and were either still in the educational system or dropped out along the way. A more recent analysis of student statistics in South Africa, for the period 1995-2004 (South African Qualification Authority, 2007), indicates the average completion rate for science degree programmes at contact[7] universities to be around 57%, showing that the problem of low throughput is still prevalent within the country's higher educational system. The University of the Witwatersrand has targeted a pass rate of over 80% for each course in order to address the low through-put reported in some of the courses (University of the Witwatersrand, 2009).

Astin & Oseguera (2002) highlight the importance of completion rates as a measure of faculty or institutional performance or accountability, since high rates of completion signify that both the institution (and its components) and students have been successful. Institutions may have to take a cue from this yardstick of measurement, and work on the throughput of their students if they are to be taken seriously by their governments.

One institutional problem that has been pinpointed to have contributed to the increasing level of drop out and failure rates in some countries (McInnis, James & McNaught, 1995; Rickinson & Rutherford, 1995), which could now be relevant for South Africa, is the increasing diversity of student groups. The assumption being made here is that many students are admitted from diverse educational backgrounds, which could have contributed to some students being educationally at risk.

[7] A distinction is made between contact universities, where students are in face-to-face contact with lecturers, and distant learning institutions where most of the subject matter is delivered through paper-based teaching materials or through online learning networks.

From the United Kingdom, Rickinson & Rutherford (1995) reported on the government's policy of opening universities in a non-selective way to the population, widening access and growing student numbers. McKenzie & Schweitzer (2001) noted from Australia educational reforms in the late eighties which advocated a move from an "elitist education" to one of "mass education", and to having equity and access to education for all of its citizens. Government policy for higher education has had similar results in both countries: increase in numbers and diversity amongst student populations who have come from different social and cultural backgrounds, and with varying levels of education. Numbers of students have battled to cope with their studies (McInnis *et al*., 1995; Rickinson & Rutherford, 1995; McKenzie & Schweitzer, 2001).

In the United States of America a different aspect of the increasing diversity of the student population has to do with the country as a whole becoming more racially, culturally and linguistically diverse. (Treisman, 1992; Reyes, Scribner & Scribner, 1999). This diversity has left in its wake a widening gap (first noted in the 1960s), in the academic achievement and economic status between the "racial minorities" and white students who tend to be of middle- and upper-class (Gandara & Maxwell-Jolly, 1999; Reyes *et al*., 1999). The middle- and upper-class white students seem to be graduating at a faster rate and move up the economic ladder faster than their counterparts (Ogbu, 1983; Miller, 1998). Reasons sought to explain this phenomenon of differences in academic achievement have included racism (Ogbu, 1983; Miller, 1998); the lower motivation of minority groups to succeed at academic tasks (e.g. Graham, 1994; Cooper & Dorr, 1995; Schuman, Steeh, Bobo & Krysan, 1997); stereotype vulnerability (Steele, 1997); and lower cultural (human) capital of parents or family groups of such students (Clifton, Perry, Stubbs & Roberts, 2004). I am aware of the success of some of the Asian population in mathematics and sciences. These are discussed later.

Goodwin (2002, p. 522), however, warns that the phenomenon of under-representation associated with the achievement gap should not be seen from a racial perspective, and calls for a broader understanding of what she calls the "*community of disadvantaged students*". Norman, Ault, Bentz & Meskimen (2001) agree, seeing the gap in the American society as a manifestation of the poor quality of resources available in the educational systems that the majority of black students attend. Treisman (1992) claims the achievement gap seems to reflect the socio-cultural position of groups and not racial differences.

The persistence of the achievement gap in the American society despite earlier attempts at addressing it is a cause for concern for educationists (e.g. Harper, 2005; Lew 2007; Rovai, Gallien & Stiff-Williams, 2007) and this problem area is being addressed from various practical and theoretical perspectives, such as using cultural ecological theory[8] (Ogbu, 1983), ecological development model[9] (Bronfenbrenner, 1979; 1993) or malintegration (Tinto, 1975, Loo & Rolinson, 1986). Harper (2005, p. 14) suggests that it is important to realize that the minorities are *"... not a monolithic group whose members all make the same choices, [and] approach college education in the same ways"*. A number

[8] The theory recognizes cultural differences among individuals, and attempts to explain, for instance, why some cultural groups do well in school while others do not. According to Ogbu (1983) individuals who see themselves 'subordinated' in the social, economic or political system tend not to do well academically.

[9] This theory resulted in a model known as the 'bioecological model' which looks at child development within the context of the system of relationships that constitute their environment. These systems include family, community, and society, all of which are seen to steer children's development.

of different approaches may have to be used to minimize the achievement gap in the various societal settings.

In South Africa a widening economic gap is emerging between the rich and poor irrespective of racial groups (Groves, 2009) which has led to disparities in academic performance among the economic groups. It is therefore pertinent to heed the call (Ochse, 2005) for intensification of efforts to address the academic achievement gap among learners, especially those coming from under-resourced backgrounds, if an equitable society is to be created.

1.4 FACTORS INFLUENCING EARLY WITHDRAWAL OF STUDENTS FROM INSTITUTIONS

This section focuses on what research tells us about why some students cancel their registration; it provides insight into the factors within and beyond the institutional control, and implicitly suggests possible intervention measures.

Tinto (1975) suggested three reasons why students are likely to withdraw early from tertiary institutions. According to Tinto early withdrawal occurs when:

a) students are insufficiently integrated into the social and or academic systems of the institution,
b) their levels of commitment to earning a degree (goal commitment) are low.
c) their reasons for commitments to the institution (institutional commitment) are somehow incongruent to their academic/social integration.

These reasons, suggested by Tinto over 30 years ago, allude to students not being fully integrated academically and socially into the university culture and as a result being dissatisfied with it. The views of Mann (2001) and other authors resonate with Tinto, who explains student withdrawal in terms of student alienation either with the academy or with the social structure and the culture at the institution (see discussion on p.16).

McInnis *et al*. (1995), in an extensive study conducted in Australia, argue over one-and-a-half decades ago, that whilst the relationship between integration and satisfaction could be crucial to students' academic performance and persistence, several assumptions which were previously true are no longer tenable in most twenty-first century Australian institutions. Academics can no longer assume that:

a) first-year students have completed a good general education at school before being admitted to a tertiary institution.
b) students come from families or social environments with the necessary "cultural capital" to fit with the lifestyle and expectations of the university.
c) students are keen on acquiring the values and skills of academics.

In Australia and Great Britain it is the national educational policies of 'massification' aimed at improving human-power (McInnis *et al.,* 1995) that seem to have created problems of significant attrition of first-year university students (McKenzie & Schweitzer, 2001). If cancellation occurs for personal reasons there is nothing the university can do. If it is for academic reasons, timeous intervention could help in some cases.

1.5 FACTORS INFLUENCING ACADEMIC SUCCESS AT TERTIARY LEVEL

The research reviewed in this section focuses on the trends worldwide regarding factors that have been found to influence academic success, and the lessons that have been learned from them. These studies are reviewed in the hope that where comparable situations exist in South Africa the solutions proposed could be used in addressing the problem of low pass rates in tertiary institutions. Based on the literature a conceptual summary showing three levels of factors influencing students' success is proposed (see Figure 1.3). Three levels of factors emerging from the literature are concentrically arranged: personal, institutional and national levels. As shown in the figure, there is a dominance of factors in the inner circle, at the personal level, and this suggests that success depends largely on individuals taking control of the factors that influence their academic achievement.

1.5.1 Factors operating at a personal level

Within the personal level, six clusters of factors have been created from the literature reviewed (see Figure 1.3). These include factors associated with students' educational background; factors relating to cultural variables; social factors; factors relating to psychological dispositions; factors associated with affective variables; and factors relating to students' learning strategies and behaviours.

Educational background of students

The educational background of students has been identified as one of the important predictors of their success at tertiary institutions (Dale & Zych, 1996;). According to Ezewu (1983) it is during their school years that the cognition of students is shaped. The cognitive structure of the students, whilst genetically programmed, is influenced by two broad factors: quality of schooling (Treisman, 1992; McInnis *et al*., 1995; Drew, 2001; McKenzie & Schweitzer, 2001; Zeegers, 2004) and students' academic achievement at pre-tertiary schools (e.g. Power, Robertson & Baker, 1987; Mitchell & Fridjhon, 1989; Potter & van der Merwe, 1993; Lourens & Smit, 2003). These variables within the students' background form the 'educational baggage' students come with to tertiary institutions. The influence of each is discussed in turn.

Quality of schooling

Schools, as socio-cultural entities, facilitate the development of knowledge and skills of students. Studies have recognised that the quality of schooling students receive plays a role in determining their eventual success (Zaaiman, van der Flier & Thijs, 2000; Perna & Thomas, 2008; Orr, 2009). Studies show that students' success is associated with indicators such as high school quality, and level of government funding (Perna & Thomas, 2008). During the apartheid years in South Africa students attending black government schools had a lower per capita expenditure than other race groups. According to Andrews (1994), in 1989 the capital expenditure for white students was four times that of black students. Kahn (2006) noted that during the apartheid era quality schooling in science, mathematics and English was available to only a few blacks[10] who attended

[10] The term black, spelled with a lower case "b", under apartheid was used to designate all races that were not of European origin. The term "coloured" was used to describe a person of mixed race e.g. of African and white heritage.

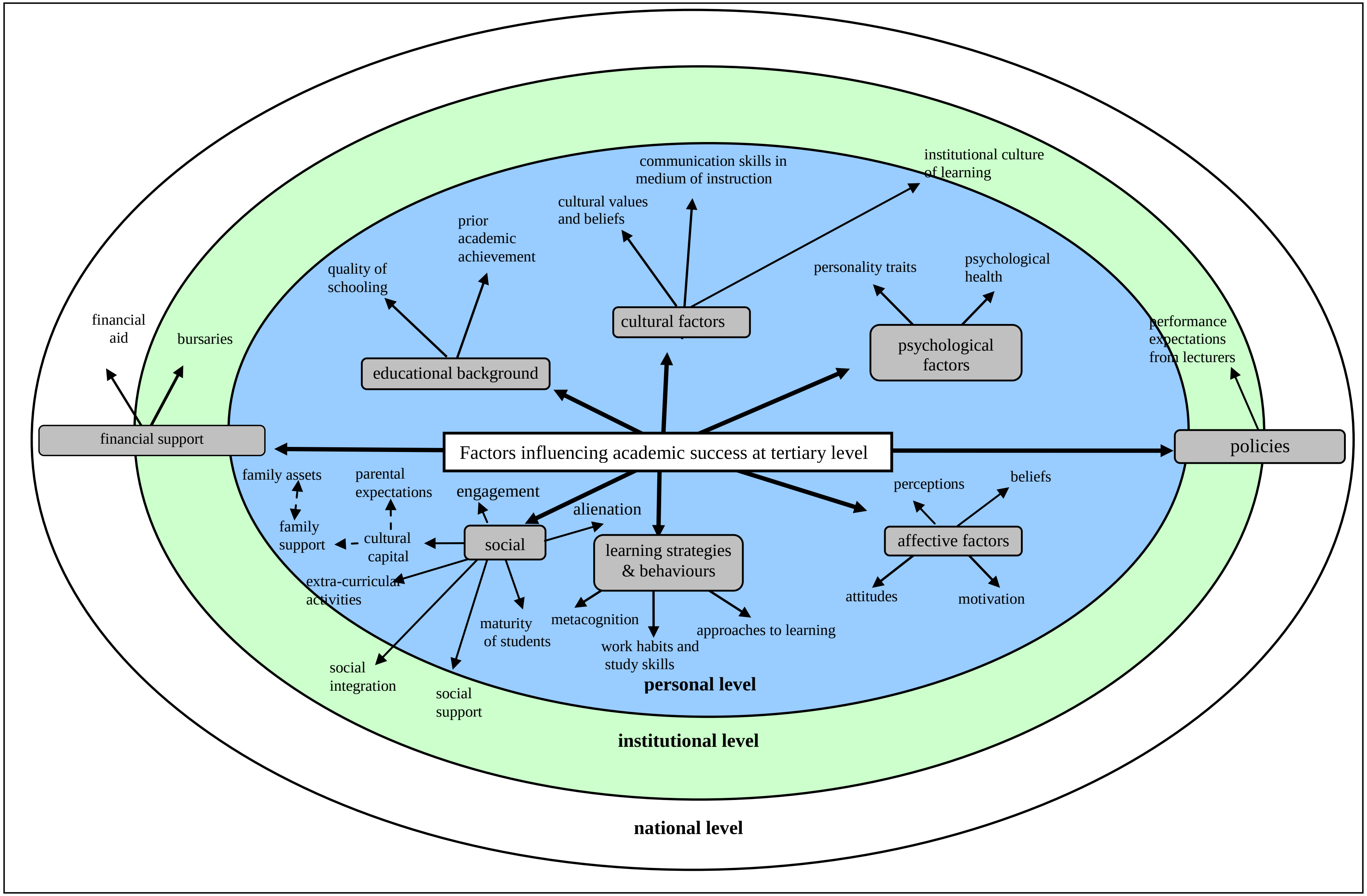

Figure 1.3 Factors operating at national, institutional and personal levels, and affecting academic success

what he termed the "core"[11] schools. He says the rest of the black learners, did not stand a good chance of getting quality tuition in Physical Science, Mathematics or English. Many students coming to university from under-resourced schools were considered to be educationally "at-risk" and needed academic support to steer them through their courses (Hunter, 1991; Eiselen & Geyser, 2003). The disparity in terms of both material and human resources has not been significantly reduced since. Arnott, Kubeka, Rice & Hall (1997) and Kahn (2006) report that previously black-only education systems still had relatively fewer qualified science and mathematics teachers and inadequate or non-existent physical facilities at the time these reports were published. This suggests such under-resourced schools will, for the period it takes to upgrade both physical and human resources in such schools, continue to turn out students who would need academic support should they be admitted into tertiary institutions.

Prior academic achievement

Students' academic achievements at high schools provide the basis for their selection and admission into universities in many countries. Students' academic achievement and ratings are often determined by an index or a combination of indices (Mitchell & Fridjhon, 1989; McKenzie & Schweitzer, 2001) based on their school results. In the United States admissions are often based on standardised Scholastic Aptitude Test (SAT) results; in Australia, the Tertiary Entrance Record (TER) is often used (McInnis *et al.*, 1995), whilst in South Africa it is the 'matriculation[12] endorsement', a score based on performance in an aggregate of at least six subjects which is used (Mitchell, Fridjhon & Haupt, 1997). The matric ratings for admission differ for each Faculty at the University of the Witwatersrand but in the Faculty of Science the minimum admission requirement was 26 points[13] with a 40% pass at higher grade mathematics (Faculty of Science, 2009).

The relationship between academic achievement at pre-tertiary, and tertiary institutions has also been determined. Power, Robertson & Baker (1987) and Zeegers (2004), in two Australian studies, reported a correlation of between 0.4 and 0.5 for secondary school results and grade point average (GPA) at the university for school leavers. According to Power *et al.* (1987), these secondary school-leaving results signified a reliable predictive value of students' performance at university.

Significant changes occurred in the structure of the South African education system after 1985 (Mitchell *et al.,* 1997) which included the reorganization of the secondary education system and the elimination of many of the examination boards[14]. Based on comprehensive data at this

[11] Kahn (2006) used "core" schools to refer to better quality schools, whether in black or white areas.

[12] A distinction needs to be made between marks based on *aptitude tests* and matriculation examinations. Matriculation examinations in South Africa measure previously learned subject knowledge, and are achievement tests (Rollnick, 2010); ability tests measure reasoning and other skills and are often done in a content-free environment. SAT, which often assesses verbal and mathematics ability, is an aptitude test and often linked to ability testing (see Rollnick 2010).

[13] These are based on the 2009 rating criteria of the University of the Witwatersrand.

[14] Macrae (1994) notes that under the apartheid system curriculum management in South Africa was administered to four racial groups in each province. In addition there were 12 regions of the country officially referred to as "self-govering

university from 1980-1991, Mitchell *et al.* (1997, p. 384) found the matric mark was generally a good predictor of university performance. In essence the "*lower the matric average mark, the lower the pass rate"* at the university. Whilst high average marks (65% or more) might ensure a higher success rate at South African universities, this would mean only a limited number of students would be eligible for admission (Mitchell *et al*., 1997), which would be contrary to the spirit of the nation's equity and transformation policy. Universities would be unable to fill the classes, and it would probably be the educationally disadvantaged students who would be excluded. As noted by Mitchell *et al.* (1997), the mark students obtain measures not only their intellect, but reflects socio-economic and family circumstances, the academic environment in which the schooling was done, the encouragement received, the value the family placed on academic achievement, and students' commitment and interest to achieve good marks. Studies reported much later into the South African democracy (Zaaiman, van der Flier & Thijs, 2000; van der Fliers, 2003) consistently showed that first-year students who scored at least a higher grade D in matric Mathematics were more likely than others to succeed in science-based courses at university.

The argument of Mitchell *et al.* (1997) that it is important in terms of equity and transformation, for universities to admit students with lower pass marks, but to ensure that such students have academic support to make their university experience worthwhile, does have some credibility.

Learning strategies and behaviours

The second cluster of 'personal factors' emerging from the literature on factors influencing academic success, as depicted in Figure 1.3, is associated with learning strategies and behaviours. These include metacognition (Flavell, 1979; 1981, 1987), use of appropriate work-habits (Britton & Tesser, 1991; TeBeest, 1998; Lahmers & Zulauf, 2000), the application of appropriate study skills (Pantages & Creedon, 1978), and different approaches to learning (Meyer, 1990; Case & Fraser, 2002; Case & Gunstone, 2002).

Metacognition

Metacognition is one[15] of the factors I have discussed in more detail in Chapter 2, which deals with the theoretical framework for the study. Here I simply report on research findings. The literal meaning of 'metacognition' is 'one level beyond cognition'. So metacognition is any knowledge or thought process that monitors, or controls any aspect of cognition (Butler & Stevens, 1997). A distinction is often drawn between metacognitive knowledge and metacognitive regulation (Flavell, 1981). Knowledge is said to be metacognitive if it is actively used in a manner to ensure that a goal is met (Livingston, 1996). Researchers maintain such knowledge can be used to help students "*learn how to learn"* (Flavell, 1981; Harker, 1990; Grayson, 1996). Various studies reported in educational literature have focused on the metacognitive regulation aspects (e.g. Pintrich & De Groot, 1990; Pintrich, Smith, Garcia &

states" or "independent states". Each of these areas had its administrative education department that reported to a central department for each race group.

[15] The other factors are attitudes and motivation

McKeachie, 1993). Moderate correlations (in the region of r = 0.30) between self-regulation and academic success have been established in quantitative studies (Pintrich & De Groot, 1990; Pintrich *et al.*, 1993; Vermunt, 1996). Wolters (1998), Case, Gunstone & Lewis. (2001) and Davidowitz & Rollnick (2003) used qualitative data-gathering techniques (open-ended questionnaires, observations, interviews) asking students to respond to learning scenarios in order to gain insight into their strategies for studying. These qualitative techniques, when properly designed, have been valuable in providing insights on the nature of factors influencing students' success.

Work-habits and study skills

Work-habits are defined as regular behaviours students use to modify or structure their learning environment or manage their time (Devine & Meagher, 1989). Devine & Meagher identify three components of students' work-habits that can be structured to improve performance: study environment, time management skills and attitudes. "Work-habits" and "study habits" have tended to be used synonymously in educational literature (see Devine & Meagher, 1989; TeBeest, 1998). There is a third term "study skills" which shares common functions with the two terms. Tobin (1988) defines study skills as 'acquired abilities' used in learning. Rothenburg (1991, p. 4) defines study skills as abilities "*used to acquire, organize, understand, remember and express any information*" when students learn. I argue, based on these definitions that the three terms need to be considered as complementary. Leggett, Kinnear, Boyce & Bennett. (2004) classified the many study skills found in the literature into four core skills: *communication*, *critical thinking*, *computing* and *team work* skills, and claim proficient use of study skills gives students greater mastery and independence in the learning process.

Researchers have consistently shown positive relationships between use of study skills and academic success at primary school level (Akinoglu & Yasar, 2007); secondary school level (Jones, Bell & Saddler, 1991; King, 1992; Jones, Slate & Kyle, 1992; Jones, Slate, Blake & Holifield, 1992); undergraduate tertiary level (Agnew, Slate, Jones, & Agnew, 1993; Jones, Slate, Mahan, Green, Marini & DeWater, 1994) and post-graduate level (Onwuegbuzie, Slate, & Schwartz, 2001). The recommendation of Beder (1997) that students be introduced early enough to use study skills, which helps to develop their abilities in their educational careers, is therefore important.

Time is a limited resource for students in tertiary institutions, and managing time in academic institutions is seen by students as important in preparation for class assessments (Drew, 2001; McKenzie & Schweitzer, 2001) and submission of papers (Onwuegbuzie, Slate, Paterson & Schwartz, 2000). Britton & Tesser (1991) found that when students spent less time on non-academic goals it allowed them to plan their time more effectively and attain higher academic goals.

Approaches to learning

Students' approaches to learning have been claimed to influence their academic performance (Entwistle, 1997; Case & Marshall, 2004). The term *approaches to learning* (Marton, 1976; Marton & Säljö, 1984) refers to what students do (strategies) and why they do it (intentions) when performing academic tasks. Cano (2005) suggests these conceptions are based on epistemological beliefs (what individuals believe about the nature of knowledge and learning). Originally used in the reading environment, the *approaches to learning* concept has been expanded to other learning environments to explain various learning behaviours students exhibit (Ramsden, 1979; Entwistle & Ramsden, 1983). Marton & Säljö (1997) identified five (later six) conceptions of learning of students at universities and categorized them as: *quantitative increase in knowledge, acquisition of facts, abstraction of meaning, processes of understanding reality,* and *development as a person*. These different ways of understanding learning are believed to underpin three basic approaches to learning (Marton, 1976; Ramsden, 1983): *a surface, a deep* or *a strategic approach*. Of the three approaches deep learning is associated with a holistic, meaning-oriented style of learning, and students being intrinsically motivated (Entwistle & Tait, 1990; Case & Marshall, 2004). A surface approach is associated with a cautious narrrow stance, fear of failure and attempts made by students to reproduce the material (Hazel & Prosser, 1994; Entwistle, 1997; Marton & Säljö, 1997; Prosser & Trigwell, 1999). A strategic approach to learning is associated with students' use of both deep and surface approaches when appropriate, and is evidenced within competitive academic environments by students who are oriented to achieve (Entwistle & Tait, 1990). Students who use a strategic approach might use different strategies in different contexts, depending on the nature of the task.

Schommer (1994) hypothesized that as individuals mature and go through the education process, their epistemological beliefs evolve and are influenced by their degree of education and maturation. Cano (2005) confirmed this epistemological development among 1600 Spanish high school learners. Holtman, Marshall & Linder (2004), in South Africa, showed that students' epistemological beliefs can be developed by structuring the curriculum and the teaching and learning processes that take place at the university, and these in turn positively influence learning approaches students use.

Although researchers agree that the adoption of deep approaches to learning promotes academic success there is not universal agreement on the defining features of deep approaches, especially within different disciplines (e.g. Richardson, 1994; Entwistle, 1997). Biggs & Moore (1993), in exploring the ambiguity implied in the use of the term, note that for situations requiring accurate recall of information, such as when 'learning lines in a play', rote learning may not imply a surface approach but rather a deep memorizing approach. In contrast, rote learning for an exam may be seen as a surface approach if the intent is to reproduce information. The paradox of Asian learners, where a surface approach is used to augment understanding, is a case in point and provides support for researchers not to label surface approaches as being unproductive (Biggs, 1996; Entwistle & Entwistle, 2003). Students have used both approaches mindful of the outcomes required, and have been successful (Entwistle & Entwistle, 2003; Zeegers, 2004).

Despite the plethora of studies (e.g. Ramsden, 1987; Richardson, 1994; Drew, 2001; Case & Gunstone, 2002) on students' approaches to learning and the impact of the approaches on academic performance, the research has not been without criticism. The fundamental beliefs underpinning the *approaches to learning* literature are rooted in cognitive psychology (Case, 2008), and in terms of epistemology it is positivistic in outlook which is not agreeable to some post-modern researchers (see Webb, 1997; Haggis, 2003). Haggis (2003) believes that *approaches to learning* ideas are elitist and limited in academic goals and values. In an educational climate that supports massification, she believes a theory with a socio-cultural slant would better address the academic needs of most students that presently are admitted to tertiary institutions. The alienation theory suggested by Mann (2001) is proposed by some researchers (see Haggis, 2003; Case 2008) to offer better potential to understanding factors influencing students' academic performance at tertiary institutions. Alienation theory is discussed further on page 16.

Psychological factors

The third cluster of 'personal factors' emerging from the literature on factors influencing academic success (Figure 1.3) are predominantly *psychological* in nature and include the psychological health of students (Rickinson & Rutherford, 1995), and personality traits relating to socialization and responsibility for learning (Van Eeden, de Beer & Coetzee, 2001).

Psychological health

The psychological health (absence of depression, low anxiety, and low stress levels) of students has been indicated as important for academic attainment (Rickinson & Rutherford, 1995; Ballantyne, 2000). McKenzie & Schweitzer (2001), in an Australian study, found that the time at which data were collected was important in predicting whether stress or anxiety levels predicted academic success. They found that the influence of these variables would peak (and be significant) at particular times of the year, such as examination periods.

Personality traits and students' responsibility for their learning

Students, as they get involved in the university life, form social bonds. They develop a sense of belonging in the community, and an appropriate identity (Loo & Rolison, 1986; Beder, 1997). This process of socialization and integration, according to Beder (1997), is rather complex and involves students' personality traits, experiences and perceptions of behaviours at the university.

Mature students, because of their personality traits and social contexts, are found to become less easily integrated into the university community than younger ones (McInnis *et al.*, 1995). This condition of not being 'socialized' can be either advantageous or disadvantageous to older students. McInnis *et al.* (1995) reported, in an Australian study, that mature students reported being overwhelmed by their own ignorance and were not able to adjust well to the university environment because of the poor communication links they had established with classmates.

Students with stronger student identity had a higher academic orientation and were generally able to deal with academic issues positively (McInnis *et al.*, 1995).

Social factors

The fourth cluster of 'personal level' factors emerging from the literature on factors influencing academic success (Figure 1.3) is predominantly social in nature and includes cultural capital[16] (McInnis *et al.*, 1995; Goodwin, 2002), students' alienation or engagement (Mann, 2001; Haggis, 2003), maturity of students (Stoker *et al.*, 1985; McInnis *et al.*, 1995; McKenzie & Schweitzer, 2001; Zeegers, 2004) and extracurricular activities (Tinto, 1975).

Cultural capital

One of the constructs that has been widely used to explain the influence of social factors on academic success is cultural capital (Wood, 1998; Russell & Atwater, 2005). "Capital", defined in a broader context, includes *"goods, symbols and status that present themselves as rare and worthy of being acquired in a particular social group"* (Bourdieu, cited by Harker, 1990, p. 3). Wood (1998) explains cultural capital as the cognitive resources students acquire through their upbringing which makes schooling comfortable and easy to master. Cultural capital, in terms of the level of family support (McInnis *et al.*, 1995; Fraser & Killen; 2005; Russell & Atwater, 2005); and academic goals of the family (McInnis *et al.*, 1995; Goodwin, 2002) have been found to influence academic success.

Whilst parents can generally be supportive assets they could be also a source of stress if their relationship with their children turns sour. As explained by Willson, Ackerman & Malave (2000), some students may find this relationship a negative influence when they try to assert their independence from parental influence.

Student alienation

Alienation describes a situation where students become disconnected or isolated in the learning process (Brown, Higgins & Paulsen, 2003). Such students tend not to fit or engage successfully in the higher education community (Mann, 2001). Various factors leading to alienation of students at tertiary institutions include curricular, institutional and socio-cultural factors (Mann, 2001; Huffman, 2001; Redden, 2002; Brown *et al*., 2003). Newmann (1981) lists four consequences of student alienation as powerlessness, normlessness, meaninglessness and social isolation. Students experience powerlessness when they perceive the absence of personal control in learning. Students experience normlessness when they perceive lack of rule-governed behaviour at the institution, and meaningless when they interpret the curriculum and find that it is not in line with their current perceptions and future needs. When students feel lonely and socially separated from peers and teachers, they become socially isolated.

[16] The term cultural capital is used in the literature, although this factor seems to be a social one rather than a cultural one.

Findings based on alienation have been used to explain why students demonstrate undesirable learner outcomes such as academic failure in institutions (Taylor, 2000; Redden, 2002; Thorpe, 2003). Mann (2001) and Case (2008) have proposed that *alienation* and its associate term *engagement* could better help explain academic performance of students from a socio-cultural perspective than the *approaches to learning* research.

Maturity of students

The age, or more specifically the maturity level, of students admitted into universities has featured in discussions on factors influencing academic success. The age at which students enter universities varies from country to country and this translates into students' maturity or academic readiness in such institutions. The average age at which most students enter universities in countries such as America and South Africa is about 18 (Mitchell & Fridjhon, 1989; Shah & Burke, 1996); Australia, has a two-tier admission system. According to McInnis *et al*. (1995), there are the young entrants of about 18 or 20 years who come in immediately from school, and a dominant population of mature students who enter universities years after completing secondary school.

Positive correlations between maturity of students and academic success have been reported in several studies (e.g. Stoker *et al.*, 1985; McInnis *et al.*, 1995; McKenzie & Schweitzer, 2001; Zeegers, 2004). Stoker *et al.* (1985), citing Gous, state that the youthfulness of 18 year-old students admitted into South African universities was blamed in 1982 by the Committee of University Principals and Rectors for contributing to the low first-year success rates. As a result, recommendations were made to reduce from 34 to 20 the percentage of 18-year-old students who were accepted into South African universities (Gous, cited by Stoker *et al*., 1985). Shah & Burke (1996), in an Australian study, found that 20 year-olds had a higher chance of completing their courses successfully than did 18 year-olds. McInnis *et al.* (1995) claim mature students, possibly because they have career orientations or lower social integration needs, are more likely to achieve higher academic success than the younger students are. Zeegers (2004), in an Australian study, found students less than twenty years of age tended to have higher self-efficacy (perceived capabilities) than the 20 year-olds, but this did not seem to translate into higher academic achievements. Zeegers (2004) believes that older students (20 and above) were more likely to have a deep approach to learning than the 18 year-olds and this gave them an edge over the younger students. Maturity in these contexts implies students have the psychological readiness and developed cognitive abilities to be able to use the knowledge and skills requisite for academic success.

Extracurricular activities

Important features of social life at the university are the extracurricular activities: sports, hobbies, dating, participation in student government (Tinto, 1975). Research in this area, however, does not provide a clear picture of the effects of participation in these activities on academic success. It is plausible that the students' extent of involvement in extracurricular activities will probably affect students' academic performance, especially for students proven to have weak academic abilities.

Cultural factors influencing academic success

The major cultural factors in this fifth cluster of 'personal factors' (see Figure 1.3) that influence academic success at tertiary institutions include communication skills in the medium of instruction (Coley, 1999; Holder, Jones, Robinson & Krass, 1999) and cultural values and beliefs of groups (Graham, 1994; Simpson, Koballa, Oliver & Crawley, 1994; Wood, 1998; Perna & Thomas, 2008).

Cultural values and beliefs of families or societies

Simpson *et al.* (1994) see values and beliefs as culturally linked, although they can vary greatly among individuals from the same cultural group. Wood (1998) found that values are important in educational settings when different cultural groups are characterized by different values, beliefs and practices which affect learning, and argues that such differences lead to greater academic success of some students than others (Wood, 1998). The superior performance of many Asians in mathematics and science courses seems to be related to their cultural values of working in groups, persistence at tasks, and sharing know-how (Treisman, 1992; Perna & Thomas, 2008). Such cultural values have rekindled debates on how other racial groups can inculcate such values and work ethic to improve performance in mathematics and science (Treisman, 1992; Gandara & Maxwell-Jolly, 1999).

Communication skills in the medium of instruction

In most English-speaking countries, competency in the English language is required for coping with the multiplicity of tasks at the world of work and at tertiary institutions. Several studies have indicated that students do not enter universities well-equipped with the literacy skills for university work (Coley, 1999; Holder *et al.*, 1999; Richardson, 2004; Zeegers, 2004). The problems seem to be peculiar to foreign students (Coley, 1999; Zeegers, 2004) or individuals whose mother-tongue differs from the language of tuition in their own countries, such as in South Africa (Moll & Slominsky, 1989; Wood, 1998; Boughey, 2000; Van Eeden *et al*., 2001).

Volet, Renshaw & Tietzel (1994) found that with international students in Australia their weak command of English had the greatest negative impact on their achievement in the first year of study. This disadvantage disappeared by the third year in environments where students were given the necessary scaffolding instruction. According to Zeegers (2004, p. 53) this "*familiarization and confidence*" building in English offered to students whose mother tongue is not English could help students deficient in English language skills to cope academically.

Whilst researchers are concerned over the inadequacy of communication skills of some students, and have placed a premium on the improvement of such skills (Miller, 1998; Holder *et al.*, 1999), it is worrying to note that students in a South African study (Fraser & Killen, 2005) did not give much prominence to the importance of written communication skills. These students rated effective written communication skills very low (27 out of 34) in their ranking of factors considered important for academic success (Fraser & Killen, 2005). Students who are not aware of the importance of communication skills in English as a discourse will not realize they must work on their deficiencies and acquire mastery of the discourse. Boughey (2002) suggests a change in mainstream teaching to afford students the opportunity to construct a better understanding of the written English language as the discourse. Richardson (2004) believes the writing and reading of the academic discipline at universities should accommodate the cultural context, for it to be appreciated by the students.

Affective factors

The sixth cluster of 'personal factors' identified after reading the literature on factors influencing academic success deals with affect or emotions. Affective factors are those associated with "feelings" (Simpson *et al*., 1994) and include a host of constructs such as perceptions, attitudes and motivation, which Koballa & Glynn (2007) state are considered by researchers as the most critical constructs of the affective domain in science education. Perrier & Nsengiyumva (2003) point out that attitudes and motivation are not just catalysts for learning to occur but a necessary condition. The impact of this cluster of constructs on academic success is discussed in this chapter and in Chapter 2, where they form part of the theoretical framework used in this study.

Students' perceptions

Students' satisfaction with the level of teaching has been shown to be associated with academic success (Treisman, 1992; McInnis *et al.*, 1995; Drew, 2001; Russell & Atwater, 2005). Maton, Hrabowski & Schmitt (2000, p. 630), reported on studies in America, which found freshman classes in Science, Engineering and Mathematics to be large, "*lecture-based"*, "*fast paced*" and "*generally unmotivating*" and concluded these conditions were likely to wear down students' initial interest, and negatively impact on their success. Drew (2001), in a study in Britain, and Killen and Fraser (2002), in a South African study, reported that students preferred teaching styles that had clarity of aims, and which encouraged interaction between lecturers and students.

It is important to realize that many students do achieve the necessary academic outcomes under non-stimulating class conditions. The lack of motivation of some students is a consequence of their perceptions and attitudes. Because it is not solely a direct teaching matter, but a reflection on students' personality traits such as attitudes, lecturers should focus on changing inappropriate attitudes of unmotivated students.

Attitudes

A number of studies and reviews have looked at the relationship between attitudinal constructs and achievement (e.g. Willson, 1983; Willson *et al*., 2000; Papanastasiou & Papanastasiou, 2004). Stipek & MacIver (1989) predicted students' self concept would produce expectations and so guide their behaviour, and Simpson & Oliver (1990) found that high school students self-concept in one grade significantly predicted their achievement at a higher (11^{th}) grade.

Willson (1983) used a statistical analysis on a sample of 43 studies from 21 countries to establish the degree of correlation between attitudes and achievement and other independent variables. The sample, categorized as elementary, secondary (junior secondary, senior secondary) and college, was examined separately and jointly. Willson (1983) found that for high school and college students attitudes weakly predicted later achievement (coefficients between 0.2 and 0.3). Other studies (Simpson & Oliver, 1990; Simpson *et al*., 1994; House 1995; Freedman, 1997, Willson *et al.*, 2000; Papanastasiou & Zembylas, 2004) have confirmed the modest relationship between attitudes and achievement at senior levels. The general finding from the correlations studies, as noted by Willson *et al*. (2000, p. 113), is that the correlation of *"…attitudes to achievement declines with public school advancement*."

The literature reviews and statements about the relationship between science attitudes and achievement would have led one to expect a high positive correlation coefficient. However, as found by the researchers, the coefficients tend to be weak. Reasons suggested for weak associations between attitudes and achievement scores identify the impact of alternative variables which include the perceived difficulty of science (Osborne, Simon & Collins, 2003), lack of effective teaching (Osborne *et al*., 2003; Papanastasiou & Zembylas, 2004), cultural attitudes towards science (Papanastasiou & Papanastasiou, 2004; Papanastasiou & Zembylas, 2004), and motivation to behave in a different way (Osborne *et al.*, 2003). Stated in another way, students' background variables (race, country, home environment, amount of homework done) have all contributed to some degree to their achievement scores (Schibeci & Riley, 1986; Willson *et al*., 2000) and therefore weakened the correlationship with attitude. Weak scores in relation to students' attitudes is important to remember in terms of my expectations about the attitudes of my sample of students after they have used the *Bioskills* programme.

Academic intentions

Research studies indicate that some students tend not to be able to carry out their intentions (Moore, 2006; 2007). Moore (2007) found that at the start of the year for a biology course in the USA, students claimed they would attend an average of 90% of classes, 90% of laboratory sessions, and would earn a final course grade of 89%. More than three quarters claimed they would attend at least one help session, and 81% of students indicated they would take advantage of extra-credit opportunities. Moore (2007) found, however, that only 24% did one or more of the extra-credit assignments. However, students who submitted assignments also attended lectures regularly. A distressing observation was that none of the 43 students on academic probation submitted additional credit-earning assignments. A common reason given by students was that they did not have enough time to do the work. However, Moore (2008) found that academically successful students used this excuse far less than weaker students, suggesting that these students scheduled and used time more efficiently than students earning lower grades. In addition, low achieving students work more slowly, and when they are provided with extra remedial tasks they have more work to do than the average student (Rollnick, 2010).

Motivation

There are a number of constructs in the literature reviewed which relate to student motivation. One such construct is self-efficacy, which refers to students beliefs about their capabilities to learn and perform at chosen levels (Bandura, 1997). Studies show that self-efficacy predicts students' academic motivation and learning (Pajares, 1996; Schunk, 2003). Self-efficacy has been positively related to higher levels of achievement and learning (Schunk, 2003). High self-efficacy beliefs were found to be positively related to students' cognitive engagement, such as the use of study skills and the grades earned (Pintrich & De Groot, 1990; Pintrich, 2000). Students who have more positive self-efficacy beliefs (i.e. those who believe they can do the task) were more likely to work harder, persist at tasks, and eventually achieve at higher levels (Eccles, Wigfield & Schiefele, 1998; Schunk, 2003).

Personal interest, measured as continued engagement, has been interpreted as an indication of students' intrinsic motivation (Breen & Lindsay, 2002; Hidi, 2006; Young, 2007). Young (2007) suggested that evidence of mastery goals was predictive of students' personal interest. In identifying situational interest, researchers looked at the students' reactions to different instructional techniques. Breen & Lindsay (2002) found that students' motivational performance differed across disciplines. These findings have been supported by Bong (2004), and Chiu & Xihua (2008).

In the literature on mastery and performance goals, the general theoretical assumption has been that mastery goals[17] encourage a number of beneficial motivational, cognitive and achievement outcomes (Nolen & Haladyna, 1990; Archer, Cantwell & Bourke, 1999). Performance goals[18] generate less adaptive or even maladaptive outcomes (Nolen & Haladyna, 1990; Ames, 1992; Haynes, Daniels, Stupnisky, Perry & Hladkyi., 2008). Nolen & Haladyna (1990) found the positive orientation to mastery goals to be strongly related to deep processing of information. Studies by Eppler & Harju (1997) and Tuominen-Soini, Salmela-Aro & Niemivirta (2008) found that most successful students in terms of GPA scores were those who rated mastery goals higher than performance goals.

Harackiewicz, Barron & Elliot (1998) found that the environment has a moderating effect on both types of achievement goals. They investigated college students in an introductory psychology class over the semester, and measured students' achievement goals early in the semester, using a self-report questionnaire. Mastery and performance goals were found to have positive effects on interest and performance, with no evidence of negative relation between performance and interest. They reported, however, that the adoption of performance goals at the outset of class positively related to final grade in the course and found it advantageous for students to adopt both mastery and performance goals (Harackiewicz *et al.*, 1998).

[17] Mastery goals orient learners to develop new skills to master tasks, and to improve on their own previous performances (Nolen & Haladyna, 1990).

[18] Performance goals orient students to focus on their abilities, which they demonstrate by outperforming others in grades or achievement (Nolen & Haladyna, 1990).

1.5.2 Factors operating at the institutional level

The variables discussed in section 1.5.1 operate at the personal level of the student (see Figure 1.3). Four clusters of factors have been created from the literature reporting on institutional level influences on student success. These include variables within the pedagogical environment (Maton *et al*., 2000; Clifton *et al.*, 2004; Fraser & Killen, 2005; Russell & Atwater, 2005), financial support and bursaries available (Maton *et al.*, 2000; Herzog, 2005; Rollnick, 2010), social integration (Clifton, Etcheverry, Hasinoff & Roberts 1996; Russell & Atwater, 2005), and the broader institutional culture of learning (Zhao & Kuh, 2004; Clark, Dodd & Coll, 2008; Perna & Thomas, 2008).

Pedagogical environment

The pedagogical environment is the teaching atmosphere at institutions through which institutional policies and priorities, academic skills, and content knowledge are transmitted to students (Clifton *et al.,* 2004). There are two aspects of the pedagogical environment: cognitive demands (Clifton *et al.*, 2004; Fraser & Killen, 2005) and social support (Loo & Rolison, 1986; Clifton *et al.*, 1996; Russell & Atwater, 2005), as discussed below.

Cognitive demands

Clifton *et al.* (2004, p. 802) define cognitive demands as the "performance expectations" that lecturers or tutors communicate to students. They found, from a Canadian university study (n = 854), that lecturers, as part of their "cognitive demands", focused on both comprehension of information and evaluation of arguments from their students and placed even more importance on these from senior students.

Fraser and Killen (2005) reported that lecturers' perceptions of factors influencing academic failure were seemingly different from those of students, in two studies conducted in South Africa with over 1300 students. The authors argued that these differences in perceptions between students and lecturers were likely to create misunderstandings and conflicts between them as to what institutional expectations were. Fraser & Killen (2005) stressed the importance of lecturers and students engaging in dialogue to clarify their beliefs and expectations and to develop common strategies to increase students' chances of academic success.

Holtman *et al.* (2004) reported on curriculum reforms in a first-year university physics course in South Africa that placed different cognitive demands on students. Students were required to master contemporary 'ground rules' of the discipline. The ground rules involved values and attitudes and new ways of thinking and doing physics that were believed to foster academic success. The impact of this innovation on student learning led to shifts in their approaches to learning and improved pass rates in physics for the students (Holtman *et al.*, 2004).

Social support

Social support relates to the encouragement, academic or otherwise, provided either by lecturers (Loo & Rolinson, 1986; Russell & Atwater, 2005) or other students (Clifton *et al.*, 1996; Russell & Atwater, 2005) concerning course work. Clifton *et al.* (1996) found that lecturers, by their encouragement, definition of performance expectations and explanations of policies of the institution, contributed significantly in improving the grade point average of students in a study in Canada. The lack of social support often leads to sociocultural alienation (Loo & Rolinson (1986) and this has played a role in dropout behaviours among ethnic minorities in predominantly white schools in the United States of America. When student are able to interact with other students from similar ethnic subcultures such relationships allow them to form social subcultures which in turn foster integration within the overall student community (Loo & Rolinson, 1986).

A number of institutional measures can be put in place to counter perceived sociocultural alienation, especially of minority students, to promote academic success. Loo and Rolison (1986) suggest a higher representation of the minority groups in the student population, the presence of a residential or academic community on campus that provides social and cultural support, and increased numbers of academic staff to whom students can comfortably relate.

Social integration

Social integration of students in institutions with culturally diverse populations, such as the United States of America, has been reported to influence academic success in a number of studies (Tinto, 1975; Pascarella & Terenzini, 1983; Rickinson & Rutherford, 1995; Baillie, 1997), although McKenzie & Schweitzer (2001), in an Australian study, found that social integration was a weak predictor of academic success at university. Baillie (1998) found that the ready availability of accommodation at institutions encouraged social integration. McInnis *et al.* (1995) found that a greater percentage of students who studied in groups got average marks, whilst students who tended to be less social in their academic work either achieved the highest or lowest marks in the class. Whilst it is the quality of work done as individuals or as groups that is important, it does seem that strong students often do not like working in groups, and poorly performing students who are socially inept cannot get into groups (Lazar, 1995).

Institutional culture of learning

A factor that researchers (e.g. Tinto, 1975; Rickinson & Rutherford, 1995; Russell & Atwater, 2005) believe could illuminate our understanding about why some individuals fail and others succeed at tertiary level is the institutional culture of learning. The presence of a strong culture of learning is one of the features of successful institutions (Zhao & Kuh, 2004). Such institutions are characterized by a high degree of student engagement, enculturation, and high through-put rates (Kuh, Kinzie, Schuh & Whitt, 2005; Kuh, 2007; Clark *et al.*, 2008). Kuh *et al.*, (2005) point out that what institutions do to “induce” learning contributes to student *engagement* with learning and the culture of learning at the institution. Five benchmarks can be used to identify effective institutional practices (Styrdom & Mentz, 2010): level of academic challenge at the institution (how students perceive the nature of academic work at the institution); how active and collaborative learning, in and out of class, is promoted at the institution; the extent of student interaction with staff members, in and out of class; the level of enriching educational experiences available at the institution, and the supportive nature of the campus environment (how students experience the environment both physically and psychologically). Using a National Survey of Student Engagement (NSSE) instrument, researchers identified institutions with higher than average rates of student engagement in the United States of America, and have suggested what could be done to improve the culture of learning in institutions with lower than average rates (Kuh, 2001; Kuh, Kinzie, Schuh & Whitt, 2005).

In a pilot study involving seven tertiary institutions in South Africa, and using a similar instrument (SASSE[19]) Strydom & Mentz (2010) reported a range of perceptions of students (n = 13,636) about the institutional culture of learning. Although, a pilot study, there is a lot to learn from the results, which suggest areas that institutions in South could pay more attention to in order to promote conditions for students to become more engaged in learning.

Financial support and bursaries

Sufficient funds to finance academic studies constitutes the economic capital required to be in good standing at universities (College of Science, 1996; Herzog, 2005). Students have been excluded from universities due to their inability to pay university fees (St John, 2000; Herzog, 2005). Students from families of low socio-economic status in the United States of America and South Africa reported that financial support, in terms of bursaries and monthly stipends granted them, influenced their academic performance (e.g. College of Science, 1996; Wood, 1998; Paras, 2001; St John, Paulsen & Carter, 2005; Russell & Atwater, 2005). Maton *et al*. (2000) state that beneficiaries of financial awards in their American study cited the absence of financial worry as one of the reasons for their persistence at the institution and their success. Whilst availability of funds does not affect success directly, it can induce some students to work harder and benefit in the long term from the funds made available (Herzog, 2005).

Based on the researcher's observations, and supported by the observation of D. Matlou[20] (personal communication, April, 2000) in South Africa casual jobs or weekly jobs with sufficient remuneration have not been readily available for many university students, especially those of colour. Needy students have tended to rely on full package financial aid and bursaries granted them by government and financial institutions to sustain them and see them through their academic studies (College of Science, 1996). When financial grants are late students become concerned and insecure and this negatively influences academic success (College of Science, 1996). This is an area of concern for student counsellors, and needs to be addressed within institutions.

[19] South African Survey of Student Engagement
[20] The Academic Counsellor in the College of Science, University of the Witwatersrand

It could also be asked why students cannot work to save money and then come to university later, as in countries like Australia. Unfortunately, the culture of working for some time before coming to the university is not common in South Africa. The culture of expectation that the government will finance tertiary studies seems entrenched in some sectors of the society, and many from poor homes are not able to obtain support, due to lack of adequate collaterals, from financial institutions. As a developing country with dwindling resources, it may be more appropriate for aspiring university students to first earn money to fund their studies.

1.5.3 Factors operating at the national level

Factors affecting academic success operating at the national level are government educational policies which express concern for education or demand success for its citizens in education (e.g. McKenzie & Schweizer, 2001; Department of Education, 1997; Department of Education, 2003). In Australia and Great Britain the national policies have called for increased intake of students as part of their educational reforms (McKenzie & Schweitzer, 2001) to meet the increased skill needs of both countries.

In South Africa, the South African White Paper 3 on Higher Education (Department of Education, 1997) called for a rapid transformation of higher education to redress past inequalities of representation of students from previously disadvantaged populations. The policy demanded that institutions increase their output of students of colour to augment the reported shortage of highly trained graduates in the fields of science, engineering and technology. The Department of Education recognized the importance of access and foundation programmes in improving output and made funding, linked to throughput, available to institutions involved in such initiatives (Department of Education, 2003). Another policy enacted, and serving the same goal, is the introduction of information and communication technologies in higher education as an agent of change to equip greater numbers of formerly disadvantaged students to enhance their academic studies at universities (Department of Education, 2004).

Successful implementation of the first-mentioned policy at the institutional level in South Africa would require institutions to use more favourable selection criteria without compromising admission standards (University of the Witwatersrand, 2003). Administering interventions and monitoring throughput levels so that the critical numbers of graduates can be produced is essential. It would require recognizing the diversity of needs and catering for this changing group of students. The focus of action, as stated by Power *et al.* (1987, p. 3), should not only be on "…*admitting a wider range of students, but giving them the support and help needed to ensure a reasonable chance of success*". Admitting students without the necessary support would be tantamount to a revolving-door policy without ensuring epistemological access (Morrow, 1994). Boughey (2002) explains epistemological access as vital to sustain knowledge construction and to grow the numbers of underprepared university students at tertiary institutions. Some institutions have, for years, been aware of the need to grow the numbers of adequately qualified underprepared students graduating from their institutions. The ways in which the university involved in this study has tried to do this over the last three decades are described in Section 1.6.

1.5.4 Interactions of factors influencing academic achievement

The variables discussed above may be perceived to operate independently (Figure 1.3). However, it should be borne in mind that many variables affecting success interact within a level and sometimes interact between personal, and institutional and national levels (Clifton *et al.*, 2004; Zeegers, 2004). For example, as shown in Figure 1.3, "financial support" and "policies" are factors acting at all three levels. The values and goals of institutions and how compatible they are with the students' personal and cultural values, goals and attitudes (McInnis *et al*., 1995) can be one disconcerting factor. For example, the academic environment may influence students' psychosocial dispositions which in turn influence academic performance (Clifton *et al.*, 1996).

The number of factors influencing academic success, either independently or interacting with other factors, suggests that interventions that focus on one or two factors may not result in anticipated outcomes. A holistic approach should be adopted. As stated by Pascarella & Terenzini (1998).

> "…[r]*esearch approaches that try to isolate the influence of a few variables for all students will simply miss the point and probably provide little in the way of useful, practical or policy relevant evidence*". (Pascarella & Terenzini, 1998, p. 155)

1.6 SUPPORT AT THE UNIVERSITY FROM THE 1970S TO THE PRESENT

Institutional support programmes have been instrumental in trying to address educational problems of students arising from inadequate schooling in countries such as the United States for over a century (Tinto, 1975). In South Africa institutional support at the post-secondary level was more recently implemented compared to that in the USA (Hunter, 1991). Commenting on the distribution and popularity of the such programmes in South Africa in 2001, Pinto (2001) pointed out that almost all the estimated forty[21] tertiary institutions in South Africa were offering access programmes in science to students from disadvantaged backgrounds. Rollnick (2010) states that science support programmes were interventions aimed at breaking the cycle of poor performance by academically underprepared students, predominantly blacks, in science.

Although many South African institutions have been involved in support programmes for at least the last thirty years, I have used one institution as an example to illustrate the changes that have taken place in trying to support students. The following review highlights the genesis and developmental phases of "bridging" programmes in the Faculty of Science at the University of the Witwatersrand, where this study was conducted. This review is set against the backdrop of the three (out of four[22]) development models – "deficit, change, and development" – suggested by Moulder (1991). According to Moulder (1991, p. 8) each of these models addresses the *"institution's answers to different questions"* regarding the type of remediation being provided at the institution. As will be noted in this

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[21] This figure is based on the number of delegates from different institutions in South Africa registered at the Science, Engineering and Technology Foundation Programmes "Indaba" in 2001.

[22] The fourth is the problem-solving model. It is not applicable to the context being described. In this model, problem solving is valued as a means of overcoming problems associated with students' growth, academic changes and institutional deficiencies. The curriculum is flexibly structured to deal with issues in education as they arise.

review, and as hinted at by Moulder (1991, p. 8), the demarcation between these models was often "*muddled*" having not been "*guided by an overall conceptual framework*".

1.6.1 The deficit model

This is a remediation approach which attempts to identify knowledge and skills that entrants did not acquire at school and provide these, either during bridging programmes (before students begin to study for a degree) or in addition to the lectures and tutorials in support programmes (Moulder, 1991). In this context, the educational system in South Africa has had an academic gap existing between the secondary and tertiary levels even in the apartheid period (College of Science, 1992). According to this report this gap meant that only a minority of students completed their basic science degree in the stipulated three-year period. In an attempt to bridge the gap and promote greater pass rates at tertiary level, science, engineering, and technical education at post-secondary levels were singled out by educators, for national economic reasons, as areas to be strengthened (College of Science, 1992).

The University of the Witwatersrand's interest in bridging programmes can be traced back to 1970, with the inception of the Intermediate Year programme in the of Science (Bradley & Stanton, 1986). According to a College of Science report (College of Science, 1992), at its inception 100 students identified as at-risk benefited from a special one-year bridging course in mathematics, physics, chemistry, biology, and communication, prior to entering the three-year B.Sc. programme. This project lasted for three years but was discontinued for not being cost effective (Bradley & Stanton, 1986).

The commitment of the Faculty of Science to improve throughput can be seen in the various solutions attempted after the demise of the Intermediate Year Programme. This included the Pre-university School (Gerrans, 1986), in which students were enrolled for a short four-week[23] course in preparation for the degree programme. There was also the Summerbridge Science Project in 1986, which was specially tailored to address basic language and study skills of students from inadequate school backgrounds, over a four week period (Gerrans, 1986).

Although these early experiments with bridging courses targeted a small number of students the stage was set to expand the programme to larger student groups. The educational principle was in line with the deficit model of academic support which recognizes that achievement gaps do exist between the many students from deficient educational backgrounds, and attempts to minimize the gap (Moulder, 1991).

The support of the University of the Witwatersrand[24] for equity and transformation in higher education was another factor that led the Faculty of Science to initiate the establishment of academic support programmes in various departments (Bradley & Stanton, 1986). Established in 1980, Bradley & Stanton (1986) claim that these support programmes were primarily directed at some members of the black racial group who, although "elites" from their cultural groups, were disadvantaged in having

[23] The session was held in January and February of each year, and continued for eleven years.

[24] The University of the Witwatersrand often worked in league with other liberal "white" universities, which included the University of Natal, University of Cape Town, and Rhodes University.

come from the inadequately resourced schooling backgrounds (Bradley & Stanton, 1986). Coming to the university may thus be seen as a sort of "border-crossing" (Aikenhead, 1996) in which these students moved across the cultural borders from their schools into the sub-culture of science at the university (Clark *et al.*, 2008). Functionally, the academic support programmes provided the necessary "enculturation", and fitted into the social and academic community students who had come via the Pre-University School, or Star Schools programme[25] (Bradley & Stanton, 1986). It can thus be said that the academic support programme instituted was a necessary "assimilation" for those who needed academic scaffolding to succeed at the University.

The apartheid government did not fund the academic support initiatives (Bradley & Stanton, 1986); funding came from a grant provided by the Harry Oppenheimer Study Fund (Bradley & Stanton, 1986). This provision of funding by a private donor underscores the role private financiers have played in changing the educational landscape in the country by their commitment of funds to educational projects and offering bursaries to deserving students.

1.6.2 The change model

Volbrecht (2003) states that the change model is characterized by an acceptance by lecturers that many curricula do not meet the needs of the students and should be overhauled to promote excellent teaching and learning. In this context, the 1990s was a period that saw increasing numbers of students from diverse educational backgrounds admitted to the university (see Table 1.1).

Some black scholars were by then attending former "white" government schools or affluent private schools and were receiving better quality education than they would have received in "black" government schools. Futhermore, there was great variability in the quality of schooling in such township schools. Therefore as more black students were admitted to the University diversity increased in terms of educational preparedness. The admission of educationally underprepared students came with huge financial outlays made by the University by way of bursaries and financial aid, and with the poor pass rates it did make sense to look in a new direction for improving courses (University of the Witwatersrand, 2003). This led to a period of introspection and curricular reform, as evidenced by the new curricula developed by the departments of Botany and Zoology (Starfield, 1996). Skills which students needed to succeed in their chosen fields became an area that received a lot of attention in the curricular reform of this period (Cron, Osberg & Still, 1995; Department of Zoology, 1996). There was also a growing realization that many academic support staff were under-prepared to cope with the growing numbers and the diversity in academic preparation of students that were admitted. Starfield (1996) claims this awareness led the central Academic Support Unit to become involved in staff and curriculum development.

[25] The Star newspaper established a Vocational Guidance Unit called the Star Schools. This initiative started the summer schools around 1975. The aim was to provide academic support to students to better cope with science and mathematics subjects at the university (Gerrans, 1986).

Table 1.1 Student registrations in the Faculty of Science showing trends in the proportions of the racial groups registered

Year	White	Black	Total	% black students
1980	1326	250	1576	15.9
1983	1597	349	1946	17.9
1986	1702	516	2218	23.3
1992	1642	819	2461	33.3
1994	1564	991	2555	38.8
1996	1381	1151	2532	45.5
1998	1232	1136	2368	48.0
2000	1099	1319	2418	54.5
2002	1283	2049	3332	61.5
2004	1380	2631	4011	65.9
2006	1230	2019	3249	62.1
2007	1200	1952	3152	61.9
2008	1172	2024	3196	63.3
2009	1073	2214	3287	67.4

Source: Academic Information and Systems Unit, University of the Witwatersrand

In the School of Biology, in the late 1980s, two academic support services were provided: Tutorial assistance was provided by subject specialists based in the two major departments[26] to students identified to be in need of such support. These students attended the Academic Support Programme on a voluntary basis but once committed they were expected to attend regularly. The second service was provided by language tutors from the central Academic Support Programme (Bradley & Stanton, 1986). These tutors worked with students to develop the needed skills and competencies in the English language. The goal of these services was providing support to students to improve pass marks and retention rates in the various departments.

The services provided by the Academic Support Programme were additional lectures and were constrained to specific time-table slots. Students could only benefit from them if clashes in time-table with their other subjects did not occur (Bradley & Stanton, 1986). This lapse in the organizational structure was catered for in the next model.

1.6.3 The development model

This is the third of the model practiced at the University of the Witwatersrand. The development model is premised on the belief that students entering universities need life skills, work skills, and academic skills to survive. It was the university's responsibility to identify and provide the required skills and ensure that students develop them (Moulder, 1991; Grayson, 1996). One of the key developments during this phase was the establishment of the College of Science by the Faculty of Science in 1991 (Rutherford & Donald, 1993). The College of Science can be said to be one of the bold steps the Faculty of Science took to cater for non-traditional students, thus addressing transformation issues (College of Science, 2003). The non-traditional students accepted were students who, although they had a matric exemption, had weak passes in mathematics (e.g. Standard Grade C or Higher Grade E) or with mature age exemption who would not otherwise have been accepted into

[26] Department of Botany and the Department of Zoology

the BSc programme (College of Science, 1992). At its inception the College provided a broad-based first-year curriculum in the physical, earth, and biological sciences, spread over two years. Language and study skills were incorporated into each course (Rutherford & Donald, 1993). Successful students at the end of the two years were admitted to the second year of the mainstream course. This was therefore a two-plus-two model in terms of years.

In the biological sciences a team of academic staff, supported by student tutors at tutorials and laboratory sessions, carried out teaching. The curriculum was designed to develop students' study skills, communication, and comprehension of subject matter, using small group tutorials, lectures and practicals (Rutherford & Donald, 1993). In terms of cost, it was more expensive to run than the mainstream group. This was justified in terms of the mandate of the college; to initiate the turning out of graduates from students with academic potential but lacking the educational qualities, within four or five years of study (College of Science, 1994). Financial aid from donors and the university played a big role in funding tuition and accommodation costs of those early students (College of Science, 1992).

The few years after the establishment of the College were a period of intensive growth of numbers that saw increasing diversity in the demography of students at the university as a whole (College of Science, 2003). It was also a new political era in South Africa. Table 1.2 shows that in 1996, just five years after the establishment of the College, black students constituted about 45% of the student population in the Faculty of Science, which was to rise to about 60% in another five years time. Although most of these students in the faculty had attended well-resourced and advantaged schools[27] some came without the required competencies and basic skills necessary for academic success (for example in the biological sciences). This lack of basic skills and competencies seemed to cut across all racial groups (University of the Witwatersrand, 2003), which was seen as a reflection on the poor state of the country's schools (Miller, Bradbury & Pedley, 1998). Academic support continued in various departments to help develop the skills of students, and running in parallel with the College of Science (College of Science, 2003). It is interesting that in line with international trends the Academic Support Programme underwent a name change and became the Academic Development Programme, emphasizing that bridging programmes were not scaffolding supports for students but were developmental in nature, building on what students already had (Volbrecht, 2003).

Unfortunately, the late 1990s was also a period of huge financial cut-back to stream-line the expenditure of the university. One of the effects of this cost-trimming exercise was the phasing out of the central Academic Development Unit and the devolution of all viable programmes to faculties (University of the Witwatersrand, 2003). The Faculty of Science, unlike other faculties, was able to financially support a number of academic development tutor positions during this period of dwindling grants from donors. The provision of tenured positions to some Academic Development Programme tutors meant they could continue offering their subject-specific skills to students in mainstream courses as well as those registered for the Academic Development Programme without fear of being retrenched. Academic teaching in the science departments was enriched by the wealth of experience,

[27] A term used for such schools was "Model C schools"

mainly in teaching and the development of skills, such tutors brought into mainstream teaching of students.

1.6.4 Institutional support in the Faculty of Science

An establishment that came under much scrutiny during this period of financial cut-backs was the College of Science (University of the Witwatersrand, 2003). Whilst it cannot be denied the successes the college has achieved supporting students who went on to graduate in various fields and thus addressing the equity and transformation agenda of the University of the Witwatersrand, it was expensive to run (University of the Witwatersrand, 2003). Donor funding had declined and the university was not willing to bear the cost involved (S. Hanrahan[28], personal communication, 2010). Cost effectiveness became the criterion to use to decide its further operations, despite the headways it had made (College of Science, 2003). A decision was taken that called on College administrators to streamline its operation and align its funding strategy to that of the university in order to break even, or consider closure. College staff members were to be integrated into their various schools as a financial management strategy (College of Science, 2003).

Whilst one can understand the stance of the Heads of Schools,[29] it was counter-argued by the College staff that developing the potential of ‘underprepared’ students, as College was mandated to do, “...*is of necessity not as efficient or cost effective as taking better finished products from the better resourced schools*” (College of Science, 2003, p. 58). The university was called upon not to abandon its equity and transformation mission by ignoring the large number of promising students (College of Science, 2003). However, in the absence of sufficient external funding the College as an institution was trimmed at the end of 2004, and made to surrender to schools its once autonomous position (University of the Witwatersrand, 2006b).

The academic activities of the foundation programme continued in the Faculty of Science but with fewer administrative staff (University of the Witwatersrand, 2006). Another major restructuring of the foundation programme took place in 2006, instituting a *one-plus-three* model. In essence, to obtain their BSc degree, selected students had to complete one foundation year followed by three years in mainstream setting (Faculty of Science, 2006). This restructuring, in 2006, was accompanied by a formal name change of the College of Science to the *BSc 4-year Extended Programme* (Faculty of Science, 2006; University of the Witwatersrand, 2009). The curriculum of the former College of Science as an access programme was streamlined (Faculty of Science, 2006), and provision was made for increasing numbers of first-year students to attend mainstream Academic Development tutorials in the School of Biology (University of the Witwatersrand, 2009). It is proposed to use the wealth of knowledge and skills gained by the staff who taught in the Extended Programme over the years to enrich first-year teaching (A. Crouch[30], personal communication, 7 June, 2010).

The shift in terms of greater support offered by the university towards mainstream first-year academic development initiatives confirms the observation of Kloot (2010) that access programmes world-wide are never static but dynamic. They evolve and negotiate a sometimes complex and “*uneasy*

[28] Former Head of the Department of Zoology, University of the Witwatersrand

[29] This seems to be the collective decision of the Heads of Schools within the Faculty of Science

[30] Currently the Dean of the Faculty of Science, University of the Witwatersrand.

relationship with the traditional university structure" (Kloot, 2010, p.173). The College of Science and the Extended Programme of the University has certainly evolved as an agency of the University's transformation programme but has become eclipsed in 2010[31] by another vision of the university - that of becoming a research-focussed institution.

The University of the Witwatersrand, whilst still committed to excellence in teaching and learning, research, and community engagement, aims to build and improve on its reputation as a leading university in Africa and the world by 2020 (University of the Witwatersrand, 2010a; 2011). The University intends in future to grow its research and post-graduate output. One way it intends to achieve this is to use research into teaching and learning to enrich the undergraduate and postgraduate teaching (University of the Witwatersrand, 2010a).

The competence levels of students admitted to the university, and who would in future feed into the post-graduate programmes, have not improved sufficiently to put the university on track to achieve its goals. In fact, with the growing student numbers in the 2010s, more academic support seems to be needed to ensure epistemological access is achieved for a greater majority of students (University of the Witwatersrand, 2006b; 2010a). What has been learnt from the experiences of the past thirty years of academic support is that raising retention and throughput levels is not a quick-fix process (University of the Witwatersrand, 2003; 2007). It would require improving practices already in place, such as improving the selection tests and admission policies, the academic development practices, and the teaching and learning in the departments (University of the Witwatersrand, 2003, 2006b). Particularly important is the need to conduct rigorous research into the problems and instituted solutions, so they are better understood. One such solution is to look for innovative ways to meet the learning needs of students.

Arguments over the effectiveness of academic support efforts have been raised by academics and administrators at auditing sessions during the three decades of academic development at the University of the Witwatersrand, specifically in the Faculty of Science (University of the Witwatersrand, 2003; 2007). It is argued that, given the funding, skills and time invested in academic development programmes, their performance in general has not been as effective in helping students acquire the attitudes and competence for their various courses of study as originally hoped (University of the Witwatersrand, 2003; 2006b).

1.7 THE PURPOSE OF THIS STUDY

The problems that motivated this research were the high attrition and high failure rates of first-year biological sciences students at universities worldwide and in this university in particular. In trying to address the problems of low throughput and high failure rates at the University of the Witwatersrand,

[31] It has been confirmed by the Dean of the Faculty of Science that 2010 would be the last year of the Extended Curriculum at the university. This brings a final closure to the College of Science and also closes the access route into university of those students mathematically unprepared from their secondary schools (A. Crouch, personal communication, 7 June, 2010). This new direction of the university seems to be in line with its overall vision to be a research-driven institution.

an area that has not received much attention is that of investigating the “para-academic” variables[32] (Pinto, 2001; Rollnick 2010) of the students, and helping them take control of their learning (Grayson, 1996; 1997). These investigations are needed to feed into, and inform, the strategic plans of the University.

Solutions to these problems were researched in two main phases similar to the “diagnostic” and “therapeutic” phases of action research. The aim of the diagnostic phase was to identify factors that, according to stakeholders (lecturers teaching first-year biology, Honours biology students, and first-year biology students) influenced academic success in the first-year biological sciences at this university. Results from such a study were deemed important to inform teaching and learning practices at the institution, and so contribute to improving students’ success rates. Although a wide range of factors was identified, the focus of my study was limited to the areas of attitudes, work-habits and metacognitive knowledge stakeholders believed to be necessary for achieving academic success. It is important to note that these areas were previously understudied aspects of students learning, and have increasingly been recognized as crucial to student success (Alsop &Watts, 2003; Styrdom & Mentz, 2010). A computer-based programme, *Bioskills,* was designed as an intervention during the therapeutic phase, and its effects on students’ attitudes and behaviours investigated using, amongst other methods, aspects of “formative” and “effectiveness evaluation” (Reeves, 1993). Formative evaluation is a method of assessing the worth of a programme during its construction, in order to implement improvements. Reeves (1993, p. 15.17) explains that the purpose of “*effectiveness evaluation*” is to assess, after intervention materials have been used by participants, whether “*some degree of difference exists between the knowledge, skills and attitudes* [participants] *possessed before the training*” and after the training.

1.8 RESEARCH QUESTIONS

In order to operationalize the aims of the study four research questions were formulated to direct the research.

Research question 1. What factors do lecturers teaching first-year biology, Honours biology students and first-year biological sciences students, perceive to be important for academic success in first-year biological sciences at the University of the Witwatersrand?

Research question 2. What changes in students’ perceptions occur after a year at the university?

Research question 3. What metacognitive gains did the students derive from using *Bioskills*?

- 3a What metacognitive knowledge did the students say they have about factors promoting academic success, before and after using *Bioskills?*
- 3b What metacognitive control (application of metacognitive knowledge) did the students say they use, before and after working with *Bioskills*?

Research question 4. What are students’ opinions about *Bioskills* as a learning tool targeting academic success?

[32] Three variables addressing students need for metacognitive skills, behaviours and attitudes, outlined by Grayson (1996) could well be termed “para-academic” as they do not address purely academic skills or cognitive variables.

1.9 ORGANIZATION OF THE THESIS

Chapter 1 has described the context of the study, the aims and the problems that motivated the study, and has reviewed relevant literature on at-risk students. The following information is provided to orientate the reader on what is in the rest of the chapters.

Chapter 2 describes the theoretical framework used to underpin the study. It clarifies constructs used in the study relating to attitudes, work-habits and metacognition, and the relationships between the constructs.

Chapters 3 and 4 deal with the diagnostic phase of the study. In **Chapter 3** the research questions and methods for the first phase (the diagnostic phase) of the study are outlined and justified. In **Chapter 4,** the results of the diagnostic phase are reported. Identified in this chapter are possible attitudes, work-habits and metacognitive factors that stakeholders believed affected success, factors which were used to develop the package in the therapeutic phase of the study.

Chapters 5 to 7 deal with the therapeutic phase of the study. The development and formative evaluation of a computer-based programme, *Bioskills*, is reported in **Chapter 5**. It describes the reasons for the choice of computers as the vehicle of instruction, the design theories considered in its development, and the involvement of first-year biology students in the formative evaluation of the programme. **Chapter 6** describes the methods used in the investigation of the effectiveness of the improved version of the programme and justifies the choice of the methods used in the investigation. **Chapter 7** describes the results of the investigation of its effectiveness as an instructional tool, and the extent to which it created an increased awareness of attitudes, work-habits and metacognitive factors, using case studies of eight students.

A discussion of the limitations of the study, summary of the findings, and recommendations for future work, are presented in **Chapter 8.**

CHAPTER 2

THEORETICAL FRAMEWORK FOR THE STUDY: AFFECTIVE FACTORS AND ACADEMIC SUCCESS

Chapter 1 highlighted, from a global perspective, the difficulties experienced by some students in meeting the demands of tertiary education, factors that research suggests influence academic success, and attempts made to address the problem at the University of the Witwatersrand in South Africa. The purpose of this chapter is two-fold: firstly, to highlight the affective domain as a critical area in science education that has not received much research focus and needs to be targeted, and, secondly, to introduce the theoretical framework on attitudes, work-habits (learning behaviours) and metacognition used to underpin this study. Support for the framework is provided from studies reported in the literature.

2.1 WHAT A THEORETICAL FRAMEWORK IS AND WHY IT IS IMPORTANT

The phrase "theoretical framework" literally encompasses two words: 'theory', which is a statement of constructs (concepts), definitions and propositions, and the relationships between them (Kerlinger, 1986) and 'framework', which is defined as a supporting structure around which something [in this context, the research] can be built (Cambridge Advanced Learner's Dictionary, 2003). Theoretical frameworks are very important to researchers and readers of research, in a number of ways. According to Le Compte & Preissle (1993) a theoretical framework explains the theoretical underpinnings of the study, the web of relationships that exists among constructs, and makes explicit the impact of theory in every stage of the study. A clearly stated theoretical framework should allow researchers to formulate their research questions, choose appropriate data collection techniques, and interpret and apply findings of the study (LeCompte & Preissle, 1993; Abd-el-Khalick & Akerson, 2006). LeCompte & Preissle (1984, p. 137) contend that explicit attention to a theoretical framework helps to improve research design in terms of it's *"credibility and validity, and in precision and reliability"*.

Fetherston (1998, p.100) notes that a good theoretical framework should be relevant, have "*explanatory power*", and be able to integrate the various constructs relevant to the research. Commenting on the role of theoretical frameworks in academic research, Fetherston (1998, p. 100) states that they can convey to readers ideas about the *"political, social and cultural context in which the study is set"*. The information conveyed enables readers to gain a better understanding of *"where the research is coming from"* and, in the case of data collected and analysed, *"through what eyes data were viewed"* (Fetherston, 1998, p. 100). Caliendo & Kyle (1996) state that when researchers articulate a theoretical framework for their study it enables both researchers and the readers alike to see how the operationalization of constructs, research design and the type of data analysis used are linked to the theory. Caliendo & Kyle (1996) note that a well reviewed theoretical framework is an important aspect of scholarship, and a lack of it in research strongly undermines any scholarly endeavour.

The theoretical framework developed focuses on affective factors, work-habits and metacognition, because these were the para-academic variables, which were the areas of concern of the study. Attitudes and motivation are considered the two major constructs in the affective domain (Koballa & Glynn, 2007) but there are other affective constructs such as interests, beliefs and self-efficacy (Alsop & Watts, 2003) which are important in students' learning.

2.2 SHORTCOMINGS IN THE RESEARCH ON AFFECTIVE FACTORS

Inadequate definitions and lack of clarity in meanings of terms have stunted growth of affective research in science education (Koballa & Glynn, 2007). For the purposes of this study, identification of the various constructs and problems associated with their definitions needed to be resolved before the relationships between them and learning could be established for my theoretical framework.

2.2.1 Paucity of research on affective factors

Three domains of learning in education – cognitive, affective and psychomotor - are recognised (Krathwohl, Bloom, & Masia, 1973). Despite the recognition of these domains the focus of research in science education, according to Shrigley & Koballa (1992) over fifteen years ago, and also quite recently stated by Zembylas (2005), has remained to a large extent on the cognitive aspects of learning. According to these researchers, studies have ignored or downplayed the role of emotions (or feelings) and their contributions in promoting learning by students.

The concentration of studies on one area of learning has its drawbacks. Zembylas (2005, p. 95) notes that *"… [f]ocusing on one 'category' while ignoring others may have certain advantages for methodological purposes, however, the danger is that the holistic picture of learning is lost"*. He then states that aspects which tend to be lost include "*the learners' emotions, attitudes and beliefs as well as the social and emotional aspects of learning in a classroom community embedded in power relationships"* (Zembylas, 2005, p. 95).

According to Alsop & Watts (2003) one of the reasons for this narrow focus of research on learning by science education researchers lies in the image of science itself. Alsop & Watts claim that the traditional image of science in Western philosophy separates *"mind and body"*, and "*divorces and polarizes reason from feeling"* and this has made it difficult for an appreciation of affective variables associated with learning of science (Alsop & Watts, 2003, p. 1044). Another possible reason is pointed out by Woods (1996) who claims that emotions are considered difficult phenomena to study and therefore are not given the same emphasis as the intellect, which is easier to research.

2.2.2 Lack of agreement about definition of terms

A second shortcoming which a researcher faces when investigating affective factors has to do with the multiple definitions in the literature (Jones & Carter, 2007), and sometimes different meanings given by different researchers to some of the affective constructs in the research literature. As an example, Koballa & Glynn (2007) note that the construct *attitude* has been defined in many ways, and is often used interchangeably with other attitudinal constructs such as *interest*, *motivation* and *opinion*. Although specific definitions may be found in the science education literature, some of the definitions remain blurred, complex or not well defined. Another example is the problem of defining the term *belief*, which some researchers use interchangeably with *knowledge*, while others see beliefs and knowledge as separate constructs (Jones & Carter, 2007). Calderhead (1996, p.715) explains that knowledge is a "*factual proposition*" and evolves into a belief, a "*supposition*", when it is accepted as true or false.

Koballa & Glynn (2007) urge researchers to define the constructs they write about, in order to ensure clarity of meaning and a common understanding of terms. However, they are well aware of the difficulties involved and caution researchers that *"... reaching a universal agreement in definitions of attitudes and related terms is unlikely to occur in the near future"* (Koballa & Glynn, 2007, p. 79). Because this chapter is an attempt to construct a framework of the relationships among various constructs for my study it was essential first to get clarity on the meaning of the constructs, as I have done in section 2.3. The term *construct* itself requires clarification. It is used in this chapter to mean a concept, an idea, or a label with a definition, as explained by Le Compte & Preissle (1993).

2.2.3 Lack of a coherent theoretical framework

A third shortcoming of research on affective factors is the lack of a clear-cut theoretical framework linking all the various constructs. There have been studies on the importance of certain affective variables in science education over the years (e.g. Koballa & Shrigley, 1983; Shrigley, 1983; Simpson *et al.*, 1994; Teixeira dos Santos & Mortimer, 2003). However, Shrigley & Koballa (1992) acknowledged that the lack of sound theoretical frameworks at that time (including inadequate definitions of constructs) for underpinning the studies, and faulty assessment techniques, had limited and hampered progress in this area. The same shortcoming still applies, and more recently authors have identified one factor that has hampered the development of a theoretical framework: the different research orientations science education researchers have worked within (Pintrich, 2003; Koballa & Glynn, 2007). Over the years science education researchers have worked within the *behavioural*, *humanistic*, *cognitive* and *social* orientations (Koballa & Glynn, 2007) and some have adopted aspects of more than one orientation when studying learning (see Schunk, 2003; Linnenbrink & Pintrich, 2002; Koballa & Glynn, 2007) as typifies pragmatic researchers. For example, *social cognitivism* is indicative of broader orientations of researchers, as exemplified by the work of Bandura (1997) and Schunk, (2003). Despite these limitations, some progress has been made dealing with some of the concepts (e.g. Fishbein & Ajzen, 1975; Ajzen & Madden, 1986; Shrigley & Koballa, 1992; Osborne *et al.*, 2003; Hidi, 2006; Koballa & Glynn, 2007) but not embracing all the concepts associated with the affective domain.

2.3 CONSTRUCTS: DEFINITIONS AND RELATIONSHIPS

In the process of formulating a framework for this chapter, I reviewed a number of sources in order to accurately define the constructs shown in Table 2.2. The literature search I conducted revealed constructs that had similar definitions in the literature, others with conflicting meanings, and some that had not been defined in the literature. These constructs come from many fields, such as psychology, social sciences, and education, and I have attempted to conserve their original meanings whilst viewing them through the conceptual lens of a science education researcher. Historically, attempts to provide universal definitions for some constructs have been unsuccessful (Jones & Carter, 2007).

Before developing the framework and conducting the study I had to make sure that I had a clear understanding of each of the constructs, particularly those where the definition in the literature was unclear. This is one of the approaches outlined by Jones & Carter (2007), who say some researchers have a tacit assumption that constructs will be interpreted within the context of the research. In order to establish suitable definitions or meaning of terms used for this study, the following steps were taken.

The first step was to identify all the constructs for the theoretical framework, for which I had to find definitions. I placed these in Table 2.1. The next step was to review the literature to find definitions. I started with the definitions of seminal workers. This necessitated citing papers that appear old, but this does not detract from their value. In fact, papers that are more recent often use these "old" definitions. Where there was no disagreement in the literature the definition was removed from Table 2.1, and the original definition was used in Table 2.2 (e.g. self-efficacy). Existing definitions that were **repeated** by more recent workers were not included in the list. All the definitions were found to have component parts to them. Where differently worded definitions had the same component parts, they were not added to the list being constructed in Table 2.1. Where definitions were found with different component parts they were added to the list, for example *motivation*, where Schunk (1990) says it is a process but others say it is an internal state.

Where no definition could be found in the literature (e.g. *experiences*), English dictionaries and a thesaurus were consulted, as has been done by other researchers (e.g. Bunting, 1988; Mann, 2001). It is important to note that the majority of the constructs being defined are words used in everyday conversation, so consulting a dictionary is an obvious move. Even for the constructs defined in the literature it was found that in several instances the dictionary definition, while containing the same component parts, was more clearly worded (e.g. *attitudes*, where the phrase "complex mental orientation" expressed more clearly what Shrigley *et al.* (1988, p. 666) called "*predispositions"*). In some cases the dictionary contributed a new component which gave additional insights, for example the idea that beliefs are "*firmly held"*. This idea is not found in any of the definitions in the research papers, although the researchers emphasise how difficult it is to change beliefs (see Pajares, 1992, and Ertmer, 2005, for a detailed review on beliefs).

The next step was to consult with an English first-language person on the appropriateness of the definitions used. Numerous discussions were held with my supervisor, an English first-language speaker extremely well versed in matters of the English language and grammar. We discussed the component aspects of the definitions and the differences between them and this helped me to identify aspects to read further on before deciding which portion of the definitions to include or exclude in Table 2.2. The process of finding a common agreement for wording of terms continued through repeated cycles with my supervisor and further reading, and could be considered as part of a face-validation process. Where component parts in definitions were

Table 2.1 Range of definitions of constructs mentioned in this phase of the study

Term	Definition	Reference
attitudes	"the predisposition to respond positively or negatively to things, people, places, events or ideas."	Shrigley, Koballa & Simpson (1988, p. 666).
	"the ways a person views something or tends to behave towards it, often in an evaluative way."	Collins English Dictionary (2003).
	"settled ways of thinking or feeling".	Oxford English Dictionary (2011).
	"complex mental orientation involving beliefs, feelings, values and dispositions to act in certain ways".	Corel Corporation (2003).
beliefs	"individual's judgement of the truth or falsity of a proposition, a judgement that can only be inferred from a collective understanding of what human beings say, intend, and do".	Pajares (1992, p. 316)
	"the general acceptance or rejection of basic ideas."	Simpson *et al.* (1994, p. 212).
	"premises or propositions about the world that are felt to be true".	Richardson (1996, p.103)
	"personal constructs, propositions considered to be true by the individual… non evidential as they are based on personal judgement and evaluation."	Luft, Roehrig, Brooks & Austin (2003, p. 2)
	"firmly held ideas". **ii** "something one accepts as true".	Oxford English Dictionary (2011).
	"subjective private opinions".	Coburn (2000 p. 227)
	"any simple proposition, conscious or unconscious, inferred from what a person says or does, capable of being preceded by the phrase 'I believe that'."	Rokeach (1972, p. 113)
experiences	"first-hand knowledge of states, situations, emotions, or sensations".	Corel Corporation (2003)
	"practical contact with and observation of facts or events".	Oxford English Dictionary (2011).
	"direct personal participation or observations that a person has undergone; actual knowledge or contact".	Collins English Dictionary (2003)
motivation	"an internal state that arouses, directs, and sustains students' behaviour."	Koballa & Glynn (2007, p. 85)
	"the psychological feature that arouses an organism to action".	Corel Corporation (2003).
	"the process whereby goal-directed behaviour is instigated and sustained."	Schunk (1990, p.3).
	"the reason or reasons behind one's action or behaviour".	Oxford English Dictionary (2011).
opinions	"what someone knows or assumes to be true".	Berkowitz (1980, p. 275)
	"verbal expressions of individuals' attitudes".	Koballa & Glynn (2007, p. 78).
	judgements not founded on certainty or proof.	Collins English Dictionary (2003).
perceptions	**i.** "the act or effect of perceiving - becoming aware of something [messages] through the senses". **ii**. "the ways people see things or interpret what happens in the world around them".	Collins English Dictionary (2003)
	i. "becoming aware of something via the senses. **ii.** the representation of what is perceived; basic component in the formation of a concept.	Corel Corporation (2003)
	i. ways of regarding, understanding or interpreting something". **ii. "**the faculties of perceiving (the ability to see, hear, or become aware of something through the senses)".	Oxford English Dictionary (2011).
	"the process of the mind taking sense data and interpreting these data, that is, ' making sense' of sensory data".	Bunting (1988, p. 168)
values	"forms of thought that a specific mode of conduct or end state of existence is personally or socially preferable".	Rokeach (1972, p. 5).
	"the ideals, moral principles or standards held in high regard by people or by social groups."	Walker & Dimmock (1999, p. 99).
	"long range moral or ethical imperatives, an end rather than a means. they undergird standard of conduct."	Shrigley *et al*. (1988 p. 672).

not always true they were omitted from Table 2.2. For example, Luft *et al.* (2003) explain beliefs as personal constructs, ignoring the fact that beliefs can be passed on intact from communities to individuals, and can be accepted as true without being personally judged by the receiver.

As pointed out by Jones and Carter (2007), the interchangeable use of terms in some cases makes them difficult to define. The construct "*opinion*," although used in everyday English, has nonetheless been difficult for researchers to define (Shrigley *et al.*, 1988; Koballa & Glynn, 2007). Berkowitz (1980, p. 275) defines opinions as "*what someone knows or assumes to be true"* but this definition is similar to the meaning of beliefs, as defined by other researchers (see Table. 2.1). Koballa & Glynn (2007, p. 78), citing other sources, claim *"… [o]pinions are cast as verbal expressions of attitudes"*, but in fact opinions do not have to be verbalized. Therefore some confusion reigns between what beliefs and opinions really are (Shrigley *et al.,* 1988). The problem I have here is one of *"names in search of a distinction, rather than a distinction in search of a terminology*" (McGuire 1969, cited by Shrigley *et al.,* 1988, p. 671). The dictionaries consulted gave no clarifying insights, so the difference between opinions and beliefs could not be ascertained. Indeed Coburn's definition of beliefs as "*subjective private opinions*" shows that he considers the two as the same construct. Shrigley *et al*. (1988, p. 671), having tried without much success to tease out the difference between *beliefs* and *opinions,* recommended "*we have little need for opinion as a research construct. So let us use it in casual conversation, but put it to one side in science education research"*. So based on their suggestion the construct *opinions* was omitted from Table 2.2 and Figure 2.1. Each construct is discussed in more detail in the next section.

Table 2.2 Definitions developed for this study

Construct	Adopted definition
attitudes	complex mental orientations (states of mind), often judgemental, based on the way people view things about them (Shrigley *et al.,* 1988).
attributions	perceived causes individuals focus on as causes for their successes or failures (Weiner, 1990).
behavioural intentions	plans of actions in pursuit of (behavioural) goals (Ajzen, 1991).
behaviours	the way people act in general, especially in relation to their current situation (Oxford English Dictionary 2011).
beliefs	firmly held ideas or propositions (convictions) that something is true or false.
experiences	first-hand personal participation in, or observation of, situations.
goal orientation	the goals (mastery or performance) that students focus on within the academic environment (Linnenbrink & Pintrich, 2002).
goals	what one is consciously trying to accomplish (Schunk, 2003).
locus of control	the extent to which individuals perceive they have control over their behaviours/ successes or failures. (Bar-Tal & Bar-Zohar, 1977)
motivation	the process whereby goal-directed behaviour is instigated and sustained (Schunk (1990).
intrinsic motivation	motivation to engage in an activity for its own sake (Pintrich & Schunk, 2002).
perceptions	messages received by the senses, and interpreted by the mind of the recipient (Bunting, 1988).
self-concept	the way individuals perceive or feel about themselves.
self-efficacy	individuals' beliefs about their performance capabilities in a particular context or a specific task or domain (Bandura, 1997).
values	the ideals, moral principles or standards held in high regard by people or by social groups (Walker & Dimmock, 1999).
work-habits	regular behaviours or practices that students use for studying (Devine & Meagher, 1989)

2.3.1 Attitudes and attitudinal constructs influencing behaviour

Figure 2.1 (p. 42) displays a model linking various attitudinal and motivational variables considered for this study, and forms the basis of this discussion. The variables are shown to interact with each other, and a pathway exists by which each construct influences the next construct (Figure 2.1). In this figure, and in agreement with the literature cited, it is shown that students' behaviours are influenced by stimuli from both the external and internal milieu (or environment) that influence and mould their behaviour (Pajares, 1992; Jones & Carter, 2007).

Arising in the external milieu are *social, political, historical, educational* and *cultural* influences that impinge on students through their *experiences*. No research definition of *experiences* was found so based on the three definitions I listed in Table 2.1, I constructed the working definition for my study to be *first-hand personal participation in, or observation of, situations* (Table 2.2).

For experiences to become part of an individual's internal milieu they must be *perceived*, as shown in Figure 2.1. As a biologist, I understood perception to be the reception of sensory stimuli from the environment, but the dictionaries I consulted all had a second component, the mental construction of meaning (mental interpretation). Bunting (1988) notes that in the literature the meaning of *perceptions* had been ambiguous and unclear, historically being considered an entity that contributes to the linkages between a person and the environment. This endorses the biologists' viewpoint. However, the nature of the link, i.e. whether it is direct or not, is not clear from the various explanations. Bunting (1988, p.168), using dictionary definitions, explains that the verb *perceive* is derived from a Latin root meaning "*to grasp mentally, take note of, observe; to become aware of through sight, hearing, touch, taste, or smell"*. She goes on to explain that the noun *perception* is defined as "*the understanding, knowledge, etc. got by perceiving …"*. This emphasizes that there are two components of perception as explained in the three dictionaries I consulted: the reception of the stimuli and the subsequent mental interpretations, or as Bunting (1988, p.168) explains it "*the process of the mind taking sense data and interpreting these data, that is, 'making sense' of* [these] *… data"*. She breaks down the *interpretation* process into three steps: *selection, assimilation*, and *interpretation* of the information. I will not be able to discriminate between the three processes because they exist in the mind of the perceiver; I have used the simpler two-component definition (see Table 2.2).

Two sub-constructs associated with perceptions are *self-concept* and *locus of control* (see Figure 2.1). Simpson *et al.* (1994) define *self-concept* as "*the way individuals perceive or feel about themselves"* which according to Koballa & Glynn (2007, p. 92) connotes *"global ideas about one's identity"*. Bar-Tal & Bar-Zohar (1977, p. 181) define *locus of control* as "*the degree to which individuals perceive they have control over their successes and failures"*. These two constructs are explored further in section 2.3.3.

Perceptions influence beliefs (see Figure 2.1). When ideas or feelings are held as true these are labelled as *beliefs* (Pajares, 1992*)*. Beliefs form part of a person's identity and can be received as social constructions by an individual's community or can be personally constructed by individuals based on their perceptions (Lucas, 2005). Beliefs vary in strength and kind (Rokeach, 1972), and can be unreliable if the constructions do not match reality. Pajares (1992) states that beliefs can strongly influence perceptions, which is why I have shown the two-way influence of beliefs and perceptions in Figure 2.1.

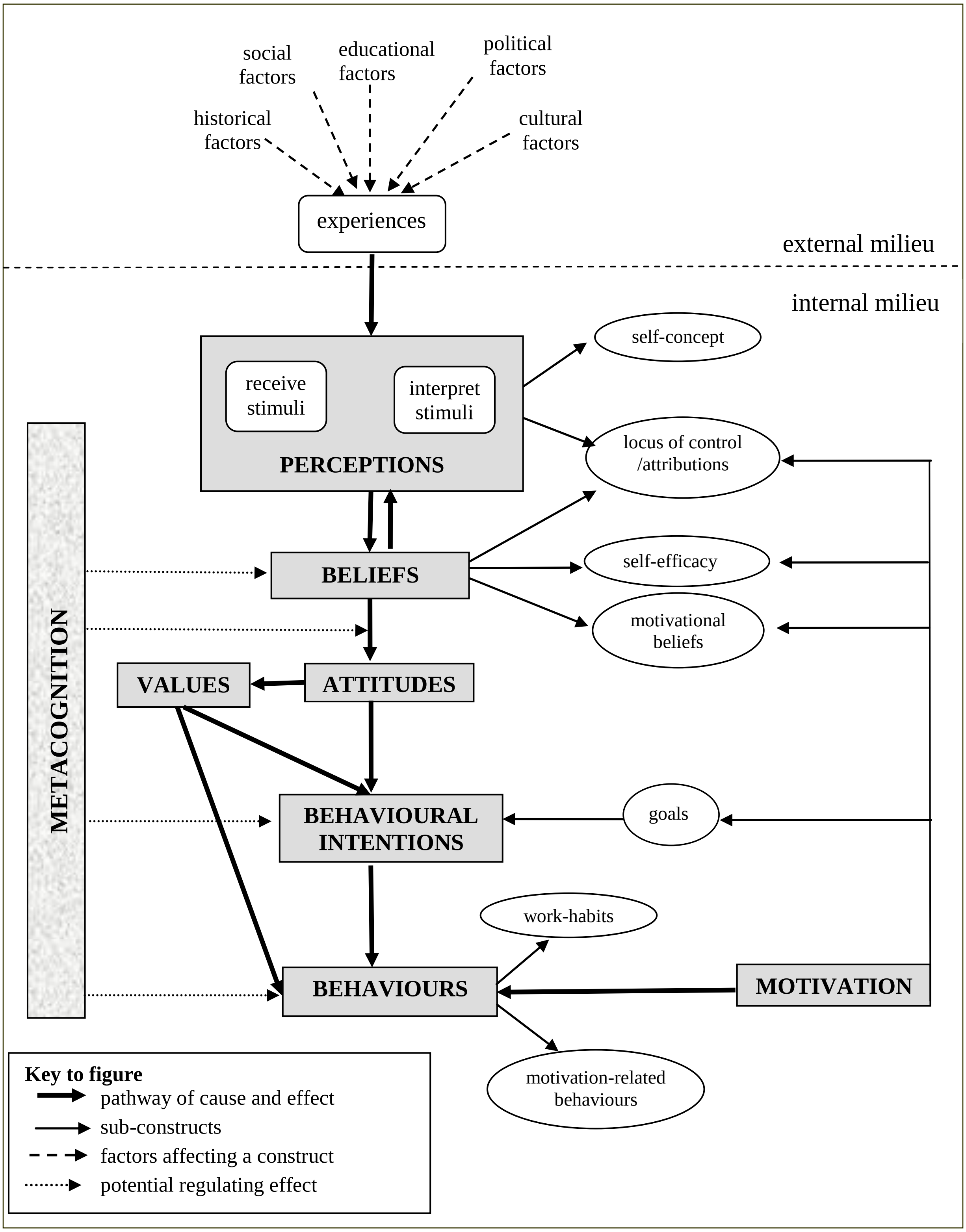

Figure 2.1 The relationships between various constructs affecting academic performance

Some researchers (e.g. Pajares, 1999; Ertmer, 2005) describe the existence of a belief system, comprising core beliefs and other peripherally placed beliefs. Core beliefs, which are resistant to change, are said to be formed through personal experiences. Peripheral beliefs are derived from authority figures and other influential figures in a community, and are seen to be less resistant to change (Errington, 2004; Ertmer, 2005).

Beliefs, whether constructed by individuals or passed on to them by their communities, influence the formation of attitudes and ultimately behaviours (Koballa & Glynn, 2007), as shown in Figure 2.1. A definition of attitudes used by Shrigley *et al*. (1988, p. 666) and adopted by various researchers (e.g. Olarewaju, 1988; Zacharia, 2003) conceptualises attitudes as "*the predisposition to respond positively or negatively to things, people, places, events or ideas"*. Shrigley *et al.* (1988) explain *predispositions* as innate, unobservable qualities that accompany individuals and provide them with a mental posture to respond to situations or having the readiness to interpret experiences, implying the response is a mental one. The phrase "respond to situations" used above may wrongly a connote a physical behavior in the minds of some people. Although some authors use the argument that attitudes are essentially a person's preferences and feelings towards an object, person or issue (Cacioppo & Petty, 1979; Petty & Cacioppo, 1981; Osborne *et al.*, 2003) some (e.g. Jaccard, Litardo & Wan, 1999) explain attitudes as a predisposition to a 'behaviour' seemingly misinterpreting the term "respond" in the seminal work of Shrigley et al. (1988). However, Osborne *et al.* (2003, p. 1054) argue that attitudes "*of themselves …will not necessarily be related to the behaviours a student actually exhibits"*. Attitudes are mental states, not the consequent behaviours. Osborne *et al*. (2003) explain attitudes as expressed preferences or feeling towards an object (e.g. students liking the subject biology) – i.e. the responses are cognitive in nature. The wording of the dictionary definition provided by the Corel Corporation (2003) (see Table 2.1) is less likely to cause confusion than Shrigley *et al*. (1988). Attitudes are often judgmental, which highlights the evaluative or affective quality of the construct (Shrigley *et al.*, 1988). For example, when a student says "*I hate botany*" or "*I love my genetics teacher"* an evaluation is involved. The Corel Corporation (2003) explains attitudes as a state of mind involving feelings beliefs and dispositions, which adds to the definition of Shrigley *et al*. (1988). The synthesized definition I have used in this chapter for *attitude*, as shown in Table 2.2, includes the component from the dictionary as "a state of mind", often judgemental, based on the way people view things about them.

Fishbein & Ajzen (1975) and Shrigley *et al.* (1988) refer to four major attributes of attitudes, all of which are important for consideration in this study. Firstly, attitudes tend to be tenacious over time (Petty & Cacioppo, 1981) although individuals may change their attitudes and the changes may be enduring (Hill, Atwater & Wiggins, 1995). Secondly, attitudes are learned, which suggests that appropriate attitudes can be taught and students can be helped to develop more appropriate attitudes. Thirdly, attitudes are a function of personal and cultural beliefs (Ajzen & Madden, 1986; Zint, 2002) which suggests certain cultural attitudes may predispose individuals from particular cultural settings either to do well or not to do well in a given situation. Instruction could help correct academically inappropriate attitudes. Whilst attitudes may be linked to beliefs, it is the fourth attribute on the relationship between attitudes and behaviour that has presented challenges to researchers in science education. Koballa (1988) and Shrigley (1990) point out that attitudes (measured as attitude scores) and behaviour are correlates; i.e., one is linked to the other. Shrigley (1990, p. 98) points to the dominance of *“attitudes preceding behaviour*” when current attitude-related research in science education is examined.

One construct, which is closely linked to attitudes, is *values*. Feldman & Newcomb (1969) define values as *“a cluster of attitude-related constructs organized around a conception of the desirable”*. The ‘desirable’ could be the ideals or standards held in high regard by a person or by a social group. Rokeach (1972, p. 5) explains that *values* are conceived *“...as an enduring thought form that a specific end-state of existence or mode of thought is personally or socially preferable.”* According to Biddle, Bank & Slavings (1990) such ‘forms of thought’ serve to organize other types of thinking related to those end states. Shrigley *et al*. (1988) point out that values can be related to the morals of individuals or their communities and they define *values* as *“the moral principles or accepted standards of individuals or their social groups”*, which agrees with the definition in the Collins English Dictionary (2003). Values, as shown in Figure 2.1, influence both behavioural intentions and behaviours.

One of my reasons for reading about affective factors is to get a better understanding of the relationships between the constructs, which should, inform on the development of a more accurate framework. An appreciation by students of the influence of the constructs on learning would hopefully encourage them to demonstrate more appropriate academic behaviours. Table 2.2 is a list of all the major constructs and sub-constructs reviewed in Figure 2.1.

2.3.2 Behaviours and behavioural intentions

The relationships between attitudes and behaviour are further confounded when it is noted that attitude is related to behaviour through intention (Ajzen & Madden, 1986; Ajzen, 1991). The “*attitude to behaviour*” and, “*the attitude through behavioural intention to behaviour relationships*” according to Shrigley (1990, p 98) form the two major thrusts in attitudes research, and are acknowledged by researchers (see Fishbein & Ajzen 1975; Koballa, 1988; Shrigley 1990, Ajzen, 2006) as important in the academic strivings of learners.

Behavioural intentions, according to Koballa & Glynn (2007), have received much attention over the past 30 years. The importance of behavioural intention is seen through the formulation of the theory of reasoned action (Fishbein & Ajzen, 1975) and in its expanded form the theory of planned behaviour (Ajzen and Madden, 1986) which clarifies the link between attitudes and behaviours. The reader should note that ‘intentions’ have been placed between ‘attitudes’ and ‘behaviours’ in the theoretical framework in Figure 2.1.

Intentions are ideas or plans of what individuals are going to do (Oxford English Dictionary, 1991) and have been shown to predict behaviours (Fishbein & Ajzen, 1975; Ajzen & Madden, 1986). Ajzen & Madden (1986) see intentions in terms of individuals *“intended behaviours”*, or *goals***:** such goals may fall along a continuum of easily achievable to those that are not easily attainable. They define them as *“... plans of action in pursuit of behavioural goals”* (Ajzen & Madden, 1986, p. 456). Behavioural intentions are shown by Ajzen & Madden to operate in conjunction with other factors to influence behaviour. In support of this view, Ajzen (1991, p. 181) explains that:

> *"Intentions are assumed to capture the motivational factors that influence a behaviour; they are indications of how hard people are willing to try, or how much of an effort they are planning to exert, in order to perform the behaviour".* (Ajzen 1991, p. 181)

Behaviours, by definition, are the way people act in general, especially in relationship to their current situation (Oxford English Dictionary, 2011). The importance of *learning behaviours* is premised on the assumption that the way learners act in general influences the information processing they undertake (Weinstein & Mayer, 1985) in and out of school, and ultimately their academic performance. Ajzen (1991) has shown that the stronger the intention to engage in a behaviour, the more likely it is that the behaviour will occur. He is, however, quick to point out that individuals in certain situations may lack certain resources (e.g. time, money, skills and willpower) and opportunities to perform certain behaviours. It is therefore crucial in the educational context that learners are aware of the importance of behavioural intentions, and so come to the educational scene with those resources, if they are to benefit from the learning situation.

In this study the behaviours in which I am interested are academic work-habits and learning strategies. Work-habits, defined as regular behaviours students use to modify or structure the learning environment or manage their time (Devine & Meagher, 1989) have been explored in Chapter 1. Associated with work-habits are *learning strategies*, which Weinstein & Mayer (1985, p. 315) define as "*behaviours or thoughts that learners engage in during learning, that influence the encoding process".* McKeachie, Pintrich & Lin (1985) recognize two classes of learning strategies:

- ***cognitive strategies*** which are what students use to integrate new material into prior knowledge before applying them to their learning.
- ***resource management strategies*** which refer to effort, time use, the establishment of a study environment, and help-seeking from peers and teachers, that students use in their studies.

Some strategies which have a bearing on this study (such as proper time management, effective preparation for lectures etc.) were used in the development of materials for the computer package, *Bioskills*, reported in Chapter 5.

2.3.3 Motivation and motivational variables

Psychologists and educators have long considered the role of motivation in students' achievement and learning and the need to target these when teaching (e.g. McKeachie *et al.*, 1985). In this respect, a useful definition for students' motivation would be a measure of commitment of energy to achieve academic goals (Pintrich & Schunk, 2002). Although motivation and its sub-constructs are important variables influencing behaviour and learning in education (see Weiner, 1979; Schunk, 1990; Ajzen, 1991) studies on motivation in science education are sparse, according to Koballa & Glynn (2007). They claim that science education researchers seem to have focussed in the past 100 years more on attitudes than motivation, whilst in educational psychology researchers focussed on the many facets of motivation (see Graham, 1994; Graham & Weiner, 1996; Schunk, 2003). Science educators have much to learn from these studies on motivation, as explained by Zusho, Pintrich & Coppola (2003).

History of studies on motivation

According to Linnenbrink & Pintrich (2002) many of the early studies on students' achievement and learning separated cognitive and motivational factors and pursued very distinct lines without integrating cognitive and affective factors. However, since the 1980s there has been sustained effort to understand how motivational and cognitive factors interact, and jointly influence student learning and achievement. The integration of motivational and cognitive factors was facilitated by *"the shift in motivational theories from traditional achievement motivation models to social cognitive models of motivation"* (Pintrich & Schunk, 2002, p. 313). Three important premises of the social cognitive models of motivation that contrast with the traditional models of motivation are that motivation:

- is a dynamic, multi-dimensional phenomenon and students can be motivated in multiple ways (Pintrich & De Groot, 1990; Linnenbrink & Pintrich, 2002).
- is not a stable trait of students, but is situated, contextual and domain specific (Schunk, 1990; Breen & Lindsay, 2002; Bong, 2004).
- involves students' active regulation of their thinking and behaviour in order to affect outcomes (Zimmerman & Martinez-Pons, 1988; Pintrich & De Groot, 1990).

These premises have enabled researchers to understand how and why some students are motivated for educational achievement and others are not. Based on these three premises motivational theorists have proposed several motivational constructs and models that may be used to explain the relationships between the constructs, and to facilitate students' learning and achievement (Linnenbrink & Pintrich, 2002). However, as noted by Pintrich (2000) and succinctly highlighted by Linnenbrink & Pintrich (2002, p. 314) although such models are justifiable they are also confusing, and *"... less than helpful to the educationist in developing applications to improve students' motivation and subsequent learning"*. This is because the usage of many models has tended to impede the development of applications by researchers which could be used to improve learners' motivation and subsequent learning at school.

To reduce the confusion over terminology used in various models, Linnenbrink & Pintrich (2002, p. 314) have identified the four motivational constructs [or four key families of motivational beliefs], that are the "*enablers of students' achievement and learning*": "*self-efficacy, attribution, intrinsic motivation*" and "*goal orientation*". According to Linnenbrink & Pintrich (2002):

> *"These four families represent the currently accepted major social cognitive motivational theories (Eccles, Wigfield & Schiefele, 1998; Graham & Weiner, 1996; Pintrich & Schunk, 2002) and, therefore, seem most relevant when thinking about how motivation relates to achievement and other academic enablers"*
>
> (Linnenbrink & Pintrich, 2002, p. 314).

Each of the four general components, also shown Table 2.2, is defined in the following sections using the literature reviewed, and a summary of how each of the motivational components is related to students' learning and outcomes, as well as the other academic enablers, is provided.

Self-efficacy beliefs and academic success

A major motivational factor affecting student achievement is self-efficacy (see Figure 2.1), which is defined as students' beliefs about their capability to do a task or activity (Schunk, 1990; Bandura, 1997). Self-efficacy is conceptualized to be situated and contextualised and not a general belief about self-concept or self-esteem (Pintrich & Schunk, 2002). The "situated" premise means that students' self-efficacies vary as a function of subject matter domains and courses they are doing (Linnenbrink & Pintrich, 2002). For example, a student might have high self-efficacy for general biology topics but lower self-efficacy for evolution topics which, according to Linnenbrink & Pintrich (2002), may depend on the student's past successes and failures.

Attributions and academic success

The second motivational enabler of academic success is students' attributions. Attribution theory (Weiner, 1979; 1985) suggests that when failure or success occurs, students subconciously analyze the situation to determine the perceived causes for the result. Weiner (1985) categorizes perceived causes into three causal dimensions:

- Locus (whether the cause is internal or external). Weiner (1985) states the causes may be perceived as environmental (e.g. a distracting testing environment or bias on the part of the lecturer) or personal (such as lack of knowledge, ability, or failure to prepare adequately for the examination).
- Controllability (whether or not the perceived cause can be controlled, or how much control a student has over a cause).
- Stability[33] (whether the perceived cause is fixed or stable or whether it is variable and unstable across situations and over time).

Because attribution theory is used to discuss students' beliefs about their performances in Chapter 7, some further discussion is provided in this section. The locus, controllability and stability dimensions can be crossed in a 4-by-2 matrix to obtain eight cells, one for each possible combination of the three factors (see Table 2.3). For instance, a student who fails a test may say it is due to lack of ability which would, using Weiner's dimensions, be categorised as: internal (due to a feature within the ambit of the learner), uncontrollable (beyond the learners scope of control), stable (fixed over a period of time). These causes could be coded as (i/ ú /s). A student may also blame poor teaching[34] which would be categorised as external, uncontrollable, unstable and coded as (e/ ú /u). I have categorized this cause (poor teaching) as unstable as it may vary depending on the learners' opinion of the teaching over different contexts.

[33] Weiner (1979) found that the locus of control construct confounded two different dimensions of causality, i.e. the locus and stability dimensions, and this led to an expansion of the locus of control theory in motivation studies (Weiner, 1979;.

[34] Weiner, in a later revision (Weiner, 1985) of the attribution matrix, classified poor teaching as "controllable" although not by the individual but by influential others. Other researchers see this view differently. For example, Stipek (1998) argued that a cause that is external to an individual cannot be said to be under the persons control. I agree with the latter interpretation and have used this classification of controllability (Weiner, 1979) in my analysis.

According to Pintrich & Schunk (2002), the attribution dimensions can be used by researchers to explain the failure and success situations as shown below:

Table 2.3 Academic achievement attributions classified by locus, controllability, and stability dimensions (based on Weiner, 1979; 1985)

	Locus Internal		**Locus External**	
	Controllable	**Uncontrollable**	**Controllable**	**Uncontrollable**
Stable	typical effort	lack of aptitude	[35]	task difficulty
Unstable	lack of effort in a specific instance	mood/health at a particular instant	help from others	chance/ poor teaching of topic

For success situations

One of the aims of the present study is to make more students aware of the causes for their success and failures and to encourage them to take responsible actions which promote academic success. A second aim is to help them take actions to forestall the future occurrence of causes of past failures. According to Weiner (1985), if an attribution for success is made that is internal and stable, the student will expect to succeed in future tasks of the same type. For example, if a student says " *I did well in the biology test because I have the aptitude for it*", he/she will be more likely to do well on similar future tasks. This is because he/she is aware of a similar context of task presented to which he/she has demonstrated an earlier efficacy. If an attribution for success is made that is classified as unstable (e.g. due to test-specific effort or luck), the individual will not necessarily expect to do well in future (Weiner, 1985).

For failure situations

Pintrich & Schunk (2002) suggest that if students have inappropriate perceptions about their performance it will not help them to do well. It is only when they consciously think about the causes and make appropriate attributions that they will be able to overcome their difficulties. According to Weiner (1985), for failure situations, *unstable* and *controllable* attributions (e.g. lack of effort, lack of studying) are easier to correct than stable and uncontrollable attributions. This is because "*…the lack of studying can be changed and is controllable by the student; as long as the student puts forth the effort in studying for the next exam."* (Pintrich & Schunk, 2002, p. 118).

Attributions for failure that are perceived to have *internal*, *uncontrollable* and *stable* (i/ú/s) dimensions are considered to have the most detrimental consequences for students' future expectancies for success (Weiner, 1979; 1985). This is because if students perceive attributions to be stable (that is, not likely to change in the future) and beyond their control, they tend not to make any effort to correct them.

Of the three dimensions *stability,* as perceived by the student, is suggested as the dimension most closely linked to future expectations for success or failure (Pintrich & Schunk, 2002). Effort

[35] Pintrich & Schunk (2002) acknowledged the difficulty of having an entry in all the eight cells in "a locus-by-stability-by-controllability matrix". Stipek (1998), cited by Pintrich & Schunk (2002, p.116) suggests, and I agree to this proposition, that this cell be kept empty because by definition, "*a cause that is external to the individual is not under the person's control"*.

demonstrated by an individual can be either a stable or an unstable characteristic of that individual (Pintrich & Schunk, 2002). For example, a student can put forth effort for a specific subject or task (unstable) or could sometimes be lazy (unstable) or he/she could work hard consistently (stable). Ability or aptitude[36] is seen as a relatively stable internal characteristic of a person, whilst effort (depending on the type of effort involved) can be either stable or unstable.

Research shows that students who attribute success to stable, internal, controllable factors (such as their ability and their use of skills[37]) are more likely to succeed than those who do not (Schunk, 1990). Attribution of performance to unstable but controllable internal factors, such as lack of effort, is also found to be helpful to the student in the sense that the student's effort can be modified or students can be helped to see a way to avoid failure in future using acquired skills (Linnenbrink & Pintrich, 2002). Researchers suggest that students, where they attribute failure to lack of effort alone, should be helped to see their failure to be the result of both lack of strategy use (or inappropriate strategy use) and lack of effort and to do something about it. This is important because attributing failure to both lack of effort and use of an inappropriate strategy could help to dispel the notion that effort always leads to success, when it is really a combination of appropriate strategies plus effort that leads to success (Borkowski & Muthukrishna, 1992; Linnenbrink & Pintrich, 2002).

Intrinsic motivation and academic success

The third enabler of academic success under motivation is *intrinsic motivation*. Intrinsic motivation is explained as an individual's motivation to engage in an activity for its own sake (Pintrich & Schunk, 2002). *Extrinsic motivation* refers to motivation to engage in an activity as a means to an end. One of the lines of research on intrinsic motivation involves *interest*. Hidi (2006, p. 70) refers to *interest* as a person's '*relatively enduring predisposition to re-engage with particular content*", which is characterised by increased attention, concentration and affect. Hidi (1990) and Hidi & Harackiewicz (2000) construe interest as multi-dimensional, having "personal" and "situational" components. In distinguishing between personal and situational interest, Wade (2001, p. 245) sees personal interest of a student in a topic as "*specific, developing over time… relatively stable and … associated with personal significance".* This interest, according to Harackiewicz *et al.* (1998), may continue beyond a particular course. Situational interest is that evoked by the environment (Wade, 2001) or the learning context, and may be temporary or long lasting (Hidi & Harackiewicz, 2000).

Personal interest, measured as continued engagement, has been interpreted as an indication of students' intrinsic motivation (Breen & Lindsay, 2002; Hidi, 2006; Young, 2007). Young (2007) suggests that when students demonstrate mastery goals, they (such goals) are indicative of the students having personal interest in the course or topic. In researching situational interest researchers, looking at the students' reactions to different instructional techniques, found that individual student's motivational performances differed across disciplines (Breen & Lindsay, 2002; Bong, 2004; Chiu & Xihua, 2008). This finding is important in helping me to understand students' motivation and

[36] Aptitude signifies a stable unchangeable internal characteristic of a person and is considered a better term to use than ability (Pintrich & Schunk, 2002).

[37] Skills connote abilities that can be learned over time and are therefore considered internal and unstable characteristic of an individual (Pintrich & Schunk, 2002).

performance in biology, and those other subjects they mentioned as their favourites, as noted in Chapter 6.

Goal orientations and academic success

The goals students pursue within the academic environment are important determinants of the outcomes achieved (Pintrich & Schunk, 2002; Bong, 2004; Young, 2007). In Figure 2.1 goals are shown as a sub-construct of behavioural intentions. Two general goal orientations confront students when they approach and engage with academic tasks: to master a task or to outperform other students (Dweck & Leggett, 1988). A number of terms have been used to express these two ideas, which makes the landscape on goals achievement indistinct. According to Linnenbrink & Pintrich (2002):

> "*[a]cademic goal theorists have used a variety of labels to refer to these two goals including learning and performance goals (Dweck & Leggett, 1988), task and ability goals (Maehr & Midley, 1996), task-involved and ego-involved (Nicholls, 1984), and mastery and performance goals (Ames, 1992; Elliot, 1997; Elliot & Church, 1997; Elliot & Harackiewicz, 1996; Harackiewicz, Barron, & Elliot, 1998). Although there are slight variations in the interpretation of these goals under these various labels, they will be referred to as mastery and performance goals for simplicity."*
> (Linnenbrink & Pintrich, 2002, p. 320-321).

I have adopted the terminology of Linnenbrink & Pintrich (2002), and used the definition of Harackiewicz, Barron & Elliot:

> *"… performance goals highlight normatively based standards and promote the demonstration of ability relative to others; whereas mastery goals are self-referential, focussing on the development of skill and competence relative to the task and one's own past performance."* (Harackiewicz, Barron & Elliot, 1998, p. 2).

In other words, performance goals orient students to focus on their abilities, and to demonstrate this in surpassing others in grades or achievement. Mastery goals orient learners to develop new skills as they work to improve on their previous performances.

2.3.4 Metacognition and metacognitive development

The last major construct that forms part of my theoretical framework is metacognition. Metacognition, is a "*somewhat fuzzy concept*" (Flavell, 1981, p. 36) and has been defined loosely and broadly as "*knowledge that regulates any aspect of any cognitive endeavour*" (Flavell, 1981, p. 36). Flavell (1981) differentiates it into "metacognitive knowledge", "metacognitive experiences", and metacognitive and "cognitive strategies". In education circles, metacognitive knowledge refers to "*individuals' knowledge about the nature of learning, learning strategies, and personal learning characteristics*" (Baird, 1990). Metacognitive experiences are any conscious or affective experiences which are concerned with an intellectual activity (Flavell, 1979). Baird & Mitchell (1986) explain metacognitive strategies as activities that promote reflection on learning or increase awareness and control of learning.

According to White (1998) some authors have added "willingness" to the list of metacognitive factors to emphasize the role played by both cognitive and affective dimensions in learning. As noted by Case *et al.* (2001, p. 315) "*[i]n order for learners to improve their metacognitive abilities, it is important that they are not only able (cognitive aspect), but also willing (affective aspect).*" Stated differently, this definition conceptualizes metacognition as willingly planning, monitoring and evaluating cognition (Brown, 1978; Gunstone & Baird, 1988; Case *et al.*, 2001). Based on the above discussion metacognition has a cognitive and an affective component, and exerts a regulating influence and is shown in Figure 2.1 (page 42) to influence beliefs, attitudes, behavioural intention and actual behaviours.

There are various directions followed in research on metacognition in education (Case *et al.,* 2001). One of these is the exploration of students' understanding of concepts or topics. Ramsden (1988) believes students show understanding of a topic when they are able to relate to a concept or a topic in the way an expert on the subject does. Based on the assumption that strong intentions to understand a topic are suggestive of 'deep' approaches to learning (Ramsden, 1988), Davidowitz & Rollnick (2003, p. 66) have suggested that cognitive actions such as deep approaches emanate from metacognitive thinking. They note (p. 66):

> *"… metacognition is a prerequisite for deep approaches. While surface approaches can result from a lack of metacognitive thinking, it is possible for students using a surface approach to engage in metacognition."* (Davidowitz & Rollnick, 2003, p. 66*)*

The use of metacognitive strategies by students has been shown to move them towards "deep" approaches to learning and lead to significantly better learning outcomes (Baird & Mitchell, 1986; Martin & Ramsden, 1987; Linder & Marshall, 1997).

Another focus in the study of metacognition is in the area of metacognitive development. Gunstone (1994) argues that all learners have some level of metacognition but they can be trained to develop metacognitively. Case *et al.* (2001) call this move to develop learners' metacognitive abilities 'enhancing metacognition', which implies the move to greater knowledge, awareness and control of individuals' own learning. Davidowitz & Rollnick (2003) and Case *et al.* (2001) have, in studies from South Africa, explored what is entailed in metacognition enhancement of learners, which subsequent researchers have shown to vary within specific disciplines, as discussed in section 1.5.1, page 12.

One of the pedagogical challenges I envisaged was helping students develop metacognitively so as to show greater awareness and control than before in their learning. I therefore explored students' metacognitive knowledge, and use of metacognitive control and these are reported in the therapeutic phase of this study.

2.4 SUMMARY AND CONCLUDING REMARKS

The affective domain in science education is beset with lack of clear definitions of constructs. Schunk (2000, p. 116) accuses educational researchers of "*renaming or defining motivational constructs to fit their theoretical models and research methodologies with insufficient attention paid to extant* *conceptualizations"*. It is reasonable to suggest that this loose categorization of constructs has posed impediments to researchers in their attempts to establish concrete relationships among the constructs, a criterion Abd-el-Khalick & Akerson (2006) mention is necessary in order to formulate a robust theoretical framework. Using ideas from science education and educational psychology, working definitions of constructs relevant to this study have been provided; relationships among the various affective and cognitive constructs, as shown in Figure 2.1, have been discussed. Evidence in support of this skeletal framework has been gleaned from a number of studies reported. With the theoretical framework in place, it is now possible to investigate other areas of the study.

CHAPTER 3
RESEARCH APPROACH AND METHODS: DIAGNOSTIC PHASE

As mentioned in Chapter 1, this study was conducted in two phases. The first stage, the diagnostic phase, aimed to identify factors which staff and students perceived to affect academic success. In this chapter the research questions, issues related to the research methodology, and the data-gathering methods used for the diagnostic phase of the research are described to provide the basis on which the credibility of the results may be judged.

3.1 THE PURPOSE OF THE DIAGNOSTIC PHASE

The aim of the diagnostic phase was to solicit, in a systematic way, conceptions about academic success held by stakeholders in this university. The literature reviewed in Chapter 1, section 1.5, examined, from a global perspective, factors known to influence academic success at tertiary level. This information was used to complement what stakeholders at this institution perceived were the contributing factors, and also to improve the theoretical[38] validity (Maxwell, 1992) of the data.

3.1.1 Research questions

According to Tashakkori & Teddlie (2004) research questions provide a framework that determines the methods used, and are used to guide the stages in a study. Onwuegbuzie & Leech (2005) state research questions can be used to set limits to a study, and guide researchers in determining the type of data that are eventually collected. Research questions are never cast in stone. They are seen as emerging and evolving and could be re-evaluated at the data collection and data analysis stages (Onwuegbuzie & Leech, 2005).

Two broad research questions directed this stage of the research:

1. What factors do lecturers teaching first-year biology, Honours biology students and first-year biological sciences students, perceive to be important for academic success in first-year biological sciences at the University of the Witwatersrand?
2. What changes in students' perceptions occur after a year at the university?

Research question 1 is a typical open-ended question. As noted by Connolly (1998) questions beginning with "What" attempt to obtain insights that exist within a specific context. Research question 2 is a comparative question which seeks to compare one group at two points in one year.
Simpson *et al*. (1994) state that students' metacognitive awareness of factors affecting academic success is vital for academic success and, if absent in groups of individuals, such appropriate factors

[38] Theoretical validity is the degree to which a theoretical explanation developed from research finding fits the data (Maxwell, 1992).

can effectively be taught. My exploring perceptions in Research Question 1 was a follow-on of this suggestion by Simpson *et al.* (1994). Ausubel (1963) stresses the importance of ascertaining relevant prior knowledge in learners and building on such to promote meaningful learning. Whilst the first question was of importance to me as a tutor, the second was of concern to me as a tutor wearing a "researcher's hat" and interested in the perceptions of students as they entered first year at university as well as when they completed the year. This information was needed in order to establish the effects a year of studying at the university had on the conceptions students held about factors affecting academic success. A second reason for ascertaining this information was to find out whether students gain metacognitive knowledge simply by experiencing first-year, or whether it needs to be taught, and what aspects need to be taught. This information was needed for planning the intervention.

3.2 RESEARCH PARADIGMS

Research paradigms are explained as worldviews or belief systems of researchers, and provide the inherent theoretical assumptions that guide investigations (Lincoln & Guba, 1985). These assumptions include views about the nature of knowledge, the nature of reality, and the relationship between an inquirer of knowledge and the object of inquiry (Lincoln & Guba, 1985). As belief systems determine the research methods a researcher uses for a study (Patton, 1980) it is important that researchers spell out their belief system so that readers know the researcher's stance, and the type of methodology to be expected (Mertens, 2005).

Two major paradigms were dominant in scientific inquiry until the late 1980s (Patton, 1990). These paradigms have been referred to by several names in the literature but I will simply call them 'positivist' and 'constructivist' paradigms in this study[39].

Historically, positivism was the foremost of the two paradigms. Research in the positivist tradition is underpinned by beliefs that reality is "*single, tangible, fragmentable"* and can be studied and discovered independently using a "*universal scientific language*" (Lincoln & Guba, 1985, p. 22). The methods of discovering and measuring this external reality were predominantly through experimental designs, quantitative measurements and statistical analysis. Researchers operating within this belief system were tagged "positivists" or "quantitative" researchers, and were seen as objective outsiders who employed value-free observations to obtain generalizable results (Lincoln & Guba, 1985).

The positivist paradigm became increasing unsatisfactory in the field of education, as the basis for doing "good science", mostly because of its emphasis on quantitative methods and experimental analyses (Patton, 1980). Researchers in the field of education contended that human behaviour was too complex to be explained in the ways appropriate for processes and objects in scientific experiments (Bryman, 1984).

[39] Mertens (2005) calls them the "postpositivist" and "constructivist" whilst Guba and Lincoln (1985) refer to them as "post positivist" and "naturalist" paradigms. Other researchers call them the "quantitative" and "qualitative" paradigms, which is misleading as these terms denote research methods rather than the researcher's belief system, which is what paradigms should reflect.

The constructivist paradigm emerged in the early 1970s as a major paradigm and challenged the once dominant position held by positivism in educational inquiry (Patton, 1980). In direct contrast to the tenets of positivism, researchers working within this paradigm maintain that "*realities are multiple and socially constructed*" (Mertens, 2005). Constructivists argue that there is a fundamental difference between the study of natural objects and the study of humans, in that humans' actions are complex and it is humans, from their standpoint, who interpret situations and give meanings to them. Qualitative researchers see human actions as "social constructions" rather than as a result of outside forces moulding individuals in predictable ways (Bryman, 1984). As noted by Bryman (1984) researchers working in the constructivist paradigm are not independent of their respondents, but observe and interact with the subjects of their research. Patton (1980, p. 19) points out that in order to relate with targets of their study, researchers "…*use techniques of in-depth, openended (sic) interviewing and personal observations to gather qualitative data*" which are holistically analysed. The process of understanding social groups and institutions from their own perspective is distinctly associated with constructivist beliefs (Bryman, 1984).

Research conducted in this way was criticized as being subjective and value-laden. Kulik *et al*. (1983) claim some of the methods of obtaining data are subjective and anecdotal and thus of little scientific value. Proponents, however, believe they are able to produce results that are valid, using multiple methods and triangulation of observations which address the lack of methodological rigour critics had questioned (Patton, 1980).

Bryman (1984) and Vulliamy, Lewin & Stephens (1990) report on the division among social and educational researchers over the incompatibility of beliefs associated with the two paradigms, which therefore prevented the mixing of methods associated with each of the research paradigms. Also contested amongst researchers was which form of inquiry was superior (Hoepfl, 1997). These debates and competition over the paradigms constituted the so-called *paradigm wars* (Bryman, 1984; Johnson & Onwuegbuzie, 2004).

One of the characterizations of the paradigm wars era was the incompatibility thesis (Guba & Lincoln, 1994) in which quantitative methods were associated primarily with positivism (and postpositivism), while qualitative methods were associated with constructivist ideas (Howe, 1988; Guba & Lincoln, 1994). The debate over which of the paradigms and the associated methodologies is the most appropriate for social and education research led to three viewpoints held by researchers on the relationship between epistemology and research methods (Bryman, 1984). Two groups of "purists" exist. There are those at one pole, the positivists, who believe in value-free, objective studies and use quantitative methodologies to verify generalisations, laws and causal relationships (Peshkin, 1993). At the other pole are those who value the interpretative approaches as the only valid one for the study of human behaviour, and do not allow a blend of epistemologies (e.g. Lincoln & Guba, 1985). However, there is a group of middle-of-the-road researchers (whose viewpoints this researcher subscribes to) who believe it is not necessary to pit the two methodologies associated with these paradigms against one another.

Patton (1990) agrees that at the epistemological level tenets of positivists and constructivists differ, and are linked to specific methodologies. But he believes that one can responsibly make mind shifts about the best research approaches to use, and methods typically associated with either of the paradigms, without compromising the underlying beliefs. By such a stance, Patton advocates a "*paradigm of choices"* that seeks "*methodological appropriateness as the primary criterion for methodological quality"* (Patton, 1990, p. 39). Patton advocates the use of the most appropriate methodology combining qualitative techniques with traditional quantitative research methods to investigate the problem at hand. Such *"situational responsiveness,"* Patton (1990, p. 61) notes, will help practitioners to gather data that strict adherence to one paradigm or another will not. As noted by Howe (1988) pragmatism is not wedded to a single methodology and mixing typically quantitative and qualitative methods is therefore held to be appropriate.

Patton's views and practices (proposed in the 1970s) have gained ascendancy among researchers since then. Reeves & Hedburg (2003) refer to this paradigm as the "eclectic-mixed methods-pragmatic paradigm". The name used by Reeves & Hedburg (2003), whilst unduly wordy, is actually descriptive of the paradigm[40]. The usage of this descriptive name is not widespread, other researchers preferring to call it "pragmatic paradigm" or "mixed-methods paradigm" (see Greene, Caracelli & Graham, 1989; Johnson & Onwuegbuzie, 2004; Tashakkori & Teddlie, 2004). The name "mixed-methods paradigm" is, however, misleading, as it emphasizes the methods used and not the belief system of the researcher, which is what paradigms are about. Thus "pragmatic paradigm", as an abbreviation, is the preferred term I have chosen to use for my study.

Tashakkori & Teddlie (1998) remind us that research should be done with a clear intent to answer a question or evaluate a programme. According to Tashakkori & Teddlie (2004, p. 21):

> *"pragmatists consider the research question to be more important than either the method they use or the world view that is supposed to underlie the method. ...researchers prefer addressing their research questions with any methodological tool available, using the pragmatist credo of "what works".*

Depending on the nature of the research question, Johnson & Onwuegbuzie (2004) and Tashakkori & Teddlie (2004) point out that research questions may be better answered with mixed-methods research design than with a sole reliance on either the qualitative or quantitative research design. One benefit for combining qualitative and quantitative methods in a study, noted by Johnson & Onwuegbuzie (2004), and which seems relevant for my study, is that it produces more complete knowledge than using mono-methods.

Cresswell (1997) presented three mixed-methods research designs that could be adopted by researchers in their inquiry. The "mixed methodology design" seems to fit closely with the design I

[40] The "pragmatic" aspect to the name reflects the realistic, practical orientation that adherents adopt to deal with problems that confront them (Reeves & Hedburg, 2003). The "eclectic" aspect reflects openness of researchers to combine methods that seem best to collect information and solve problems. The "mixed methods" tag is in recognition among researchers that multiple perspectives are necessary in order to establish information or conclusions about a phenomenon (Reeves & Hedburg, 2003).

used because I used data-gathering methods traditionally considered to be qualitative and quantitative in both stages of the research.

3.3 RESEARCH DESIGN

Research design is defined as a “plan” or a ‘blueprint’ of how one intends conducting the research (McMillan & Schumacher, 1993). The design includes a plan for choosing subjects, data collection techniques, and ways that will be used to analyse data to answer research questions. Figure 3.1 (page 57) provides a flowchart of the research design used for the study emphasising the diagnostic phase of the study.

A literature review was undertaken in order to articulate the theoretical framework and the appropriate research methods to use to collect the data. The theoretical framework selected was on at-risk university students and factors affecting academic success, and was presented in Chapter 1 and Chapter 2. Chapter 3 deals with the research design and methods. Two data-gathering instruments were designed, face-validated, piloted, and used at specific stages of the diagnostic phase as shown in Figure 3.1. The samples identified for this phase of the study were lecturers teaching first-year biological sciences, and students from the University of the Witwatersrand. They were purposively selected and therefore constituted convenience samples. Details of the samples and the data-gathering techniques used are provided in the following sections. As shown in Figure 3.1, the data obtained from using the two instruments were analysed and these informed the therapeutic phase, which is the second stage of the study.

3.4 DATA-GATHERING STRATEGIES

3.4.1 Interviews

An interview is explained as a conversation between two or more people (the interviewer and the interviewee) where questions are asked by the interviewer to obtain information from the interviewee (Kvale & Brinkman, 2008). Interviews, as a data-gathering technique for establishing personal viewpoints (Posner & Gertzog, 1982; Powney & Watts, 1987), can be of various types from the unstructured form, through the semi-structured to structured interviews (Fontana & Frey, 2000). In unstructured interviews, few questions are prepared beforehand and the interviewer tends to rely on the interviewees’ responses to steer the session (Powney & Watts, 1987). As a disadvantage, where there is no structure there is the likelihood for some items which were meant to be investigated to be accidentally left out. In structured interviews all respondents are asked the same series of pre-established questions without the option of changing the wording or sequences (Fontana & Frey, 2000). Such interviews are problematic, as they tend to be rigid, as new ideas introduced by the interviewee cannot be probed. Semi-structured interviews permit some variation in the list of questions to be asked. Gall, Borg, & Gall (1996) state that using semi-structured interviews permits researchers to follow up on leads from respondents to obtain greater clarity and expansive information where needed. These factors contributed to my choosing to use semi-structured interviews.

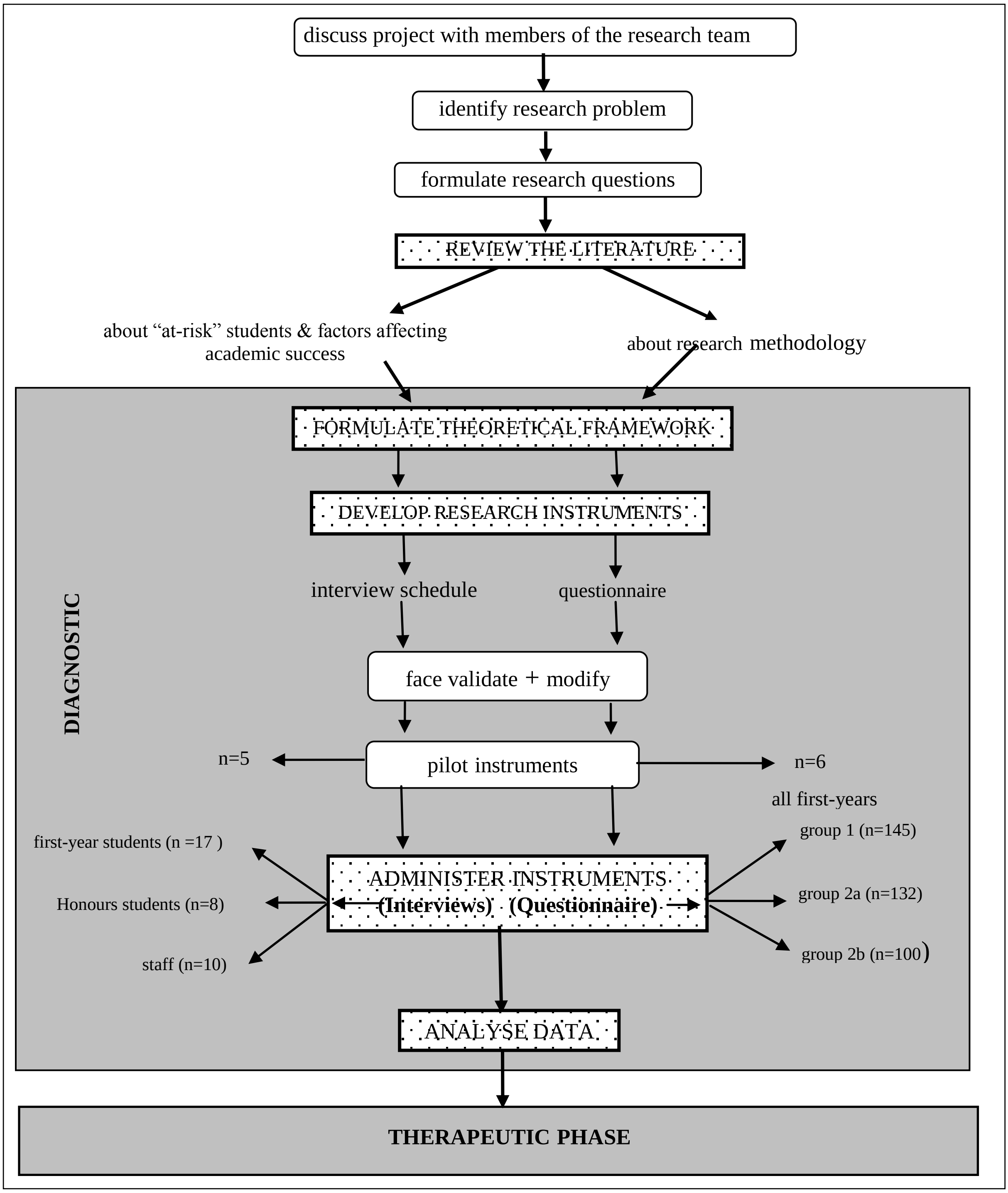

Figure 3.1 A summary of the research design used for the diagnostic phase

Benefits of using interviews

Powney & Watts (1987) point to some of the benefits of using interviews, such as allowing researchers to obtain insight into the perceptions of people within a situation. They can be used, unlike questionnaires, to refocus questions and to engender active interactions with interviewees.

Whilst questionnaires are structured to provide succinct information, Patton (1980) points out that interviews can yield expansive, in-depth information depending, on how the questions are asked.

Limitations of using interviews

Although interviews can be used to provide in-depth and detailed information, the successful use of the method depends on the skills of the interviewer. Powney & Watts (1987) point out that the interview would have to be kept focussed on content specified by research objectives and directed by the interviewer in order to obtain research-relevant information. Oppenheim (1966) points out that the interviewers' own opinions, tone of voice or facial expressions may influence the responses given by the respondents. In such cases the respondents are likely to respond in ways that are acceptable to the interviewer, rather than honestly. Another limitation about interviews is that they are time-consuming to conduct, transcribe and analyse (Fontana & Frey, 2000), and as a result most studies which use interviews involve smaller samples than those with questionnaires to gather data.

Designing well-structured interviews

The purpose of the interviews in my study was to elicit, from a diverse group of students and lecturers, perceptions on factors that contribute to academic success, and by so doing obtain a richer source of information than starting with questionnaires. In my study efforts were made to design well-structured interviews. I conducted an extensive literature review on how to design and conduct good interviews, and consulted with science education experts to obtain advice on how to formulate questions with clarity. In order to reduce researcher bias a suggestion by McMillan & Schumacher (1993) to use an interview schedule was followed. An interview schedule is a list of questions and issues that are to be explored during the interviews.

Designing the interview schedules

Two researchers (both PhD students) who were involved in the investigation of various factors related to academic success in the biological sciences designed the interview schedules and conducted the interviews. We were part of a research team of staff members exploring the effective use of computer-aided instruction. Whilst I was interested in the influence of affective factors, work-habits and metacognition, the other researcher was interested in the influence of skills on academic success. We hoped the use of two interviewers was a technique that would avoid the interviewees being interviewed twice, and which would create an interviewing atmosphere that would be similar to an informal chat and less threatening to the respondents.

Three interview schedules were developed, one for use with the lecturers and one each for the two student groups (first-years and Honours). (These are shown to the left on Figure 3.1, p. 58) The development of the interview schedules used in this study followed guidelines provided in the research literature (e.g. Powney & Watts, 1987; Cohen, Manion & Morrison, 2000). The content of the interview schedule was influenced by suggestions from the research literature on factors affecting successful learning (e.g. Pintrich, Cross, Kozma & McKeachie, 1986; Ramsden, 1988) and from contributions from science education experts in the Department of

Botany. My focus for the interview was on the influence of affective factors, work-habits and metacognitive knowledge on academic success.

All interview schedules had a common introduction stating the University's concern over the poor first-year pass rates, the need to address this situation and the introduction of the team of researchers who were presently trying to find out ways to address the situation. The latter part of the introduction varied for the different samples, as will be shown in subsequent sections.

For the first-year students the "draw card" used to solicit their views was their having been at the university for almost a year. Two major questions were posed to them. One was on what, in their opinion, made students successful in their first year. A second question asked them to think of factors that could lead students to be unsuccessful in their first year. Students were encouraged to list a number of factors and their verbal contributions were sustained by the use of probes and prompts. As my research included attitudes, motivation, study habits and academic success, these constructs were introduced in the interview when they were not mentioned by the interviewee. Respondents were asked if they thought these factors were important for academic success. Again they were required to elaborate on their responses, and probes such as 'any more?'; 'what do you mean?' were used to get students to clarify what they meant (see Appendix A3, p. 247, for the interview schedule used for the first-year students).

The interview schedule used for the Honours students acknowledged they were senior students having spent three or more years at the university. Between the two PhD students that were conducting the interviews we had framed eleven questions, addressing the importance of skills, attitudes, motivation, learning strategies and academic success. The context for the first question posed was for them to imagine a relation of theirs just admitted to the university coming to seek advice on what to do to be successful in biology. Probes were used to ensure responses were expansive and focussed on content specified by the research objectives, for example, "How does that contribute to academic success?" What other factors do you think make students academically successful?" "Could you explain that a bit further?" (see Appendix A2, p. 245, for the interview schedule used for the Honours students)

For the lecturers, our involvement in the research was made explicit to them in the introduction. "… *We were hoping to identify attitudinal and educational factors which could contribute to success, and so be in a position to teach these to weaker students and help them to pass.*" The questions on the interview schedule of the lecturers were similar to those for the post-graduate students. The introductory question asked directly what factors they believed influenced academic success in biology (see Appendix A1 p. 243 for the interview schedule used for the lecturers).

Face validation of the interview schedules

In the construction of the interview schedule it was important that questions on affective factors, metacognition and work-habits that influenced academic success, which my research questions attempted to investigate, were included as part of the content-related validation process. Content validity, as explained by Anastasi (1988), although in the context of tests (but the same will apply to all research instruments), says it is the systematic examination of the instrument content to determine whether it covers a representative sample of the domain to be researched. Content-related validation is essentially the task of the instrument designer, who ensures that the instrument covers a representative sample of the content being investigated. It is built into an instrument from the outset through selection of items as dictated by the research objectives.

The validity of an instrument, as explained by Anastasi (1988), concerns what the instrument measures and how well it does so. The interview schedule was face-validated. Anastasi (1988, p. 144), in the context of establishing test validity, explains face validity as "*what an instrument appears superficially to measure"*. Face validity is usually checked by referring the instrument to experts with a request of what to check (Anastasi, 1988). The determination of face validity of an instrument is not to be considered as an objective measure of validity, but Anastasi (1988) claims it is often 'inaccurately' used by researchers as a method to check for the content validity of an instrument.

The expert consulted in my study was a science education researcher with years of experience in designing research instruments. The expert checked that the content covered the domains being researched; that the wording of the questions was clear and unambiguous; that the items were grammatically correct; and that the language used was appropriate for respondents who were mostly English-second language speakers.

Piloting the interviews

Researchers (e.g. Gall *et al.*, 1996) recommend that schedules are piloted before the main study is conducted. When piloting, the instruments to be used in a study are trialed on a small sample similar to the targeted sample, to check if potential problems exist with the instrument. Only the first-year interviews were piloted, and with five first-year Botany students[41] The piloting served to check if the interviews obtained the data needed to answer the research questions. It also provided an opportunity to hone my interviewing skills, and to find the approximate time the interviews took. These steps were necessary in order to identify possible problems, address them, and ensure smooth running of the subsequent interviews. The interviews lasted from 20 to 25 minutes, and this information allowed us to schedule an appropriate number of interviewees for each time slot available.

Conducting the interviews

The interviews were conducted in English, which is the medium of instruction at the university, by the two PhD researchers mentioned earlier. Participants were encouraged, at the start of the interview, to ask for clarification if the questions during the interviews were not clear to them. They were provided with a pen and paper to write down any thoughts they wanted to bring to our attention later in the interview session.

[41] The Honours students and lecturers available were few in numbers and I did not want to lose any of the already limited respondents by using them in a pilot study.

Fontana & Frey (2000) recommend that during interview sessions researchers should try to establish a person-to-person relationship with the respondents to gain their trust. These authors suggest that establishing rapport with participants in this way contributes to maximize the quality of information to be elicited, and improves the validity of the data. In my interview schedule there was an introductory statement to each interview session in which the nature of the study was briefly explained. The following briefing, which formed part of the introduction to the first-year students, was meant to establish the rapport with them and so partially addressed the concerns expressed by Fontana & Frey (2000):

> Thank you for agreeing to talk to us. As we explained to you, the university is very keen to improve the pass rates of its students, especially those in the first year, and would want to see more students graduating at the end of the year. I am sure you will have noticed that while some students struggle to cope with their studies, others tend to cope and pass their exams easily.
>
> A whole group of staff and PhD students in the Department of Botany [42]is involved in a research project to find what makes some students so successful, and why others struggle. The factors you identify will help us to develop programmes which will benefit in-coming students, helping them become more successful as students.
>
> You have been a first-year student for almost a year now. You have experienced what it is like, and you have seen successful and unsuccessful students around you going about with their studies, and may have developed some ideas about factors which contribute to success. It is these we want to ask you about.

Gall *et al.* (1996) point out a disadvantage of note-taking by researchers which can influence researchers to be selective and lead them to either forget to write some of the interview details or to select data favouring their biases. Taking notes comprehensively during the interview session can also take a lot of time and may not be in the best interest of the interviewee. The interview was therefore tape-recorded, providing a complete verbal record, which could be transcribed and analysed.

Sample selection for the interviews

Three groups, all from the biological sciences departments, were interviewed as detailed below. Their views were obtained in order to elicit a variety of views to structure a questionnaire to administer to a larger sample, as well as to obtain more in-depth qualitative data than is possible with a questionnaire.

Sample 1: Undergraduate students

The students interviewed were from the mainstream first-year biology course. The expert-novice technique recommended by McMillan & Schumacher (1993) was adopted to investigate the opinions of high and low-achievers in the biology class who, it was anticipated, could have varying viewpoints. To select the high- and low-achievers, mid-year examination results for Biology were used to rank the students. Those with marks below 40 percent were categorized

[42] The Department of Botany is now defunct, having being merged in 2000 with the Department of Zoology to constitute the School of Animal, Plant and Environmental Sciences

as low-achievers (unsuccessful students), whilst those with a mark of above 70 percent were classed as high-achievers (successful students).

Ten students from each group were arbitrarily selected, and individually given a letter specifying the intentions of the study, and inviting them to an interview. Students all agreed to be interviewed and informed the researcher of the time they would be available for the interview session and a roster was designed. By working within their time schedules we hoped to reduce the anxiety generated by such interviewing protocols.

Of the twenty students who arranged interviews, seventeen students (10 high-achievers and 7 low-achievers) turned up on the arranged day and times, and were interviewed by the two researchers.

Sample 2: Honours[43] students

Ten senior students who had spent a minimum of three successful years at the university and were now doing Honours work in the biological sciences were invited to be interviewed. It was felt that Honours students have insights to convey about factors associated with success in first-year biology. These Honours students were “teaching assistants”[44] at the laboratory sessions for the first-year students. They constituted a convenience sample. The times they would be available were requested and the most suitable times verbally agreed upon between us.

Two Honours students could not find an appropriate time for the interview. Eight Botany Honours students arrived at the scheduled times. The interview sessions took about thirty minutes.

Sample 3: Lecturers teaching first-year biology students

Lecturers interviewed were drawn from the two departments which offered courses for first-year students. These departments were the Department of Botany and the Department of Zoology. Most of the lecturers had taught first-year students for many years. As such, it was felt they would have observed first-years students and become acquainted with the characteristics successful students often display. Eliciting the viewpoints about factors contributing to academic success from all the lecturers teaching first-year courses in the department was considered necessary in order to tap into the body of knowledge held by lecturers in the two departments.

All lecturers teaching first-year biology were approached, and asked if they would be willing to be interviewed. One lecturer declined. The rest (n=10) agreed, and appropriate times for the interviews were arranged via e-mails and verbal confirmation.

[43] Post-graduates who have completed their under-graduate degrees and are starting on a further (higher) degree.

[44] Teaching assistants are post-graduate students who, during laboratory sessions, are assigned a group of students to supervise, and mark their laboratory work.

All the interviews were audio-taped, after obtaining permission from the respective interviewees, and the sessions lasted about twenty-five minutes. The recorded interviews were transcribed and the transcriptions carefully checked by science education specialists in the department for accuracy to improve the reliability of the data, as recommended by McMillan & Schumacher (1993).

Analysis of the interview data

The transcripts were analysed using open coding (Strauss & Corbin, 1990). This involved a process of thorough reading of the responses of a sample of the transcripts, picking up and categorising trends that emerged, and naming the categories and sub-categories. Theoretical saturation (Strauss & Corbin, 1990) was achieved when no further categories could be identified. The categories were face-validated by an expert to see if the categories and their subdivisions were logical, comprehensive, and mutually exclusive. The face-validated categories were then used to analyse the transcripts from scratch again.

A technique which was used to ensure the reliability of the coding was that of constant comparison that each piece of data fitted with existing categories (Strauss & Corbin, 1990). Inter-coder reliability was used by asking a science education researcher to check the coding. She used my coding system to analyse the transcripts already coded. Areas of disagreement were discussed and, where necessary, modified until there was mutual agreement on the allocation into categories.

3.4.2 Questionnaires

Galfo (1975, p. 27) describes questionnaires as instruments used *"...to obtain factual data, opinions and attitudes in a structural framework from respondents not contacted on a face-to-face basis."* In questionnaires the respondent is required to record in some way their responses to a set of questions or statements (Cohen & Manion, 1994). Oppenheim (1966) sees questionnaires as an inexpensive way, compared to interviews, of gathering information, especially from large samples. The purpose of using a questionnaire in this study, was to consult a larger sample of first-year biology students which would be more representative of the population than those interviewed.

Cohen & Manion (1994) note that although questionnaires cannot be used to probe respondents' views to find out what particular responses mean, unlike interviews, questionnaires can be structured for the respondent to write in-depth answers to open-ended questions. One problem commonly encountered when using questionnaires is that of poor return rates for mailed questionnaires (Oppenheim, 1966). The issue of poor return rates did not apply in this study as the questionnaires were personally administered and collected by the researcher during a lecture period. But as students' participation was voluntary, it was important, as recommended by Cohen & Manion (1994, p. 93), for me to structure the questionnaire to engage their "… *interest, encourage their co-operation*" and so elicit responses that were honest and true. Cohen & Manion (1994) point out the importance of an attractive, easy-to-read questionnaire, to encourage respondents to answer. Leedy (1989) recommends an introduction explaining the context of the study, what it is setting out to discover, and why it is important to provide honest responses to the statements. An adequate introduction, according to

Leedy, helps respondents to see the importance of their contribution, which would be more likely to lead them to provide responses to all questions in the questionnaire.

A problem associated with the use of questionnaires is that of respondents providing inaccurate information, which may arise when anonymity is not guaranteed, or due to lack of interest on their part (Oppenheim, 1966). Inferences made from such erroneous data lead to reliability and validity problems (Powney & Watts, 1987). In this study respondents were asked to write their student numbers, not their names, on the questionnaire. Although each respondent could be identified by the student number by anyone with the list of names and numbers, students were guaranteed their anonymity as far as usage of the information they were providing was concerned.

Development of the questionnaire

Cohen & Manion (1994) point out that an ideal questionnaire should be clear and unambiguous so that it minimises potential errors from respondents. Powney & Watts (1987) recommend questionnaires should be subjected to self-criticism as they are being developed, and they recommend that questionnaires should be piloted, and if weaknesses are identified, they should be modified. The following steps were followed, as suggested by Oppenheim (1966); Gay, (1981); Foddy (1993) and Cohen & Manion, (1994), to improve the structure of the questionnaire. These included:

Reviewing the literature on questionnaire development

One of the suggestions in the literature concerned the type of questions to be used in the instrument - open questions or closed questions. Oppenheim (1966) points out that a benefit of using open-ended formats is that respondents are encouraged to write descriptively on what comes to mind. However, this format requires a lot of writing from respondents, and invariably requires some thought and may take some time for respondents to complete. Researchers such as Oppenheim (1966), Gay (1981) and Foddy (1993) state that closed-ended questions are easier and quicker to answer from the respondents' point of view, but are prescriptive, in that respondents are limited by the options provided and can be forced to choose inappropriate options when the one that describes their situations is not included.

In this study the questionnaires used both open-ended and closed-ended questions. Open-ended questions were important in obtaining from the students a wide array of views without restricting them to choosing those provided. The close-ended statements used a Likert-format so that respondents could indicate their extent of agreement or disagreement quickly and easily within the timeframe provided. Provision was also made to allow respondents to write views that were not in the options provided, by including space for additional comments. In this study limited use was made of open-ended questions in order to reduce the time respondents spent in writing their responses.

The next issue considered in the design of the questionnaire was the presentation (appearance, lay-out) of the instrument. The presentation of questionnaires is vital in encouraging completion by respondents (Cohen & Manion, 1994). Oppenheim (1966) and Sanders (1995) suggest the use of relevant graphics and speech bubbles as a way to motivate respondents to complete responses.

Drawing up the statements and questions

A number of factors considered important for academic success, based on information from the interviews and from the literature surveyed, were identified and used as statements in the questionnaire. The theoretical framework which was based on the literature served as a guideline as to statements to include. The design of the questionnaire followed a reiterative cycle which involved submitting to the experts the various drafts of the questionnaire for reviewing, and modifying where necessary. The checking and the modifying cycles were part of the rigorous design process needed to give a sharper focus to the items and to improve on the validity of the instrument. The questionnaire was kept short and covered three pages [A copy of the questionnaire is included under Appendix B p. 248-251].

There were three major questions to the questionnaire. Question 1 was open-ended and respondents were required to write, in four speech bubbles, strategies that they believed helped students to do well in first-year biology. Question 2 asked students to indicate their level of agreement or disagreement, using a 5-point scale (I strongly agree, I agree; I am not sure; I disagree; I strongly disagree), to twelve statements on factors affecting academic success. Question 3 requested students to indicate their level of agreement or disagreement, using a Likert-format for 15 statements on attitudes and behaviours they believed top biology students adopt in studying.

Face-validation of the questionnaire

Two biology educationists face-validated the questionnaire. They checked that:

- the instructions for completing the questionnaire were clear and easy to understand,
- the statements were unambiguous,
- no irrelevant statements (for answering the research question) were included,
- the language and grammar used were correct.

Piloting the questionnaire

As advised by Oppenheim (1966), the questionnaire was piloted. Six students from the College of Science were involved. The piloting was done in order to discover and correct flaws with the instrument before the main study was carried out. It took the members of the ‘pilot sample’, on average, 15 minutes to complete the questionnaire. Informal chats with them on completion of the questionnaire revealed no major problems with the questionnaire and that they had understood what each item required them to do.

Sample of students given the questionnaire

The questionnaire was administered to two groups of first-year students over two subsequent academic years (shown to the right on Figure 3.1, p. 58). The first instance was towards the end of the year (Group1, n=145). During the following year, the questionnaire was administered to a class of biological sciences students during the first week of the academic year (Group 2a, n=132), and again towards the end of the year (Group 2b, n=100). Matching student data from Group 2 at the start and end of the year were obtained from 83 questionnaires, and provide the sample for the comparison.of first-year students explained on pages 67-68.

Analyses of the questionnaire data

Three different types of analyses were carried out on data from the questionnaire, in order to answer research questions 1 and 2.

Analysis of the open-ended data

Data obtained from open-ended question were analysed using an open-coding system, as recommended by Strauss & Corbin (1990). Care was taken to obtain inter-coder agreement with an evaluation expert in the department on the various categories identified from the open-ended data. Frequency counts and ranking of all the statements on factors affecting academic success were done for the sample. As mentioned previously, data was to be extracted from the same set of students' questionnaires at the start and end of the year to shed light on whether students' perceptions had changed as a result of their experiences during first year, without specific intervention.

Analysis of the closed-ended data

The closed-ended statements of the questionnaire, with Likert-format responses, were analysed using two methods.

METHOD 1: Indices of Agreement/Disagreement

To determine students' perceptions of the importance of factors influencing academic success I used a formula that involved the calculation of indices of agreement and disagreement from the raw scores. The following scores for the Likert-format categories were used in the formula below: "strongly agree" +2; "agree" +1; "not sure" 0; "disagree" -1; "strongly disagree" -2. Negative statements were switched around in the calculation of the index to match the opinions held.

$$\text{(dis)agreement index (IA)} = \frac{2\text{x [no. of strongly (dis)agree scores] + no. of (dis)agree scores}}{\text{maximum possible score (2n)}}$$

The index of agreement (or disagreement) quotient, obtained when the formula is applied to data, ranged from 0 to 1, and took into consideration the "strongly agree" and "strongly disagree" choices of respondents (the size of their choices) which were weighted by a factor of two, relative to the "agree" and "disagree" options. The quotients are a reflection of the opinion of the group as whole about the importance of each factor influencing academic success. The various indexes of agreement were then ranked.

METHOD 2: Rasch analysis to determine significance of differences between scores
To determine if there were statistically significant differences in students' perceptions at the start and end of year I used Winsteps[45] Rasch modelling techniques to overcome problems associated with untransformed nominal data from the questionnaires. The Rasch techniques are a family of tools (Bond & Fox, 2001) which have computer-based capabilities, to transform and analyse data.

The closed-ended statements I used in the questionnaire had a five-point Likert-format to which respondents expressed their level of agreement or disagreement. Such responses generate nominal[46] data. Based on mathematical theory (Stevens, 1946; Siegel 1956) the permissible operations on such data are to look at frequencies in each category and determine the categories with most responses. In order to do statistical analyses the nominal data must first be converted to ordinal[47] data by allocating scores. [In Rasch transformations the following are used +4 for strongly agree; +3 for agree; +2 for not sure; +1 for disagree and 0 for strongly disagree (see Linacre, 2006)]. Further specific mathematical operations can then be calculated, for example, total scores which are calculated for all items measuring a common construct e.g. attitude to biology or perceptions of the nature of science. But such data does not permit the use of parametric statistics. In order for parametric tests to be used for comparing differences between two groups the data must first be converted into interval data. This is because a **mathematical requirement** for performing parametric tests, is that the data used must be interval data and normally-distributed (Siegel, 1956; Anderson, 1961). Where these two conditions are not met the validity of inferences drawn from such studies can be questioned.

It was important for me not to violate the mathematical requirements for using parametric tests. I decided to use Rasch (Winsteps) analysis in order to comply with the assumptions. The programme has in-built capabilities using log linear transformations to transform ordinal data into interval data (Bond & Fox, 2001; Linacre, 2006).

Researchers might be interested to know whether the results are different if one uses ordinal data (and violates the methodological requirements) or converts the raw data to interval data so as not to violate the methodological requirements. Our research team, using data from the 83 students, found judgements about statistical significance are influenced by the use of Rasch-transformed data. As stated by Fletcher, Sanders & Ayayee. (2008, p. 453): *"…Using the same test (a t-test) with transformed and untransformed data results in 3 of the 27 cases giving different results"* (see Appendix C for the paper presented at the SAARMSTE[48] conference)

[45] Winsteps is a Rasch-based computer programme that can be used to analyse ordinal data, and which meets statistical requirements.

[46] refers to data which have no order or equal intervals and thus one cannot perform arithmetic or logical operations on such data. Assignment of numbers to categories is purely arbitrary (http:// www2.chass.nscu.edu/garson).

[47] refers to data that has order, but the intervals between scale points may be uneven e.g. rank data. Arithmetic operations such as divisions cannot legitimately be performed on such data (http:// www2.chass.nscu.edu/garson).

[48] Southern African Association for Research in Mathematics, Technology and Science Education.

The nominal Likert-type data for the 27 items from the 83 students were converted into ordinal data by assigning values of *strongly agree* = 4; *agree* = 3, *not sure* = 2, *disagree*= 1; strongly *disagree* = 0. These data initially recorded in Excel were recoded as text documents and then captured into the Rasch programme. The "Winsteps item fit" statistic of the data was generated and used to check whether there were any items with responses that were misleading and which could be removed from the analysis. This is an important step in ensuring the validity of the data. As noted by Boone & Rogan (2005), some unexpected responses could be the result of miscoding and need to be corrected before statistical tests are conducted. According to Boone & Rogan (2005), if this index is above 2.0, there is what is called "misfit". In the data, I did not find any unwarranted misfit cases.

Winsteps Item statistics programme "Table 10.1" was run to check on the item reliability of the data. Winsteps programme Table 30.1 which provides a-two sample t-test in Rasch scores, was also run. The null hypothesis is that the two estimates are the same, except for measurement error. The t-test results and associated probabilities were at the 5% probability level, and the results were based on Winsteps output "Table 30.1".

3.5 ISSUES RELATING TO RELIABILITY AND VALIDITY

The trustworthiness or rigour of research has traditionally been assessed using the criteria of reliability, validity, and objectivity (Lincoln & Guba, 1985). One of the unsolved problems researchers working within the constructivist and pragmatic paradigms have to confront relates to what terms and definitions to use for the constructs reliability and validity. Denzin & Lincoln (2000, p. 17) call it the "*crisis of legitimation"* which they believe requires a "*serious rethinking of such terms as validity, generalizability, and reliability*" – terms that are rooted in postpositivism. Onwuegbuzie & Leech (2004, p. 778) point out that *"lack of legitimation*"… in research … implies "*data ... captured has not been adequately assessed, or that any such assessment has not provided support for legitimation."* Researchers, however, are divided over the legitimacy and usefulness of the 'conventional' concepts of reliability and validity in qualitative studies. Maxwell (1992) points out that some qualitative researchers prefer to stick with the old terms whilst others, notably Guba & Lincoln (1989), have proposed various new analogous terms[49]. Wolcott (1994) is sceptical that analogous terms would be useful in qualitative inquiry.

While the debate over legitimation continues, the overriding question that needs to be answered, in my view, and as noted by Sanders (1995), is how do researchers, irrespective of the underlying paradigm, increase rigour in their research and avoid being tarnished by critics as producing untrustworthy research. Denzin (1997, p. 7) explains rigour or trustworthiness in research as *"... the goal of making data and explanatory schemes as public and replicable as possible*". In the absence of terms which are widely accepted among pragmatists, I will use the traditional terms of "reliability, validity" and "generalisability".

[49] dependability, credibility, transferability and confirmability are the equivalent terms proposed by Lincoln and Guba (1989) for reliability, internal validity, external validity, and objectivity respectively

It is important, as noted by Sanders (1995), that practitioners are not made to lose confidence in the products of academic inquiry because of untrustworthy research. Loss of confidence or trust in academic output demotes academic research, and prevents research findings being used in the development of educational theory (Donald, 2001). One of the ways to avoid this pitfall, according to Sanders (1995), is for researchers

> "*…to be aware of problems in the design of research instruments and in the interpretation of their results which might affect reliability or validity of their research findings...* [for] *if the validity of the results and inferences is doubtful the research is useless to the teaching community."* (Sanders, 1995, p. 724)

I have addressed validity in both the design of the data-gathering instruments used and the analysis of the data. The instruments were face-validated by experts, and inter-coder reliability checks as discussed in section 3.4.1, were part of introducing rigour in the study.

3.6 RESEARCH ETHICS

There has been heightened concern globally for ethical issues to be part of the research planning and implementation process, and not to add them as an afterthought (American Educational Research Association, 2000). Mertens (2005, p. 33) points out that ethical guidelines are needed to guard against not only obvious atrocities humankind can do to each other but against "*less obvious, yet still harmful, effects of research*". Sieber (1992) identifies some of the less obvious threats of research as deception and invasion of privacy. Other research bodies add loss of dignity and loss of self-esteem of the respondent to the list (American Educational Research Association, 2000; Scottish Educational Research Association, 2005).

In America the National Commission for the Protection of Human Subjects in Biomedical and Behavioural Research identified principles that should guide scientific research. These include researchers treating individual research participants with respect and courtesy; ensuring that research procedures are carefully considered and fairly administered.

At the University of the Witwatersrand concerns for strict ethical guidelines have led to the establishment of research ethics committees for non-medical human research (University of the Witwatersrand, 2006a). The Human Research Ethics Committee (non-medical), a sub-committee of the ethics committee, is tasked to monitor ethics of research protocols involving non-medical human subjects. The committee, among other things, scrutinizes submissions by researchers to ensure that participants who take part in the studies do so without threat or undue inducement; that questions posed by researchers are not inappropriate; and that researchers show responsibility towards participants. Furthermore, researchers are expected to undertake to handle circumspectly confidential matters; to truthfully inform respondents about the research; and to receive consent from them before proceeding. It is the task of the university's committees to ensure that researchers understand the conditions under which they are permitted to carry out the research and to guarantee to ensure compliance with the conditions stipulated in the approved protocol (University of the Witwatersrand, 2006a).

The Human Research Ethics Committee (non-medical) was established after this study had been initiated. At this point in time, I was into the therapeutic phase of the study reported in Chapter 5. I therefore applied to the ethics committee setting out the protocols I had followed in conducting the earlier part of the study and other studies I envisaged to do, and retrospective ethic clearance was granted. The protocol I explained to the ethics committee included putting in place measures to guarantee anonymity of respondents; obtaining prior consent for interviews from respondents, and spelling out the benefits of the research to the volunteers. The number of the ethics clearance protocol issued was H070615.

In practice, the ethical standards mentioned above were ensured by asking students to write their student numbers only on the questionnaires, and these numbers were not referred to after complemetary sets of data were obtained. During the interviews sessions, the transripts were not identified by interviewees' name but rather by coded numbers to protect their identities. All the raw data obtained have since then been securely kept to prevent other parties having access to them.

3.7 CONCLUDING REMARKS

The research questions which guided this phase of the study have been discussed. In addition, I have justified the choice of the data-gathering instruments used, and described how they were developed. The data collected from the two instruments used are analysed and discussed in the next chapter.

CHAPTER 4
RESULTS AND DISCUSSION: DIAGNOSTIC PHASE

This chapter deals with the data collected during the diagnostic phase of the study. The broad purpose of the diagnostic phase was to establish what the factors were which stakeholders believed affected academic success, so that suitable intervention materials could be designed to help students to be more successful. These factors were elicited, using semi-structured interviews, from three groups: lecturers, Honours students and first-year biology students, and a questionnaire with a much larger sample of first-year biology students. The following sections present and discuss data collected in order to answer the two research questions framed to direct this phase of the study.

Research Question 1
What factors do lecturers teaching first-year biology, Honours biology students and first-year biological sciences students, perceive to be important for academic success in first-year biological sciences at the University of the Witwatersrand?

4.1 EXPERTS' PERCEPTIONS OF FACTORS CONTRIBUTING TO ACADEMIC SUCCESS

4.1.1 Who are the "experts"?

I have grouped lecturers from the School of Biology and Honours students in the Department of Botany together and called them "experts". Views from these two separate groups of experts were elicited in order to widen the contributed perspectives on factors influencing academic success. Lecturers were considered to be experts because, as teachers of the first-year courses, they had input in determining the curriculum, and set assessment criteria and standards by which students were judged successful or unsuccessful at the end of the year. However, for most lecturers it had been many years since they were university undergraduates. It was felt their perceptions might be biased by their long years of teaching experience and might be different to undergraduate students' needs. It was therefore necessary to look at the views of a second group of experts.

The second group of experts, the Honours students, by virtue of a minimum of three successful undergraduate years, were considered experts at knowing the requirements for success at the university. As role models to some of the younger students in the department, their views may well be closer to the first-year students than the lecturers' views. The Honours students were involved in teaching assistant duties of demonstrating at practicals; they have one-on-one interactions with their group of students and this seems likely to put them in a better position than lecturers to understand the academic problems of first-year students.

4.1.2 The views of the experts

Table 4.1 summarises the results from the interviews of the two groups of experts on the factors they thought contribute to academic success.

Table 4.1 Perceptions of lecturers and Honours students of factors important for academic success in first-year biology

	Specific factors mentioned	Total number identifying a factor			Lecturers' responses (n=10)		Honours students' responses (n=8)	
		n	%	rank	frequency	rank	frequency	rank
Affective factors	Being *motivated**	16	89%	1	8	1	8	1
	Having *positive attitudes* to studies*	10	55%	3	6	2	4	3
	Being *committed* to one's work	7	40%	5	2	5	5	2
	Being *interested* in the subject	4	22%	8	2	5	2	5
	Being *self-confident*	3	16%	9	3	4	-	-
	Being *responsible* for one's own learning	1	5%	11	1	6	-	-
Work-habits	Using *appropriate study skills**	14	80%	2	6	2	8	1
	Managing time effectively	9	50%	4	5	3	4	3
	Asking for help and clarification	7	40%	5	3	4	4	3
	Discussing and *studying in groups*	6	33%	6	1	6	5	2
	Having a *textbook-reading* habit	4	22%	8	3	4	1	5
	Preparing for lectures, and practicals	5	28%	7	-	-	5	2
	Attending all lectures	3	16%	9	-	-	3	4
	Working hard and consistently	3	16%	9	-	-	3	4
	Being *well organized*	3	16%	9	3	4	-	-
	Revising lectures as soon as possible	1	5%	11	-	-	1	5
Other factors	Coping with the *language of instruction*	6	33%	6	6	2	-	-
	Attending, *and taking ADP*[50] *seriously*	2	11%	10	-	-	2	5
	Integrating practical and lectures	2	11%	10	1	6	1	6
	Use of *computers to learn*	2	11%	10	-	-	2	5
	Basic intelligence	1	5%	11	1	6	-	-
	Ability to *memorise and recall* information	1	5%	11	1	6	-	-
	Importance of *prior experience and knowledge*	1	5%	11	-	-	1	6

* = top three factors in ranking

What is noticeable from Table 4.1 is that, except for the first three ranked factors, which were mentioned by over 50% of the sample, many of the 24 items were contributed by only a small number of lecturers or Honours students. The more commonly perceived factors, based on an overall ranking, which influenced academic success (see Table 4.1) include *being motivated* (n=16), *using appropriate study habits* (n=14), *having positive attitudes to studies* (n=10), *managing time effectively* (n=9), *asking for help and clarification when necessary* (n=7), *being committed to one's work* (n=7), *discussing and studying in groups* (n=6). It is interesting to note that in terms of distribution of

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[50] ADP is the Academic Development Programme in the department and taught by tutors to support students in need of academic scaffolding.

statements across the factors identified relatively similar numbers of affective factors and work-habits factors constituted the top quarter of the 23 factors.

The ranking of the items for the lecturers and the Honours students represented as ratios, were also close, as shown in the cases of *being motivated* (1:1), *being interested in the subject* (5:5), *asking for help and clarification* (4:3), and *managing time effectively* (3:3). The criterion for judging the ranking of items as being close was when the rank order was within two rank units. The rank order for some factors showed larger differences for the two groups (e.g. *being committed to one's work* (5:2), *discussing and studying in groups* (6:2) and some items were not mentioned by one of the two groups at all. This suggests possible differences in what each group, based on their backgrounds and experiences, considered important for academic succcess and could also be a reflection of what came up in their minds during the time-limited interview.

The order of the discussion follows the three categories identified, the frequencies of the factors within each category, and their importance in the literature. Some of these factors have been clustered or have been presented graphically to promote easier discussion.

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Affective factors

The affective factors (Figure 4.1) are discussed in turn, based on the combined ranking order obtained from the lecturers' and the Honours students' responses.

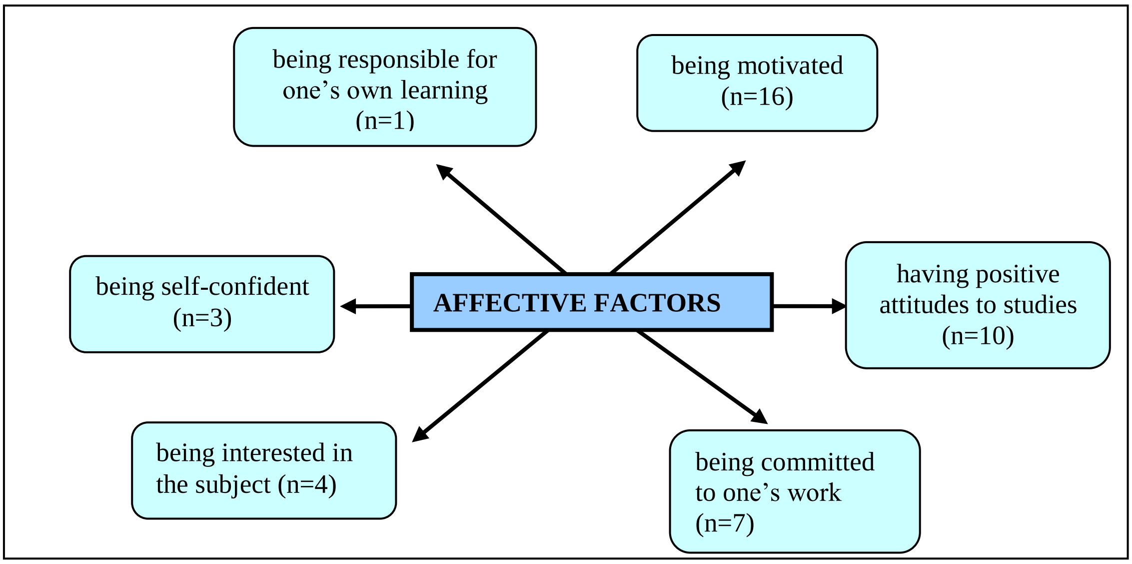

Figure 4.1 Affective factors contributed by lecturers and Honours students, ranked clockwise

Being motivated

Sixteen experts in this study (89%) mentioned students' motivation to succeed as important for academic success. One Honours student stated:

> *If you don't have motivation … it will be a very difficult mission to get through 'varsity.* (Honours Student #2, lines 229-230)

One lecturer explained why motivation is important.

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> *…Motivation goes with self-discipline. If there is motivation obviously there is discipline. The motivation is to pass. I think the motivation is not to enjoy the course… they are driven to get through the course to pass. That is their goal.*
> (Lecturer #2, lines 305-308)

The importance of having a goal in mind, and an underlying self-discipline to keep students focussed, as mentioned by this lecturer, should be noted. Pintrich & Schunk (2002, p. 5) explain motivation as the *"process whereby goal-directed activity is instigated and sustained*". Thus students require some level of discipline in order to sustain their motivation. Motivation can be intrinsic or extrinsic, as discussed in Chapter 2, Section 2.3.3. Two experts distinguished between the influence of intrinsic motivation and external motivation on learning. One lecturer commented on the intrinsic nature of motivation and the need for students to be first intrinsically motivated when she said:

> *I think motivation has to come from within. Then I think you can encourage students, you can make them feel its worthwhile. But ultimately it has to come from within.* (Lecturer #10, lines 1931-1932)

Another lecturer explained motivation in terms of its levels:

> *I think motivation can be at a number of levels. I think it is a two-part thing in terms of the student's motivation ... If they really wanted to go into medicine[51],…you have two things happening. One, they really want to work hard to get the marks to get into medicine…*[and when they fail to achieve that].. *they become totally disillusioned and just aren't interested in what they are doing. So that's motivation from their part… motivation must also, I think, come from the staff as well.* (Lecturer #1, lines 40-46)

Hidi & Harackiewicz (2000) believe extrinsic motivation has a role to play in academic success, but it is important that students have the intrinsic motivation or interest to study. Hidi & Harackiewicz (2000) conceptualized intrinsic motivation as personal interest. Although ultimately motivation must come from within, lecturers could influence students' motivation to study through the nature of their lecturing, and provision of emotional support. Three of the experts identified three ways in which lecturers could motivate students. Lecturers' attitudes were mentioned as important in motivating students to work. A lecturer attested to this when she said:

> *Many times I have seen students that will go the extra mile if the lecturer has got a really good attitude: he's been enthusiastic, excited, is willing to let students… you know, get involved with the course. I think they are far more willing to go the extra mile.* (Lecturer #1, lines 52-54)

[51] The biological sciences course provides an access route into medical and allied disciplines for students who excel in their courses during the year. It is a competitive route, as few applicants are admitted into the medical science programmes in this way.

Academic Development tutors, and lecturers who provide support, both emotionally and academically, do encourage students to do well. This point of view was mentioned in the following context:

> *Those people* [lecturers and tutors] *who … put their emotional support in class get the successful students. So I think that emotional support influences attitudes because I think as soon as people feel somebody cares, and that somebody is watching, they try to work harder.* (Lecturer #5, lines 742-744)

The positions expressed by the experts in the cited quotations, echo the views of Kuh & Zhao (2004) who, in a national survey of student engagement in America, listed students' interactions with lecturers as one of the five benchmarks of effective educational practice. Schunk (2003) claims that to improve work quality of students in the classroom teachers must strive to increase students''motivational orientations'. Based on her personal experience, an Honours student related how lecturers had motivated her to work well:

> *I know if I have a good lecturer, I tend to work a little bit harder for them, 'cos I enjoy the lectures and I prepare, I tend not to fall asleep, and it's more enjoyable and so I'm taking more in .... So more dynamic lecturers, for sure, would motivate their students to do well.* (Honours Student #5, lines 694-697)

Sixteen of the eighteen experts in this study (89%) referred to motivation as being important. However, it would be interesting to know if they really know what motivation is. This is because so many people think motivation is the same as the desire to achieve something. But, as explained in Chapter 2, motivation involves having a desire and using goal-directed behaviour to achieve what one desires (Pintrich & Schunk, 2002). Although I did not ask the interviewees for their understanding of motivation, one volunteered a 'near' understanding of motivation when she said:

> *If you are really motivated then you tell yourself this is what I am going to do, and I am going to achieve it. That is when you attain your goal.*
> (Honours Student #4, lines 472-473)

Having positive attitudes to studies

Attitudes was the next major factor in ranking order mentioned (see Table 4.1). As pointed out in Chapter 2, section 2.3, attitudes are complex mental orientations, often judgemental, which predispose people to act in particular ways. The importance of attitudes in influencing academic success was mentioned by ten of the experts in contexts such as *having good attitudes* to study (Lecturer #1, line 4), *attitudes of conscientious learning* (Lecturer #2, line 295); students *acknowledging personal responsibility for [their] undertakings* (Lecturer #7, line 1336). Distinctions were also made between *attitudes to the subject or course (*Lecturer #1 line 3*)*, *attitudes to the lecturer* and *attitudes to one's self* (Lecturer #1, line 49). With regard to attitudes to the course, one lecturer mentioned:

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> *[If] … they have got a good attitude they'll want to study the course. I think if they have been forced by their parents or it's not exactly what they wanted to go into…, and their attitude is not focussed on that course ... then it's a problem.*
> (Lecturer #1, lines 3-6)

The link between attitudes and motivation is evident in the above quotation and could be used to affect the model in Figure 8. 2. As noted by Koballa & Glynn (2007, p. 89) intrinsic motivation "*taps into the natural human tendency to pursue interests".* Students' interest in a subject and the subject's personal significance to the student becomes important in this context of achieving academic success.

Students' attitudes were cited as contributory factors as to why some took more than a year to complete their first-year courses. According to one lecturer, it is not uncommon to find such students with perceptions and attitudes such as:

> *We do **not like** this topic this year. It does not matter if we fail. We'll do it again next year. So I think attitudes do play a part.* (Lecturer #3, lines 413-415

Lecturer #7 believed negative attitudes of students concerning academic tasks could make a major difference between success and failure, even for bright students. This was explained, for example, when students came to the practical and they are upset at having to spend the whole allocated three hours in the lab, not seeing it as an opportunity to learn the laboratory material provided, an attitude explained by one lecturer:

> ... *"boy! they gonna keep us here for three hours" …. I really think that makes an amount of difference to performance.* (Lecturer #7, lines 1290-1292)

It is possible for students to be unaware of the negative effect of their attitudes on their performance. Lecturer #3 noted that some students come into first year with inappropriate attitudes, but tend to be unaware of this, and "*by the time they realise it is too late*" (Lecturer #3, line 417). This comment provides some justification for an early intervention to be put in place to help such students, and hopefully improve their attitudes.

Students have been noticed by lecturers to display poor attitudes towards themselves, which negatively impacts on their academic work. Lecturer #5 (line 867) pointed out that this attitude was displayed in situations of students "*trying to live up to the expectations of others*". This comment suggests to the researcher the need to investigate locus of control of learners in first-year biology and its influence on learners' achievements. The importance of an internal locus of control and its influence on perceptions and work-habits has been explained in Chapter 2 section 2.3.1, page 41.

Scientific attitudes embody attributes of scientists which are considered desirable in students (Koballa, Crawley & Shrigley, 1990), and include open-mindedness, curiosity and persistence. Two lecturers mentioned that having appropriate scientific attitudes to complement acquired skills was important for successful academic work. These lecturers distinguished between scientific attitudes, which are the characteristics displayed by scientists (Simpson *et al.,* 1994), and attitudes students display towards a subject:

> [Students] *need to develop ... professional attitudes so that they can become useful with the skills they have got. There is no point having all the skills and ... bad attitudes. Attitudes that make it difficult for* [them] *to share that knowledge. We can't always communicate through paper.* (Lecturer #4, lines 572-577)

One important scientific attitude mentioned by one lecturer was "being imaginative". Although it is acknowledged this attitude cannot be taught (Simpson *et al*., 1994) students, according the lecturer, were expected to become more imaginative during the process of enculturation into the academic environment as they interacted with the lecturers and peers.

Persistence was another factor mentioned. Lecturer #6 was perturbed at students' giving up easily in the face of difficulties and advised that students should learn to persevere:

> *If they give up on themselves ... that is fatal ...* [they] *must not give up. I mean even when they are at the borderline in the first half of the year*. (Lecturer #6, lines 977-981)

Other values mentioned by lecturers which are often associated with scientists, were those of students "being enthusiastic with their studies" and "being determined". Studying in a second or third language is known to present problems which influence the academic performance of learners (e.g. Coley, 1999; Nenty, 1999; Zeegers, 2004). Such problems can be overcome by determined students, as described by one lecturer:

> *I have actually seen for example, a Japanese, coming from Japan ... come across here and in a year was so determined to overcome the language barrier that the marks went from 20 percent right at the bottom of the class to 89 percent at the end of the year.* (Lecturer #8, lines 1468-1474)

Being committed to one's work

Being committed to ones work was mentioned by seven experts under various contexts, such as "being keen to work", "putting in effort", as important for academic success. For example, "*… the students who put more effort from the little that they get from lectures, I think, those are the ones that survive".* (Lecture #4, line 537)

The effort required to succeed, according to Lecturer #4, includes:

> *… the student doing extra reading, anything that the lecturer is prescribing, …. and the student does not depend on the lecture material ... self study, that kind of thing, to supplement the lecture material.* (Lecturer #4, 538-542)

Being self-confident

Three lecturers in the study mentioned students having self-confidence as important for academic success. One lecturer remarked on the 'personal confidence' of the present intake of students, compared to previous students. She felt their sense of confidence seemed to positively correlate with good passes the students were achieving during the year. Self-confidence is closely related to self-efficacy or self-efficacy beliefs, which is a variable under motivation (Linnenbrink & Pintrich, 2002). As pointed out in section 2.3.3, self-efficacy beliefs are learners' beliefs about their ability to perform certain academic tasks or behaviours. Students with positive self-efficacy beliefs would tend to have greater confidence in themselves to perform given tasks than those with low self-efficacy beliefs (Linnenbrink & Pintrich, 2002). A lecturer alluded to the importance of students who have appropriate self-efficacy beliefs being able to perform the tasks required in biology in order to be successful:

> *Students who understand that they don't know often are people who understand what they do know. And the students who don't know what they do not know don't ask questions. So students who have some ... basic confidence and have some understanding of themselves can help themselves.* (Lecturer #5, lines 726-730).

It is important to note that this factor, which is related to self-efficacy, was not mentioned by any of the Honours students.

Work-habits

Work-habits, as used in the context of this study, are regular behaviours or practices that students use for studying to achieve their academic goals (Devine & Meagher, 1989), and include study-related behaviours used before, during and after lectures. These work-habits relate to the creation of a suitable study environment, organisation of time and academic activities, preparations for study, and motivational strategies (Jones, Slate & Kyle, 1992). I have categorised into eight groups the factors mentioned by the experts that students need to use for successful academic outcomes. These are discussed in the ranking order of contributed responses (Figure 4.2). Fourteen different types of skills were mentioned but as skills or competencies were not the focus of my study they are not discussed until in Chapter 8.

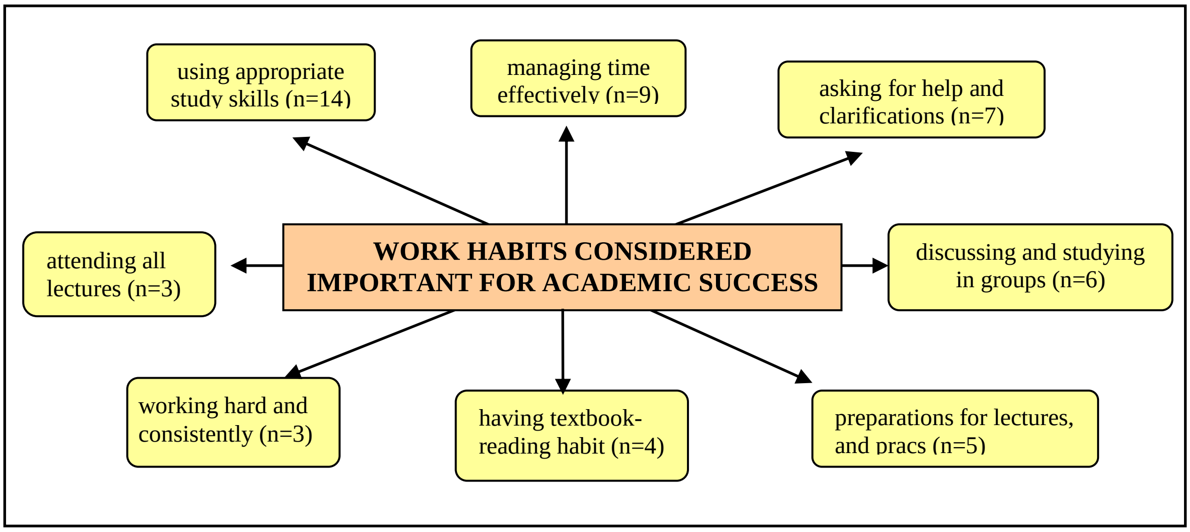

Figure 4.2 Major work-habits identified by experts as important for academic success

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Managing time effectively

Organisation in terms of available time and activities (time management) was the second most mentioned of the work-habits (50%). As one lecturer mentioned:

> *I think if you can organise yourself in terms of time management, knowing what is expected of you,… that is going to make you more successful* (Lecturer #1, lines 8-10)

One Honours student reflected on the time factor involved in organising academic work, and recalled her experiences with poor time management and offered the following piece of advice:

> *Basically, keep on top of your work. You know, don't leave it till the last minute. That's the most important thing. …. I know that I have not, in the previous years. And I ended up very sort of …. stressed.* (Honours Student # 3, lines 391-393)

The habit of regularly studying and staying on schedule is recommended from many studies to make preparations towards examinations much easier (e.g. TeBeest, 1998, Entwistle & Entwistle, 2003; Moore, 2003). A number of phrases were used by lecturers and Honours students to express this position. These included *staying on top of the work* (Honours Student #3, line 399); *going through your work as it comes* (Honours Student #8, line 1058); and *dealing with the information daily* (Lecturer #10, line 1952).

Asking for help

Seven of the experts (40%) mentioned students' asking questions in order to clarify ideas, either during or after lectures, as an important habit to cultivate. An Honours student stated the importance of asking questions especially during the tutorial periods and consulting the lecturer:

> *It helps you to understand. Even consultations. I think it has played an important role in my first-year in the overall studies.* (Honours Student #4, lines 625-626)

Although asking for help from colleagues and lecturers has traditionally been seen as a dependant activity, more recently it is also seen as a proactive and mastery-oriented activity (Karabenick & Knapp, 1991). Karabenick & Knapp (1991) distinguish between seeking help to get tasks done, (e.g. get answers) termed "executive help-seeking", and "instrumental help-seeking" getting the minimum assistance to achieve independently. In the context of the classroom, poorly performing students should be helped to see this route as an achievement-related behaviour (Karabenick & Knapp, 1991).

Students from educationally disadvantaged backgrounds in South Africa are noted to be more reserved in asking questions than other groups. One lecturer was of the opinion that such students should be encouraged to break through their reservations and ask questions at lectures or after lectures in order to use the human resources available.

Discussing and studying in groups

This was the next factor in terms of frequency, and was mentioned by six of the experts as an important strategy that contributed to academic success. Incidentally, there is no consensus in empirical literature of the benefits of studying and discussing in groups (Kimmel & Volet, 2010). Whilst one line of research suggests studying in groups can engender benefits such as productive engagement, and co-construction of knowledge (see De Vita, 2002; Barron, 2003), there is a parallel body of literature which suggests negative perceptions of students on its importance (Volet & Mansfield, 2006). I am inclined to argue that the positive impact of discussing and studying in groups (Lazar, 1995) may be contextual and influenced by other factors.

Preparing for lectures and practicals

Five out of the eighteen experts (28%) mentioned the need for students to prepare for lectures and practicals. Preparing for lectures and practicals involves work-habits and, as noted by the experts, could be done in many ways.

- Before lectures: This entails learners reading texts or laboratory materials that will be covered, and making notes while reading.
- After lectures: This involves learners re-reading the material that was covered at lectures, studying some work every day and, working with study buddies.

The last point was brought out by one lecturer:

> *The successful student will be the one who .... religiously reworks his notes ... breaks his notes into summaries, reworks his notes on a daily basis and gears himself towards the exam.* (Lecturer #2, lines 297-299)

Textbook reading and working consistently

Four experts mentioned students should develop the habit of reading their textbooks in order to be successful. Closely following the habit of "textbook reading" were three work-habits of *working consistently* and *attending all lectures* (Table 4.1) which were both mentioned by three Honours students, and the other factor *being well organised*, mentioned by three lecturers.

> *I think probably the most important thing is studying ... go through your work as it comes to you rather than try a day before your test or exams or essay, try and quickly spot the ball.* (Honours Student #1055-1058)

Although the factors were mentioned as single factors, one lecturer, when asked if work-habits were important, pointed out the inter-relatedness of other factors contributing to success.

> *I think work-habits do influence ... although one can have them separately, I am not quite sure that ... things such as work-habits, motivation, attitudes are independent.*
> (Lecturer #3, lines 427-430)

Although the majority of the experts believed work-habits were important in succeeding in biology, an Honours student had reservations about the need to teach work-habits at the university. In his opinion:

> *... by the time students get to the university they have learnt study habits that work for them. So I do not think it's a real necessity for lecturers to concentrate or even have a little ... techniques course dealing with study habits.* (Honours Student #2, lines 253-257)

This Honours student, it turned out from further probing, came from a privileged social and educational background, and had learned a number of study habits at school. When asked what study habits worked best for him he mentioned a number of work-habits such as … *sitting by a desk, not lying down…, studying in the library*. What perhaps he was not aware of was that there were a number of students, especially from educationally deprived backgrounds, who had not learned or acquired these work-habits, and who would certainly benefit if they were taught.

Other factors

Succesful studying requires using various behaviours at the appropriate times. Experts mentioned the importance of students learning to understand and cope with the language of instruction (discussed in the next section) amongst other factors. An Honours student described her behaviour:

> *I read and write notes. And I make sure that I understand. and ask questions. Know the reason behind what's happening.* (Honours Student #4, lines 439-441)

The reading and note-taking behaviour portrayed in the above quotation is not only an aspect of active reading but it also shows metacognitive monitoring of what she is reading through self-questioning. Metacognitive behaviours, which involve students' awareness and monitoring of how well learning is taking place, were not readily contributed by the experts but could be gleaned from some suggestions as noted in the above views.

One lecturer identified the need for students to have a certain level of "… *basic intelligence [which] is required at 'varsity* (Lecturer #5, line 873); whilst another felt "*... passing at university does not require you to be brilliant"* (Lecturer #1, line 8). The two viewpoints can be resolved when it is realized that university students are expected to have *academic readiness* which comes through their prior schooling. At the university, the focus often is on skills development for the workplace and living in the society. Thus, it can be argued that passing at university should not be difficult if the student came with the required cognitive ability and skills.

Reasons why some students fail at university

Although success and failure may be at opposite ends of a continuum, reasons why students fail their courses may not necessarily be deduced from negative aspects of qualities that were mentioned by the experts. For example, if working consistently led a student to be successful in class, working inconsistently may not necessarily lead all students to fail their courses. The experts were therefore asked "*why do some students fail at the university*?" A number of reasons were suggested, as shown in Table 4.2 which resonates with the construct of alienation. It is important to realise that this was not a major research question and was posed to the experts as a way to get them to contribute further ideas to inform the study. Some of the lecturers and Honours students did not get to answer this question in depth, and fewer factors were mentioned (Table 4.2). Consequently, ranking the ideas was considered inappropriate for this data.

An attitude-related factor mentioned by four experts was students' lack of interest in the courses for which they were registered:

> *It might be someone who is not necessarily incapable but really not of that field. I mean there are some people who started the BSc doing biology …., and just find that this is just not for them.* (Lecturer #7, lines 1399-1401)

Two lecturers felt first-year students' failure was a consequence of their *taking things lightly* (n=2) and neglecting academic work in order to socialize (n=1), whilst one Honours student saw laziness as contributing to students' failure.

Table 4.2 Reasons suggested by lecturers and Honours students why some students fail their first-year courses in biology

	Specific factors mentioned	Lecturers' responses (n=10)	Honours Students responses (n=8)	Total
Affective	*Lack of **interest*** in chosen course	2	2	4
	Taking things *lightly*	-	2	2
	Trying ***to live up*** to other people's expectations	2	-	2
	Laziness	-	1	1
Work-habits	Failure to cope with work load	2	2	4
	Poor work habit due to failure *to recognise the gap* between high school and university	2	2	4
	Poor preparation for tests and exams	2	-	2
Other factors	Lack of *mathematical skills*	2	-	2
	Language and communication difficulties	2	-	2
	Being emotionally unstable	-	1	1

Two lectures mentioned some students' attitude of taking things for granted, trying to live up to parent's dreams for their lives, and not taking responsibility for their future.

> *I am afraid to say … there are those who come with an attitude of like life owes them a favour… it's kind like "well I am here now, so the next step is my degree".*
> (Lecturer #8, 1612-1622)

For many students their problem may be tied to the work-habits they adopt at the university. Two lecturers and two Honours students mentioned first-year students' lack of competencies to cope with the workload, and students' failure to recognize the gap between high school and the university as factors contributing to failure. Students' failure to recognise lecturer expectations at the university inevitably leads to poor preparation techniques being used for exams. Poor test-question reading skills contributes to students not doing well. The views of Lecturer #1 captures some of the reasons why some students fail:

> *So not being aware of what is expected of them, … they tend to not to study properly. So their studying in preparation for tests and exams are not perhaps as good as it should be in terms of something that they have got to be doing the whole time. The night before is not good enough. A lot of them will study the night before as they did at school and that comes short and then once they get into the exams, the other factor that affects them is not reading the exam questions correctly. They may know the content of the work. But*

> *they are not answering the questions properly. And those are factors that play a huge role in failures.* (Lecturer #1, lines 86-95)

Other factors mentioned by the experts were students' lack of mathematical skills (n=2), and difficulties experienced by many students with the language of instruction (n=2). It is important to note that these factors were mentioned only by the lecturers.

The suggested reasons for students' failure are supported by empirical research. For example, poor work-habits of students due to the gap between high school and university in South Africa has been investigated by a number of researchers (see for example, Grayson, 1996; Mumba, 2000; Mumba, Rollnick & White, 2002). So, also, is the lack of adequate mathematical skills (Kahn, 2006; Groves, 2009). Some of these factors have already been discussed in Chapter 2, section 2.3.4, pages 50-51. The issue of English as the languge of instruction and its impact of students is discussed on page 107 and pages 228-229. Judging by the approximately 30 percent of students who fail their biology first-year courses yearly (see Figure 1.2, page 5), a lot of commitment of energy to work harder would be expected from students. Students' would need a realistic perception of their capabilities in each subject, their self efficacy, and work to do better. The findings from this section of the study are important and can be used to strengthen the conceptual model in Figure 8.2.

Concluding remarks on the interviews with the experts

The importance of identifying and studying perceived factors that influence students' success in higher education is important for improving university success rates (e.g. Killen, Marais & Loedolff, 2003; Fraser & Killen, 2005). Using two groups of experts, instead of one, to contribute ideas on academic success possibly enriched the total number of factors identified. There were a number of commonalities in the views mentioned, but the views of the two groups did not overlap completely. Cognizance was taken of the small number of experts who mentioned some of these factors (see Tables 4.1 and 4.2).

The experts' views captured so far provide a glimpse of relevant factors needed for success. I needed to discover how the views of the first-years dove-tailed with those of the experts. The focus of the data-collection therefore turned to a population of first-year students to investigate their viewpoints on factors they considered to be important for academic success.

4.2 FIRST-YEAR STUDENTS' VIEWS ON FACTORS THAT INFLUENCED ACADEMIC SUCCESS

Two data-gathering strategies were used to answer this question on students' views as discussed in Chapter 3. Firstly, interviews were conducted with a group of 17 students, nine females and eight males, who were invited based on their performance in class (see section 3.4.1). The views of these students contributed to the development of items for the questionnaire. The second strategy, a questionnaire, provided perspectives on academic success from three larger groups of first-year biology students. These were 132 students at the beginning of one year and two end-of-the-year groups of students (n=145; n=100). The results from two of these groups were used for a replicate study.

4.2.1 Results from the interviews with first-year students

The views reported here are similar in some respects to those of the experts. However, having been expressed by first-year students, they reinforce the perspective of the various factors contributing to their success. In the following discussion I have attempted not to repeat views already expressed by the lecturers and Honours students, but to add salient points as perceived by the first-year students. These responses, presented in Table 4.3, distinguish between solicited and unsolicited answers, and are discussed using the same three groupings used for the previous tables (Tables 4.1 and 4.2)

Affective factors

Ideas involving four major affective constructs were mentioned in the responses of the students (see Table 4.3 and Figure 4.2). Interest and enjoying the subject featured strongly and "to like" or "dislike" were common attitudinal phrases used, as found by Petty & Cacioppo (1981).

Motivation

I attempted to establish from students the meaning of "motivation for academic success", and their responses varied from a desire ["*to want something badly enough for yourself* "(Student #8, line 1222); *the need to be inspired* (Student #6, line 909)] to including the action resulting from the desire ["…[m]*otivation is what makes someone want to do something, like the driving force behind your doing something"* (Student #2, lines 31-33)].

The desire to achieve as students was evident from the responses. For 13 out of 17 students (72%) this goal was getting into second-year medicine. However, motivation for success has two components, the desire for a goal and the use goal-directed strategies (Pintrich & Schunk, 2002). Although some students mentioned the two components only one seemed to realise the implications regarding effort: *My motivation is… I want to get into second-year medicine so I have been working really hard to do well.* (Student #2, lines 50-52)

Motivation to succeed can come from within or without. One student mentioned the importance of being self-motivated to achieve success, by having a drive and working towards it:

> *You have to have a drive. I mean if you study because your parents send you here, because you have to have a degree, you gonna be here and gonna be murmuring …"No I do not wanna be here." It's for yourself. You have to have a goal in life, and work towards it.* (Student #8, lines 1055-1058)

This explanation stresses the role of motivational will (Pintrich & Schunk, 2002) to do well and for a goal that is not externally imposed but self-defined and directed. Three students, however, mentioned that their lecturers, by their good lecturing, spurred students on to do well.

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Table 4.3 Factors identified by first-year students'(n=17) during the interview

	Specific factors mentioned	Unsolicited answers	Solicited answers	Total number identifying a factor
Affective factors	Being self-motivated	6	7	13
	Being motivated by lecturers to do well	1	2	3
	Enjoying the subject	4	1	5
	Being interested in the subject	5	3	8
	Having a positive attitude to subject	3	-	3
	Having positive attitude to do well	-	9	9
	Being self-confident	4	1	5
	Being committed to one's work	2	-	2
Work-habits	Asking for help and clarification	12	1	13
	Revising lectures as soon as possible	9	3	12
	Preparing for lectures	2	7	9
	Preparing for laboratories	5	2	7
	Working hard and consistently	7	-	7
	Attending all lectures	6	-	6
	Attending Academic Development tutorials	5	-	5
	Studying every day	3	-	3
	Writing down accurate notes	2	-	2
	Forming and using a study group	1	-	1
	Planning and using a study programme	1	-	1
	Obtaining and using past test papers	1	-	1
Other factors	Understanding the work	5	2	7
	Having a quiet area to study	6	-	6
	Absence of financial problems	4	-	4
	Importance of prior experience and knowledge	2	1	3
	Use of computers to learn	2	-	2
	Staying in residence	2	-	2
	Coping with language of instruction	2	-	2
	Understanding technical terms	1	-	1

unsolicited = provided by the student **solicited** = in response to my question

Interest and enjoyment of the subject

Interest[52] is an important construct in students' deliberations (Hidi, 2006). Interest in the subject featured prominently in the students' responses, mentioned by eight out of 17 respondents. The comment "…*the subjects I do better are those I like"* (Student #11, line 203) sums up the association between personal interest and students' academic behaviours. Five respondents felt *enjoying the subject* was what helped them to do well: "*… With me all my subjects … the ones I*

[52] The relationship between motivation, interest and attitudes is rather complex. Whilst interest is claimed to be a motivational factor (Hidi, 2006), it is also claimed as an attitudinal factor (Shrigley, 1994). I have therefore kept these constructs separate at this stage in the discussion, but I acknowledge the inter-relationships between them.

do better in are … all that I like… that I enjoy (Student #11, lines 202-204). This also implies that if such students do not like the subject, they are less likely to do well.

Having positive attitudes

Having positive attitudes to do well (n=9) and positive attitudes to the subject (n=3) were in the third sub-category of affective factors mentioned by the students. Students' views were not probed for their definition of "positive attitude", but one student seems to identify some aspects of it as:

> *I think, you have to have a positive attitude. I think if you don't do well in one test, you can think "oh no! I am not gonna do well in the next test". You have got to say okay, I did badly in that test. I got to now move on.* (Student #8, lines 1214-1216)

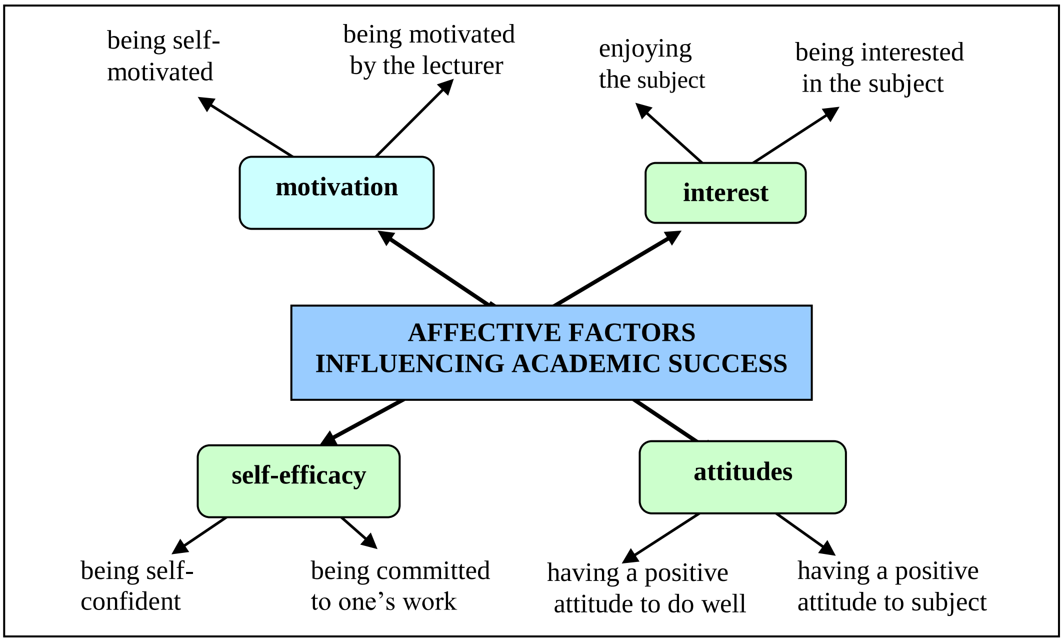

Figure 4.3 Affective factors mentioned by first-year students as influencing academic success

Self-efficacy

Five first-year students mentioned having self-confidence or the belief in one's capabilities as important for academic success, a factor also mentioned by three of the ten lecturers. Beliefs undergird academic behaviour as pointed out by Ajzen & Madden (1986).

Work-habits

Work-habits, as explained on page 79, are behaviours or practices that students use for studying to achieve their academic goals (Devine & Meagher, 1989; Cottrell, 1999). The major factors about work-habits mentioned by the first-year students included:

Asking for help and clarification

Thirteen of the seventeen students believed asking questions when work was not understood, or seeking clarification, was important in contributing to academic success. It is interesting to note that, whilst ten students agreed to the importance of asking questions, five said they would rather go to the Academic Development tutor than the lecturer. These students for this stance gave a number of reasons. These included 'shyness' on the part of one student to ask questions in class. Another student would not ask questions in the class for fear of being ridiculed by class mates and would rather … "*keep quiet and listen in class"* (Student #13, line 122). Another student felt lecturers were "unapproachable". Incidentally, all these students were black. The effect of cultural influences on patterns of behaviour exhibited by the black students seems to point to the dilemma some students face when in the presence of authority figures, as pointed out by Walker & Dimmock (1999). It is a feature that I believe needs to be brought into the open at the university and resolved.

Working consistently

Whilst working consistently was seen as important in contributing to success, students gave various meanings to working consistently such as "working hard" or "studying hard". For Student #12 it meant:

> *... to revise each and every lecture … work which was covered that day; not, say, wait for a certain date to study it, or perhaps… wait for a test . Because at school we normally studied when the test is tomorrow.* (Student #12, lines 165-167)

To Student #16, it meant:

> *... giving the books undivided attention and ... and have a plan.. like a time table.*
> (Student #16, lines, 1905-1908)

Whilst for the students working hard meant putting a lot of time and effort into the learning process, which could entail days of 'swotting' over books and assignments, the literature suggests that students could learn to work "*smart not necessarily hard*" in order to be successful. (e.g. Rossouw, 2003, p. 5). Working smarter not harder entails students managing and utilising available time better. This reduces stress as the work is better planned and the student is goal-oriented for each day. Rossouw (2003) claims that integration of goals to get a lot of tasks done could save on time and enhance academic success. Britton and Tesser (1991), in an American study, found that successful college students' time management practices allowed them to accomplish a lot more.

Preparing for lectures

Preparing for lectures, as discussed in Chapter 1, involves students previewing the lecture topic for the day in order to engage effectively with the topic when taught in class. Preparing for lectures was acknowledged by nine students (53%) in solicited responses as important for academic success. Student #16 believed students should prepare for lectures in order to be successful. In his view the pace at which lecturers taught can be fast, and students need to prepare in order to follow the pace of lectures. This seems to be the view from the experts and the literature reviewed (Kiewra, Mayer, Christensen, Kim & Risch. 1991; Rothenberg, 1991; Zhao & Kuh, 2004).

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Four students, even though they acknowledged the importance of preparations, gave reasons why they never did. Three of them ascribed the heavy workload as the main reason. According to one student "*…it may help but the work load is too much"* (*S*tudent #4, lines 603-607).

Another student, in agreement, stated:

> *…if you know the topic for that day, it is important to prepare. But you normally don't find time to prepare for lectures. 'Cause you have to do this assignment. If you have not … perhaps, you are … preparing for test next week.*
>
> (Student #12, 175-177)

Two students felt it was time wasting but one student added that it would depend on the lecturer. According to her, some lecturers reviewed and recapped on what they had taught previously before starting the day's topic, others did not.

Other work-habits, mentioned in order of frequency included attending all lectures (n=6), studying in a quiet area (n=6); attending Academic Development tutorials (n=5) and studying every day (n=3) (see Table 4.3).

Other factors

In this section four factors which are neither affective nor work-habits, but mentioned as contributing to students achieving academic success, are discussed.

Understanding the work

Understanding the subject or work was mentioned by seven students as a factor affecting performance (Table 4.3). Distinctions were made between understanding the technical terms associated with the subject (n=1), and overcoming the difficulties associated with understanding the medium of instruction experienced by some students (n=2). The advice of one student to others "*…to make sure they have a dictionary besides them while studying biology"* (Student #9, line 1390) is worthy of note. Rutherford (1993) points out that spoken language consists of words (sets of vocabulary) and sentence constructions with assumptions and expectations that may confound a student from a different language background. In lectures English, as the medium of instruction, together with the language of science, confounds learning.

Rutherford (1993) ascribes the difficulty of the language of science for science students to several causes. These include vocabulary (the technical words), the pronounciations, the syntax, and the density of the content. Each of them, according to Rutherford, was likely to cause more or less "noise" for students, depending on their level of sophistication and development of language skills.

Two students felt the study of biology was quite different from the other science subjects and as such, it demanded a different way of studying it in order to be successful. One respondent felt science (biology) in many respects is a systematic type of thing, and one needed to have that in mind as one managed ones' life. Incoming students, she advised, must *"...be orderly and regular in [their] work-habits to be successful"* (Student #10, line 96).

Student #11 believed studying biology involved a lot of learning of facts and terms and should be done differently from chemistry and physics in order to succeed. To this student, a lot more of memorisation was required for biology, but she added that you had to understand it before you could learn it. Her views tallied with those of Lecturer #2 on how to study biology.

Entwistle & Entwistle (2003) reported that some educationists have tended to place negative value judgements on memorisation, considering it an inferior process. Biggs (1996), however, highlighted the paradox of the Asian learners, who were reported to combine memorization with attempts to understand topics, and who have been sucessful. Different kinds of memorization have been defined in a number of studies (Entwistle & Entwistle, 2003). These include "rote memorization", "memorisation with understanding" and "memorisation without understanding" (Entwistle & Entwistle, 2003).

Having a quiet area to study

Disturbances and distractions seemed to negatively impact on students' attempts to study, and these were paramount in some students' minds. Six students believed that a quiet environment, such as the library or a quiet room, was necessary to support reading and studying habits if students are to be successful. There are those students whose living circumstances are such that noise is a genuine problem with inconsiderate members of the family or other students in the residence, to contend with. For others what they require is a supportive environment, not necessarily a quiet environment, to study.

Financial problems of the family

Another factor mentioned, that had a high ranking in the table of factors (Table 4.3), was about finance available to the family, which defined how far from the university some students lived and influenced academic performance. Two students believed if needy students were awarded bursaries their performance would change drastically. One commented on how a bursary he was awarded helped him to pull through the year. He had been staying at Tembisa[53] with relatives, and suffered a lot of inconveniences. This particular respondent (Student #12) had applied for a student bursary and there was some uncertainty hanging over whether it would be awarded. According to him, in that period of limbo he was:

> *... just forcing issues to come to school, not knowing whether your fees will be paid or not. That was a problem. And your parents say ... "You just have to leave for the year ... we will make a plan next year". It was discouraging to study under such conditions.* (Student #12, lines 199-205).

He claimed that after being granted the bursary in July his performance improved and he passed very well in biology[54]. Herzog (2005) mentions the positive impact of financial aid granted by

[53] A township 40 kilometres away on the East Rand near Germiston

[54] This student, whose academic performance was monitored by the researcher, has since graduated.

tertiary institutions in America, and how these helped steer students into successful learning. I contend that timeous awards to students with financial needs, as this particular case has shown, could reduce stress - but the award must be done judiciously.

Staying at the residence

Two students, personalising the issues raised, believed staying in the university residence would help them to do well in biology. They felt residence would give them the freedom to study even at night and not be bothered by disturbances from their families. As noted by one student:

> *You can do whatever you want at any time* [at residence]. *But if you are staying at home it's like you are sitting there. You want to study and your younger brothers are busy watching a certain movie on TV and they are making noise.*
> (Student #3, lines 424-427)

To some degree, and based on his particular circumstance, his perception is right, but staying at residence is not a panacea to academic success. Much discipline is required to keep focussed academically with all the freedom that comes with staying at the residence.

Summary of the interview results from the three samples

My intention for soliciting views from the experts and first-year students was to cover all possible views of factors perceived to be important for academic success. In the interview sessions for the undergraduates two types of responses were distinguished; solicited and unsolicited. In terms of the frequencies of responses, and given that the scope of the study was limited to attitudes, work-habits, and metacognition, the following (see Table 4.4) were the factors in ranked order contributed by the experts and first year students. Although in Chapter 8, section 8.2.1 I have provided a comparision of the views of the three stakeholders some concluding comments on the ranking of the views of the experts and first-years are necessary here.

Table 4.4 Top ten factors influencing academic success identified in interviews by the experts, and first-year students

Factors relating to	Rank	
	Experts	First-years
Motivation	1	1
Using appropriate study habits	2	3
Having positive attitudes to studies	3	4
Managing time effectively	4	9
Asking for help and clarification	5	3
Showing commitment to one's work	6	-
Discussing and studying in groups	7	-
Understanding and coping with language of instruction	8	8
Being interested in or enjoying the subject	9	5
Being self-confident	10	10
Preparing for lectures and laboratories	10	2
Revising lecture notes as soon as possible	-	4
Working hard and consistently	-	6
Attending all lectures	-	7

Similarities in rank order are noted with respect to *motivation*, *using appropriate study habits* and *having positive attitudes towards* the study of the biology course. These responses constitute the top three of the ranked items. Two responses which had large ranking differences between the experts and the first years were *managing time effectively* and *preparing for lectures and laboratories.* The experts placed a lot more prominence on *managing time effectively,* a fourth place in ranking. First-years, by their responses gave it a lower ninth-place ranking. A different response is noted for *preparing for lectures and laboratories*. More first-year students mentioned *preparing for lectures and laboratories,* giving this response a ranking of two compared to the tenth rank it obtained with the experts. These differences in ranking suggest the differences in emphasis the two groups would place on such academic behaviours.There were some responses mentioned by the experts but which were not mentioned by many students to be ranked among the top ten. For example, showing *commitment to ones work* ranked sixth, and *discussing and studying in groups* ranked seventh by the experts.

The factors mentioned by the experts and first-year students are important and needed to be brought to the attention of other first-year students. They were considered for inclusion in the design of the questionnaire and instructional material for *Bioskills.*

4.2.2 Results of the open-ended responses from the questionnaire

The open-ended responses were contributed by the first-year students in answer to the first question in the questionnaire: **In your opinion what are some of the strategies that help successful students to do well in first-year biology courses?** The students whose views were analysed were those who had responded to the questionnaire statements both at the beginning and end of the year (n=83).

Foddy (1993) states that as responses from open-ended statements are not suggested by the researcher, they tend to give indications of what respondents really think and believe. Table 4.5 is a summary of the 15 most common strategies mentioned by a group of 83 first-year biology students at the end of the year.

The most frequently mentioned factors were associated with appropriate behaviours. The three most frequently mentioned factors, mentioned by over 30% of the students were: *revising lectures as soon as possibl*e (n=35), *attending all lectures* (n=33) and reading widely (n=26) [Table 4.5].

Revising lecture notes as soon as possible was considered important. As noted by one student during an interview the pace at which work accumulates is fast:

> *with new information coming at you every day ... you cannot put it in the drawer and forget about it* (Student #10, lines 40-42*).*

The second most frequent factor mentioned was attending all lectures. Student #13 mentioned that, given the quantity of information delivered at lectures, students needed direction on what to read, which is provided at lectures.

It is important to note the effect perceptions about factors necessary for success may have on the actions of students. Fraser & Killen (2005) state that:

> *If students believe that attending lectures contributes to success, they will probably attend regularly even if they learn little from the lectures. However students who believe that success can be achieved without attending lectures may not attend on a regular basis even when this actually diminishes their chances of success* (Fraser & Killen, 2005 p. 28).

Certainly it is important for the lectures to be worth attending in terms of the material delivered by the lecturer, and for the student to understand that it is worthwhile to attend.

Table 4.5 Frequency and ranking of factors influencing academic success identified, in an open-ended questionnaire, by first year-biology students (n=83)

Factors	Strategy identified	Frequency	Rank
Appropriate behaviours	Revising lectures as soon as possible	35	1
	Attending (all) lectures	33	2
	Reading widely	26	3
	Asking for help and clarification when needed	17	4
	Working hard and consistently	14	6
	Making your own notes (from textbook)	12	7
	Working and discussing in groups	11	8
	Using various skills to study	11	8
	Using various examination preparation skills	10	10
	Preparing for lectures	8	12
	Making summaries to learn from	8	12
	Preparing for practicals	6	14
	Managing time effectively	4	15
Affective	Showing interest in the study of the subject	8	9
Other	Understanding the work	10	10
	Attending and taking ADP seriously	16	5

Other factors identified as important were identifed by fewer than half the number of students that indicated the first two factors. They appear in Table 4.5 and have already been discussed earlier in the Chapter.

4.2.3 Students' responses to Likert-format items in the questionnaire

The questionnaire was administered in two consecutive years and the two sets of results can be considered as a replication study. The data analysed and discussed in this section was generated from two sets of questions containing a total of 27 statements.

Results from questionnaire, closed-ended question 2

The second question was: **Here are some reasons given by lecturers and last year's students when asked the same question (see question 1). To what extent do you agree or disagree with them? *Please indicate your views by writing the appropriate code in the box next to each speech bubble.***

Table 4.6 reports on the results for the 12 items from question 2, for both samples, using the Index of Agreement and Index of Disagreement.

As discussed in Chapter 3 on page 60, the Index of Agreement is a measure of the endorsement by the group of a statement. In effect, if all students strongly agree to a statement the resulting index will be 1. A 0.5 index would be obtained if all students chose the “agree” option. The index of Disagreement values obtained were small and so are not discussed across the set of samples. Table 4.6 displays results contributed by the two different groups of students, Sample 1 (n=145) and Sample 2 (n=83), at the end of their academic year. In Table 4.6, the difference in ranking states difference between the ranks of the two samples on identical statements.
A marked similarity of the Index of Agreement (IA) values is noted between Samples 1 and 2. Specifically, in terms of ranking the following trends are noted in Table 4.6

- A quarter of the items (3 out of 12) were of identical ranking (i.e difference in ranking = 0).
- One half of the items (6 out of 12) were within 1 ranking of each other)
- A further one quarter (3 out of 12) were within 2 rankings of each other.

Comparing items by rank and across the two samples in Table 4.6, it can be noted that three statements show high levels of agreement, receiving over 0.7 Index of Agreement. These factors are *Taking accurate notes* (0.80; 0.78), *Asking for help and clarification when a topic is not understood* (0.78; 0.77) and *Attending all lectures* (0.72; 0.80) This suggests that many students are aware of factors identified in the research literature as being important for academic success, as discussed on the next page.

Taking accurate notes

The effectiveness of students note-taking skills is important if they are to do well in large introductory classes (Grabe & Christopherson, 2005). This is because the ideas and information presented during lectures constitute the heart of the course and need to be recorded accurately. Badger, White, Sutherland & Haggis (2001) see note-taking as a key component of academic literacy. Researchers have determined that college students can fail to record as many as half of the pertinent ideas from a lecture (Anderson & Armbruster, 1991). Students’ accurate notes therefore provide a record of the topics, ideas and specific information presented by lecturers, and they give an indication of which aspects the lecturer considers most important. Not only can accurate notes be used to identify those areas from the textbook students should read, but examination questions in general tend to be drawn from lecture materials. Finally, if done well, the act of taking notes contributes to learning the material and reduces the amount of additional study-time required (Kiewra, Mayer, Christensen, Kim, & Risch, 1991).

Whilst responses from the two samples of students suggest that these two groups of students recognise the importance of taking accurate notes, it needs to be emphasised that much more has to be done with the notes taken. As an external store of information, notes have to be accurate; in a form that permits later revision, review and stimulate information recall when required (Locke, 1977; Dunkel, 1988). Researchers have suggested that notes, after being taken, should be processed further. Students, for example, should be taught to re-organise their notes, create sub-headings in the appropriate locations and make a list of relevant terminology for further review (Kiewra, Dublois Christensen, Kim & Linberg, 1989). The notes could be used as the basis for writing questions about each topic, which could in turn help the student to remember the material, and also to anticipate some of the examination questions. In the absence of these techniques it becomes an uphill task for students to perform well.

Asking for help and clarification

Understanding what was presented during lectures and laboratories is necessary for mastering the course material. Some materials, due to their unfamiliarity or inherent difficulty for students, will require them to ask questions and discuss ideas with teaching assistants and lecturers, or with other students. This seeking of better understanding of subject matter is important for academic success. Student # 13 seems to agree when she observed in an interview that:

> *the student who knows biology... gets like good marks in biology... they always participate during lectures. They always talk to their lecturer after the lecture*.
>
> (Student #13, lines 1013-1015*)*

Table 4.6 Extent of agreement of two samples of students about the importance of ways of studying, contributed at the end of year

Statements	Sample 1 (n= 145)			Sample 2 (n=83)			Difference in rankings		
	Index of Agreement	Index of Disagreement	Rank	Index of Agreement	Index of Disagreement	Rank	0	1	2
Taking accurate notes	0.80	0	1	0.78	0.01	2		T	
Asking for help and clarification when a topic is not understood	0.78	0.01	2	0.77	0	3		T	
Attending all lectures	0.72	0.02	3	0.80	0.03	1			T
Setting academic goals and working hard to achieve them	0.67	0	4	0.61	0.02	6			T
Practising how to answer test questions correctly	0.63	0.03	5	0.67	0.02	5	T		
Being able to understand and write assignments properly	0.62	0	6	0.69	0	4			T
Structuring notes as summaries, hierarchical lists, etc. to make learning easier	0.57	0.03	7	0.60	0.03	7	T		
Setting particular periods to study and sticking to that routine	0.55	0.05	8	0.54	0.04	9		T	
Reading previous notes before attending new lectures	0.53	0.04	9	0.56	0.02	8		T	
Completing the day's laboratory within the allotted period	0.52	0.04	10	0.53	0.04	10	T		
Memorising a good deal of what you have to learn	0.45	0.14	11	0.30	0.18	12		T	
Having friends with whom you study	0.36	0.14	12	0.36	0.10	11		T	

Whilst some students are aware of the benefits of engaging lecturers in academic chats and discussion, others are also hesitant.

> *Sometimes you want to ask a question and you think "everybody understands this and I don't". Like if you ask this you'll seem like … "this girl is a fool" you know? You don't wanna seem like a fool in front of the whole class.*
> (Student #13, lines 1025-1027)

The above quotation suggests the tension that runs through the minds of some students and the need for them to be encouraged to raise questions, however negatively this is construed by the rest of the class. It is therefore necessary that students are helped to gather the necessary confidence. This is an item that could be addressed in *Bioskills*.

Three statements were endorsed with an Index of Agreement of between 0.60 and 0.70: ***setting academic goals and working hard to achieve them***, '***practising how to answer test questions*** and ***understanding and writing assignments properly***.

Students generally have goals, be they short term or long term. The problem for some is working hard to achieve such goals at the university. Working hard, as Student #13 states, is not always literally working hard. This is because "*… there are some students who… like… work hard, really hard, but the methods they use for studying is like … make them fail their tests*".

(Student #13, lines 980-983).

What can be gleaned from this statement is the use of inappropriate methods which produces less rewarding results.

Four other items in the questionnaire specifically probed appropriate study habits and received Indices of Agreement between 0.50 and 0.60. Three items which are all work-habits related had calculated indexes of over 0.50: ***setting particular periods to study and sticking to that routine*** (Index of Agreement = 0.55), ***reading previous notes before attending new lectures*** (Index of Agreement = 0.53) and ***completing the day's lab within the allotted period***. Student #13, as an example, explained that studying biology needs concentration. One needs the right atmosphere and adequate preparation time.

> *"You cannot study biology playing radio in the background…. So much work to learn…. They cover a lot of information even during lectures within a short period, and if you take the notes and you just pack them there and say maybe I have a test in two weeks time … I would just read like two days before the test. It simply does not work that way. It does not. You need to give it some time every day. I know that I do not do that really often. But I know …like … what is right".* (Student #13, lines 1077-1086)

While she does not do that every day she confesses she knows that is the right thing to do. She continues and advises

> *"I know every time like you get lecture notes … look through them, understand what is going on,… like … go with the lecture, do not fall behind. You know, then you can really understand. Because if you don't understand … ask if you don't know or if you don't understand. It is hard to ask if you don't read or you don't study".*
> (Student #13, 1085-1087

The last two statements in Table 4.6, *memorising a good deal of what you have to learn* and *having friends who you study with*, had an Index of Agreement of less than 0.5 across both samples. Some students perceived *studying with friends* and *memorising a great deal of materials* as factors not so important in their responses to the questions asked (Table 4.6).

While “rote-memorization” is often spoken of disparagingly in some education circles, “memorization with understanding” according to Entwistle & Entwistle (2003) can often lead to better mastery of a topic, as discussed in Section 4.2.1, page 89. The other factor, from the questionnaire, which was endorsed by fewer students was “studying with friends” (IA= 0.36). It is not clear to me why few students endorsed this factor. It is most likely the group dynamics have not favoured some of them to find studying with friends, a useful venture. Having friends to study with does have benefits if the practice is structured properly. Treisman (1992) observed that African American college students, in their attempt to be self-reliant, often studied mathematics and science as individuals and often with poor results. The performance of similar groups of students improved dramatically in contexts when they studied, and later discussed topics, in groups (Treisman, 1992). This observation seems to highlight the individual and social aspects of learning and this needs to be brought to the attention of students.

Results from questionnaire, closed-ended question 3

The third question, in the questionnaire was: **What attitudes and behaviour do you think top biology students adopt in studying General Biology? (**Students had to read 15 statements and place an X in the appropriate box to indicate how much they agreed (or disagreed) with each statement).

Table 4.7 shows the Index, of Agreement and Disagreement, with the statements. The Index of Agreement ranged from 0.17 to 0.72. A comparison of the Index of Agreement across the two samples shows some levels of agreement in the ranking order. For example, if one uses the ranking of the fifteen statements as the basis for the comparison:

- One third of the items showed identical ranking
- Over a quarter items showed a ranking difference of either one or two.
- Only two items showed a ranking difference of three

The statement that received the highest Index of Agreement across both samples was on attitudes. The two groups perceived that top biology students “*have positive attitudes towards their studies”*. One student explained, in the interview, the effect of attitude, using chemistry as her context, and suggests why it is necessary to change such attitudes to a subject in order to be successful:

> *“I don’t really like chemistry. I have an attitude. The reason why I have an attitude in chemistry is because I had problems with chemistry from standard 7. Ja. I have an attitude that chemistry is hard …. Even when I am studying it I know chemistry is hard, I won’t pass this test, and I failed my test in chemistry”.* (Student #13, 998-1003).

It was only after she had received help to overcome his fears, that his attitudinal problems with chemistry were resolved and she began to do well in chemistry. Student #10 suggested students should have a *strong determination*, that is linked with their attitudes towards the subject … and "*that, in the long term, is gonna help to get by*" (Student #10, line 90).

The statement with the second-highest Index of Agreement, just over 0.6 across the two groups, was about top students' metacognition; *they try to determine which topics they do not understand well and work on them*.

Table 4.7 Indices of Agreement and Disagreement, and ranks for statements about attitudes and work-habits top students of biology are believed by these samples to adopt

Statement	Sample 1 (n=145)			Sample 2 (n=83)			Differences in ranking			
	Index of Agreement	Index of Disagreement	Rank	Index of Agreement	Index of Disagreement	Rank	0	1	2	3
They generally have positive attitudes towards their studies	0.72	0.02	1	0.70	0.01	1	T			
They try to determine which topics they do not understand well and work on them	0.61	0.01	2	0.62	0	4			T	
They find the subject interesting and put extra effort into it	0.59	0.01	3	0.63	0	3	T			
They test themselves to be sure they know the material they have been studying	0.56	0.02	4	0.54	0.01	7				T
They plan well ahead and work conscientiously to complete class assignments on schedule	0.55	0.04	5	0.64	0.02	2				T
They enjoy being the best in what they do	0.51	0.22	6	0.49	0.02	8			T	
They believe the subject will be of relevance to them in their future careers	0.50	0.02	7	0.61	0	5			T	
They find ways to understand the subject on their own	0.49	0.03	8	0.60	0.02	6			T	
When they have to memorise new information they make meaning cues, mind maps or tables to help them remember them	0.39	0.01	9	0.36	0.04	10		T		
One way or the other they manage to get hold of all the prescribed and recommended books for biology	0.36	0.09	10	0.48	0.03	9		T		
They spend a lot more time studying biology than others do	0.34	0.10	11	0.31	0.09	12		T		
Generally, they have a good command of English language	0.26	0.18	12	0.37	0.06	11		T		
They enjoy finding the meanings of scientific words in biology	0.18	0.13	13	0.25	0.09	13	T			
They generally try to please their parents or guardians by working hard	0.17	0.22	14	0.11	.026	14	T			
They do not work hard at the subject, their success comes naturally	0.05	0.48	15	0.04	0.50	15	T			

Two attitude-related statements (*they find the subject interesting and put extra effort into it*, and *they enjoy being the best in what they do*) and two statements on metacognition (*testing themselves to be sure they know the material*, and *plan well ahead and work conscientiously to complete class assignment on schedule*) received an Index of Agreement of between 0.49 and 0.64. It is important to notice that although the ranking of the statement on top students testing themselves had a difference of three between Sample 1 and Sample 2, there was just a little difference between the two Index of

Agreement values (0.56 and 0.54). This possibly confirms the stability in the values of two groups of students perceptions calculated over two points in time rather than variability in calculated Index of Agreement values.

The statement that *top biology students find ways to understand the subject* generated very different Indexes of Agreement (IA = 0.49 for Sample 1, and IA= 0.60 for sample 2). Student #11, a top student, provided insights which seemed to support the view that top students would use various strategies to understand difficult topics. For a human physiology topic, for example, Student #11 claimed in order to understand he uses the following strategy:

> *"I'll sit on my bed and I'll read it but jot the important facts. And reason it out: out loud onto the tape… So it's kind of ….I don't just read the notes on tape. But I say: "Well if it was like this .. that would mean that … this would have to be like that". So I kind of reason out loud onto the tape and …. and read through my notes. Either in text books or my notes I took in lectures".* (Student #11, lines 1157- 1150)

This is another form of active reading, actively interrogating the lecture material, which can be beneficial when studying difficult topics.

Items which generated Index of Agreement lower than 0.40 from respondents, and ranked between #9 to #15, deserve some passing comment (see Table 4.7 for the statements). The statement ranked #13 by both groups is an attitude-related statement. The statement ranked #14 is motivation-related and the statement ranked #15 is a perception or belief. The statement ranked #14 generated a low Index of Agreement and relatively higher Index of Disagreement (ID= 0.22; 0.26) than the others. This suggests students believed at the end of the year that top students study not because of the need to please parents but for their own sake. This is certainly an appropriate attitude for all students to inculcate.

The final statement to Question 2, and with the highest Index of Disagreement, was about the belief that *top students do not work hard at their subject, their success comes naturally*. The Index of Disagreement for the two samples was about 0.50 which suggests that students had taken note of the effort put in by top students to do well.

The similarity in the ranking for the two cohorts suggests a degree of stability of perceptions of first-year biology students at this university, and points to the reliability of this data. It is also important to take note of the time the data was collected, the end of the year, when students would have experienced university life and become more aware of factors leading to students' success. I am, however, not sure of when these experiences are formed and it would be interesting to know whether it is early or late into the year. This aspect was not investigated in this study and requires more research.

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The similarity in ranking for the two cohorts reported above although impressive also point to a limitation in the study in terms of the numbers of students involved. The two groups were the end-of-year groups but sample 2 is about half the number of sample 1. This raises questions about the representativeness of the findings based on the questionnaire and needs to be noted by the reader.

4.2.4 Changes in perceptions of students after a year at university

This section of the study sought to answer the following research question.

Research question 2:
What changes in students' perceptions occur after a year at the university?

Answers to this question were important in order to determine whether an intervention was needed. If students are found at the start of the year with appropriate perceptions of factors that influenced academic success there would be no need for an intervention. If, however, at the start of the year, they are found to have inappropriate perceptions and these perceptions remained unchanged at the end of the year, it suggests an intervention is required to increase their metacognitive knowledge.

Results from open-ended questionnaire statement

The open-ended question had speech bubbles for students to write in strategies they believed contributed to academic success. These ideas, collated, coded and summarized in Table 4.8, were top strategies most frequently mentioned by the students in the sample. They are a reflection of strategies important for academic success on the minds of the group as a whole. The responses from the complete set of students (n=83) at the 'start of year' and at the 'end of the year' are shown in Table 4.8.

Table 4.8 The strategies of studying which students believed contributed to academic success, mentioned by them as they entered and as they completed first-year biology (n = 83)

Strategy identified	Students entering first-year biology		Students completing first-year biology	
	Frequency	Rank	Frequency	Rank
Reading over one's work regularly	41	1	16	6
Asking questions if you do not understand the work	27	2	17	5
Working hard / consistently	27	2	21	3
Concentrating during lectures	21	4	6	12
Preparing beforehand for lectures	18	5	9	11
Attending all lectures	17	6	**30***	1
Taking good notes	15	7	11	9
Doing extra reading from the textbook	14	8	**22***	2
Reading up in other relevant books	13	9	12	8
Keeping up to date	13	9	**20***	4
Managing time effectively	11	11	6	12
Making your own notes (from the textbook)	9	12	**16***	6
Making summaries from which to to learn	9	13	**11***	9

*= factors believed to be more important at the end of the year

Figure 4.4 on the next page is a graphical representation of the content in Table 4.8. It presents visually some of the essential aspects of the data. There were differences in the frequencies of statements contributed by the same group of students at the beginning and end of the year, which resulted in two clusters of data. If statements are ranked by frequency they show noticeable changes in ranks over the period.

This suggests some students must have recognised the factors as either more important or less important later in the year as they engaged with their studies. The factors rated as less important by the class after students experience at the university, and factors students' experience showed them were more important in first-year biological sciences.

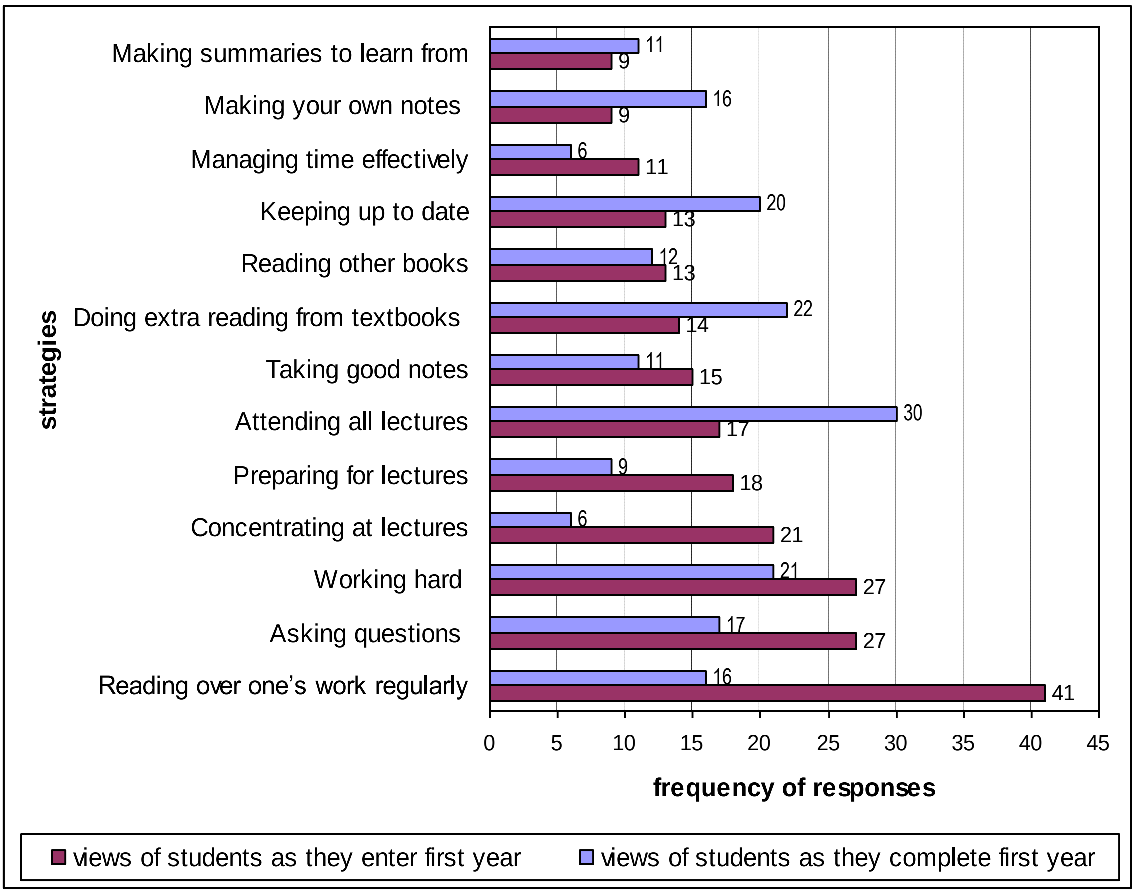

Figure 4.4 Views of students as they "entered" and as they "completed" their first year (n=83)

Based on the number of students mentioning the factor, and when such frequencies are ranked, the following factors emerged as more important at the end of the year.

Attending all lectures

This factor, attending all lectures, generated the most dramatic change in their views, from 17 to 30. Attending lectures constitutes an important aspect of university life. Friedman, Rodriquez & McComb (2001) found, in an American study, that students' characteristics and course characteristics contributed to influence students' decision to regularly attend lectures or not. Friedman *et al*. (2001) and Moore (2003) found that students with regular class attendance records tended to have better academic performance than those with poor class attendance records. Although attendance alone does not guarantee a student's success Moore (2003), albeit in an American context, believes it is important that the *correlation* (not causality) between lecture attendance and learning be emphasized to students. This is important in the American context where some at-risk first-year college students, often with no real interest in learning, skip classes (Thomas & Higbee 2000; Moore, 2003).

Whilst the context of this South African study reported earlier on may be different from that in America, it is interesting that students from the sample placed importance, at the end of the year, on attending all lectures, possibly as a result of their own experience and observation.

Doing extra reading from the textbook

The next factor which greater numbers of students mentioned as important at the end of the year was *doing extra reading from textbook.*This factor was mentioned by 22 students at the end of the year as opposed to the 14 at the start of the year. There are many reasons why students should do extra reading from their textbooks. Finding the relevant material from textbooks helps students to achieve greater understanding of the topic than from using for example, poorly written notes. The literature on reading recommends students to learn to read interactively (e.g. Lazar, 1995; Badger, White, Sutherland & Haggis, 2001); questioning what they are reading, and making notes of important points and ideas in order to improve on their understanding and their skills in writing well -written tests.

Keeping up to date

The third factor which was mentioned by a lot more students, at the end of the year as important for academic success, was *keeping up to date* (n = 20 at the end; n = 13 at the start). Student #10 in the interview explained keeping up to date:

> *"Every day you've got to keep up to date on what you do daily. And then weekly. … I suppose that is linked to setting goals in life and …. like revising, like… same day you do work, revising weekly, monthly".* (Student #10, lines 952-954)

Student #10 also provided reasons why it is important to revise regularly:

> *"The reading I have done suggests that if you study and if you do not revise at certain intervals you are wasting your time. Okay. The recall will only be maintained at a high level if you go and revise your notes"*
> (Student #10, lines 956-957)

His views are supported in the literature reviewed (e.g. Lazar, 1995; Carter, Bishop & Kravits, 2005).

Making your own notes

Linked to the factor of keeping up to date is the fourth factor of *making your own notes* (from the textbook) mentioned as important by 16 students at the end-of-the year as opposed to 9 students at the start). Students often do not take accurate notes and what students sometimes take down has been described as "a degenerate version of the lecture" (Badger *et al.*, 2001, p. 406). To improve upon the quality of notes taken Cottrell (1999) reminds us that making good notes sometimes could involve constructing extensive notes from relevant sources to help improve understanding.

It is worrying to note that some factors known to be important for success, and rated high by students at the start of the year, were not perceived that important at the end of the year. Some of these factors are recommended from the literature, as already discussed. For example, the frequency of *'reading over one's work regularly* went down from 41 to 16 (see Table 4.8 and Figure 4.4) and *asking questions when you do not understand*' went down from a frequency of 27 to 17 at the end of the year. Although reasons for this downturn in frequency could not be established, possible reasons might be be linked to students' perceptions of the workload later in the course. It is important for students to keep up with their reading habits. Lazar (1995) found, in a study in America, that between examinations students did not feel pressured to keep up with the reading and review of notes taken in class. It is also important for students to talk to others regularly about academic material to improve on their understanding of their academic work. This is an aspect of establishing learning communities on university campuses and residences, which is reported to improve on students' engagement with learning and academic performance (Zhao & Kuh, 2004).

The importance of lecturers creating opportunities, even informally immediately after lectures, for students to ask questions has been highlighted by Airey & Linder (2006) within the context of lecturing to students in their second language. They note that students' willingness to ask questions was greatly reduced when they were being lectured to in their second language. This has implications for our students, who often speak English as their second or third language.

Results from closed-ended statements in the questionnaire

As mentioned in an earlier section, the two close-ended questions in the questionnaire contributed 27 statements with Likert-type responses. Question 2 was on strategies which students believed other students used which contributed to academic success, whilst Question 3 was on attitudes and behaviours top students are believed to use in their studies (see Appendix B for details of the questionnaire). The agreement of students as a group to each statement listed at the beginning and end of the year were compared.

Rasch analysis in Winsteps, as discussed in Chapter 3, was used to compare the means from the responses of the students. A paired t-test was used to investigate if differences in mean scores for the group for each item, at start and end of year, were statistically significant or could have happened by chance. The analysis was done in two steps. First, Rasch was used to transform the raw data into interval data. Second, a paired t-test was conducted to determine if significant differences existed between the mean scores for the group for each of the items. Table 4.9 lists the 11 statements which generated statistically significant mean scores. The statements are reported separately for the two questions.

The application of a paired t-test on the Rasch transformed data showed there were differences significant at the 5% level for 11 out of the 27 items (listed in Table 4.9).

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These differences suggested that students' experiences during the year had changed their minds about the importance of some of the factors. Six out of the eleven statements from the analysis received greater endorsement at the end of the year than they did at the beginning. In other words they were considered to be more important by students who had more experience in academic life at the end of the year. The six statements are discussed below.

Setting academic goals and working hard to achieve them

Setting academic goals is a motivational strategy that helps give students a sense of achievement and the inspiration for greater and more challenging goals (Schunk, 2003). Goals must, however, be placed in a time frame if they are to be achieved successfully. That more students at the end of the year perceived this behaviour to be important for academic success than at the start of the year shows how their experiences at the university influenced their perceptions.

Table 4.9 Summary of statements that were significantly different* at end of year (n=83)

	Statements	t-value	probability
more important	**Statements from Question 2. Students' agreement with viewpoints expressed by lecturers and other students about ways of studying that lead to academic success**		
	Setting academic goals and working hard to achieve them	2.87	0.0046
	Being able to understand and write assignments properly	2.24	0.0267
	Reading previous notes before attending new lecture	2.10	0.0376
	Statements from Question 3: Attitudes and behaviours top biology students are thought to adopt in studying biology that make them successful		
	They plan well ahead and work conscientiously to complete class assignments on schedule	2.87	0.0046
	They test themselves to be sure they know the material they have been studying.	2.23	0.0273
	They try to determine which topics they do not understand well and work on them	2.02	0.0452
less important	**Statements from Question 3: Attitudes and behaviours top biology students are thought to adopt in studying biology that make them successful**		
	They do not work hard at the subject, their success comes naturally	3.72	0.0003
	They believe the subject will be of relevance to them in their future careers	3.17	0.0018
	They generally try to please their parents or guardians by working hard	2.82	0.0054
	Generally, they have a good command of the English language	2.75	0.0066
	They find ways to understand the subject on their own	2.02	0.0448

* Significance level 5%

Planning well ahead and working conscientiously to complete class assignments on schedule

Closely linked to setting academic goals is this item in question 3. Planning well ahead is part of the general strategy for effectively managing time. It is important to recall that the probability of the t-values for each of the two items discussed were statistically significant. Our students placed more importance at the end of the year on planning and time management than at the beginning.

Three of the six statements are discussed together:

Understanding and writing assignments properly

Self testing to be sure they know the material they have been studying
Determining which topics they do not understand well and working on them

It is also important to note that all the three statements have to do with behaviour and metacognitive processes that students and lecturers, believed are either important for academic success, or which top students are believed to use. Metacognition in this context is defined to include students reflecting on how they learn, and was discussed in Chapter 2, section 2.3.4, page 50. As shown in the model of the theoretical framework on page 42, metacognition feeds into students' behavioural intentions and behaviours. Intentions and behaviours are expressed as goals, work-habits and motivation-related behaviours. It is important for students to be encouraged to exhibit greater metacognitive behaviours in their studies if they are to improve on their chances of success.

Reading previous notes before attending new lectures
The sixth item with a higher endorsement at the end of the year was that of reading previous notes. Grayson (1996) noted that inadequate preparation for lectures by students was an area of difficulty among access students in one university in South Africa. Airey & Linder (2006), echoing the response of the students, believe that preparation before new lectures could help students achieve a greater understanding of the work.

"Not sure" responses

Likert-format responses which include "not sure options" have been criticized for not having a neutral midpoint (Siegel & Ranney, 2003). Siegel & Ranney (2003) point out that the "not sure" might not represent neutrality in the respondents' mind, but a state of confusion and misunderstanding. Twelve of the 27 statements (40%) received 'not sure' responses from more than 10% of the sample. These statements are listed in Table 4.10.

The large number of statements that received "not sure" responses either at the start or the end of the year (Table 4.10) suggests respondents may have been uncertain about, or were perhaps unfamiliar with, the role of certain strategies in promoting academic success. I attempt here to discuss items with a high "not sure" percentage. These items included:

They enjoy finding meanings of scientific words in biology
As noted in Table 4.10 over 40% of the respondents selected "not sure" for this statement, which is disturbing for the following reasons. Research suggests that problems around scientific language affect the effectiveness of learning in the sciences, and the vocabulary used in science lessons is a particular problem (Rutherford, 1993; Carlsen, 2007). As noted by Carlsen (2007) scientific writing is often lexically dense with colourful, made-up words that often reduce complex processes to singular identities (e.g. *photosynthesis*). Nhlapho (1993) mentions three categories of words that can pose difficulties for students; 'technical terms', 'non-technical terms' and 'paradoxical jargon' (words with more than one meaning, one often being technical and the other non-technical). According to Rutherford (1993) it is the non-technical and

"paradoxical jargon"[55] that poses a lot of challenges to students, especially English-second language speakers. What is important to note, according to (Page, 1977, cited by Sanders & Nhlapho, 1994) is that many students are often unaware they do not know the meanings of these words.

Some of the students' difficulties, as mentioned above, could be explained from a socio-linguistic perspective using the discourse of science (Rollnick, 2010). Although students may speak perfect grammatical English they may not have fully acquired the *discourse* used in biology, which is a secondary discourse to them. Gee (1996), in the context of science, lists various components of science discourse that distinguish it from the everyday discourse, one of which is the correct use of technical terms, which often are lost on new students to the subject.

It seems logical that in order for students to do well in biology they will have to test their understanding of all words, be they technical terms or paradoxical jargon, and master the secondary *discourse* of biology. A way to achieve this is to regularly find out the meanings of scientific words not understood (Carlsen, 2007). This is one of the ways top students in biology, or senior students of biology, would have acquired much earlier the *discourse*, and learned to 'talk the language of science'.

Table 4.10 Summary of the extent of "not sure" responses (n=83)

Statement	Percentage of *not* sure responses	
	S* (%)	E* (%)
They enjoy finding meaning of scientific words in biology.	43	46
When they have to memorise new information they make meaning cues, mind maps or tables to help them remember.	33	44
Having a good command of the English language.	28	29
Having friends with whom you study.	22	30
Memorising a good deal of what you have to learn.	20	28
They believe the subject will be of relevance to them in their future careers.	20	13
Completing the day's lab within the allotted time.	20	11
They find ways to understand the subject on their own.	19	13
They test themselves to be sure they know the material they have been studying.	12	28
Setting particular periods to study, and sticking to that routine.	11	11
Structuring notes as summaries to make learning easier.	10	14
Setting academic goals and working hard to achieve them.	4	11

S* = start of the year; E* = end of the year

Making meaning cues, mind maps or tables to help memorization

Over 30% of students were unsure about the use of various strategies to aid memorization and recall of information that top students are believed to use to promote their academic success That over one-third (33%) of the sample at the start of the year, and close to half of the sample

[55] Rutherford (1993) uses an equivalent term 'portmanteau' words

(44%) at the end of the year were not sure that top students do use various strategies to help them remember information is disturbing. De Simone (2007) points out that simple note-taking does not suffice to help students learn and remember complex material, and that the use of mind maps helps. It is therefore important to make students aware of the academic benefits that can be derived from using such strategies.

***Having a good command of the English* language**

Over a quarter of the respondents were not sure whether good command of English language is demonstrated by top students in biology. English is the language of instruction in the majority of tertiary institutions in South Africa (Department of Education, 2001b). Students are expected to demonstrate proficiency in written (and sometimes oral) communication skills on various subject-specific topics of assessment before they are deemed to have successfully passed their university courses. It is therefore disturbing when perceptions are held by close to a third of the sample at the start and end of the year that imply their uncertainty about the importance of proficiency in the English language in promoting academic success. Fraser & Killen (2005) also found that students in their study in a tertiary institution in South Africa, from their responses in a questionnaire, underrated the importance of communicating in English language in their specific disciplines. From the discourse perspective this observation by Fraser and Killen (2005) may not be unexpected if students are not aware of the differences between the *discourse of the science language*, the language of instruction, and the every day language. To master the academic discipline students would need to achieve ‘fluency’ in this discourse at the university level (Street, 2005; Rollnick, 2010), a feature which may not have been fully acquired. It is therefore important for educators to draw students’ attention to the intricacies embedded in language acquisition and that students are encouraged to strive, acquire and gain mastery of the language as secondary discourse.

These factors discussed make logical targets for teaching and learning programmes as they contribute to students’ academic success. They are teachable to students lacking such knowledge and skills, and studies point to their usefulness in promoting students’ cognition.

4.3 CONCLUDING REMARKS

In this chapter I attempted to identify factors which stakeholders thought affected the academic success of first-year biological sciences students. The stakeholders, including experts with various levels of experience at this university and first-year students, contributed ideas which were used to design a questionnaire, which was administered to two groups of first-year students. Some of the first-year students were not aware of the influence of some of the factors in promoting academic success, There were some first-year students who, at the end of the year, perceived such factors to be less important for academic success than they had believed at the start of the year.

The analysis of the questionnaire data allowed me to make decisions on factors that should be included in *Bioskills*. In the design of the package I was aiming to include appropriate affective factors, work-habits and metacognitive knowledge students would need to make their educational experiences at the university successful.

Three criteria were used with regard to including factors for success in the package. If a high percentage of students was unsure about the importance of a factor which research shows does affect academic performance then it was included in the package. Second, if students were not aware of the importance of the factor it was considered for inclusion in the package. Third, if many students said a factor is important for academic success it was considered for inclusion in the package.

Given the specific context of the study, care needs to be taken before considering generalizing the results. However, as noted in the Chapter 8, Fraser & Killen (2005), using different instruments and in a different context, arrived at many similar results. I have, as a result, attempted to formulate the factors into a summary which could be more generalizable and hence more widely useful (see Chapter 8, section 8.2.1). The focus of the thesis now shifts to the design of the package in the therapeutic phase of the study.

CHAPTER 5
THERAPEUTIC PHASE: PACKAGE DEVELOPMENT AND RESEARCH DESIGN

The therapeutic phase, the second major section of the study, is reported in Chapters 5 to 7. In this chapter, I provide details of how the results from the diagnostic phase and the research literature are used to inform, develop, and investigate a computer-based instructional package, *Bioskills*. Although this is a "methods" chapter, some results have been reported here because they have been used to refine the computer package during its development.

5.1 RATIONALE FOR USING COMPUTERS AS THE VEHICLE OF INSTRUCTION

The results from the diagnostic phase, reported in Chapter 4, revealed a number of factors considered to influence academic success that first-year biological sciences students were either not aware of, or about which they were unsure. An intervention was therefore required to help raise students' awareness of appropriate attitudes, work-habits and metacognitive knowledge necessary for achieving academic success, and to give guidance on how to apply this knowledge. I decided to use computers as the **main** vehicle of instruction delivery over other forms such as teacher instruction or use of textbooks. In this context, I do not overlook the supplementary roles the use of handouts and individual tuition by teachers can play, but my use of this tool is supported by the stated advantages the use of computers has over other methods reviewed in the literature below.

The merits of computers include their capacity:

- to provide instruction in a non-threatening environment for students to study at their own pace and under their own control (Hewson & Hewson, 1984; Cron & McCallum, 1998).
- to instruct students in large classes where teachers would ordinarily find it difficult to give individually tailored feedback (Steinberg, 1991; O'Hagan, 1999; Ng'ambi & Seymour, 2004).
- to complement existing courses with more individualized tuition (e.g. Ismail, 1997; Corbett, 2001; Knapper, 2001).
- to provide opportunities for simulated "apprenticeships" and to support learning (McLellan, 1994).
- to support effective (online) distance learning (Russell, 1999; Mantyla, 2000; Reeves, 2003).
- to open up new ways of accessing information and building communication links among students (Jaffer, Ng'ambi & Czerniewicz, 2007; Agostinho *et al.*, 2009).

The use of computers has provided environments where students actively participate and engage with instructional material on a one-to-one basis (Fresen, 1990; Steinberg 1991; Mantyla, 2000). However, in terms of their educational effectiveness, concerns have been raised about the weak design of some instructional materials (e.g. Keller & Suzuki, 1988; Rieber, 1994; Reeves & Hedburg, 2003) and with the short periods of engagement with programmes often exhibited by users (Keller & Suzuki, 1988; Grabowski, 1991; Reeves & Hedburg, 2003). The limitations and concerns around weak instructional designs were explored by examining theories and guidelines in the literature and taking the steps suggested to improve the design as reported in Section 5.2. In so doing it was possible to avoid some errors reported in the literature.

5.1.1 Needs assessment

The successful use of computer-based resources at institutions is hindered by a number of factors (Hew & Brush, 2007) and these hindrances must be borne in mind with a view to correcting them if the technology is to be implemented successfully. Before the resource was introduced a needs assessment was carried out on the feasibility of the project. The research team was cognizant of the fact that the successful implementation of the technology depended among others, as also recognized by Reeves (1994b), on the resources available, institutional support, and the background knowledge and skills of students about the technology being introduced.

To support computer-based teaching and research in the department, the School had a computer laboratory fitted with 43 desktops to facilitate teaching and learning. There was a technical support staff who managed the computer laboratory. Fabry & Higgs (1997) mentioned the importance of the technology being in the right location for students and teachers to have access when needed. Lack of time for students to use the facility was another resource-type impediment (Cuban, Kirkpatrick & Peck, 2001; Karagiorgi, 2005). This impediment was real at the University given the packed timetable of students. However, it was possible to negotiate with tutors teaching Academic Development Programme students to use the facility during either structured tutorials periods or when students had free periods.

Institutional impediments included leadership and school planning (Hew & Brush, 2007). These were not envisaged as a problem as the Head of School was supportive of the project and had committed resources and personnel to ensure that the computer facilities were functional (Sanders & Ayayee, 1997). The lack of computer skills or limited computer knowledge and skills of students (Amory & Mars, 1994) was another factor of concern for the successful implementation of the project. This was to be addressed by giving students basic instruction on how to use the computers available.

5.2 THEORIES AND PRINCIPLES UNDERPINNING THE DESIGN OF THE INSTRUCTIONAL MODULE

I begin by discussing the design and development of the educational package before addressing the research done on the instructional package, *Bioskills*. It needs to be mentioned that I was not the main designer of the package but I played major roles in the story board design, developing the interface for the package, the development and delivery of the instructional module.

Three main sources of information were used in the design of the instructional package, *Bioskills,* as represented in Figure 5.1.

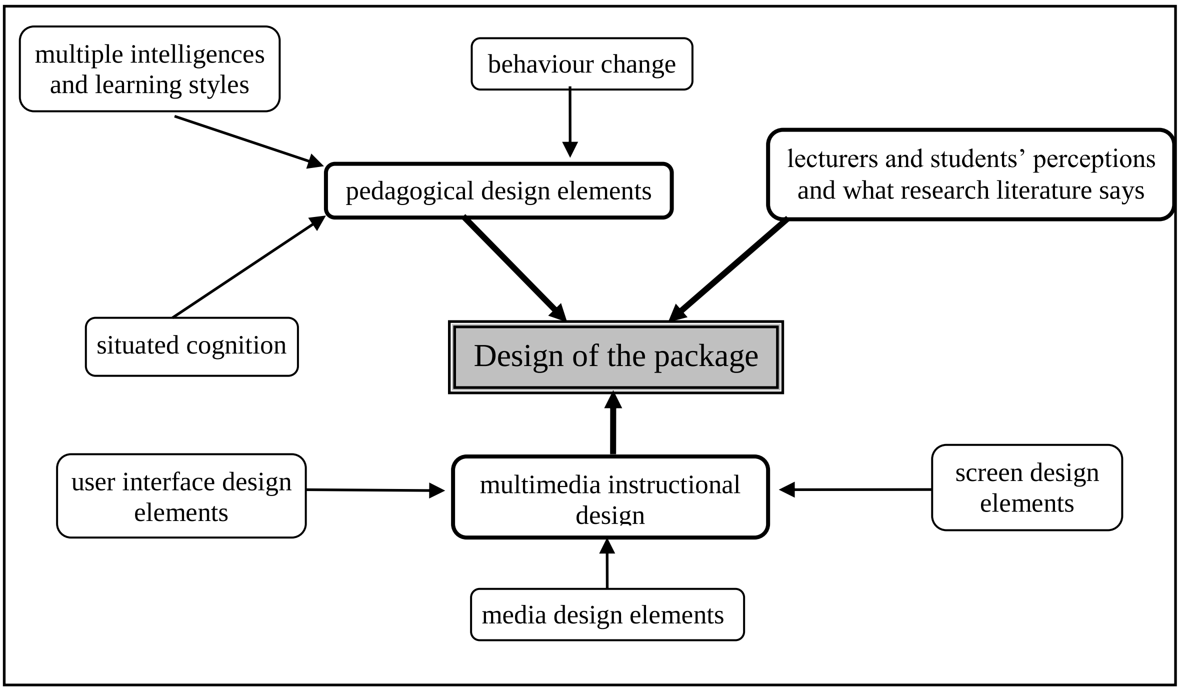


Figure 5.1 Sources of information that informed the design of *Bioskills*

The first source was the opinions of students and lecturers teaching first-year biology students about factors they believed influence academic success. To supplement their views information on relevant attitudes, work-habits, and metacognition which influence academic success was identified from research literature. The second source of information which underpinned the design was theories and guidelines about multimedia instructional design. The third source was to do with pedagogical design elements to do with learning theories, which influence the quality of teaching and learning. The first source has already been discussed in Chapters 2 and 4. The following section deals with multimedia instructional design and pedagogical design elements, and provides the principles used in the design of *Bioskills*.

5.2.1 Multimedia instructional design

An instructional design refers to the systematic process of translating general principles of learning and instruction into materials for instruction and learning (Alessi, 1996; Herrington, Reeves, Oliver & Woo, 2004). According to Rieber (1994) one of the goals of instructional design (if it is to be effective) should be to cater for learning through the provision of high quality instruction. The literature on instructional design is replete with recommendations which are based on untested practices, and such designs, according to Mayer (2005), result in less effective instructional designs. Well-designed multimedia instructional materials, according to Mayer (2005), should be research-based and learner-centred rather than technology-centred.

Different aspects of the structure of multimedia programmes are recognized and emphasized by developers in describing their designs (see Reeves, 1994, Phillips & DiGiorgio, 1997). In the present study, I focus on three aspects of the design environment (*screen design*, *media design* and *user interface design)*. I do this for two reasons: first, to give an overview of the structure of my multimedia programme, and, secondly, as pointed out by Reeves & Harmon (1994), to highlight areas of the multimedia programme that can be investigated.

Screen design elements

Multimedia design researchers emphasise the importance of effective screen design. This is because words on screens are often harder to read than print in a book, which according to Phillips (1997) is often a result of screen resolution and contrast. Screen design elements include font types and sizes, background-colour, and colour combinations, Suggestions and guidelines from the research literature used to promote an effective screen design environment are shown in Table 5.1.

Table 5.1 Guidelines for the screen design environment of a programme

	Guidelines for design	Reasons
Layout	• Keep the top-left corner of the screen as the primary focal point. Place dominant elements in this position. • Elements in the lay-out must be balanced so that the eye of the user is drawn first to the most important elements, then to the next logical element (Phillips & DiGiorgio, 1997).	• In the English-speaking world people are culturally conditioned to read a page from top left to bottom right (Reeves, 1994; Phillip & DiGiorgio, 1997). • Direction of a layout is important in determining the effectiveness of graphic designs.
Screen format	• Try to be consistent and use the same format throughout (Reeves, 1994).	• Too much variation can cause confusion for the user (Phillip & DiGiorgio, 1997).
Colour	• Maintain colour consistency in a programme. • Be aware of cultural colour sensitivities (Sanders & Ayayee, 1997). Be aware of colours that compete against one another.	• Different combinations of colours give different psychological effects. • Choice of colours appreciated by individuals tend to vary within cultures. • Such combinations tend to be hard to read and constitute strain on the eyes
Text	• Font of titles should be clear and easy to read. • Keep the number of different fonts on any one screen to a maximum of two. • Do not over-use highlighting effects (Phillips & DiGiorgio, 1997)	• This improves legibility of text. • Too much variation in font makes reading text from screens difficult

Media design elements

Media design elements include factors such as sound, pictures, video and animation. The rationale to use multimedia in programmes is based on the observation that when programmes are learner-centred[57] students tend to learn more deeply when more than one medium is used (Mayer, 2005). [see summary of views in Table 5.2]

User interface design elements

Reeves & Harmon (1994, p. 474) explain the "user interface design elements", as those aspects of multimedia that *"ensure that the learner can actually engage in a meaningful interaction"* with the programme. They include aspects that promote ease of use, ease of navigation, and reduction in *cognitive load.*

Ease of navigation

[57] A learner-centred approach to multimedia attempts to use multimedia to enhance human learning and understanding (Mayer, 2005).

Providing appropriate navigation is an important consideration to ensure users work their way systematically through the sections in a multimedia programme (Rouet & Potelle, 2005). One of the navigational problems users face is disorientation in hyperspace, which occurs when learners do not know where they are, where they have been in a programme, or how to get to where they want to be (Reeves & Harmon, 1994). Chiu & Wang (cited by Sanders & Fletcher, 2003) recommend structuring the lay-out of screens using place-cues such as mouse-overs, colour changes for sections visited, and the use of visual overviews, as means of orientating learners.

Another reason why it is necessary to provide an effective navigation system is that students entering a programme may not know enough to be left in control, or to make the best choices about the sequence in which different sections in the programme should be read. Studies indicate that students working in hypertext media have their preferred navigation patterns (Lawless & Kulikowich, 1996; Lee & Boling, 1999) and these are affected by a range of factors including the user's motivation to engage with the material, brain hemisphericity (Lee, 1999), culture, language, and learner goals (Beasley & Waugh, 1997).

Burke, Etnier & Sullivan (1998) mention the importance of ensuring that students, especially novice users of computers, do not miss out on some screens as a result of navigational difficulties. It is alarming to note that a study by Lawless & Kulikowich (1996) found that about 25% of a sample of university students (n= 42) used navigational patterns inappropriate for effective learning. Sanders & Fletcher (2003, p. 231) mention that students experience cognitive difficulties "…*when their navigational patterns are incompatible with strategies likely to result in effective learning*".

Sanders & Fletcher (2003) investigated how the first-year university biology students at our university used navigational aids in order to explore the structure of a computer programme. The navigational cues and aids were a system of *tabs* across the top of the screens and *buttons* down the side of the screen. The researchers investigated students' perceptions of whether buttons or tabs represented the main sections of the design. Only two-thirds of the students, when asked, could work their way systematically through all the screens. Very importantly, Sanders & Fletcher reported that a majority of the students whose navigational pathways were incomplete did not realize that they had not visited all screens and there was a problem because of that.

One way of getting novice users of hypertext to explore all the screens, according to Lawless & Kulikowich (1996), is to provide a structured navigational system as opposed to an unstructured one. According to Reeves & Harmon (1994), structured navigation in a programme uses logical pathways, which introduce content experts' views to the navigator, in contrast to those of low structure and control, which promote learner independence.

It is the absence of a structured navigation design, and inadequate user control, that have been blamed for some users having no idea where they are and being "lost in hyperspace" (Smith &

Hahn, 1989, cited by Phillips, 1997). Thus, my motivation for providing a logical structure was to promote users working through the programme in a systematic way to view all the screens.

Table 5.2 Some principles of multimedia design and suggestions for their use (based on Mayer, 2001; 2005)

Principle	Suggestions	Reasons	Implementation of guidelines in *Bioskills*
Multimedia principle (Mayer, 2001)	Use text combined with content-related pictures when learners have low prior knowledge but sufficient cognitive abilities to process both the text and the picture. Do not overload users' cognition.	• People learn better from words and pictures than from words alone Mayer, 2001). • Human minds have dual channels, but of limited capacity (Miller, 1956, Mayer, 2001). • Texts and pictures (if they are related) can contribute to the joint construction of the same mental model.	Texts and pictures were used. Instruction was kept simple and not wordy, so as not to induce cognitive overload.
Spatial contiguity principle (Schnotz, 2005)	If written text is used, present it in close spatial proximity to the picture.	• Visual search processes are reduced. • Enhances availability of pictorial and verbal information in working memory.	Related graphic and written texts were placed in close proximity.
Coherence or redundancy principle (Mayer, 2001) **or** Specific redundancy principle (Chandler & Sweller, 1996)	• Do not use extraneous words and pictures. • Do not add unnecessary sound or music.	• Redundant material tends to interfere with, rather than facilitate, learning (Mayer, 2001).	Music clips, although motivational, were kept to a minimum in the programme as I felt they could negatively impact on learning, especially if headphones are not used.
Site map principle (Shapiro, 2005)	Provide learners with a bird's eye view of hypertext content (Shapiro, 2005).	• Site maps give users a sense of the site content and structure (Shapiro, 2005). • They keep learners from getting lost in hyperspace.	Mind map of content was provided.
Navigational principles (Rouet & Potelle, 2005)	Navigational aids used should be considerate of the users' needs.	• Navigational aids, when properly used, help learners make their way through information with greater ease.	I used a simple hierarchically structured navigational system which was likely to benefit most users (see a discussion in Section 5).

Reducing cognitive load

Humans are posited to have a limited cognitive capacity which could be overloaded by the amount and nature of information reaching it. Two theories, *dual coding theory* (Paivio, 1986; Clark & Paivio, 1991) and *cognitive load theory* (Chandler & Sweller, 1996; Sweller, 2005), have been pivotal in framing the cognitive theory on how information can be presented to promote learning.

Dual coding theory envisages memory to consist of two separate but interrelated channels for processing information – one verbal and the other visual (Paivio, 1986). Whilst the verbal and visual channels can be activated independently, there are interconnections between them that allow dual coding of information. According to Clark & Paivio (1991) it is the interconnectedness of the two channels that permits interpretation of the environment, linking cues from one channel to the other. As noted from the theory, presenting information by both visual and verbal forms has advantages over presenting it in a single form; it enhances recall or recognition by the learner (Mayer, 2005) and caters for both visual and auditory learners in an instructional environment.

Cognitive load theory posits the existence of three components of the human memory: sensory memory, working (or short-term) memory, and long-term memory (Baddeley, 1990). Mental activity takes place in the working memory, which is limited in both capacity and duration (Carlson, Chandler & Sweller, 2003; Kiili, 2005). According to Miller (1956), humans can deal with only seven plus-minus two elements of information at a time without overloading the information-processing capacity.

The limited capacity of the working memory is recognized as the most critical factor that needs to be considered in instructional design (Carlson *et al.*, 2003).What is important for designing multimedia instructional software is that Baddeley (1990) suggests that the working memory has two additional slave systems (the visual and auditory systems), which help to increase the working memory's capacity. Chandler & Sweller (1996) and Mayer & Moreno (2002) believe that the overloading of the working memory capacity, referred to as cognitive overload, occurs when information is presented in inappropriate ways. Sweller, Van Merrienboer & Paas (1998) identified three sources of cognitive load namely *intrinsic*, *extraneous*, and *germane*. By definition, intrinsic cognitive overload results from the inherent nature of the learning material and the intellectual complexity of information, whilst extraneous cognitive overload results from the manner in which the material is presented (Moreno & Mayer, 2002). Germane cognitive overload occurs when an individual does not have adequate schemata for the organization and storage of the information. Schemata, as explained by Valcke (2002), serve as advance organizers in the long-term storage of information and thereby reduce cognitive overload.

These two aspects (dual coding, cognitive load), together with the need for learners to actually process information, are assumptions underpinning what Mayer (2005) calls his "cognitive theory of multimedia learning". In a recent book on the subject, Mayer (2005) outlines several "principles of multimedia design". Table 5.2 summarizes six of these which were relevant to my design, and includes suggestions for reducing cognitive load incorporated in the programme.

In my design extraneous cognitive overload was addressed by using brief summaries of information and call-out boxes. Extrinsic complexities of instructions were minimized by keeping sentences simple and within the users' register. At specific sections in the package, students were encouraged to actively process the information presented and link it to their experiences (see Section 5 of the package). As pointed out by Kiili (2005, p. 307), linking new information in this way with prior knowledge (a way of active learning) enables users to categorize multiple elements of related information "*as a single higher level element*" and this tends to reduce germane cognitive overload. It mis worthwhile to recall that prior knowledge is a cornerstone of meaningful learning, as noted by Ausubel (1963) almost half a century ago.

5.2.2 Pedagogical design elements

The "pedagogical design elements" formed the third set of the sources of information I used to underpin the design of *Bioskills*. These pedagogical elements relate to aspects of the design of the package, its development and theories, which directly affect learning. There are doubtless challenges in the higher education sector as educational designers attempt to integrate technology into teaching practice and make it effective learning experiences for students (Koper, 2005; Agostinho *et al*, 2009). Educational design is construed as both a *process* and a *product* (Agostinho *et al*., 2009). The design of the package entails firstly, the planning and documentation of the learning activities in advance of delivery. This is the *process* aspect of learning design (Oliver, Harper, Hedberg, Wills & Agostinho, 2002). Where instructional materials developed have proved effective they could be shared and reused among practicing educators which is the *product* aspect of educational design (Falconer & Littlejohn, 2007). Bennett *et al*. (2007, p. 52) use the term "*learning design*" and explain it as "*a communication mechanism to document and share 'good practice' for teaching and learning*". Oliver *et al*., (2002) state that researchers are exploring ways of categorizing learning designs with the view to make them easily reusable to teachers and educators with limited knowledge on how to use these resources to their best effect. Thus, where properly informed by research, learning design (as a product) could become a repository of teaching and learning resources to be shared, adapted for reuse among learning designers (Agostinho *et al*., 2009).

The focus of this section is on the *process* aspect of learning design. I address under this section the theory of situated cognition, preferred learning styles, multiple intelligences, and theories of behaviour change.

Situated cognition theory

The first theory used to underpin this design was *situated cognition* (Lave & Wenger, 1991). Collins & Brown (1988, p. 2) define situated cognition as "… *the learning of knowledge and skills in contexts that reflect the way the knowledge will be useful in real life*". Two key premises of situated cognition are *authentic context* and *cognitive apprenticeship* and these terms need to be clarified before I provide a pedagogical viewpoint for their adoption.

The environment in which learning occurs, according to proponents of the theory (e.g. Collins, 1988; Greeno, 1993) should be authentic, i.e. should reflect the way knowledge is used in real life. This criterion is met in the programme developed for this study because students use this package as part of their tutorials to help them engage effectively with course topics in the biological sciences.

The second aspect of the situated cognition concept is cognitive apprenticeship. This involves the notion of the learner as an apprentice, gradually being introduced into the "culture of practice". The learner is first seen as an observer at the boundary or periphery of the practice, until he or she is fully immersed in the culture of the group, having acquired the skills and knowledge to become a fully functioning agent (Lave & Wenger, 1991). In the context of this study my aim was to engage the students as scholars learning the skills, knowledge and attitudes of successful academics as they worked through the various sections of *Bioskills*. My use of this theory served to stress the situatedness of all learning activities students engaged in, and the close relationships between affective, cognitive, and behavioural factors in the learning environment. It was important to me as an educator that students using the programme would be exposed to “applied knowledge” – knowledge and skills which could be transferred into other courses or topics.

Herrington & Oliver (2000) identified critical elements of a situated learning environment (Table 5.3) and recommended guidelines shown in Table 5.3 for their implementation within a multimedia programme. These guidelines were adopted and used in the design of *Bioskills*

Preferred learning styles and multiple intelligences

The second set of theories used to underpin the design of the learning materials explored *preferred learning styles* and *multiple intelligences*. These two theories are discussed under one section because research (see Nolen, 2003) suggests they are intrinsically linked.

Learning styles

Learning styles denote preferences and characteristics to do with learning that distinguish one individual learner from another (Prescott, 2001) and there are many models in use (Coffield, Moseley, Hall & Ecclestone, 2004). I focussed on the model of Felder & Silverman (1988) which is cited as comprehensive and more suited to university level students (Constant, 1997; Alumran, 2008).

In a later paper explaining the earlier model Felder & Solomon (1991) classified learners’ styles on four different aspects of learning each measured along a continuum. These included the active versus reflective; sensing versus intuitive; visual versus verbal; and sequential versus global learning styles. Some of the learning style preferences associated with each of these (Felder & Solomon, 1991) are summarized in the following text.

Active learners tend to understand information best if they actively do something to learn it.
Reflective learners tend to like to think quietly about things.

Sensing learners tend to like learning facts, and do not like courses with no connection to the real world.
Intuitive learners are imaginative; prefer looking at relationships and discovering possibilities.

Visual learners tend to remember best when they see diagrams, pictures, flow charts and concept maps.
Verbal learners tend to prefer information as words.

Sequential learners like to hear about things in sequential steps.
Global learners tend to learn in large jumps, and make meaning once they understand the bigger picture.

The understanding of learners’ preferences and consideration of these styles in the development of learning materials can help educators develop more effective teaching and learning strategies (Prescott, 2001; Nolen, 2003). Zywno & Waalen (2002) and Rushby (2007) claim the use of appropriate teaching approaches is more likely to be effective because learners with a preferred learning styles will find certain approaches more comfortable and easier to learn from.

Table 5.3 Elements of situated cognition and their implementation in *Bioskills* (based on Herrington & Oliver, 2000)

Elements of situated learning	Guidelines for design of learning environment	Implementation of guidelines in *Bioskills*
Authentic context	Provide an environment which reflects the way the knowledge will ultimately be used (Resnick, 1987; Collins, 1988; Brown, Collins & Duguid, 1989; Jonassen, 1991).	• Visuals illustrating the academic context within which students work. (e.g. lecture room scenes, documents, video clips of tutorial and lectures in session) were provided. • Appropriate work-habits from successful students and from lecturers were presented. • Real life scenarios of academic work, and pass rates of students, were presented to encourage self-reflection.
Authentic activities	Provide activities which have real-world relevance for programme user (Resnick, 1987; Brown *et al*., 1989).	• Activities mirroring the kind of challenges students face were designed for learners to engage with. • Students were required to think and reflect on various attitudes, work-habits and their modifications, in order to complete these exercises and activities. Students were engaged in activities such as setting long term and short term goals, preparing "weekly to-do lists", and monitoring their achievement of goals in the semester. • Students investigated their locus of control through a self-report.
Multiple roles and perspectives	Provide different perspectives on the topics from various points of view (Collins Brown & Newman., 1989; Lave & Wenger, 1991).	• Different perspectives on strategies needed for academic success were obtained from lecturers, top-performing students and the research literature. These were presented in PowerPoint with text to raise students' awareness. • Students' perspectives were also solicited through questionnaires to reinforce the relevance and importance of such perspectives. PowerPoint presentations about what research says about external and internal locus of control and its effect on learning were provided.
Coaching, scaffolding and fading of instructional support	Provide coaching and scaffolding at critical times, fading instructional support gradually (Resnick, 1987; Collins, 1988).	• *Bioskills* had activities designed to provide coaching on tasks such as goal setting, planning for the week's lectures and assistance provided The level at which these techniques was taught was reduced as students "mastered" the techniques later in the programme, as shown in section 6, "Taking action". • An e-mail facility was set up to receive and answer queries from students.
Reflection and abstraction	Provide opportunities for students to return to any module of the programme (if necessary) to reflect on materials read (Collins & Brown, 1988).	• Navigation in the programme allowed students, after becoming familiar with it, to return to any element of their choice.

Using the Felder & Silverman model researchers have found that students' preferred learning styles, for example in science and engineering, tend to differ depending on the country and cultural background of the students (Constant, 1997; De Vita, 2001; 2002). Sanders & Vally (2009, p. 528), in a study conducted at our university involving the same student group targeted by my research, found that although a large percentage of students (between 45% and 65% depending on which continuum was looked at) had learning styles not "*radically associated"* with any one type of style, there were others with learning styles close to one or other end of a continuum. For example, out of the class of first-year biology students (n=294) almost half (46%) were found to be moderately to strongly visual learners, and only about four percent were verbal learners. They found 43% were moderately to strongly sequential learners and fewer than 10% percent were global learners; sensory learners made up 41% of the group, and about 10% being intuitive learners; moderately to strongly active learners and reflective learners each made up about 20% of the continuum (Sanders & Vally, 2009).

The students in the study reported by Sanders & Vally (2009) were from the same department as those in my study, and the results suggested that if the trend continued and were typical of this group in future years a large proportion of the students I was targeting would probably be visual learners. This overview of the possible preferred learning styles of my target population reinforced my desire to include strategies that would accommodate the envisaged large group of visual and sequential learners by providing diagrams, pictures and linear structure to the information presented. In essence, it was important that the individual preferences exhibited by learners through their learning styles were accommodated, as recommended by Desmarais, Laurier & Renie (1998).

Multiple intelligences

A theory that has teaching implications relating to the variety of learning styles is Gardner's *theory of multiple intelligences* (Gardner, 1983; 1993). Gardner recognized at least eight intellectual capacities of learners, which included *linguistic, musical, logical-mathematical, spatial, bodily-kinesthetic, interpersonal, intrapersonal intelligences,* and *naturalist intelligence.* The multiple intelligence theory posits that individuals can display traits of strength or weakness for each of the eight intelligences (Klein, 2003) and good teachers are known to adjust their instructional strategies in order to accommodate individual students' needs (Nolen, 2003). These intelligences had implications for the development of *Bioskills* although not all could be fully explored in the package development. For example, whilst the major part of the programme was presented with words, which engaged individuals' linguistic intelligences, provision was made to engage the logical-mathematical intelligences, although to a limited extent, using graphs and other reasoning tasks.

The three concepts of *learning approaches, multiple intelligences* and *preferred learning styles* are often confused. Whilst there are some links they are different. Multiple intelligences theory refers to what people are good at (their abilities). Preferred learning styles refers to a favoured way of receiving information or learning it. It is not always possible in educational situations to accommodate the preferred learning styles of all students (Nolen, 2003). Learning approaches deal with behaviours students use in a learning environment. In the design of my package I tried to accommodate the expected range of intelligences and learning styles, but did not address the learning approaches in the package.

Behavioural change: conceptual framework for modifying attitudes and work-habits (behaviours) of students

Many of the academic problems of "at-risk" students (discussed in Chapter 1) are attitudinal, or behaviour-related. In my attempt to understand the causes and to find possible solutions to the attitudinal and behaviour-related problems, the literature on psychological theories on how to influence individuals' behaviour was explored.

Two theories, the theory of planned behaviour (Ajzen & Madden, 1986) and the transtheoretical model of behaviour change (Prochaska & DiClemente, 1983; Prochaska, DiClemente & Norcross, 1992; Prochaska & Velicer, 1997), were used as the conceptual framework to explore ways to understand students' attitudes and behaviours, and by so doing offer suggestions for modifying inappropriate attitudes and academic behaviours. The theory of planned behaviour suggests that a number of factors, both personal and of external origin, interact to influence behaviour, whilst the transtheoretical model defines stages learners are likely to go through in order to adopt more appropriate behaviours. My reason for using the latter theory was to get students, after using the package, to adopt behaviours that were likely to improve academic performance. These two theories are discussed in turn, because they explain ways by which behaviour change could be achieved, an important focus of my research questions.

Theory of planned behaviour

The theory states that behaviour is a function of important information or beliefs relevant to that behaviour. Ajzen & Madden (1986) posit three kinds of beliefs (behavioural, normative, and control beliefs) which interact with and influence other constructs, as shown in Figure 5.2. *Behavioural beliefs* are the beliefs the individual has about the likely outcome of his or her behaviours and the intensity of such beliefs. *Normative beliefs* are those about how the individual esteems the approval or disapproval of important people of the community (or cultural grouping) in relation to the performance of the behaviour. C*ontrol beliefs* are the beliefs about internal and external factors which could influence the accomplishment of the behaviour (Ajzen & Madden, 1986).

As illustrated in Figure 5.2, *behavioural beliefs* influence *attitudes* towards a behaviour (the degree to which a person has favourable or unfavourable feelings to the behaviour being investigated). *Normative beliefs* influence *subjective norms* (or the social pressures and influences), which in turn affect whether or not individuals perform the behaviour. *Control beliefs* are held to underlie *perceived behavioural control* (the degree to which the individual believes he/she can control the performance of the behaviour).

Beliefs, as shown in the figure overleaf, provide the basis for the formation of attitudes, subjective norms and perceived behavioural control. In general, the more favourable or positive the attitude and subjective norm, and the greater the perceived behavioural control, the stronger the person's intention to perform the behaviour (Ajzen, 1991). Pajares (1992) noted, as mentioned on page 42, that academic beliefs can strongly influence perceptions and behaviour.

Individuals do not always have complete control to perform a behaviour (Ajzen & Madden, 1986); external factors may prevent it and this is explained by the theory. Two pathways of planned behaviour operate under two distinct conditions are described by Ajzen & Madden (1986).

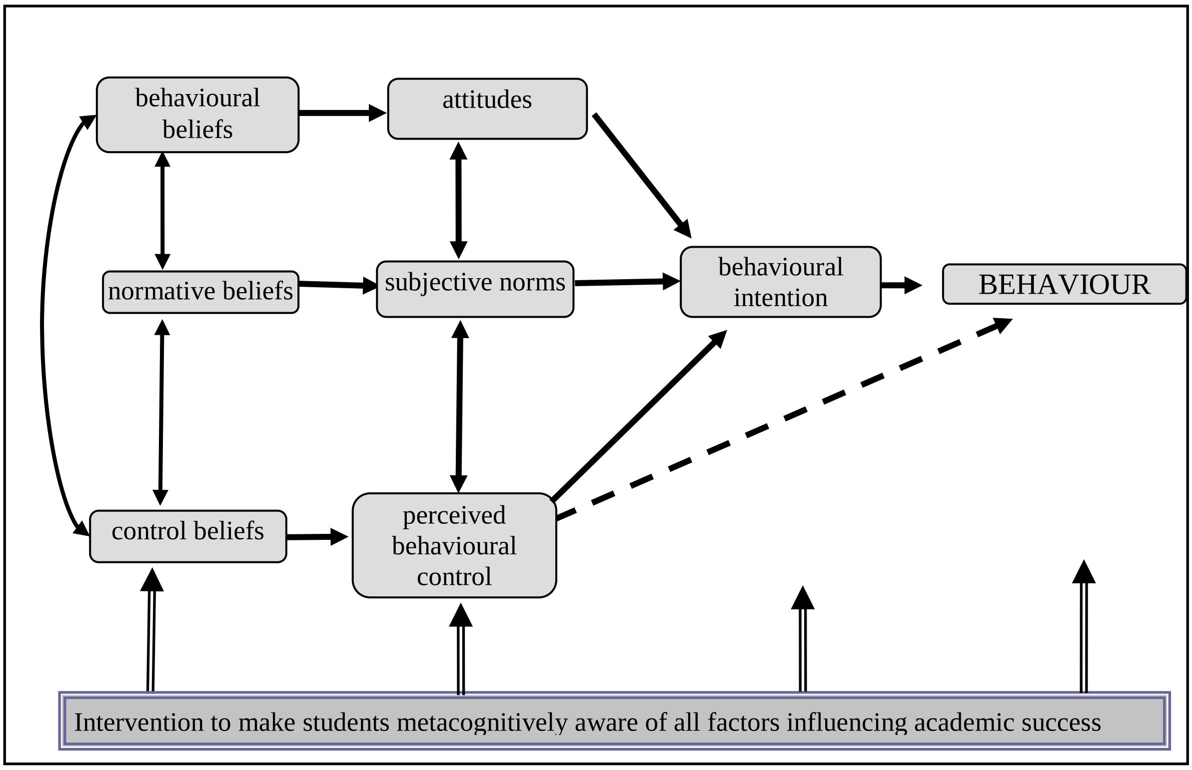


Figure 5.2 The relationships among factors that predict academic behaviour (based on the theory of planned behaviour - Ajzen & Madden, 1986)

Under conditions of complete volitional control[58] Ajzen & Madden (1986) point out that the immediate determinant of behaviour is the *behavioural intention*, which is the individual's intention to perform or not to perform that behaviour. Where behaviours are not under complete volitional control, behavioural intention does not come into play, instead *perceived behavioural control* [and its path shown by the dotted line in Figure 5.2], is believed to exert a direct influence on the behaviour displayed and in the attainment of behavioural goals.

Ajzen (1991) illustrates the interplay of the two scenarios in the following example where he points out that students, in their attempt to get high marks in their courses, often set behavioural goals or intentions, and make use of various behaviours to achieve them. Ajzen (1991) points out that students who get high marks, especially in difficult courses, may have to deal with situations over which they have partial control. In such circumstances, the students' perceived behavioural control and actual behavioural control must be very high for them to be very successful (Ajzen, 1991).

Some distinctions must be made to clarify the *perceived behavioural control* construct in this chapter. Ajzen (1991) claims that the construct resonates more with self-efficacy and achievement motivation than with locus of control in the prediction of intentions and actions. Ajzen (1991) states:

> *Whereas locus of control is a generalized expectancy that remains stable across situations and forms of actions, perceived behavioural control can, and usually*

[58] Volitional control implies the person can decide at will to perform or not to perform the behaviour.

> *does, vary across situations and actions. Thus, a person may believe that, in general, her outcomes are determined by her own behaviour (internal locus of control), yet at the same time she may also believe that her chances of becoming a commercial airplane pilot are very slim (low perceived behavioural control). .... Much of our knowledge about the role of perceived behavioural control comes from the systematic research program of Bandura and his associates…. These investigations have shown that people's behaviour is strongly influenced by their confidence in their ability to perform".* (Ajzen, 1991, p. 183-184)

Although the theory of planned behaviour identifies factors that influence behaviour, it does not describe how messages can be designed to influence behaviour.

Designing instructional messages to influence behaviour

Petty & Cacioppo (1981) point to the importance of instructors elaborating on instruction presented in order encourage favourable thoughts from the recipient of the instruction and promote positive attitude changes. Petty & Cacioppo (1981) and Koballa & Shrigley (1983) list the following two factors which should be considered when designing messages to influence behaviour: the *source of the communication,* and *message factors.*

- The source of the communication. Petty & Cacioppo (1981) found that the source of communication influences attitude change when the message comes from "important others" rather than from "less powerful others". In this package, the 'important others' were lecturers, and Honours students who, from my experience, are held in high esteem by first-year students.
- Message factors. Petty & Cacioppo (1981) and Koballa & Shrigley (1983) report that powerful arguments in messages are more effective than weak arguments. Messages relevant to the recipient were also found to encourage recipients to think and process the information. In *Bioskills* the message was on how to achieve academic success, which was relevant to students at risk of failing.

  Repetition of messages, according to Petty & Cacioppo (1981), encourages more thinking about the message. They advise that the message should be comprehensible, to enhance its processing and linkage to the learners' schema. This repetition of messages was implemented in the package.

The transtheoretical model of behaviour change

The transtheoretical model of behaviour change (Prochaska & DiClemente, 1983), the second theory I used under behaviour change, is a model of intentional change that focuses on the decision-making abilities of the individual rather than other influences (Lenio, 2004). The model has been used extensively in promoting positive health-behaviour changes (e.g. Prochaska & Velicer, 1997; Marshall & Biddle, 2001) and also in modifying academic behaviour (e.g. Scholl, 2002).

The model describes how people modify a problem behaviour or acquire a positive behaviour by going through the stages of change (Prochaska *et al.*, 1992). Five consecutive stages are defined (*precontemplation, contemplation, preparation, action,* and *maintenance)* each of which describes individuals' attitude towards behaviour change, as indicated in Figure 5.3.

I adopted the tenets of the transtheoretical model of behaviour change to the university situation using my experiences as a teacher of students' behaviour, using as an example the strategies of Scholl (2002), who applied the model in the educational field. To do this, I identified a number of missing behaviours of many of the first-year students, as well as positive behaviours that would help students progress academically. Table 5.4 lists some of the "inappropriate academic behaviours" the study targeted and appropriate behaviours that were expected from students. The defining features of each stage and an elaboration of events related to each stage, which were face-validated by two educationists in the department, are discussed next.

Table 5.4 List of inappropriate academic behaviours, and the acceptable outcomes this study targeted

Inappropriate academic behaviours	Appropriate behaviours expected or targeted
Inadequate preparation for lectures and laboratory work	Planning a management strategy to create time for preparation
Not completing assignments on time	Working consistently to achieve set goals, completing work on time
Not taking the initiative to read and summarize notes and texts ahead of tests and examinations	Taking responsibility for their own learning and using those techniques that promote academic success. Testing themselves to be sure they know the material

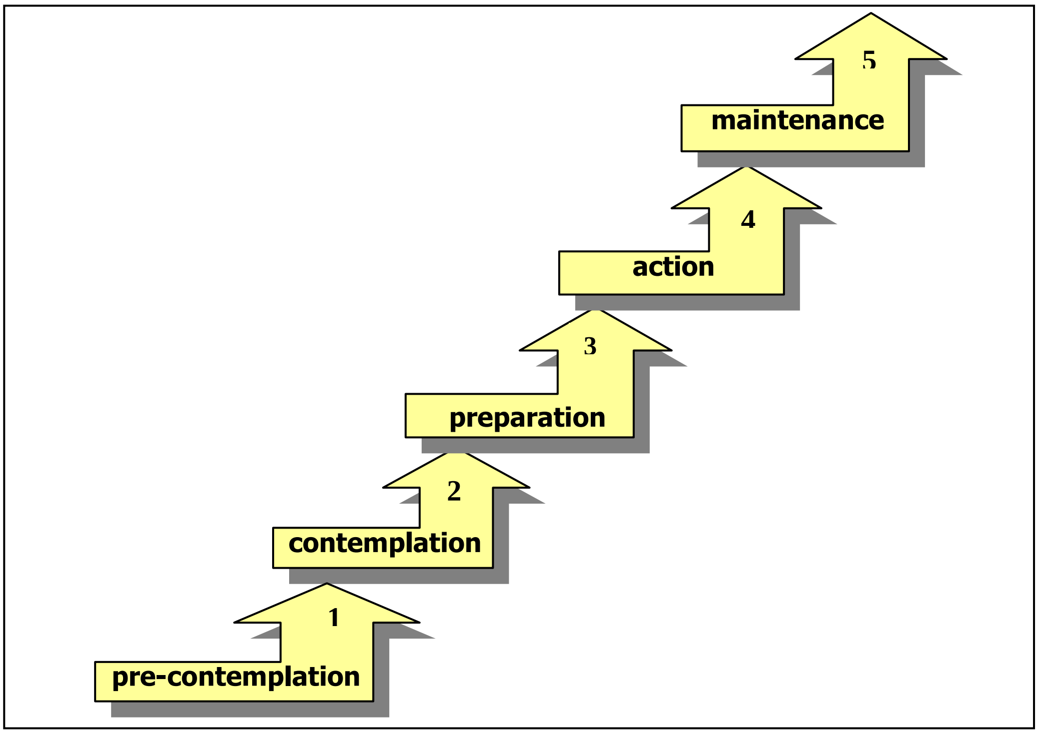


Figure 5.3 Schematic diagram of the stages in the transtheoretical model of behaviour change (based on Prochaska & DiClemente, 1983)

Defining features of each stage of change as applied to the educational setting

Stage 1: Precontemplation

By definition, individuals at this stage do not see problems with their academic behaviours and have no intention of taking action to modify them in the near future (Prochaska & DiClemente, 1983; Scholl, 2002).

At-risk students in this stage are generally in a "laid back" state due to the freedom they find at the university, which is very unlike secondary school. Students are not motivated to do more than read lecture notes; are not too sure what studying at university involves; and seem not to know why they are failing tests. Students tend to rely mostly on printed hand-outs and taking notes from lectures and do not read more widely. They fail to realize that they must process notes further, and prepare for lectures and practicals. They seem unconcerned about the effect of their behaviour on their academic performance, or tend not to have given much thought to the impact of their behaviour on their future at university.

Stage 2: Contemplation

The next stage is contemplation. The defining feature of this stage is that individuals are intending to make a change in their behaviour (Prochaska *et.al*., 1992; Prochaska & Velicer, 1997). According to Scholl (2002), in order for students to move out of the contemplation stage they must experience "cognitive dissonance[59]" and acknowledge the problem of inaction.

Students in the contemplation stage are aware that their academic behaviour patterns are below expectation. They realize that to be successful at the university requires a change in behaviour and attitudes. However, individuals at the contemplation stage often see a number of benefits in not changing their behaviour (Prochaska *&* DiClemente, 1983; Scholl, 2002). From my teaching experience, a number of students at this stage could also be involved in social or non-academic activities in a way that negatively influences the time spent on their work. Alternatively, they may not be applying appropriate academic behaviours to their studies. Given their perceived benefits of their social and non-academic activities, such students are not likely to bring themselves to take up the challenges posed by university life.

Stage 3: Preparation

The third stage of change is the preparation stage, defined by students planning to make a change in the manner they approach university work (Prochaska *et al,* 1992; Scholl**,** 2002). The defining features of students at this stage is acting on the desire to succeed at the university by planning to adopt new attitudes and behaviours that will help them to succeed, although as Prochaska *et al*. (1992) note individuals have not yet reached the stage for effective action.

Stage 4: Action

Students at this stage are characterized by observable changes in behaviour (Scholl, 2002). These include taking on a number of appropriate behaviours that make them very different from what they were before. For example, there could be some improvement in their studying patterns, such as increasing the hours of private study; preparing for lectures and labs; taking adequate notes at lectures and processing them afterward; and following a daily time-table. They also do additional reading, and do more than the minimum requirement for assignments.

[59] Conflict in the mind generated by new information that is contrary to that already held by an individual. This conflict or dissonance is often a major source of human motivation (Festinger, 1957).

Stage 5: Maintenance
Students at this stage work to prevent themselves reverting to their previous pattern of inappropriate behaviours (Scholl, 2002).

Students who have followed through the stages and are at stage 5 are characterized by observable changes in behaviour. They are proactive with their academic activities; use time management, reading, and laboratory preparation skills to save time. They, for example, set personal deadlines in order to meet course deadlines and are seen as determined to maintain the gains they have achieved. Scholl (2002) believes students who have adopted these academic behaviours should find such behaviours last beyond university.

The transtheoretical theory suggests students would use both external and internal influences to foster awareness to progress through the stages. According to Prochaska *et al.* (1992), it is first necessary for learners to understand and identify the stage they are in before a successful intervention can be designed and applied. This suggestion was implemented in the package designed (see Figure 5.9, page 123). Multiple strategies, rather than the use of a single strategy, are found to encourage students to move through the stages (Prochaska & DiClemente, 1983; Scholl, 2002). Prochaska & DiClemente (1983) advise that the learners should go through all stages sequentially rather than jump to the final one in order to pre-empt regressions of behaviour.

5.3 DEVELOPING THE *BIOSKILLS* INSTRUCTIONAL MODULES

5.3.1 Designing the storyboard

The first stage in the development of the package was the design of a paper-based storyboard. A storyboard, by definition, expresses all the content and resources needed for each screen: the text, the graphics, video and sound (Phillips & DiGiorgio, 1997). Sketches and drafts of portions of the storyboard were shown, in turn, to a research colleague and an expert instructional designer for comments on structure, layout and wording. These drafts of the storyboard were critiqued through an iterative process of design and review until the look, content and feel of the draft showed no obvious flaws in the view of the “expert” designer. This critiquing of the content was part of the continuing steps taken to improve the quality of the design.

5.3.2 Choosing the authoring software

Two software programmes, Quest for Windows, and WebCT, were trialed but discontinued, as challenges associated with their usage became evident. I discontinued using Quest due to its lack of HTML functionalities[60] as HTML became the preferred option for software design. WebCT was proprietary software with limited adaptability for the design of the storyboard. It supported the general university teaching activities such as delivery of course content, keeping track of students’ activities, and record keeping, and also had a chat room, but it did not support the interface design envisaged for

[60] Quest did not have web-based functionalities when I was learning to use it.

Bioskills. Dreamweaver had the necessary structure and the flexibility required, and was compatible with the Windows XP used in our computer laboratory, so became our preferred authoring software.

5.3.3 Developing the *Bioskills* software

Development is defined as the process of "*... translating into electronic form the content and structure of learning systems*" (in this context the storyboard) to create an educational programme (Phillips, 1997, p. 37). Resources such as graphics, sound and video clips were designed in readiness for use in the development of the package. Videos of authentic university life were captured and digitized. These included videos of student activities during the orientation week, and photo-shots of students at lectures and at laboratory sessions (see Figures 5.6 and 5.7).

These early electronic versions were first shown to the team of researchers for comments, and later to a sample of first-year students in an interview session, to establish if the screens of the prototype had the ideal look and feel to capture the attention of users. Four versions of the "Home page" and "Challenges of 'varsity life" sections were developed. The students' (n=11) responses to the questionnaire about the screen, in a small survey conducted by a colleague, showed preferences for pictures that were relevant and represented the racial mix at the university; with graphics brightly coloured, and mind maps in different colours. We, as designers, were more inclined to softer shades in blue and earth colours.

Sanders & Ayayee (1997), in an earlier study conducted with a large sample of first-year biology students (n=145) from the potential target group in the same institution, found that the colour preferences of designers were not always the preferred choices of the students. The study revealed that student-related preferences would need be considered in the design of computer programmes. It was therefore important to incorporate students' preferences into the *Bioskills* design. Phillips (1997) states that testing prototypes promptly in this way, as reported above, ensures that the design is continually refined and the optimum design standards obtained.

Developing the alpha version of the package

An outcome arising from the diagnostic phase of this study was the development of an intervention to raise awareness of factors influencing academic success. *Bioskills* has three main aims:

- to help raise students' awareness of appropriate attitudes, work-habits and metacognitive knowledge likely to improve academic success (according to research and theory)
- to help students identify factors in their lives, such as attitudes, behaviours and work-habits, that are likely to affect success.
- to suggest ways in which students can enhance their chances of success

The alpha version of *Bioskills* was developed based on suggestions from design experts, students and the research literature. The alpha version had only five of the six main sections and was without the Statscounter audit trail.

Figure 5.4 shows the basic format used in *Bioskills*, which uses the metaphor of index cards to structure the design. The main sections are indicated by a system of **tabs** along the top of the screen. The sub-sections are accessed by **links** down the left side of the screen. This choice of screen design, reported by Sanders & Fletcher (2003), facilitated greater ease of use, and allowed logical system of navigation.

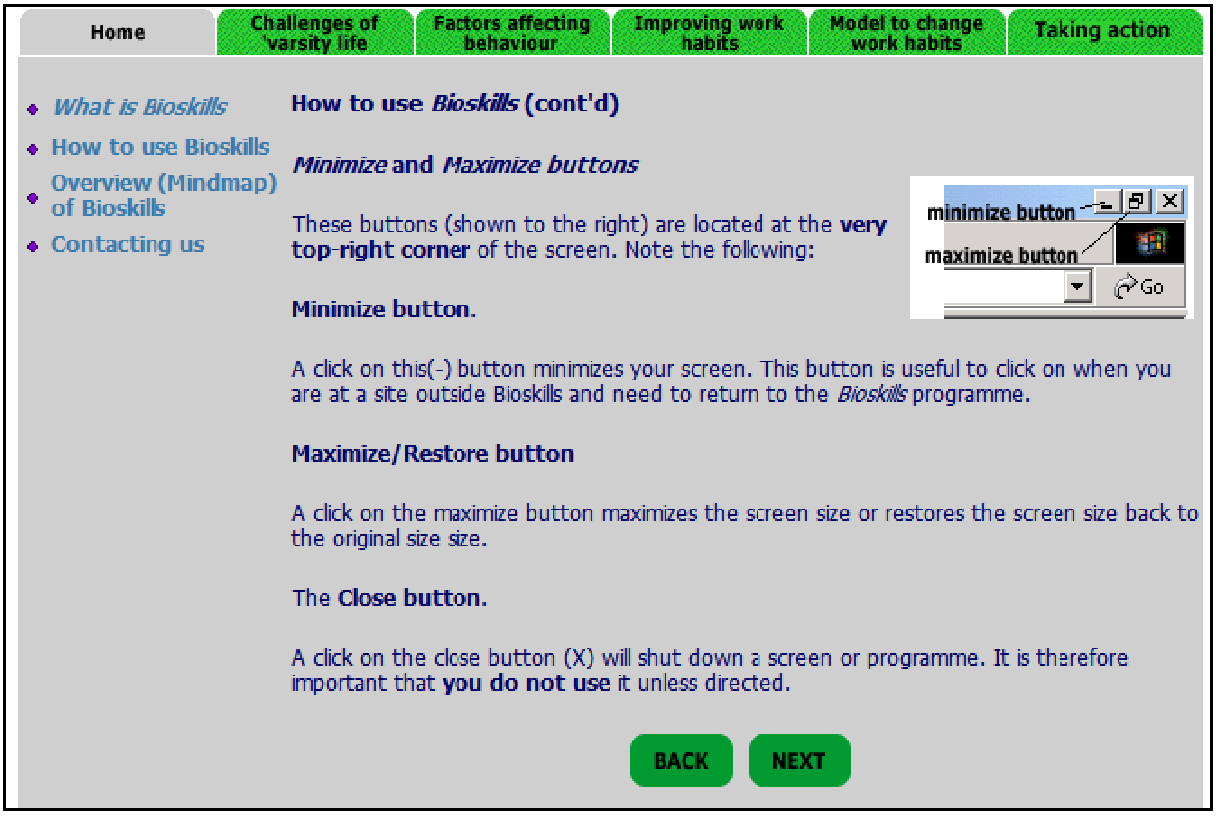


Figure 5.4 Home section of *Bioskills* showing tabs, buttons and navigational aids

Consistency of screen format, as advocated by designers (e.g. Reeves, 1994; Phillips & DiGiorgio, 1997), was adhered to in all screens except for those screens which utilized formats such as PDF and PowerPoint. The layout of each screen consisted of three columns and three rows.The first “row” was reserved for the tabs, the second the text and graphics, and the third for the navigational buttons. The second row of each screen, centrally placed, was reserved for the title to each screen. A title, as noted by Rouet & Potelle (2005) is a local cue, which helps readers to make sense of the underlining text.

The left column was for the sub-section template. Instructions were placed in the central column, and graphics (photographs and videos) on the right. Navigation buttons[62] (BACK or NEXT) were positioned at the bottom “row” of the screen for users to proceed or return to the previous screen. This navigational scheme, as discussed earlier on page 111, was essentially hierarchically structured, as advised by Phillips & DiGiorgio (1997), but afforded logical sequential movement across screens.

[62] There were two navigational schemes one at the top of the screen, and the other at the bottom of the screen in this alpha version. Students were told to use the navigation at the bottom of the screen.

Other navigational guidelines and cognitive tools used in the development of the screens are summarized in Table 5.5

Font use was consistent throughout the programme. Graphics that were appropriate and represented the broad cultural perspectives of the university were used, as suggested during the formative evaluation about colour preferences of the target group (Sanders & Ayayee, 1997). Sound clips, whilst important as a motivational aid were used minimally as students had suggested that without headphones, and each student playing their sound tracks could be disruptive to teaching and learning (N. Linkonyane, personal communication, October 2002). Table 5.6 describes the content of each section and sub-section of *Bioskills* and the goals each sought to achieve.

Table 5.5 Navigational guidelines from the literature and their application in *Bioskills*

Items	Guidelines and reasons	Application in *Bioskills*
Mind maps	Provide visual overview of the contents of the project (Sanders & Fletcher, 2003). This provides a representation of the global content and helps readers make sense of text.	A spider diagram format was used to construct the visual overview of the contents of Bioskills. This was the preferred choice of the students from the School in an earlier study (Sanders & Fletcher, 2003).
Navigational buttons	Provide navigational buttons at same place of each screen. This facilitates easy navigation through the package (Rouet & Potelle, 2005).	Button was always at the bottom of screen to take the navigator forward or backwards.
Colour changes	Indicate access/exit from screen with colour changes of navigational buttons. This helps to give an indication of where users are in programme.	A hyperlink which changed colour when the page was accessed was used to designate screens already visited. Dreamweaver, by default, had access and exit colour codes which in *Bioskills* was bold font, and exit a lighter colour .
Hotspots	Provide hotspots from images to other web pages. Hotspots are links from images on a webpage to another web page (Phillips, 1997).	They were used, for example in the “Stages of behaviour change” section (see Figure 5.9) and in the design of the mind maps to provide links.
Hyperlinks	Provide hyperlinks to access external and internal sites. These non-linear links help users to navigate information screens, by selecting links based on their needs or interest (Rouet & Potelle, 2005).	Internal and external hyperlinks were used to provide links to hypertexts in the package and to external web sites (e.g. Virginnia Polytechnic Institute and State University, Web survey of Locus of Control).
Color coding	Provide consistent colour schemes for screens (Phillips & DiGiorgio, 1997).	Each section had a grey background. The tabs to each section were green. Areas that needed to be emphasized were either in red or in bold.

Figure 5.5 shows the visual overview of the content of *Bioskills*. Although not provided in this version, each topic and sub-topic could be made a hotspot which, when clicked on, could take users to desired links. Figures 5.6 and 5.7 illustrate the tone of text, which was aimed at getting students motivated using images from an authentic context displaying real life scenarios of the university’s academic life.

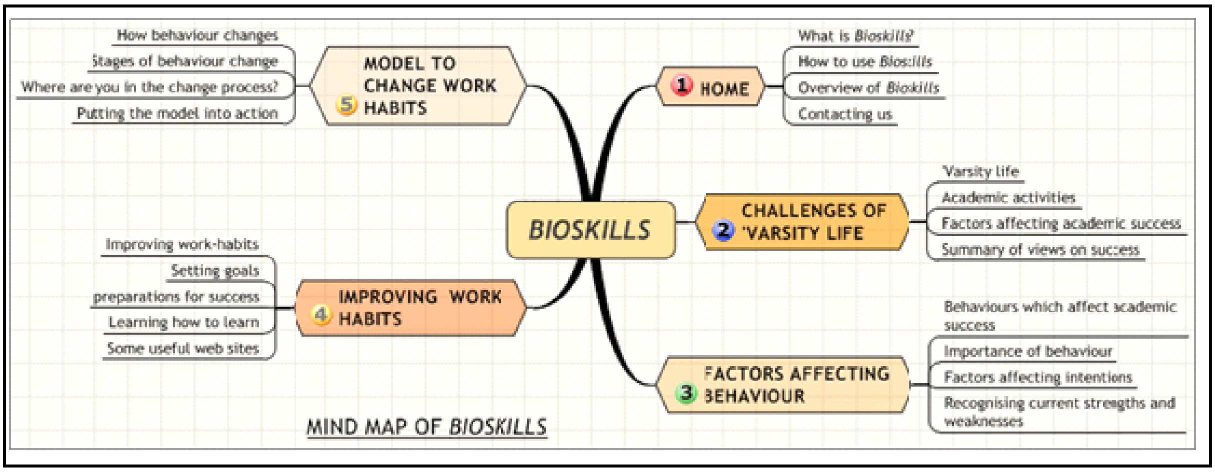


Figure 5.5 Mind map of the initial five sections of *Bioskills*

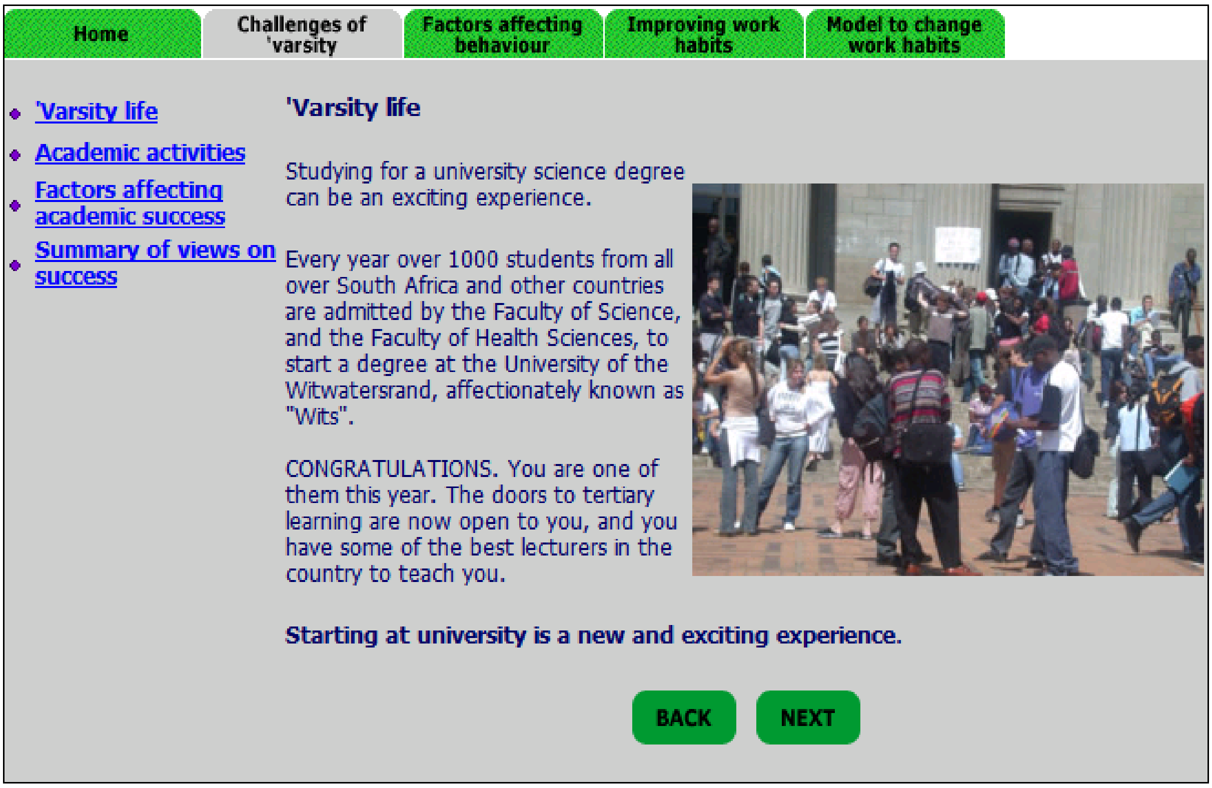


Figure 5.6 Screen from *Bioskills* highlighting the tone and relevant graphics used to create authentic context and motivate students

Table 5.6 Main features of the sections in *Bioskills,* with the instructional tasks and aims

Sections	Titles of sub-sections	Content covered and tasks included	Designer's aims
Home page	*What is Bioskills?* *How to use Bioskills* *Introduction to the navigation used in the programme* *Overview (mind-map) of the programme* *Contacting the programme developers*	Introduces layout of the screen, and various devices used to promote easy navigation across screens (*minimize* and *maximize*, *next* and *back* buttons) hypertexts (see Fig 5.4).	• Students should get a better understanding of what the programme is about. • Students should be better equipped to navigate through the programme successfully.
Challenges of 'varsity life	*'Varsity life* *Academic activities* *Factors affecting academic success* *Summary of views on success*	• Introduces student to 'varsity life, and the advantages of being at 'varsity (see Fig 5.6). • Introduces students to various social and academic activities. • Includes a discussion of pass rates and how various student activities impact on them.	• Students should become aware of the academic demands of the university, • Factors affecting academic success are brought to students' attention.. • Balanced approach to social and academic activities recommended
Factors affecting behaviours	*Behaviours which affect academic success* *The importance of behaviour* *Factors affecting intentions* *Recognising students' current strengths and weaknesses*	• Set of questions to help students examine antecedents of learning behaviours. • Exercise on students' attitudes, beliefs and subjective norms. • Internal or external locus of control, work at the university and locus of control survey. • Influence of perceived locus of control and performance.	• Students should experience an increased awareness of how academic work is influenced by individuals' beliefs and intentions. • Students should be able to reflect on the relationship between attitudes, beliefs, subjective norms and academic success. • Students should be able to compute their locus of control score and reflect on its implications.
Improving work-habits	*Improving work-habits* *Setting goals to improve work-habits* *Preparations for success* *Learning how to learn* *Some useful web sites* *Tasks on what to do to achieve success*	• A review of important work-habits. • Exercise on setting long-term and short-term goals, work-habits (see Fig 5.8). • Learning how to learn. • Time management, processing information. • Preparing for lectures, practicals, and tests. • Forming learning groups.	• Students should be able to set properly worded short-term and long-term goals, and adhere to them • Students should be able to identify their typical work-habits and reflect on the effects these have on their studies. • Students should be able to prepare for lectures, labs and tests and be motivated to use the guidelines given in subsequent preparations.
Model to change work-habits	*How behaviour changes* *Stages of behaviour change* *Where are you in the change process?* *Final word* *Putting the model into action*	• Setting of goals; motivation to achieve goals. • Self-identification of (possible) stages users have reached according to the transtheoretical model of behaviour change (see Figure 5.9) .	• Students should have increased awareness of the importance of goals, and how to set achievable goals. • Students should be able to determine the "stage of change" they are at and take steps to improve on their academic behaviours.
Taking action to change behaviour	*Further application of the principles of Prochaska et al. (1992) to studies at 'varsity*	Activity-based worksheet and tutorial exercises based on topics for the forthcoming term.	Student should have 'hands-on' and 'minds-on' engagement with Block 3 requirements

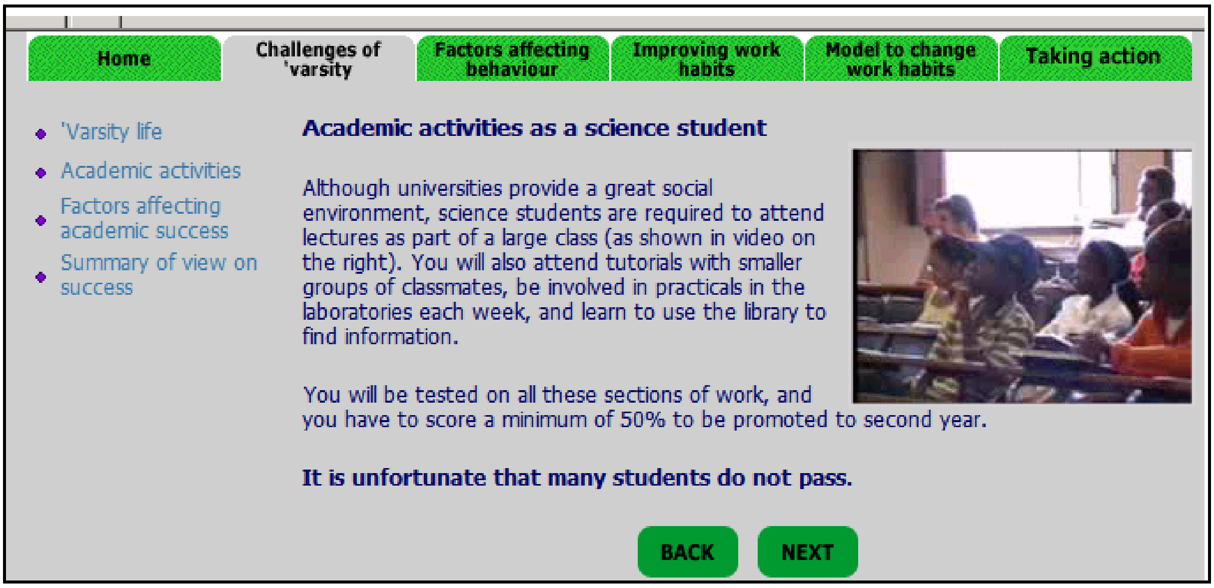


Figure 5.7 A video clip in a screen from *Bioskills* highlighting an authentic classroom context and used to motivate students

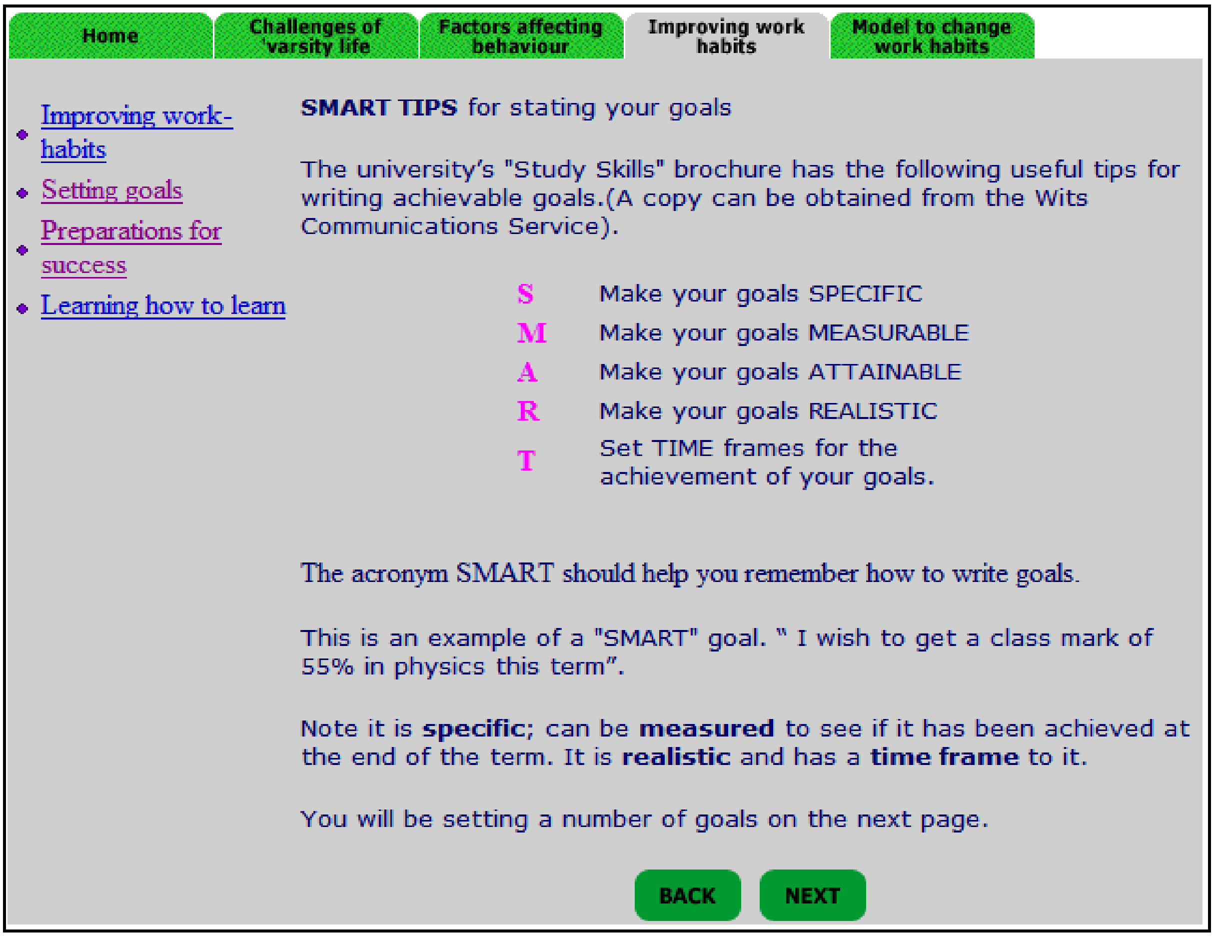


Figure 5.8 Screen from *Bioskills* showing students how goals are set

Web hosting and technical support

Internet Information Server, a software package for local server testing, was installed on the computer. MySQL, a software database, was downloaded to store all the data to be captured from students' usage of the package. The *Bioskills* programme was hosted on a sub-domain server that supported Active Server Pages and FTP provided by the Central Network Services of the university. It was envisaged to be made available to all students who had expressed interest to use the programme both during school hours and after school hours. I sought and obtained permission from the Head of the School in order to be allowed to host the programme on the university's host domain.

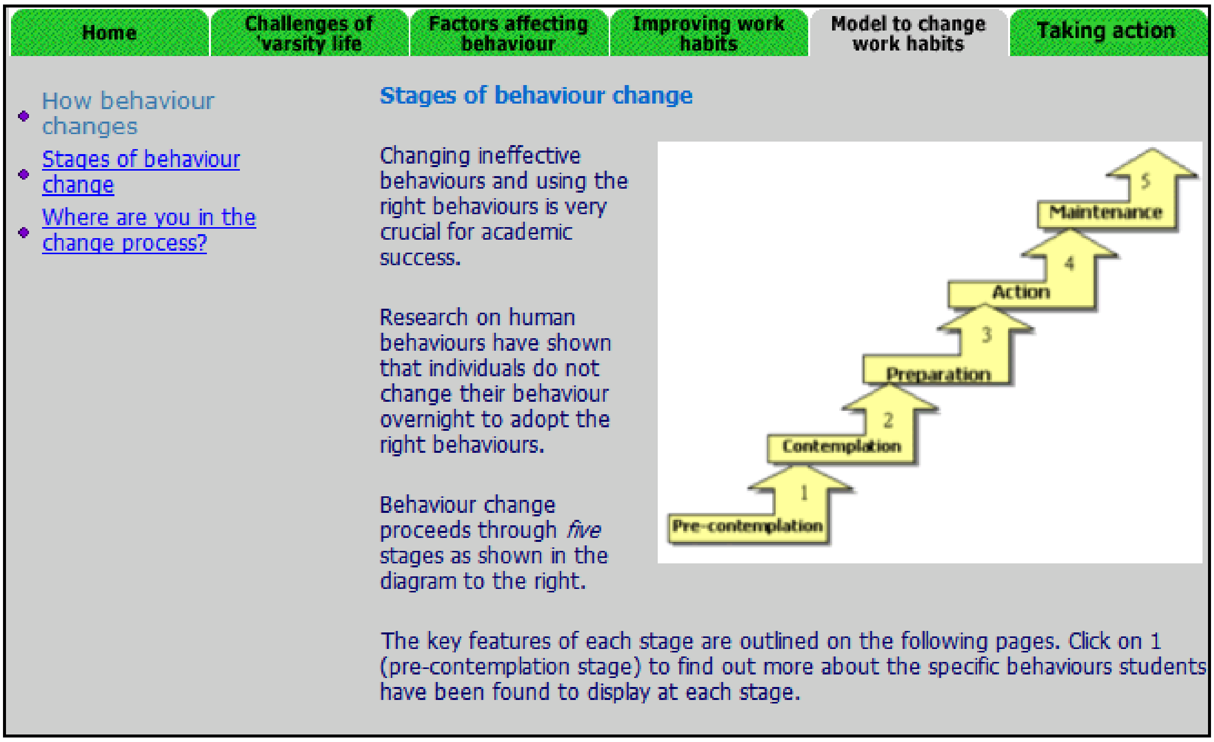


Figure 5.9 Diagram showing portions of how the transtheoretical theory was implemented in *Bioskills*

5.4 PURPOSE OF THE THERAPEUTIC PHASE

Having discussed the theory underlining the design of the package, and how the package was developed, I now detail how the usage of the package was investigated. As mentioned at the start of this chapter, the purpose of the therapeutic phase was to design, develop, and investigate the use of a computer-based instructional programme which had as its focus the factors identified in the diagnostic phase of the study. Although an instructional module was developed as part of this study, it needs to be mentioned that in this university the design of instructional modules is not considered to be research. It is the investigation done using the intervention that is important for research purposes.

It is necessary to clarify the term "evaluation" because it has a number of connotations, one of which is to assign a value or a judgement of merit (Thornton & Phillips, 1997). Within the multimedia context, the term 'evaluation', as noted by Thornton & Phillips (1997, p. 128) can also involve answering "*… the many questions that arise during the development and implementation of the IMM software*", that is, for formative evaluation. This explanation of evaluation forms the basis of the investigation reported in this section of the study. The “many questions” to be addressed in the therapeutic phase were the research questions (listed in the following section) and questions within the research instruments. Research questions 1 and 2 have already been addressed in the diagnostic phase. Research questions 3 and 4 for the therapeutic phase are addressed in Chapter 6.

5.5 RESEARCH DESIGN FOR THE THERAPEUTIC PHASE

Cohen *et al.* (2000) suggest that if research is to have momentum and purpose it should have a clear plan of action - the research design. In this section of the study the computer package *Bioskills* was used by a volunteer group of students, and their reactions to the computer package were investigated using research questions 3 and 4 to direct the investigation. Their responses are reported in Chapter 6. Figure 5.10 shows a flow chart of the research plan of the therapeutic phase. The shaded boxes indicate the major research-related stages of the study. The unshaded boxes with straight corners represent the instruments used, and the rest the sample which took part in the study.

The research design started with a three-pronged literature review of the salient factors that should be incorporated into the instruments to be used, and the design and content of the instructional package. The review of the literature led to the design of the storyboard, the content of which was translated into the development of the trial versions of the package. The final package was evaluated in two stages using results from instruments designed for the purpose. The instruments used in this phase of the study were questionnaires and interview schedules. Questionnaires and interview schedules as data-gathering strategies in general have been discussed in Chapter 4. The results from the data-gathering instruments administered in the therapeutic phase of the study are discussed in this chapter and the subsequent chapters. The instruments administered, students and lecturers who used them, and the period of time from the formative evaluation week are indicated in Table 5.7.

Table 5.7 Instruments, time administered, and participants in the formative evaluation and investigation of effectiveness stages of the study

Time frame	Version	Instrument	Participants
Formative evaluation (experts)			
Weeks 1-5	Alpha version	Paper-based questionnaire “Your views about *Bioskills”* (Appendix D1, and Appendix D2)	Lecturers (n= 4) CAL experts (n=2)
Formative evaluation (students)			
Week 1	Alpha version	Paper-based questionnaire ‘Tell us what you think about *Bioskills’* (Appendix E1).	CoS students (n=61)
Week 1	Alpha version	Paper-based questionnaire ‘My observations about the screens of *Bioskills’* (Appendix E2)	CoS students (n= 36)
	Alpha version (with some corrections)		CoS students (n=25)
Week 3	Beta version	Paper-based questionnaire “Tell us what you learnt from *Bioskills*.” (Appendix F)	CoS students (n =22)
Week 16	Final version	Paper-based questionnaire “*Bioskills* & you” (Appendix J).	ILS students (n= 8)
Investigation of effectiveness			
Week 23	Final version	Semi-structured interview schedule	ILS students (n= 8)
Following academic year Week 1	Final version	Paper-based questionnaire “Tell us what you learnt from *Bioskills*.” (Appendix F)	CoS students (n=53)

CoS = College of Science ILS = Introductory Life Sciences CAL = Computer-Assisted Learning

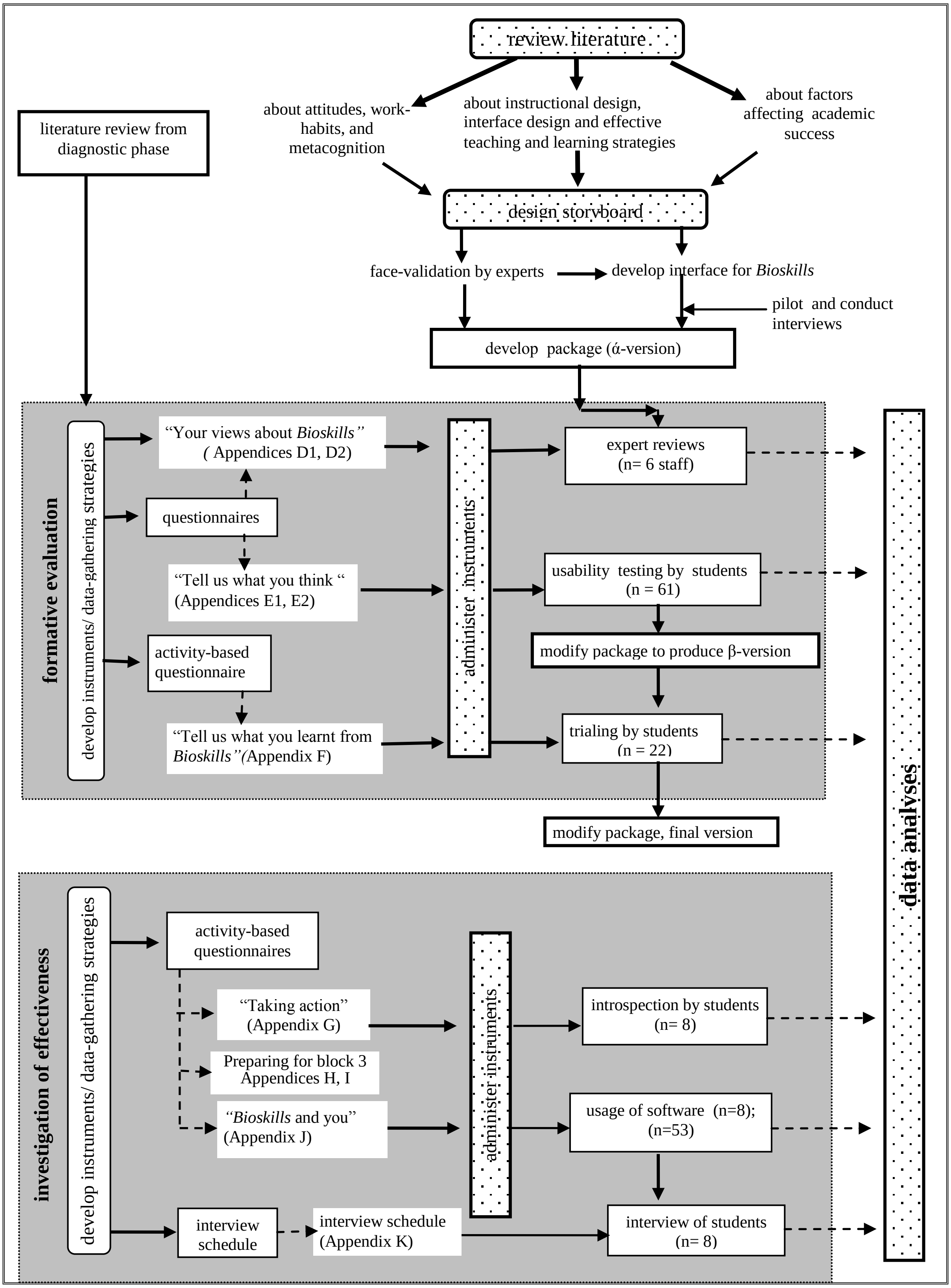


Figure 5.10 Flow chart of the research plan for the therapeutic phase

The reader should note that Table 5.7 has two sub-sections: the upper being that for formative evaluation and the lower section investigation of the effectiveness, which took place in the third block, from week 23 onwards. Appendices D-K (pages 262-301) contain all the instruments for both formative evaluation and the effectiveness investigation indicated in Figure 5.10. The rest of this chapter reports on the "usability" aspects of the formative evaluation. The educational effectiveness of *Bioskills* are reported in Chapter 6.

5.6 FORMATIVE EVALUATION OF *BIOSKILLS*

Thornton & Phillips (1997) explain formative evaluation of multimedia design as a series of techniques and strategies used to answer questions about whether users can use the programme, and what improvements can be made to both the process and product before the final version is released. According to Thornton & Phillips (1997, p. 137), during the process a number of techniques such as expert reviews, automatic data collection, usability testing, observation of users, and interviews can be used to "*provide a rich source of data about what users think and feel about the interface and design".* Two of the five data-gathering strategies or techniques mentioned above were used to a greater extent than the others in the formative evaluation of the package, and are discussed here.

5.6.1 Expert review

The purpose was to seek the views of experts on aspects of the package development in order to enhance the product, as recommended by Reeves & Hedburg (2003). Reeves & Hedburg (2003) point out that different experts come with unique kinds of information. They could assess the accuracy of content (content matter experts), evaluate pedagogical dimensions (instructional design experts) or provide information on logistics (teachers and trainers). A key advantage of using experts to contribute data on the package review, as noted by Thornton & Phillips (1997, p. 138), is that they identify problems, and "*offer advice on how to resolve them*". It was important to use different experts to comment on the programme.

The experts I chose for the review were six lecturers in the biological sciences who were involved in teaching these students, and who could make appropriate inputs into the content and design of the package. Two of the experts (Experts D and F), in addition to their background in biology, were also instructional designers, whilst Experts A, B, C, and E were lecturers with years of experience in teaching first-year biology students. They were asked to comment on the alpha version of the programme in terms of both instructional and graphic design, and to suggest improvements.

Questionnaire for expert reviewers

A paper-based questionnaire was designed to be used as they worked through the package (see Appendix D2). Each user had a user name and password assigned to them. A printed version of all the screens was provided for their comments.[63] The instrument had sections for comments and

[63] This is Appendix D1 and due to its size it is not appended to the appendices, but can be viewed at http://146.141.47.24/bioskills

suggestions on the interface design, navigation, cognitive load, and the extent to which experts perceived the package achieved goals mentioned in Section 5.6.1.

The instructions were detailed on the questionnaire. Each expert was asked first to read through the questionnaire to familiarize themselves with the questions I wanted them to address later on. They were then to work through *Bioskills* as would a student, but using their insight as educators. It was suggested that they could review the package in phases so they did not get tired.

Results of the expert review: Experts comments and opinions

The comment from the experts on interface design, navigation and cognitive load contribute part of the "results" for my study, so one would expect to find them in a "results" chapter. However, they are discussed in this chapter as they were used in the further development of the beta version of the package. Although all six experts returned written comments on the hard copies of the package they were given, only four of them returned the questionnaire. These four experts included one expert designer and three education experts. The questions for the reviewers (n=4), and the feedback obtained from them about the content of the programme (n=6), and the subsequent action taken to modify *Bioskills* are summarized in Tables 5.8 to Table 5.11.

Table 5.8 Instructions, feedback and comments from experts during formative evaluation, and resulting modification: Screen design

	Reviewers' feedback	**Resulting action for *Bioskills***
Instruction: Please examine the screen design elements, and comment on the extent to which you think the features listed below have been addressed in the programme in order to make the text legible.		
Font size colours	*Font of top buttons nice, but text a bit small, increase font size.* (Ex B) *Font size fine in the text.* (Ex A) *Fonts in main text body are ok for size on my 21" monitor –might not be on a smaller monitor.* (Ex D) *Legible, but a slightly bigger font is needed.* (Ex C) Log-in page *nice professional look.* (Ex E) *Red on green (button at bottom) is a bad idea. Some people with colour vision deficiency cannot distinguish between red and green* (Ex D) **Summary: Font size should be increased, colour on navigation button to be changed.**	Font size for screens #54, #62, #64, which was considered to be small, was made bigger. Changes to navigation buttons to be considered for next revision.
	Requested to bold some of them text and some headings (n=2). (Ex B and D)	
Background/text contrast	*much more colour needed + use bold. Screen #10 red on grey hard to read* *Would prefer yellow; Screen #37 pink also hard to read* (Ex B) *Grey quite soothing* (Ex A)	Colour changed from pink to red to emphasize contrast. Headings to screens #23, #37, #42, #45 were changed to bold font. Text on some screens (Screens #1, #15 #17, #43, #54) was changed into bold to improve readability.
	Summary: Change colour of indicated texts.	
Instruction: Please comment on the layout in *Bioskills* and whether, in your opinion, it would be effective in helping students to visualize and understand the information presented.		
Layout effectiveness	*For most part I did not have problems with layout of text information*; but *...I did wonder where some of the graphics fitted in* (Ex D) *So much space at top is wasted before the buttons for sections appear on screen #3. Fill screen.* (Ex B)	Graphics modified to link with screen in section five. A number was added on all screens to enable users to measure progress through the package
	Summary: General screen layout was acceptable to two experts. Suggestion that some text be reorganised to reduce scrolling and the graphics could be linked more closely to text.	Spaces removed; screens #3, #5 rearranged to reduce scrolling.

Table 5.9 Instruction, feedback and suggestions from experts, and resulting modifications duing formative evaluation: Media elements

Instruction: Please comment on the degree to which the range of multimedia applications (text, graphics, sound, animation, video) used in the programme have helped to capture your attention.		
Media integration	*I enjoyed them for the most* (Ex B) *Animation in the Power Point presentation reasonably effective* ...but ...*some of the graphics and video seem like add-ons. Stuck in the top right corner of the screen* (Ex D). *I need time to absorb all the information- cannot say that I needed my attention to be captured* (Ex. A)	Slow links in the presentation were fixed to open into the programme and not to another window. Relevant sections (Screens #23,-#25) on "Factors affecting behaviour" modified.
	Summary: Specific changes were suggested to be made on the media aspect[64] ; and to integrate graphics with text.	

Table 5.10 is about experts' comments on the cognitive load, and their suggestions for its improvement, whilst Table 5.11 is about experts' comments on the user interface, and their suggestions for its improvement in *Bioskills*.

Table 5.10 Instructions, feedback and comments from experts, and resulting modification during formative evaluation: Cognitive load

	Reviewers' feedback	Resulting action for *Bioskills*
Question: With reference to cognitive load, what is your opinion about the terms, the explanations provided, and their organization in the following sections of *Bioskills*?		
Factors affecting behaviour	*Quite a heavy section overall…wording could be simplified and or reduced ...., more engagement with the student* (Ex B) *...behaviours are a broad category... refer to learning behaviours* (Ex C) *...there does seem to be quite a lot of useful material here. From what I know of some students attitudes, the locus of control" concept seem to be particularly useful* (Ex D) *...This should be a section on its own* (Ex A) *… send students away to reflect and come back shortly to reflect on self-discovery.*	Screens #25, #26, #28 and #30 on perceived behavioural control and behaviour were rephrased and simplified to reduce cognitive load for students. Screen #26 had "academic behaviour" substituted for "behaviours" to make meaning clearer. Used "learning behaviours" in text instead of "behaviour" in screen # 21. This metacognitive engagement was considered for implementation in a later version.
	Experts' comments: General opinion was section although useful, had lots of technical details. These should be corrected or simplified.	
Improving work-habits	*Better* (Ex B). *... the text seems Ok* (Ex D) *indicate section end, with some reflective rounding up statement, rather than "now to the final section*" (Ex A) Asked if *...work-habits and behaviours were equivalent concepts* (Ex C)	Delineated the end of the section on "attitudes" as suggested. Screen #38 modified to include Introduction which linked with previous text. This activity reinforces previous knowledge of students.
	Experts' comments: Some text seemed satisfactory for this section (n = 4); requested to delineate section end clearly.	
Model to change work-habits	*Fine* (Ex A). *... personalise language more to engage the learner.* (Ex B) *... the bullet points are too formal. Perhaps challenging types of questions could lead students to ask themselves how to change their work-habits*. (Ex C)	Screen #54, problematic sections were personalised: e.g. *A critical look at your work-habits.* Recap of what has been learnt included. Cross referencing of stages to link with "stages of change".
	Experts' comments: Satisfactory but requested to make text more challenging and engaging.	

[64] Two experts did not have sound cards in order to comment on its effectiveness in the package.

Table 5.11 Questions, feedback and suggestions from experts, and resulting modification during formative evaluation: User interface

Reviewers' feedback	Resulting action for *Bioskills*
Question: To what extent do you think students, after working through the "Home page' will know what is in the package?	
Students "*should have a good over view*" (Ex D) *All the relevant information is provided* (Ex C) *I think they will know the main sections, but the hierarchy of the main sections and subsections was not immediately clear to me* (Ex B). Students "*...must work through it thoughtfully, go over it twice* (Ex A)	Links between PowerPoint screen corrected, made PowerPoint presentation open into the same browser window to ensure continuity. Colour changes and font size of text made consistent across all the screens.
Summary: Basic navigation structure was evident but not immediately apparent to all.	
Question: To what extent do you think the package is easy to use without getting lost? (Please describe any difficulties you had)	
Reasonably, but there is no clear indication of when I have finished a section (Ex B) *Easy to use, navigation buttons are helpful* (Ex C) *Next*" and "*Back*" were fine (Ex A) *Remove Back button on Screen* 1 (Ex E) *They should have a reasonably good overview* (Ex D)	End of each section re-written to give clearer demarcation of the end of the section. Navigation problems associated with PowerPoint presentation opening in to an external browser corrected. Redundant "Back" button on screen #1 removed.
Summary: Four experts agreed it was easy to use.	
Question: Were there times when you seemed to get stuck?	
I could not click on Home page tab (screen 22) *and go back to it Model to change behaviour section "Next" takes you to a new window after which the programme closes but the first window remains on the screen* (Ex C) *Clicking "Submit" button ...#27 could not get back to where I was and had to start again* (Ex. D)	These problems had to do with links created on PowerPoint. Problems were flagged and corrected in the Beta version.
Summary: All four experts got stuck on at least one occasion.	
Question: How easy is it to see if you have already visited a section of the package?	
Kept on returning to mind map (Ex A) *...very clear for the subsections due to the colour change but not very clear for the main sections* (Ex B) *... fairly easy, except, for one page* #13 (Ex D) *... a bit confusing .. the fonts and colours are the same* (Ex C)	Page loading on some computers was slower. Links reworked to ensure quicker loading of pages with reported problems.
Summary: Three felt it was easy whilst one (Ex C) felt it was confusing.	
Question: What helped you to keep track of the sections you visited?	
Colour changes of text (n =2). (Ex A; Ex B) but *colour change from blue to purple not easiest to pick up* (Ex. D) *Hypertext on LHS and navigation buttons* (Ex C) *Kept on returning to mindmap. Later linked the mind-map to the "Tabs" at the top of the grey screen. .Insert little mind-map perhaps* (Ex A*)*	Colour changes were part of the default setting with Dreamweaver MX and could not be modified.
Summary: Mind map was found useful by Ex A as a source of reference; suggested it be placed on each screen.	Indicated the screen number for each screen in Beta version. Mind map per screen to be considered in later version.
Instruction: Please explain any difficulties you had and make suggestions of what could be done to alleviate the problem.	
Pages with PowerPoint presentation opened but disappeared too quickly (n=3) *Some of the links did not work if I clicked on the second part of the sentence.*	Animation slowed down to enable reading. PowerPoint used to produce graphics of screens # 56 to #60 in beta version. This simplification of text should help reduce "extraneous cognitive load". I checked on the specific screens and corrected the links.
Summary: Requested to make changes to the links of the non-functioning PDF files and use PowerPoint (Ex D)	

Concluding remarks about experts' views

The experts gave different suggestions to improve the design and effectiveness of the package as reported in Tables 5.8 to 5.11. Whilst some were about the content and structure (see Table 5.8) others (Ex. D) focused on the technical design aspects. This was a reflection of their experiences as designers or lecturers.

The expert reviews and the usability testing took place in parallel, which was a drawback in the execution of this phase. It would have been ideal to fix all of the design and navigation problems before administering the alpha version of the package to students. However, constraints of timing of the available sessions in the students' curriculum made it impossible for this to be done. As researchers (e.g. Chapanis, 1991; Lousberg & Soler, 1998) note about formative evaluation, even if faults revealed as a result of testing are not rectified in the package, the information is important for designers in planning for the following major version of the package. In this context, several corrections were done to produce the beta version.

5.6.2 Usability testing of the package

Usability testing is the second technique I used in the formative evaluation of the package. Lee (1999, p. 4) defines *usability testing* as a "*process of observing and collecting data from users while they* (users) *interact with multimedia prototypes*". One purpose of usability testing is to obtain data to answer questions regarding users' interaction with multimedia software. Another, recognised by some researchers (Nielsen, 1990; Shackel, 1991; Reed, 1992), is to investigate user satisfaction, which they see as an essential dimension of usability testing. Lee (1999, p. 6) defines the dimension *user satisfaction* in usability testing as a measure of user's perceptions, feelings, and opinions of the system, and states multimedia software … "*should be enjoyable to use and aesthetically pleasing".*

Sample of student users

My intended users of *Bioskills* were first-year biological sciences students registered at the university. Two convenience samples were identified which would be available at specified stages of *Bioskills* development. These were:

i) a complete class of *College of Science* students (n=61) studying biological sciences as one of their courses, and
ii) a tutorial class of the mainstream *Introductory Life Sciences* students (n=60) who were involved in using the final product.

Bioskills was hosted on the Univeristy's sub-domain as mentioned (p. 132) and made available to participating students in the study. Students could log in during school hours and after school hours. All the *College of Science* students (n=61) had a scheduled tutorial period at the beginning of the academic year introducing them to the use of computers. I was interested to find out if students experience with computers influenced their opinions and attitudes towards computers. I considered the beginning of the year a suitable time to solicit information on students' past computer use and to determine whether previous computer skills influenced their opinions. As a co-tutor of the class, I negotiated with my other colleagues teaching the class to have the students use *Bioskills.* Students came in two batches (n=36; n=25) on two consecutive days, and used the alpha version[65] of the *Bioskills*. Table 5.12 and Table 5.13 provide a profile of their experience with computers.

Table 5.12 Computer skills and experience of the College of Science sample (n=61)

Experience with computer use	n	%
First-time users	14	23.0%
Less than a year	7	11.5%
About one year	5	8.2%
More than a year	35	57.3%
Total	**61**	**100%**

Almost a quarter of the students (n =14) had not used computers before. These students with no past exposure to computers presented another dimension to the study. Studies have shown that students' attitudes towards computers are positively related to their prior computer exposure (Anderson & Hornby, 1996; Mitra, Steffensmeier, Lenzmeir & Massoni, 2000). Variables associated with computer attitudes, according to Palaigerogiou, Siozos, Konstantakis & Tsoukalas (2005), include liking computers; ease of use; self-confidence; and computer anxiety. I separated the students into those who had used and not used computers before and analysed their views captured in response to items in the questionnaire separately.

Table 5.13 Major activities for which College of Science students (n=61) used computers

Activities	n	%
Work-related internet searches	38	62.3%
Playing games	35	57.4%
Typing assignments	35	57.4%
Surfing the web for fun	27	44.3%
Sending and receiving e-mail	21	34.4%
Listening to music	2	3.3%
Making movies and CD's	1	1.6%

Some students from the same class of *College of Science* students who used the alpha version of the programme reported for another tutorial session on the use of computers seven weeks later. This was a smaller group (n = 22), and for my research they formed a convenience sample to provide me with further information to improve *Bioskills*.

Administration of questionnaire

The original 61 *College of Science* students were informed at the start of the session about the computer programme developed, that it was in its testing stage, and their comments were being solicited in order to help improve its quality for the benefit of all future users. It was therefore

[65] More-or-less completed version of the programme but lacking an audit trail, and the last main section.

important for them to provide honest comments that could help to enhance features of the next version of the package.

Analysis of data from students (n=61) who used the alpha version of the package

i) Students' perceptions, at 30-minute intervals, of the ease of use of *Bioskills*

Users' perceptions about the ease of use of a programme form a vital part in usability testing (Lee, 1999). During the two hour session students were asked every thirty minutes *how easy do you think Bioskills is to use*? They were required to select *very easy, easy, not sure, difficult,* or *very difficult* in response to the question. Some students said they had finished the work before the two hour session was up.

Table 5.14 shows students' perceptions of the ease of use of *Bioskills*. A comparison of experienced users with new users showed the following trends:

- Greater numbers of experienced users found it easy at the beginning to use (91.5% experienced users to 42.8% new users).
- Differences between the two groups decreased after an hour of use (89.3% of experienced users compared to 76.8% of new users).
- Differences between the two groups were even smaller after 90 minutes (88% experienced to 84.7% new users). However, it should be noted that one new user still found it difficult to use after 120 minutes, and one was still not sure.

Table 5.14 Experienced users and new users' perceptions over time about the ease of use of *Bioskills*

	Experienced users (n = 47)						New users (n =14)					
Time interval (mins.)	Very Easy	Easy	Not Sure	Difficult	Very Difficult	Total (n)	Very Easy	Easy	Not Sure	Difficult	Very Difficult	Total (n)
30	21 (45%)	22 (47%)	4 (8.5%)	0	0	47	1 (7%)	5 (36%)	6 (43%)	2 (14%)	0	14
60	23 (49%)	19 (40%)	3 (6%)	2 (4%)	0	47	3 (23%)	7 (54%)	1 (8%)	2 (15%)	0	13
90	24 (57%)	13 (31%)	5 (12%)	0	0	42	6 (46%)	5 (39%)	2 (15%)	0	0	13
120	17 (71%)	7 (29%)	0	0	0	24	3 (43%)	2 (29%)	1 (14%)	1 (14%)	0	7

The length of time spent on the computer had the effect of reducing the differences in the perceived ease of use between the experienced and new computer users. New users seem to have acquired the skills needed to work in the computer environment very quickly, and this would probably have influenced their confidence or self-efficacy beliefs about using the programme. Coffin & MacIntyre (1999) and Hasan (2003) have demonstrated that a positive correlation exists between the amount of time spent using computers and computer self-efficacy. However, it should be noted that about 12%

of experienced users (n=5) did not find it progressively easier to use. At 90 minutes they selected the "not sure" option.

ii). Students' opinions, at 30-minute intervals, of *Bioskills*

Users' opinions and feelings about a programme form part of the usability testing of the programme (Lee, 1999). Students were asked *what is your opinion of Bioskills?* and indicated their opinions about *Bioskills* using a 5-point Likert format. The categories were *really like*, *like it*, *not sure*, *don't like* and *really don't like* it. Students were given enough time to complete the questionnaire and some students left the computer laboratory with minutes to spare.

A small number of students (both new and experienced) did not provide any information about their opinion after the first thirty minutes. Possible reasons for this could have been their overlooking the question after the first thirty minutes (as some most likely did), or they could have completed working through the package in less than an hour, so had left by the 60-minute mark.

Table 5.15 shows, in brackets, the percentages of the opinions expressed. These percentages are calculated based on the number of students who reported results at every 30-minute interval. A comparison of experienced and new users who provided information every thirty minutes showed the following trends:

Table 5.15 Students' indications, at 30-minute intervals, of their "like" or "dislike" for *Bioskills*

	Experienced users (n=47)						New Users (n=13)					
Time interval minutes	Really like	Like it	Not sure	Don't like	Really don't like it	Total	Really like it	Like it	Not sure	Don't like	Really don't like it	Total
30	12 (25.5%)	17 (36.2%)	18 (38.3%)	0	0	47	5 (38.5%)	5 (38.5%)	3 (23.0%)	0	0	13
60	11 (24.4%)	24 (53.3%)	8 (17.8%)	2 (4.5%)	0	45	6 (54.6%)	4 (36.4%)	1 (9.0%)	0	0	11
90	14 (34.2%)	19 (46.3%)	5 (12.2%)	3 (7.3%)	0	41	8 (72.7%)	3 (27.3%)	0	0	0	11
120	9 (40.9%)	13 (59.0%)	0	0	0	22	4 (80.0%)	1 (20.0%)	0	0	0	5

- After the first 30 minutes slightly greater numbers of new users than experienced users liked *Bioskills* (61.7% experienced users to 77% of new users).
- After 60 minutes 90% of new users liked it in contrast to the 78% of experienced users.
- At the end of 120 minutes equal numbers of both experienced (99.9%) and new users (100%) indicated they liked *Bioskills*.

Studies indicate students experience varying emotions when required to use computers (Coffin & MacIntyre, 1999; Beckers & Schimdt, 2001) and these emotions could provoke like or dislike for the programme, especially among new users. As indicated earlier, slightly greater numbers of new users than experienced users at the start indicated they liked the package. Possible reasons for this perception could have been due to the ease of use reported and the hold "noveau" objects have on first-time users. However, it is interesting to note that in the results reported at the end of the session, differences in numbers had narrowed down between the two groups. This observation suggests experienced students seem to have got into liking the package just as much as the novice users. The numbers involved are small and this prevents me from making any generalized claims. The results also provide glimpses of students' answers to Research question 4 which is addressed in Chapter 7, page 205.

iii) Students' perceptions, at 30-minute intervals, of the usefulness of *Bioskills*

Users' opinions about the programme was another aspect investigated in the usability testing. Students were asked to indicate every 30 minutes *how useful did you find Bioskills in helping you to think about improving your chances of academic success?* Students' perceptions about the usefulness of *Bioskills* as they responded to the items of the questionnaire showed the following trends:

- After the first 30 minutes, (see Table 5.16) a slightly higher percentage of new users found *Bioskills* "useful" than experienced users (92.3% new users: 71% experienced users).
- The differences in percentage between the two groups after 60 minutes narrowed (100% new users to 88.7% experienced users) and it was pretty close after 90 minutes (100% new users found it useful to 97.6% of experienced users).

Table 5.16 Students' perceptions, at 30-minute intervals, of the usefulness of *Bioskills*

	Experienced users (n =47)						New Users (n = 14)					
Time interval minutes	Very useful	Useful	Not sure	Not useful	Not very useful	Total	Very useful	Useful	Not sure	Not useful	Not very useful	Total
30	10 (22.7%)	22 (50%)	11 (25%)	0	1 (2.2%)	44	8 (61.5%)	4 (30.8%)	1 (7.7%)	0	0	13
60	16 (36.4%)	23 (52.3%)	2 (4.5%)	3 (6.8%)	0	44	9 (75.0%)	3 (25.0%)	0	0	0	12
90	18 (43.9%)	22 (53.7%)	0	1 (2.4%)	0	41	11 (91.7%)	1 (8.3%)	0	0	0	12
120	14 (56.0%)	11 (44%)	0	0	0	25	5 (83.3%)	1 (16.6%)	0	0	0	6

I observed some students making notes from the computer screen. This action could be interpreted to indicate the relevance students attached to the information presented. The following individual comments about the sections also provide evidence of the worth of the programme: Two independent comments on the "Views of top students" and "Preparation for tests" sections were "*interesting*". The section on "Varsity life" had a comment *"I liked it" (*Student #47*).* A student wrote "… *very informative it has changed my mind to set goal and achieve my best but when the segetion (sic) are* *fixed then all is great"* (Student #8). Another student wrote, "*I'd like to come back and look at the site again*" (Student #31). These comments were volunteered and indicate these students' positive reaction to the package.

In summary, students' perceptions on the usefulness of the package were positive irrespective of their being new or experienced users. Ten percent of experienced users were unsure of the usefulness of the programme until after 90 minutes, which suggests something in the content in the last quarter of the session may have caught their attention.

Students' observations about the screens of *Bioskills*

This aspect of the formative evaluation is premised on the assumption that after a programme has been designed there are likely errors that have to be identified and fixed (Reeves & Hedburg, 2003). Sixty-one *College of Science* students were involved in an investigation of the navigation problems and explanation-related problems students encountered going through *Bioskills*. Students were given a questionnaire, "Tell us what you think about *Bioskills*" (see Appendix E1) on which they were to record the problems while working on *Bioskills*. Students came in two batches and answered the questionnaire on two consecutive days.

Each screen in the instructional module was serially numbered so that comments on the navigation and language-related problem could be linked to particular screens. Table 5.17 shows the distribution of the comments on navigation and explanation-related problems.

Table 5.17 Summary of the observations made by students (n=61) about the screens of *Bioskills*

Section	Navigation problems				Explanation-related problems			Details of problems on various screens students reported (# = screen number)
	Buttons not working	Buttons not easy to find	Screens could not return to *Bioskills*	Could not get to where I wanted to be	Screens with explanation not clear enough	Screens where more explaining needed	Screens with language problems	
Home page	2	1	3	2	1	1	3	#2 Explanation was too long #6 Could not click on icon of mindmap #6 "contacting us" submit button not working
Challenges of 'varsity life	0	0	0			2		#11 More details on academic activities requested #8 "Contacting us button" not working (n=15) #16 Slide show was too fast
Factors affecting behaviour	1	0	2		1	2		#21 unable to go to a link #31 link to next page not visible
Improving work-habits	4	0	1			2	1	#51 Link to "seven strategies" not working
Model to change work-habits	1	2	2	1	1	4		#56; #57 pages were corrupted and needed to be redone #61 message not understood. Clarification required
Total observations	**8**	**3**	**8**	**3**	**3**	**11**	**4**	

Some of the navigational problems mentioned by group one were fixed before group two used the programme the following day and this was reflected in the lower frequency of comments received on day two. Twelve comments (out of a total of 18) from group 1 were navigation-related, whilst Group 2 flagged 13 explanation-related problems (out of a total of 23).

5.6.3 Trialing of the Beta version of the package

The alpha version was corrected to create a beta version of the package. Navigational problems and glitches reported by both expert reviewers and students with the alpha version (Tables 5.8 to 5.17) were fixed. Thornton & Phillip (1997) point out the importance of detecting and fixing design problems early enough as part of the “ongoing evaluation”. According to Thornton & Phillips (1997, p.127), early fixing “*reduces wastage of effort,*” and improves “*research output*” in academia.

Two new features were also introduced in the beta version. Firstly, users typed-in responses to questions and statements could be captured on a database. Secondly, a tracking mechanism was installed which recorded the following details about students’ actions in a “text field”: *visit length statistic*”, which is time from first page accession to last page; *page load activity,* which is the number of times the sections were visited, and the sequence of such visits. The commercially-produced tracking mechanism, StatsCounter, was piloted with two users. The reported use was checked against the logged use. No errors were detected with the two users’ logs that were checked. Unfortunately, in the final package the data proved not useful for research and as such, the results are not reported in the study.

5.7 CONCLUDING REMARKS

In this chapter I outlined theories and guidelines from the literature which were used in the design of a computer-based instructional package. I conducted a formative evaluation of the package identifying and correcting a number of problems pointed out by the users. In order to do this I took the unusual route of reporting some results in a “methods” chapter. The production of an improved version of the package was followed by an investigation of the effectiveness of the package, which is reported in Chapter 6.

CHAPTER 6
THERAPEUTIC PHASE: RESEARCH DESIGN
(INVESTIGATION OF EFFECTIVENESS)

The research conducted on *Bioskills* was similar to two aspects of evaluation: *formative* and *effectiveness* evaluation. The formative evaluation was conducted using the alpha version of the package, as reported in Chapter 5. Based on the findings, the package was modified to produce the beta version. This chapter deals with the research design and methods used in the investigation of the effectiveness of the beta version of the package.

6.1 INVESTIGATION OF EFFECTIVENESS OF *BIOSKILLS*

Reeves (1993, p. 15.17) explains that the purpose of *"effectiveness evaluation*" is to assess, after a package has been used by participants, whether "*some degree of difference exists between the knowledge, skills and attitudes* [participants] *possessed before the training*" and after the training. This aspect of my study is not considered to be a complete effectiveness evaluation, but is a small-scale study of the effectiveness of the package. In the context of this study, the investigation of the effectiveness of the package sought evidence through a case study regarding the instructional effectiveness of *Bioskills*. A case study, according to Stake (2000, p. 436) "*... is both a process of inquiry about the case and the product of that inquiry*". Stake (2000) reminds us that researchers have tended to call a great variety of things a case study, but he sees it as a form of research where a case study is defined by *interest* in individual cases, not by the methods of inquiry used. Gall, Borg & Gall (1996) point out that any phenomenon of study may have many aspects to it and it is important for the researcher to select a focus for the investigation and the unit of analysis. In this study, the case I was investigating was the use of *Bioskills,* how students worked with *Bioskills,* and students' opinions and reported results from that engagement. Techniques, to be described, were used to assess what students thought was the influence of *Bioskills* on their attitudes, metacognitive knowledge and work-habits.

6.1.1 Research questions

Readers are reminded that the study had four questions: questions 1 and 2 directed the diagnostic phase of the study. The questions which directed the investigation of the effectiveness were:

Research question 3: What metacognitive gains did the students derive from using *Bioskills*?
3a: What metacognitive knowledge did the students say they have about factors promoting academic success, before and after using *Bioskills?*
3b: What metacognitive control (application of metacognitive knowledge) did the students say they use, before and after working with *Bioskills*?
Research question 4: What are students' opinions about *Bioskills* as a learning tool targeting academic success?

6.2 RESEARCH DESIGN

The steps followed in this section of the study to answer the research questions are highlighted in the grey section of the flow chart in Figure 6.2 (shown on the opposite page). The alpha version of the package developed and used during the formative evaluation was modified based on the suggestions from experts and students to produce a beta-version and this is the version evaluated here. Two types of data-gathering instruments, activity-based questionnaires (discussed in section 6.3.1) and an interview schedule (discussed in section 6.3.2), were designed and used in the study to answer the research questions. Details about the participants are discussed in Section 6.2.1.

6.2.1 Participants in the study

The participants in the investigation of effectiveness were students drawn from the *Introductory Life Sciences* course who were attending Academic Development tutorials. Of the 60 students who were attending the tutorials in the second half of the year 45% (27/60) had failed their mid-year examinations and as a result were requested by the *School of Biology* to attend these tutorials in order to improve their performance in the third block. Fourteen of these students used the *Bioskills* programme, but only eight were available at the end of the block to be interviewed. These eight students, whose mid-year results are shown by asterisks (Figure 6.1), became the sample for the interviews.

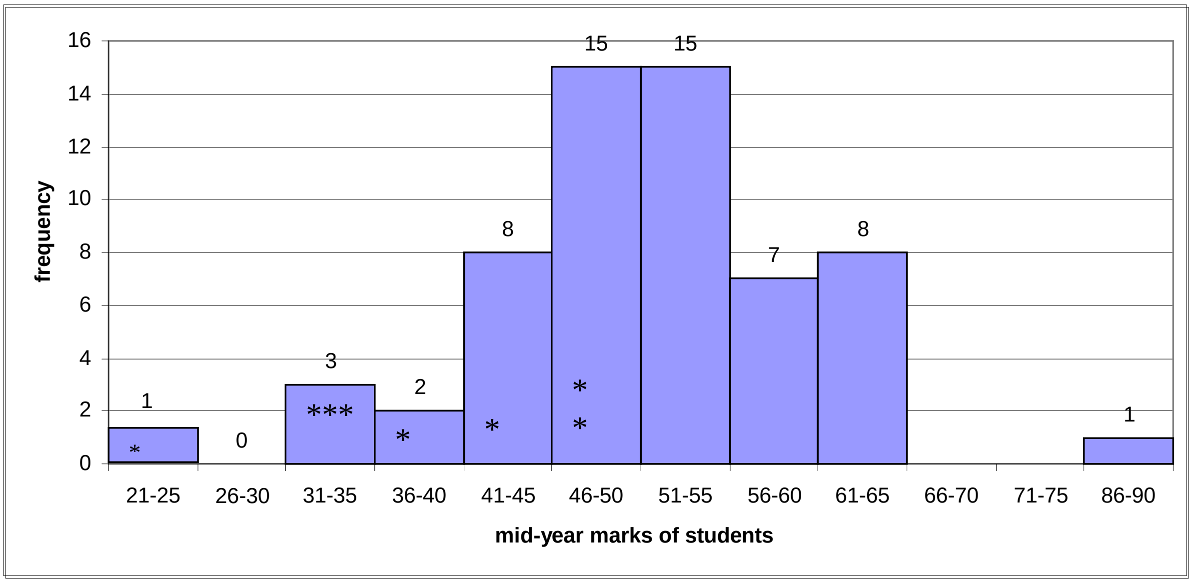


Figure 6.1 Distribution of mid-year marks of students (n=60) attending Academic Development tutorials in the second half of the year

Although one would expect only at-risk students to attend Academic Development Programme tutorials, some high-achieving students also attended the tutorials, as is evident from Figure 6.1.

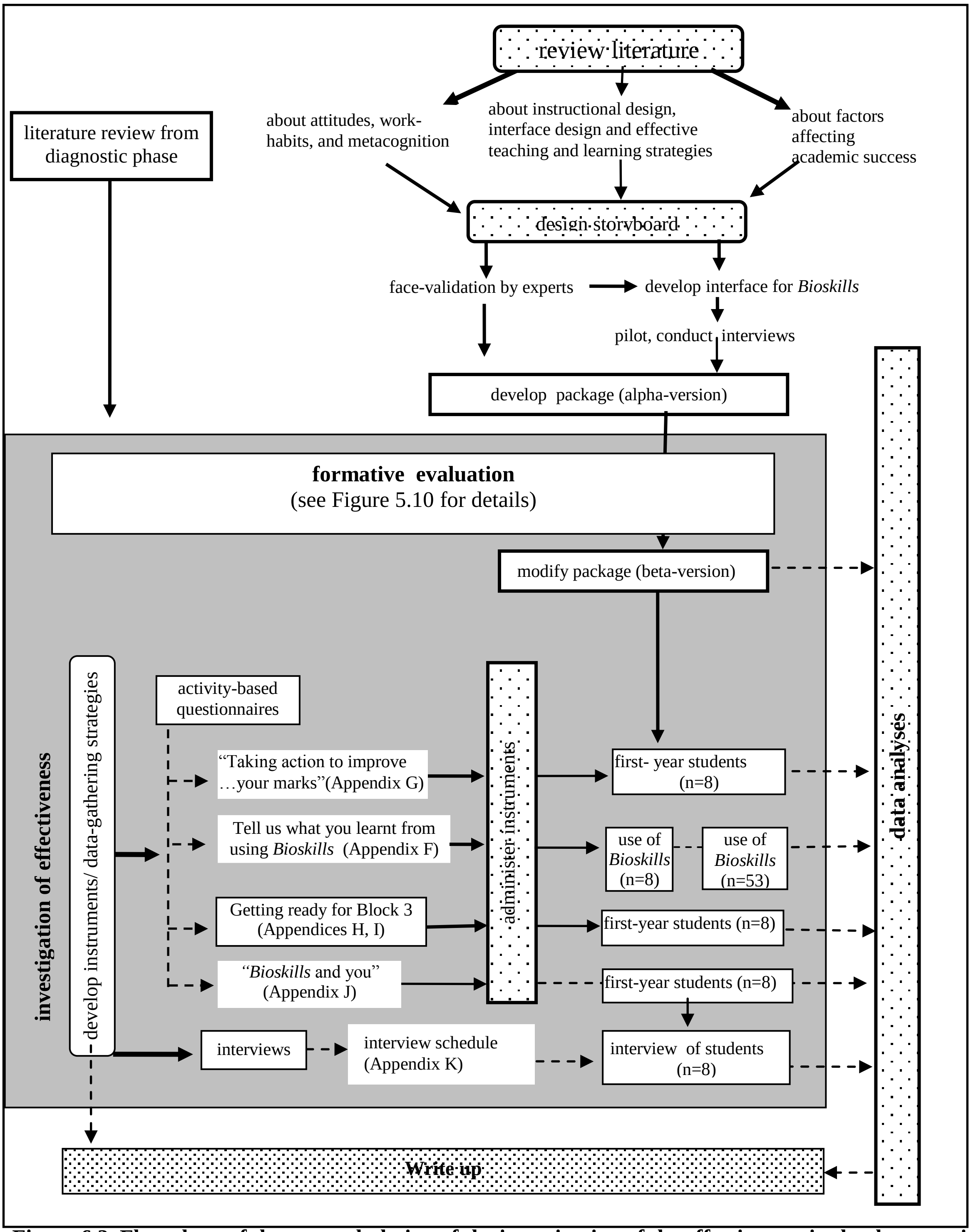


Figure 6.2 Flow chart of the research design of the investigation of the effectiveness in the therapeutic phase

6.3 DATA-GATHERING STRATEGIES

6.3.1 Activity-based questionnaires

Activity-based learning is a form of active learning in which students are engaged in activities such as listening, reading and thinking with their minds acting on what is being learned during the process (Carin & Sund, 1980). The emphasis here is not on just doing, but on reflecting on the activity. Evolving from activity-based learning is the concept of activity-based questionnaires (Mashalaba & Sanders, 2003) in which questionnaires are used for the dual purpose of reflection by the users during activity-based learning tasks and for gathering data for research purposes.

Five activity-based questionnaires, numbered 1 to 5 below, but referred to as Appendices F to J in Figure 6.2, were designed to gather data for the study. The statements used in the questionnaire were based on the ideas elicited from the stake-holders during the interviews during the diagnostic phase, and from research findings (e.g. Weiner, 1985; Ajzen & Madden, 1986; Fraser & Killen, 2005). A description of each questionnaire and the specific purposes for which each was used is now provided.

Activity-based questionnaire 1: *Taking action to improve your marks* **(see Appendix G)**

This questionnaire was developed as a starting point to help students to reflect on their attitudes and work-habits of the previous semester.[66] It was believed that helping students to reflect on their attitudes and work-habits would help them identify factors that contributed to their academic performance and help them plan a way ahead as they worked through the *Bioskills* programme.

Activity-based questionnaire 1 had an introduction (see Figure 6.3) and five tasks. The purpose of the introduction was to motivate students and get them to realize the importance of the activity, and to provide honest responses if the threat to validity was to be avoided. As noted by Maxwell (1992) inaccurate data or incompleteness of data is a threat to validity.

The first task was on *Thinking about your June mark* (see Figure 6.4). In this task students were asked to reflect on their June mark in relation to the amount of work they had done. Students were also asked to identify negative and positive factors that they thought contributed to their performance, and by so doing provided information on their perceived locus of control. This information was used to partly answer research question 3.

The reliability of questionnaire data often can be compromised if researchers do not gain the trust and willingness of participants (Leedy, 1989). As a lecturer and a researcher, I offered to help students to improve on their performance after a poor June examination performance. Students under this situation were willing to share both the positive and negative factors that contributed to their performance. Their responses having both the positive and negatives could therefore be seen to be honest.

[66] As the first of the activity-based questionnaires discussed, it is denoted as Activity-based questionnaire 1.

TAKING ACTION TO IMPROVE YOUR MARKS

Student Number________________________

The June biology results are out, and many ILS students were disappointed with their mark. Even students with good marks could do better.

We are willing to work with interested students to improve their academic performance. A number of ADP sessions in the next few weeks will focus on ***improving students' chances of academic success.***

The first step in taking action to improve your mark requires you to think about HOW you worked in the first half of the year. Doing this will help you:

- to identify factors which contributed to the mark you earned
- and will help you to consider a way forward.

It is important that you answer the following questions honestly, otherwise you will not benefit from the exercise.

Figure 6.3 Introduction to activity-based questionnaire 1

Thinking about your June mark

My June mark was ☐

My mark was

☐ better than I expected ☐ about what I expected ☐ worse than expected ☐ much worse than expected

In terms of the work I did in the first half of the year I think that my mark is

☐ a very good reflection ☐ a reasonable reflection ☐ a poor reflection

of the amount of work that I did.

List the factors (**positive** or **negative**) which you think contributed to the mark you got.

Figure 6.4 The first task in activity-based questionnaire 1

The second task was on *Some important things to think about* (see Figure 6.5). Students were required to indicate how strongly they agreed or disagreed with each of 23 statements on various attitudes and work-habits related to academic success. By going through the list students had to identify attitudes and behaviours they displayed in the previous semester. The data obtained was used to inform the study on general patterns of knowledge students displayed at the start of the year, and to answer research question 3

Some important things to think about

Indicate how strongly you agree or disagree with each of the following statements by placing a tick (☑) in the appropriate box.	Strongly agree	Agree	Not sure	Disagree	Strongly disagree
a My estimate of what I would get for my June mark was very accurate.					
b It is not important to attend **all** lectures as you can catch up later					
c Setting academic goals and working hard to achieve them makes **NO difference** to a student's mark.					
d Studying in a group is a useful way to cope with biology.					
e It is important to work extra hard if you find the work boring .					

Figure 6.5 Extract from the second task in activity-based questionnaire 1

The third task was on *Factors which affected your June mark* (see Figure 6.6). The purpose of this sub-section was to ensure students reflected about their attributions for their successes and failures, as a precursor for getting them to learn about attributions and their effect on performances, in *Bioskills.* Attribution theory (Weiner, 1979, 1985) classifies individuals in terms of perceived causes of the factors external or internal, and their degree of controllability, which they believe play a role in their results.

Factors which affected your June mark

Which of the following factors do you think affected your mark (either made it **worse** than it should have been or **improved** it)? Tick all the boxes **which apply to you.**

☐ Help from my friends

☐ Biology being a very difficult subject

☐ Too much work to learn in biology

☐ Too little time to study biology

☐ Me not studying hard enough

☐ Not being given study notes for the course

☐ My friends distracting me from work

☐ I studied very hard

☐ I made good notes to study from

☐ Preparing for the exams in good time

Figure 6.6 Extract from the third task in activity-based questionnaire 1

The fourth task was on students' behavioural intentions (see Figure 6.7). The tasks listed in Figure 6.7 were on possible goals and intentions of student and whether they accomplished such goals at the end of the year. Completion of such goals were considered necessary for effective and successful management of academic work by the students. This task also help provide information on students intentions at the start of the year (before using *Bioskills*) and the extent to which such intentions were kept. Stated differently, answers to these statements revealed the metacognitive controls students exercised during the first half of the year.

Regarding your intentions at the start of the year (tick only the boxes which applied to you)

	Yes	No		Yes	No
I intended to file my notes regularly			If you had intentions, indicate (by ticking the relevant *yes / no* box on the right) whether or not you kept your intentions		
I planned to attend all lectures and pracs					
I intended to hand all work in on time					
I planned to work hard from the start					
I planned to rewrite my notes after lectures					
Most things I intended to do I actually did					

Figure 6.7 Fourth task from activity-based questionnaire 1

The fifth task was *Reflecting on your work-habits* (see Figure 6.8). The purpose of this activity was to draw students' attention to their perceptions about the nature of the work-habits and attitudes they displayed in the previus semester. Accurate perceptions are important to help students to know how to improve on their work habits. Students had to read the 13 statements on work-habits and place a tick in each of the boxes that they thought applied to themselves.

Reflecting on your work-habits

Carefully read the following statements. Place a tick (☑) in each of the boxes that **you think apply to you.** You may tick more than one option in each case.

I started preparing for the exams

☐ near the start of the the term ☐ about two weeks before the exams ☐ about a week before the exams ☐ a few days before the exams

To help me remember lecture notes

☐ I summarized the work in point-form ☐ I made mind-maps to study from ☐ I rewrote the notes a number of times ☐ I read the work many times over

Figure 6.8 Extract from the fifth task in activity-based questionnaire 1

Activity-based questionnaire 2: *Tell us what you learnt from using Bioskills* **(Appendix F[68])**

Purpose of the activity-based questionnaire

This was designed to investigate students' self-reported opinions about what they learned from using *Bioskills*. Answers from students provided a glimpse of their opinions about *Bioskills* as a teaching tool, and this data contributed towards answering research question 4. In the investigation of the effectiveness of the package this was the second activity-based questionnaire used, and is therefore labeled as questionnaire 2.

Description of the questionnaire

The questionnaire had an introduction, as shown in the following quote, in which students were encouraged to contribute honest information. Honest opinions were essential for improving validity of the data.

> "*Bioskills is a computer programme designed to promote academic success. It attempts to raise students' awareness of some of the factors which affect academic success, and suggests ways in which students can enhance their chances of success. ….We value your contributions as students involved in this study and in order to help us return your scripts to you, we would appreciate it if you would write your students number in the section below".*

The questionnaire had five sections, each with callout boxes for students to record their replies. Each student was informed *As you worked through the sections of Bioskills you may have learned some new things. Write these out in the "callouts" provided. The script will be collected at the end of the Block*. Figure 6.9 is a sample of the call-out box for section 1.

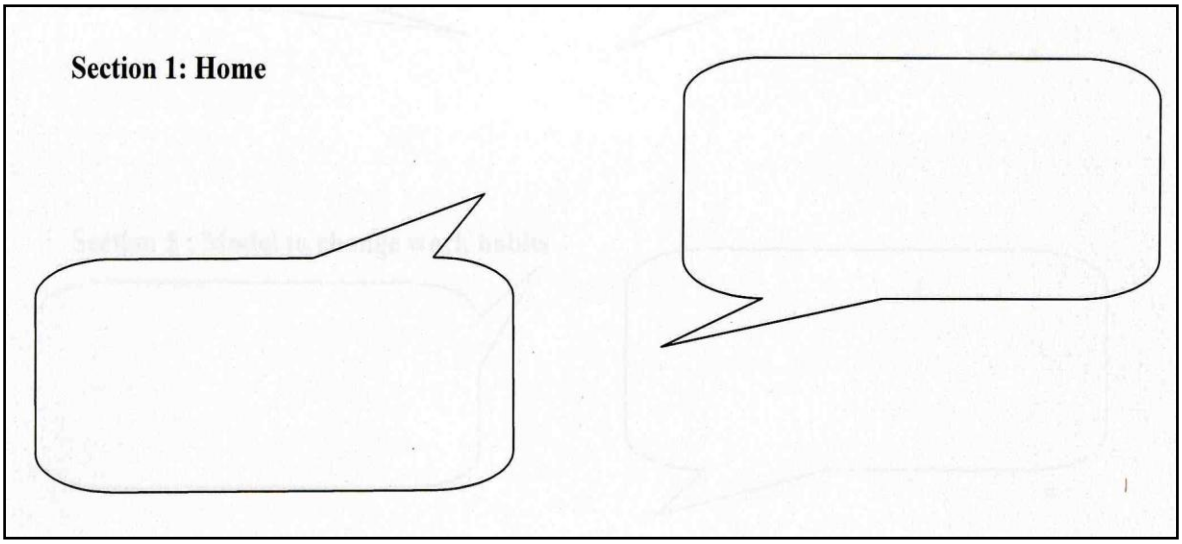


Figure 6.9 A sample of the call-out box on task 1 in activity-based questionnaire 2

[68] The order of naming the appendices is not sequential. The questionnaire in the appendix labeled **Appendix F** was used much earlier by students (n=61) in the formative evaluation, and used by two groups (n=8, n=53) in the investigation of the effectiveness.

Activity-based questionnaires 3 and 4: Getting ready for Block 3

Purpose of the activity-based questionnaires

As stated in the introduction to the questionnaire to the students, the purpose of this set of activities was to get them "*familiar with the topics that will be covered in biology in Block 3, and to get you to plan now for the forthcoming practicals, tests and assignments. By being ready for the block you will be able to work consistently and be more focused".* Four paper-based[69] questionnaires on the broad-based theme of getting ready for the block were administered during tutorials during the first two weeks of the third academic block. Two were activity-based questionnaires whilst two were tasks (*preparing your weekly "to-do-list*" and *week-by-week planning of activities*) for students. Although these two tasks did not contribute data to answer the research questions they were valuable in reinforcing some of the instruction in *Bioskills* (see questionnaire below). Students were asked to think about and plan for the semester during the tutorial periods, and the use of these questionnaires was meant to reinforce the various learning strategies introduced in the *Bioskills* package.

Activity-based questionnaire 3: *Setting goals for Block 3* (Appendix H)

This was on setting goals, and students were instructed both in the questionnaire and in *Bioskills* on how to set short-term goals for the block and long-term goals for the year. Research tells us that for learning to be beneficial it must be directed towards the achievement of **personal goals**, which must be determined by the learner (Rossouw, 2003).

Task: *Preparing your weekly "To-do-list"*

The activity reinforced tasks discussed in *Bioskills* by providing students with hard copies of tasks discussed. Students were instructed how to prepare for the specific lecture topics to be covered that week and were reminded why they had done the above strategies for the day.

As noted in the introduction to students in the questionnaire "… *not only does it help learners to identify where to focus their learning energies, but it [preparing your weekly to-do-list] also saves time for them to do other equally important activities, and as a result they experience less stress".*

Task: *Week-by-week planning of activities*

The purpose of this questionnaire was to help students develop the habit of weekly planning for their activities and to continue to use this planning strategy in the subsequent weeks of the block.

Students were requested to write down their plans (intentions) for the week, which should include preparations for lectures, practicals and topics they did not understand and needed to

[69] These paper-based questionnaires formed part of the multimedia package .

research (or discuss with friends or raise at Academic Development Programme tutorials). A table specifying topics for weeks 2 to 7 was provided. This table was to help them prepare on a weekly basis for their studies. Preparations were checked over the two weeks and students were provided with the necessary feedback during tutorials.

Activity-based questionnaire 4: *Preparing for practicals* (Appendix I)

This activity was used to check students work-habits. The importance of positive attitudes in the preparation for practicals, and in attending practicals was addressed. Developing a positive attitude helps students to make better preparations towards course work than having a negative attitude.

In the activity-based questionnaire 4 students were encouraged to first examine their attitudes to the topic on which each practical is based. Students were provided with a check-list of things to do in preparation for a practical session. They were to place a tick against all items either completed or not done (see Figure 6.10 and Appendix I, page 296). Students were reminded of the importance of completing all the tasks they had not done if they intended to score good marks for their practicals.

Check list of things to do for the practical

	Tasks to do	Done	Not done
A	I have read the lecture notes on the topic		
B	I have read the relevant section in the prescribed text book		
C	I have read the topic in the lab manual thoroughly		
D	I have looked at the tasks in the lab manual and divided my time accordingly in order to finish on schedule		
E	I have answered questions which can be pre-answered before the practical		
F	I have graph sheets to take along with me to the practical		
G	I have got a text book with relevant diagrams to take with me to the practical		

Figure 6.10 Extract from a check-list included in questionnaire 4

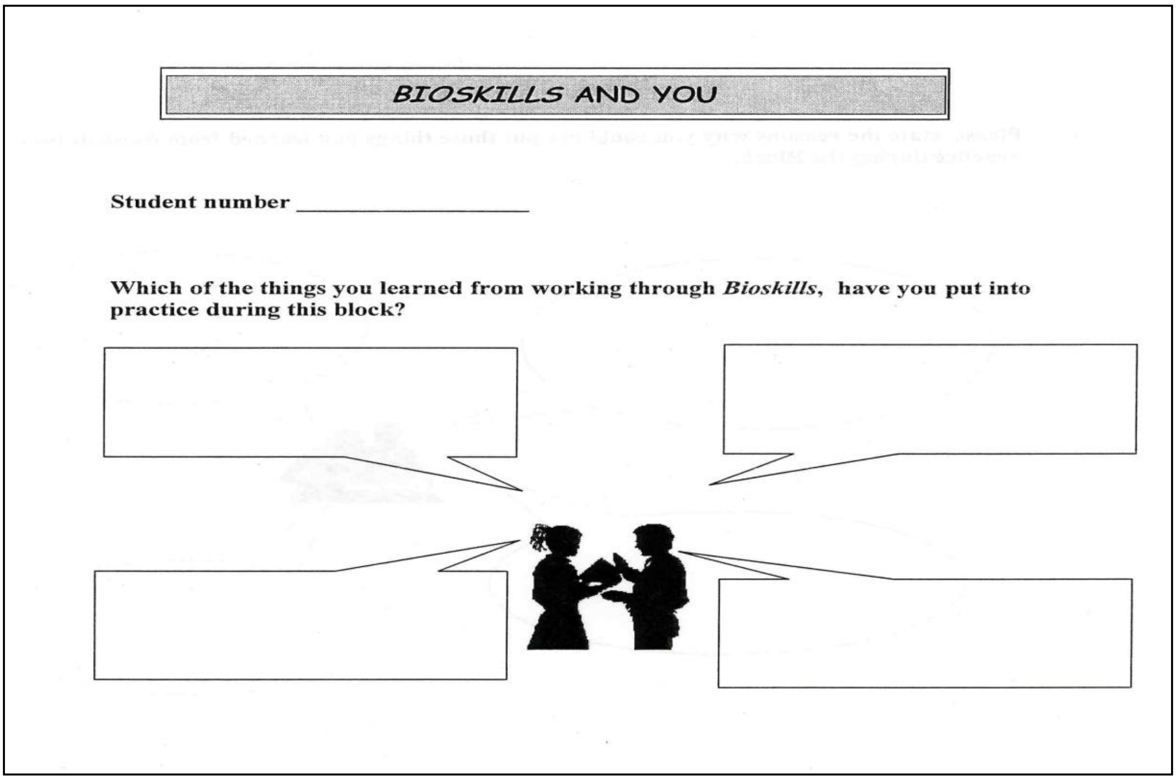
Activity-based questionnaire 5: *Bioskills and you* (Appendix J)

Purpose of the activity-based questionnaire 5

Activity-based questionnaire 5 was designed to gather data to answer research question 4 on students' immediate reflections after working through *Bioskills,* and after seven weeks of using it. The information this questionnaire solicited was about the behaviours, perceived behavioural control, and intentions of students, which are key areas of my theoretical framework.

Description of activity-based questionnaire 5

Activity-based questionnaire 5, *Bioskills and you,* can be said to be a follow-on from the activity-based questionnaire 2. Here were tasks that called for more elaboration of information than activity-based questionnaire 2 (see Appendix F). For example, it asked students to write down things they had learned from *Bioskills*, things they put into practice (see Figure 6.11 for the first question), and things they did not put into practice, with reasons for each (see Appendix J, p. 298). In essence, these questions sought to establish the level of reflection students accomplished after working through *Bioskills*. Their responses were also expected to provide pointers on possible behaviour changes students experienced.


BIOSKILLS AND YOU

Student number ____________________

Which of the things you learned from working through *Bioskills*, have you put into practice during this block?

Figure 6. 11 Example of a task in activity-based questionnaire 5, *Bioskills* and you

Administration of the questionnaires

Activity-based questionnaire 1 was administered to all ILS students (n=60) who attended the ADP tutorial during the first week of the third quarter. Note, this is a different sample to the 61 College students who were involved in the usability study reported in Chapter 5. This was the group targeted to work on *Bioskills* and whose test performance was reported in section 6.2.1. Responses from activity-based questionnaires 2 to 5 were obtained from those students who had used *Bioskills,* and completed the tasks from the questionnaires.

Table 6.1 Research activities and the week in which they were conducted during the eight-week period

Research activities	Block 3 (Third quarter)							Block 4
	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 1
Activity-based questionnaire 1	n=60							
Activity based questionnaire 2		n=8						
Activity-based questionnaire 3-4		n=8						
Activity-based questionnaires 5							n=8	
Interviews							n=8	

6.3.2 Designing the interviews on the influence of *Bioskills*

Purpose of the interviews

Reeves & Hedburg (2003) mention user satisfaction and the acceptance of computer-based instructional material as two important extrinsic factors that contribute to the educational effectiveness of instructional material. In order to answer research questions 3 and 4 it was important to probe students' opinions about *Bioskills* and how they thought it helped (or did not help) them get on with the semester's work.

An interview schedule was designed to elicit responses from students who had worked through *Bioskills* during Block 3. The interviews were used to i) explore their perceptions of the package and ii) gather data about the influence of *Bioskills* on their academic practices during the semester.

Development of the interview schedule

I designed the interview schedule (see Appendix K) and the content of the schedule was face-validated by a science education expert in the department. The interview schedule questions were informed largely by the theoretical framework in Figure 2.1 and suggestions from the literature in the field of evaluation (e.g. Reeves, 1993; Phillips, 1997; Reeves, Herrington & Oliver (2005). The two theories on behaviour, and behaviour change (Ajzen & Madden, 1986; and Prochaska & DiClemente, 1983) also proved useful in trying to establish if changes in attitudes and behaviour occurred after students used *Bioskills.* The thrust of the interview questions was to establish the nature of students' work-habits, opinions and their academic preparations during the year, so that changes could be determined.

Specific aspects of students' perceptions that were focused on in the interview sessions were:

- their attitudes and work-habits before, and after using *Bioskills.*
- their opinions about *Bioskills.*
- what they remembered about *Bioskills* and what they did with the instruction.
- what their intended academic preparations were after using the package.

Description of the interview sessions

- Students who had worked through Activity-based questionnaire 1 (Appendix G), and who had used *Bioskills,* were invited for the interview. Apart from one English first-language student, the interviewees were all English second-language speakers, with different academic performance in biology, as observed from their mid-year biology exam marks (Table 6.2). Fourteen students had expressed willingness to be interviewed, but for various reasons six students did not make it. The interviewer, after seeking permission from the students, audio-recorded the interviews and then transcribed them verbatim.

- The interviews took place towards the end of the seventh week of the third academic block, and into the first week of the next block[72]. This was after all the students had written a test in biology. Some statements interviewees made reflected the perceived effects of *Bioskills* on their performance.

Table 6.2 Characteristics of students who participated in the final interview

Interviewee	Number of times used *Bioskills*	E1L[73] or E2L[74]	June exam mark	Favorite subject
#1	Thrice	E2L	31%	Calculus
#2	Once	E2L	38%	Statistics and Biology
#3	Once	E2L	21%	Chemistry and Mathematics
#4	Four	E2L	46%	Chemistry
#5	Four	E1L	49%	Biology
#6	Twice	E2L	34%	Mathematics and Statistics
#7	Once	E2L	35%	Chemistry and Biology
#8	Thrice	E2L	42%	Human Biology

6.4 VALIDITY ISSUES

The activity-based questionnaires and the interview schedule were used to gather data. Two steps were taken to address possible threats to the validity of the data. All the instruments were face-validated by my supervisor, a science education expert. She checked the content, and the suitability of the items to elicit appropriate responses to answer the research questions, and based on her recommendations corrections were made to the structure of the text.

A factor which could pose a threat to validity is that of students providing inaccurate data. To encourage students to provide accurate data they were told of the purpose of the contributions they were making in answering the questionnaire and interview questions - to motivate incoming first-year students and to support departmental research. They were requested to give honest and accurate responses, which was necessary to improve the quality of the package. Whilst it cannot be ascertained if all students gave honest answers there is eveidence as shown in Chapter 7 that some students were honest in their responses by providing both negative and positive responses, even blaming themselves. for not applying appropriate academic work related techniques to their studies.

[72] The academic year is split into four teaching blocks or quarters, each six to seven weeks long.
[73] E1L = English first-language speaker
[74] E2L = English second-language speaker.

6.5 CONCLUDING REMARKS

The two major data-gathering strategies that have been described in this chapter generated data that were used to answer the two research questions that directed the investigation of the effectiveness of *Bioskills*. The results from these methods, and the answers to the research questions, are reported and discussed in Chapter 7.

CHAPTER 7
THERAPEUTIC PHASE: RESULTS AND DISCUSSION
(INVESTIGATION OF EFFECTIVENESS)

The previous chapter described the research methods used in investigating the effectiveness of *Bioskills*. The results from the investigation reported in this chapter focus on how *Bioskills* was reported by students to have influenced their knowledge, attitudes and academic behaviours. These responses, obtained from two sources of data (activity-based questionnaires and interviews), were used in answering research questions 3 and 4.

7.1 VALIDITY OF STUDENTS' ANSWERS

It is important to note that I was depending on students to provide data to answer the research questions. In the responses to the questionnaire items, it is possible for students to provide answers they might not believe but which they think are more appropriate or socially desirable. Such answers weaken the validity of inferences drawn in any research. As noted by researchers (e.g. Gall *et al.* 1996) the purpose of research is not merely to collect data, but to use such data to draw warranted conclusions. In this chapter the conclusions were about the instructional effectiveness of the package *Bioskills*. As a lecturer in the department, I was likely to be perceived by students as an authority figure. There was thus the potential of their trying to please me through socially acceptable responses. Another related issue would be students' fear that by being too critical, they might be penalized by the lecturer in their course assessments and this would therefore jeopardize their academic interests.

Whilst my concern over honest answers was an issue with the questionnaires, the submission of untruthful answers seemed, as noted by Gall *et al.* (1996), likely to be a bigger problem in face-to-face interview sessions. During interviews, students are in direct contact with the interviewer as an authority figure and under that condition, there is the heightened sense of their giving answers they might not believe.

In the administration of the questionnaires, steps were taken to ensure that students reported their perceptions as accurately as possible. I used a strategy recommended by Jones *et al.* (1996), assuring students before they filled in the questionnaires that they would not be penalized as a result of any information they provided. I also informed the students that the study was for research purposes that would benefit them and future students to the university, and that critical comments, if any, were welcome. The negative responses (for example, in Table 7.8 to the open-ended questions, and in Table 7.9 to the close-ended items) suggested that some students paid heed to the instruction.

In the face-to-face interviews students were told how much the research team valued their critical feedback, which was needed for the improvement of the package for use by future students in the biological sciences. Both negative and positive feedback was received (for example from Students #2 and #4) and this seemed to suggest that some students were not intimidated by the presence of an authority figure to 'sing the praises' of *Bioskills.*

7.2 VIGNETTES OF STUDENTS WHO WERE INTERVIEWED

Vignettes are short descriptions or character sketches of the participants being reported on. In this chapter, these provide a backdrop on their backgrounds, which can help the reader better understand their attitudes and behaviours reported elsewhere in this chapter. This information was gathered from university records and the interviews.

I have used four different terms to describe the type of school attended: private schools, former Model-C schools (or public[76] schools), township schools and rural schools. Private schools in pre-independence years in South Africa, were owned and run by private concerns such as religious bodies and they tended to be well managed and well-resourced.[77] All other schools are considered "public" and are funded by the government. Former Model-C schools were government schools in formerly white areas but which became multiracial in the early 1990s. Teachers were generally experienced, and schools tended to be well managed. After the transition to independence in South Africa such schools, due to dwindling government financial support, had to put in a lot of private funding (often from parents and guardians) to sustain the high levels of teaching and learning. Learners who attended a private school or a former Model-C school could be said to have received an advantaged schooling. Rural schools tended not to be well resourced, and were often, although not always, poorly managed. Historically, 'townships schools' were urban government schools in 'non-white' areas. Prior to 1994 these were run by the Department of Education and Training (for Black Africans). They were underfunded during the apartheid era and were often poorly managed (Crouch, 2005). Such schools tended to experience a lot of disruption of classes during the pre-independence era and many have not managed to regain a disciplined environment (Zwane, 1991). Students who attended township and rural schools could generally be said to have had a disadvantaged schooling.

Students' liking for a subject can influence the time they spend in studying the subject (Palaigeorgiou *et al*., 2005) and this was one reason students' favourite subjects were recorded in the vignettes.

What can be noted from the vignettes are the following characteristics displayed by sub-groups of students in their studies.

- Seven of the eight members of the sample were English second-language or possibly third-language speakers. Only Students #5 spoke English as her mother-tongue. Students #1 and #4 both spoke Afrikaans as their mother-tongue whilst the rest spoke an African language as their mother tongue.
- Four of the eight students (students #1, #4, #5 and #7) lived at home with parents and commuted to university daily. Student #7 found it a burden travelling the distance from home to school. The other four students (students #2, #3, #6 and #8) either stayed on campus, or lived within walking distance.
- Students came from the four types of schools (private schools, former Model-C schools, rural and township schools) but shared the common fate of failing their mid-year examinations.
- Few students used ADP tutorials to seek help during the first half of the year. Three students (students #1, #5, and #8) voluntarily attendedADP tutorials during the second quarter of the academic year. The other five students did not attend until they were told to do so.

[76] Public schools are government funded schools.

[77] In post apartheid years a number of private schools have mushroomed in the inner cities. These so-called "fly-by-night" schools tend not to be well resourced and are often poorly managed (pers. obs).

Student #1

This coloured female student, aged 18, had attended a private school in Springs, Gauteng. Her home language was Afrikaans. She stayed at home on the West Rand and commuted to the university. She had used computers since primary school for activities such as completion of “projects” and surfing of the internet.

Her favourite subject at university was calculus. She attended ADP tutorials during the first-half of the year and continued into the second half. She was repeating biology, because she had failed the first time.

This student used the *Bioskills* programme on three occasions and claimed she was excited to be part of the project.

Student #2

This black female student, aged 18, had attended a rural school in Limpopo Province. Her home language was Sepedi (northern Sotho). She lived in private accommodation close to the university. Based on her comments during the interview, her computer skills were not sophisticated. She used computers at high school for word-processing, and to work on spreadsheets.

Her favourite subjects at university were statistics and biology. She claimed she studied biology more than statistics.

She had a very quiet disposition and did not sound confident during the interview. She did not attend ADP in the first half of the year but did in the third quarter. This student used *Bioskills* once. She had hesitated in joining her peers in use of *Bioskills* because she felt that it would not help her. Her reasons for eventually using it were “*trying to get used to the environment of the university and improving my mark.”*

Student #3

This black female student, aged 19, had attended a public co-ed high school in Mpumalanga; she studied basic computer literacy at her school. She lived in a university residence on campus and had a personal computer at the residence. Her home language was Sepedi (northern Sotho).

Her favourite subjects at the university were chemistry and maths. She said she “loved” biology in the first quarter of the year, but she “*does not have love for biology anymore*” due to the poor mark she got in the June examinations. She sounded demotivated as a result of the biology mark and had considered deregistering from biology in the second quarter of the year. She eventually deregistered at the end of the third quarter of the year. She did not attend ADP during the first half of the year.

She used the *Bioskills* programme once, in the belief that it would help her in her studies, and because it was free.

Student # 4

This student, a white male, aged 19, attended a former Model-C Afrikaans-English school in Benoni, Gauteng Province. He lived with his parents in Benoni, and commuted to the university.

His favourite subjects were biology and chemistry. He did not attend ADP until he was told to do so for the third quarter of the year. My impression was that he was very committed to his academic progress and wanted to do well.

He was very interested when he was invited to use *Bioskills*, and wanted to find out what the programme was about. He used the programme on four occasions.

Student #5

This white female student, aged 19, was an English first-language speaker. She attended a private English-medium school in Florida Park, Gauteng Province. As part of sporting activities at school she played netball and tennis. She used computers at high school for the International Computers Driving License (ICDL) programme. She stayed at home in Florida with her parents and commuted to the university.

Her favourite subject at the university was biology, but claimed she was having problems during the second quarter of the year. She started attending ADP in the second quarter and continued into the third quarter.

She used the *Bioskills* programme on four different occasions. Her reasons for coming to use *Bioskills* were "*to give it a go*" and because she "*liked trying new things*".

Student #6

This black female student, aged 18, attended a private school in Pinetown near Durban. Her mother–tongue was IsiZulu. She lived in a private residence close to the university. She had not had much experience with using computers in the past and wanted "*to learn more of computers*".

Her favourite subjects at the university were maths and statistics. She did not attend ADP during the first half of the academic year and only came to ADP when directed by the school's administration officer after failing the June examination. From my observations, she did not attach much seriousness to using the package and worried about the time it would take to use it. She also participated in a mind-mapping tutorial held for interested first-year students during the first-half of the year, which indicates to me her desire to learn new things and improve her situation.

She used *Bioskills* twice. Her participation in the *Bioskills* programme, according to her, was "*to know more about the 'varsity life … in order to be able to survive in 'varsity".*

Student #7

This black male student, aged 18, attended a township school in Vosloorus in Gauteng Province. He spoke TshiVenda as his mother tongue. He lived with his mother and commuted to the university. He started using computers from Grade 11, when he typed assignments and used Excel spreadsheets in managing a small family business account.

His favourite subjects were chemistry and biology. He did not attend ADP during the first half of the year, and only did so in the second half. From my observations, he was often together with three students doing biology. I noticed some sense of seriousness about him for academic tasks.

He used the *Bioskills* package on one occasion. He participated to use *Bioskills* because he felt it would help him "*through the process of engaging with 'varsity life*". His reason for not using it more than once was because "*he did not have time on his hands"* as he needed to study physics and chemistry too.

Student #8

This student, aged 18, attended a rural school in Mpumalanga. His mother-tongue was Xitsonga. He shared a flat in Braamfontein with a colleague, within walking distance. This student had not used computers at school, but had acquired one since coming to the university.

He said that biology was his favourite subject and he spent a lot more time studying it at the expense of other subjects. He did ADP during the first quarter of the academic year and continued into the second half. The impression I gathered about this student was that he seemed keen to study.

He used the *Bioskills* programme on three occasions.

Two of the eight students (Students #8 and #6) had no sophisticated experience with computer hardware or software. Such lack of experience with using computers was a source of concern to me, as explained in the following section.

7.3 CONCERNS ABOUT STUDENTS' LEVEL OF COMPUTER EXPERIENCE

Differences in computer experience were noted in the sample of first-year students who responded to the questionnaire, as well as those involved in the case study. One of the problems lecturers have to deal with when providing computer-aided instruction is how to cater for students with varied computer skills. Unless learning tasks allow students in a class to work at their own pace a situation arises where students with high levels of computer skills are made to work at the slow pace of those in the class with low computer skills. This control imposed on students with different levels of skills in a class, as noted by Palaigeorgiou *et al*. (2005), could lead to boredom for experienced users, or frustration for new users who fall behind. These feelings could influence students' attitudes and lead to students providing a negative review of an instructional package (Palaigeorgiou *et al*., 2005).

MacArthur & Schneiderman (1986) and Majsterek (1990) recommend that new learners should be provided with some keyboard instruction before they use a programme. Mostert (1994) recommends that in order for computer skills to become a positive experience for learners, the teacher should decide which computer functions students should master in order to use the programme effectively and should provide help. In addition, there should be enough time for practice to ensure students use the programme effectively.

The whole class started using *Bioskills* together when it was introduced. Three staff members in charge of the tutorial monitored progress, especially of those new to the computer environment to help them overcome their initial difficulties, e.g. in using a mouse and using a key-board. It was believed providing such assistance would allow the new users to use the programme effectively.

Of the sample of 61 students who used the package as part of the formative evaluation, a quarter were new users of computers. Although they struggled initially, with the help provided by the class tutors the difficulties reported diminished during the period. The eight students involved in the evaluation of *Bioskills* reported varied levels of computer skills and experience as listed in Table 7.1.

Table 7.1 is an analysis of the responses students provided during the interviews. It can be seen that most students were relatively experienced. Students with a question mark (?) in a cell did a computer literacy course at high school, which probably included spread sheets (although they did not confirm this). Student #1, being a repeat student, was more experienced than the others, given the time spent at the university. She said she had used computers for "… *the internet, projects, and …. personal things"* (Student #1, line 74). Student #5 (lines 70-71) said she used it for an International Computer Driving License programme, which involved learning "…. *the various applications of the computer".*

Two students had minimal computer experience. This was inferred from their responses to a general question posed during the interviews, "How long have you been using computers?" Student #6 (line 83) stated, "…*I did use computers before, but … we didn't use it … more often".* Student #8 (lines 56-57) responded, “*I wouldn’t say that I have been using it. But … you get computer games here, but nothing like I have a computer at my home to work something.*”

Table 7.1 Computer usage and experience of the eight students

Student number	Frequency of use at school	Length of experience	Purposes computers were used for					Home computer
			games	internet access	word processing	spread sheet	other	
# 1	Extensive	> 6 years		T	T	?	T	T
# 2	Extensive	> 3 years			T	T		
# 3	Frequent	3 to 4 years			T	?	T	T
# 4	Extensive	3 to 4 years		T	T		T	
# 5	Extensive	3 to 4 years		T	T	T	T	
# 6	Infrequent	3 to 4 years		T	T			
# 7	Frequent	2 to 3 years			T	T	T	T
# 8	Minimal	new user	T					

T = experienced

? = assumed experienced as they had completed a computer literacy course

I was concerned that these two students, who were relatively new to the use of computers, would not be able to keep up with their peers. As noted by Palaigeorgiou *et al* (2005), this situation could result in negative attitudes or negative responses to questions. However, my fears over their usage of the computers were allayed. Student #6 used the programme twice, whilst student #8 used it on three occasions.

7.4 THE METACOGNITIVE GAINS STUDENTS’ DERIVED FROM USING *BIOSKILLS*

As discussed on page 43 in Chapter 2, ‘metacognition’ is widely accepted to be made up of two components. The first is metacognitive knowledge[78] (what people know about successful learning and how it happens). Desautel (2009) refers to this as the “product” aspect of metacognition. The second component is metacognitive control (application of the knowledge). Various terms are used by different authors. Desautel refers to this as the “process” aspect of metacognition; Flavell (1979) calls it “metacognitive experience”; Case *et al.* (2001) refer to it as “metacognitive control”, and this is the term I chose to use.

Metacognitive knowledge is frequently tacit or held at the subconscious level and, according to Case *et al.* (2001), improving students’ metacognition includes helping learners to be more aware of their implicit beliefs about their own learning.

This chapter reports on the results of an investigation of the effectiveness of *Bioskills*. The purpose of this investigation, as reported earlier, and more succinctly phrased by Reeves & Hedburg (2003, p. 173), is to determine whether the programme “*accomplishes its objectives within the immediate or short-term context of its implementation”*. Reeves & Hedburg (2003) explain that when investigation of effectiveness of a package is done that “*hopefully*” there would be some degree of difference in terms

[78] Metacognitive awareness, which is a term used by Baird (1990) in explaining metacognition, is considered part of metacognitive knowledge in this discussion.

of knowledge, skills and attitudes before and after learners use a programme, and the focus of the investigation was to determine that difference.

In this section I am looking at the eight students' metacognitive gains after using *Bioskills* and will report on changes in both metacognitive knowledge and metacognitive control of learners. In practical terms, it is the difference in 'what they know' about factors influencing academic success, and differences in their "application of the knowledge of appropriate attitudes and behaviours" about effective learning practices.

The data analysed and discussed in the following section were generated from activity-based questionnaires 1 and 3 and the interview sessions, and were used to answer research question 3.

Research question 3:
What metacognitive gains did the students derive from using *Bioskills*?

7.4.1 Gains in metacognitive knowledge

In this section, my focus was on students' gains in metacognitive knowledge about factors affecting academic success, including attitudes and behaviours that students said they got from using *Bioskills*. The sub-question which explored the knowledge gain was:

Research question 3a:
What metacognitive knowledge do the students say they have about factors promoting academic success, before and after using *Bioskills?*

Whilst it would have been useful to do a comparison of students' knowledge of attitudes and behaviours affecting academic success before and after using *Bioskills* under a common sub-section, the use of different instruments to obtain the data made this difficult[80]. As a result, the knowledge reported before and after using *Bioskills* is first discussed separately, in most sections, before a comparison of changes is made.

Students' knowledge about factors affecting academic success before using *Bioskills*
In order to evaluate the influence of *Bioskills* on students' knowledge of factors influencing academic success. I began by investigating students' knowledge (of factors that promote academic success) before they used *Bioskills* to provide me with the necessary base-line data for comparison with students' responses after they used *Bioskills.* A list of statements on twelve behaviours was provided in activity-based questionnaire 1, with a Likert-format. The eight students expressed how strongly they agreed or

[80] Measuring a programme's success in pretest and posttest designs using similar or different instruments comes with different challenges. Even where statistical measures are applied there has been observed the lack of statistical significant differences between comparative studies (Russell, 2001). The observation, known as the "the No Significant Difference Phenomenon" (Russell, 2001; Reeves 2005) has been explained to be the result of the many complex factors involved in the analyses, which often are difficult to identify or let alone control or measure. A question that could be posed is if comparative studies have anything to offer researchers? Conger (2005, p 2) in response, states that "l*ike most research we can draw some conclusion despite inevitable flaws in study design and conduct; we simply need to be careful to account for those flaws in our interpretation of results*".

disagreed with each of the twelve statements which made claims about how behaviours affected academic success in activity-based questionnaire 1, by placing a tick in the appropriate box of a 5-item Likert-format response. Appropriate or inappropriate behaviours for academic success were determined based on what educational literature says about knowledge and practices which promote academic success. A total score per student was calculated based on appropriate (+) or inappropriate (-) practices for promoting academic success. Practices appropriate for promoting academic success were scored as *Strongly Agree* = +2, *Agree* = +1; *Not Sure* = 0; *Disagree* = -1; *Strongly Disagree* = -2. Statements about practices which do not promote academic success were scored in reverse order (*Strongly Agree = -2; Agree = -1; Not Sure = 0; Disagree = +1; Strongly Disagree = +2*).

Table 7.2 Students' knowledge of appropriate academic behaviours

		Student number							
		#1	**#2**	**#3**	**#4**	**#5**	**#6**	**#7**	**#8**
Work-habits	Setting academic goals and working hard to achieve them makes **no** difference to a student's mark*	0	2	2	1	2	2	2	2
	Successful students often read up on a topic before the lecture	1	2	1	0	2	2	2	1
	It is not important to attend all lectures as you can catch up later*	1	2	2	-1	2	2	2	1
	Taking complete and accurate notes in lectures is important for academic success	1	2	2	1	2	0	2	1
	Good students ask for clarification and help when they do not understand a topic	0	2	2	1	2	0	1	1
	Preparing for practicals beforehand makes **no difference** to how well students manage in the practicals*	1	2	2	-1	2	2	2	1
	It does not really matter if you hand work in a little late*	1	-1	2	2	0	2	2	1
	It does not matter if you leave the lab before finishing the practical because you can complete it later*	0	2	2	1	0	2	2	1
	Understanding what an assignment requires is important for getting a good mark	2	2	-1	1	2	2	2	1
Study habits	Setting aside a particular time to study, and sticking to that routine, affects academic success	1	1	2	1	2	2	2	1
	Preparation for the exams should start near the beginning of the term	1	2	2	-1	1	2	2	1
	Students who revise their lecture notes and make summaries to study from do better in exams	1	2	-1	0	2	1	1	1
"Lack of knowledge of appropriate behaviour" score		**0**	**-1**	**-2**	**-3**	**0**	**0**	**0**	**0**
"Knowledge of appropriate behaviour" score		**10**	**21**	**19**	**8**	**19**	**19**	**22**	**13**

*Practices which do not contribute to academic success

I have defined work-habits as regular academic practices used by students in their studies during the course of the year. Nine out of the 12 statements from a section in the questionnaire (see Table 7.2) were about work-habits. A number of students scored "+2" across most of the items. Out of the 96 possible responses (12 statements, 8 students), 50 responses (52%) were '*strongly*' in the right direction. This suggests many students already had appropriate metacognitive knowledge about such practices before using *Bioskills*. For example:

- *Setting academic goals and working hard to achieve them makes* **no** *difference to a student's mark* was '*strongly disagreed'* to by six out of eight respondents; '*disagreed'* to by one, and only Student #1 was '*not sure'* of its importance. This suggests that six out of eight students had appropriate prior knowledge of this work habit before using *Bioskills* and saw this behaviour as critically important. That many students had prior knowledge of this work habit suggests they are more likely to apply it to their studies if they are instructed to, or reminded of the efficacy of such behaviour to academic success in an instructional programme.

- *Attending all lectures* is an important practice if students intend to know what is taught and what is expected of them (Moore, 2003). Five students '*strongly disagreed'* to the statement that "*It is not important to attend all lectures as you can catch up later"*. From this negatively worded statement, it can be implied that the five students realized the critical importance of attending lectures. Two students saw it as important but did not realize just how important the practice of attending lectures is. This suggests that by informing students of the importance of lecture attendance lecturers could help them to become more committed and improve on their learning and chances of success (Moore, 2003). Simply telling students to attend lectures may not address the problem. The issue goes deeper, into what the students believe would help them to be successful, as noted by Fraser & Killen (2005). This has implications for student counsellors and tutors who may with the necessary 'empathy' (Case *et al.*, 2010), have to gain access into the beliefs and belief structures of students and encourage them to become fully encultured into the social practices of the discipline (Gee, 1996).
- *Preparing for practicals beforehand*. Five students "strongly disagreed" to the statement that *preparing for practicals beforehand makes* ***no difference*** *to how well students manage in the practicals*. In effect, these five students strongly agreed to the importance of preparation for improved performance in practicals.

For some practices, a small number of students were '*not sure*' of the importance of the behaviour in promoting academic success. About 10% (9 out of the 96 responses) showed a lack of certainty about certain factors in promoting academic success. Although these responses formed a small fraction of the total, there is the need to provide students with such missing knowledge of important practices. The long-term effect of the use of appropriate practices is to improve performance and increase throughput rates. These instances where students were '*not sure*' of such practices are pointers to areas *Bioskills* could target to help students to be more aware of the importance of such practices in promoting academic success. For example:

- *It does not matter if you leave the lab before finishing the practical because you can complete it later*. This statement, when stated in the positive sense, underscores the importance of students' managing available time effectively, and managing time is considered an appropriate work habit for academic success. Two students were unsure whether completing the work during the lab session was important for achieving academic success. It is important students know of the time-saving strategies at the university and use them to meet the many academic demands required.
- *Asking for clarification and help when you do not understand a topic* is considered an importance practice that leads to mastery of work (Karabenick & Knapp, 1991), yet two students were unsure of the efficacy of such a practice. This is more important when it is realized that Academic Development tutors are available for consultation to help students if they do not understand.

A few students *disagreed* that certain practices were important. I have interpreted this '*disagree*' as evidence of their lack of metacognitive knowledge. This lack of knowledge was not widespread and limited to one person in each of the following cases. Out of the 96 responses, there were only 6 negative scores. For example:

- *Understanding what an assignment requires is important for getting a good mark.* Student #3 "*disagrees*". Student #3 incidentally, due to poor performance in the first half of the year, deregistered from biology during the latter part of the third quarter.
- *Preparation for exams should start near the beginning of the term* is regarded as an important study habit. Examination preparation is complex, time-consuming, and involves coordination of a number of behaviours and resources (Van Etten, Freebern & Pressley, 1997). Some of the behaviours and resources involved in examination preparation include class attendance, keeping up with readings; using learning strategies, and managing time available. This makes it appropriate for students to start preparing quite early in the year. Student #4 was the only student who disagreed with the statement. This single response out of eight suggests there could be some students who may not start preparing for examinations early in the year and a persistent reminder by lecturers, what is termed *metacognitive pestering* (Birkenhauer, 2010), could help students to take the necessary action in time.

There were five students who did not select any inappropriate behaviours (Students #1, #5, #6, #7, #8). Three students (#2, #3 and #4), however, showed evidence of their 'lack of knowledge of appropriate behaviours' (see scores in Table 7.2). Such instances of students not having appropriate knowledge, although very limited, required that such gaps in knowledge be addressed. This specific knowledge of appropriate behaviours was catered for in the *Bioskills* programme.

In terms of total scores reflecting knowledge of appropriate practices Student #7 scored 22 out of 24 points, Student #2 obtained a score of 21 points, and there were three students (Students #3; #5; #6) who obtained 19 points. These scores suggest these students had the appropriate knowledge of success indicators for doing well at the university even before they started using *Bioskills*.

As a concluding summary, out of the 96 possible responses, students' beliefs were strongly in the "right direction" for 50 out of the 96 responses. Students' beliefs about 31 out of 96 behaviours, although in the "right direction" would suggest they did not seem to see how very important these factors were for academic success. Nine out of 96 (about 10%) of the responses suggested the lack of certainty about the role of knowledge of these factors in promoting academic success. Students' responses for 6 out of 96 answers were inappropriate. These last two groups of responses, i.e. those with lack of certainty about appropriate behaviours, and students whose beliefs were considered inappropriate, serve as immediate targets for remedial instruction, as discussed in more detail in Chapter 8.

Students' knowledge about factors affecting academic success after using *Bioskills*

Students who used *Bioskills* were asked, as they completed each section, to write down the new things they learned. This activity-based questionnaire 2 was to be handed back to me at the end of the third quarter of the year. Four students' responses about *Bioskills* were obtained (four students did not return them at the end of the period). I have taken this data as an indication of the four students' short-term gains since it gave some idea of the message they immediately gained from *Bioskills.* I differentiated this from the 'long-term gains' collected seven weeks after using *Bioskills*, obtained from the interviews and from their completing activity-based questionnaire 5.

Based on data from activity-based questionnaire 2, Table 7.3 shows the sections in *Bioskills* and what new things students said they learned after using *Bioskills*. The number of screens in *Bioskills* covering each section is shown in Table 7.3. The four students reported ideas from four out of the five sections. Items students' contributed, when ranked in terms of frequency, came from the following sections

- Improving work-habits (n=14)
- Challenges of 'varsity life (n=10)
- Factors affecting behaviour (n=6)
- Model to change behaviour (n=3)

Students' contributions of what they learned were not proportional to the number of screens in the sections but, I believe, to what seemed was important to them. Alternatively, it could be that as not all students reached the end, especially students who only used it once, and as such did not reveal they learned a lot new things from *Bioskills,* especially the later sections.

Important messages students learned from the *improving work-habits* section included; "*preparation before lectures"* mentioned by two students. This item was the only item mentioned by two students and suggested it was uppermost on their minds. Other work-habits, contributed by single individuals, were: " *attending lectures, reviewing lecture notes, learning more from the library, asking questions, working hard, working in groups, having good studying environment, setting a time table* and *techniques for reading* such as *skimming, SQ3R*[81]*, MURDER*[82].

Whilst some students claimed to have learned new work-habits from *Bioskills*, some students said in the interview they learned them from other sources. As noted by Student #2 when asked during the interview about her source of information:

> *I: Are you suggesting you got this from using Bioskills?*
> *R: Ja. Some of them I got it here, but some of them I was told by my sister.*
> (Student #2 line 185-186)

The next section of *Bioskills* students said, in the activity-based questionnaire, they learned much from was the *challenges of 'varsity life* (shown in Table 7.3). It deals with views of lecturers and students about factors that contribute to academic success. For example:

> "*I learnt about other peoples' opinions towards success and failure*" (Student #1)

[81] Acronym for Summarize, Question, Read, Recite, and Review, a study system, used in *Bioskills.*
[82] Acronym for Mood, Understanding, Recall information, Digest it, Expanding and Review (Dansereau *et al* , 1979)

Table 7.3 Outline of what is in *Bioskills* and what students (n=8) learned on first using *Bioskills*

Section	No of screens	Sub sections in *Bioskills*	Student numbers							
			#1	**#2**	**#3**	**#4**	**#5**	**#6**	**#7**	**#8**
		Numberr of times student used programme	**3x**	**1x**	**1x**	**4x**	**4x**	**2x**	**1x**	**3x**
Home	**8**									
Challenges of 'varsity life	***12***	*'Varsity life (an exciting experience; social environment)*		1			1			
		Academic activities (as a science student, end of year pass rates)								
		Factors affecting academic success (attitudes, work-habits)								
		Views of lecturers suggesting the importance of (taking good notes; being able to listen and understand)	1		1		1			
		Summary of views on success (having good work-habits, having positive attitudes to studies, knowing how to learn effectively, applying advice on effective learning)	1							
		Behaviours which affect academic success (setting goals for year, drawing-up a study time table; managing work loads)	1		1		3			
Factors affecting behaviour	***17***	*The importance of academic behaviour (importance of intentions on behaviour)*			1		1			
		Factors affecting intentions (exercise on attitudes, perceived behavioural control, locus of control)	1				2			
		Recognizing your current strengths and weaknesses	1							
Improving work habits	***12***	*Improving work-habits (importance of work-habits*		1						
		Setting goals to improve work-habits (SMART tips, motivation to achieve goals)		1			1			
		Preparation for success (managing your time preparing for lectures, processing information, preparing for practicals, preparing for tests)		2	1		4			
		Learning how to learn			1					
		Some useful web sites			1		2			
Model to change behaviour	**11**	*How behaviour changes*	1				2			
		Stages of behaviour change								
		Where are you in the change process?								
		Final word								
Frequency of statements written			**6**	**5**	**6**		**17**			

Although the above statement was in the right direction, the statement did not give much detail and lacked depth. Another student wrote she learnt:

> "…*Students balancing there (sic) academic life and social life*" (Student #3).

In terms of what she learned, the message of Student #3 does not come out clearly. The lack of depth to the message could be attributed to this students' general poor communication abilities in English language.

Students' comments relating to *factors affecting behaviour* in the section, although not many were contributed in slightly higher frequencies than others were. Three students said they learned about locus of control, an important concept in the theoretical framework, influencing behaviour. For example, "*I learnt about locus of control [where mine lies]* (Student #1)

"*I have a strong internal locus which I should use to my advantage in 'varsity*"
(Student #5)

The point of view of Student #5 about her locus of control is interesting given the fact that she exhibited some *external* locus of control features, such as shifting blame onto others and citing external events causing her poor performance in the second quarter of the year. That she had read about locus of control in *Bioskills* is important, as it will, hopefully, give her a better understanding of the role beliefs play in academic achievement.

Two students said they learned about motivation and the relationships that it entailed.

"*Motivation equals desire and action to achieve it"* (Student #5)
"Motivation = desire + action" (Student #1)

Students have often misconstrued motivation as simply a desire. This view does not lead them to accomplish their set goals. It is important that they see motivation not only as a desire but also with accompanying actions to achieve their goals.

There were items students said they learned about which included behavioural intentions, behaviour change and work-habits.

"*Attitudes, subjective norm and perceived behavioural control affect the intention to act*"
(Student #1)

"*3 factors influence behavioural intention*" (Student #5)

"*Behaviours can affect your academic results, so you have to make sure that your behaviour doesn't affect you anyhow*" (Student #3)

These comments indicate that these students found the thrust of *Bioskills* message.

Finally, students' wrote things they learned relating to the section on the *model to change behaviour*. Having appropriate knowledge about steps involved in behaviour change is important and should help students who need to change their behaviours. Student #5, for example, said she learned about the five stages of behaviour change explained in *Bioskills*. This is a pointer to how meticulous she was in using *Bioskills*.

"Precontemplation → contemplation → preparation → action → maintenance
It is important to adopt new behaviours and maintain positive change". (Student #5)

The information elicited from these students is wanting in two respects. Due to the small size of the sample, and the low frequency of the ideas contributed, trends could not be established of the types of knowledge students obtained from *Bioskills*. Secondly, the information provided related to what students said they learned just after using *Bioskills*. It would be appropriate to find out what they remembered in the longer term in order to evaluate the contributions the use of *Bioskills* made to their knowledge.

The data on what was remembered seven weeks after using *Bioskills* was gleaned from the interviews. The eight students related these during the interviews as the important messages they got from *Bioskills* and these were considered as students' long-term memory account. I did not probe to extract details of students' recollections because at that stage I was trying to elicit students' opinions of the package, and was not focusing on what they could remember.
Table 7.4 is a summary of what is in *Bioskills* and the metacognitive knowledge students remembered (during the interviews). I am assuming that if they can recount what was in the package, then they have metacognitive knowledge. As a group, references students made to some of the content tended to be sketchy in detail. Students recalled items from two out of the six sections of *Bioskills* (e.g. *Challenges of 'varsity life* and *improving work-habits*). The lack of information about the other sections was worrying when *Bioskills* also focussed on affective factors and helping students to learn about appropriate attitudes to use in their studies.

Students who had used the programme on three or more occasions (#1, #4, #5, #8) seem to remember more from the programme. Except for Student #1 their contributions during the interviews tended to be more detailed. An example of 'detailed information' comes from Student #8, who used the package on three occasions:

> *"Cause the first time I used it, it actually told me the good side of the university, the part … like registering … like O-week. And it makes you want to buy in your first-year experience. Okay. That is one of the main reasons that you come to university … freedom and whatever. And then it concentrated more on the part about the … lectures and how to get through the lectures. It helped you".* (Student #8, lines 72-76)

Student #8 was referring to the perspective on registration week the package gave and the insights it provided on how academic activities were conducted at the university and the need for students to work hard from the start of the year.

Student #1, who also used the programme on three occasions, recalled during the interview the relevance of the information *Bioskills* provided:

> *"When you get here no one tells you that "okay. This is the amount of time you're supposed to spend on this subject … or a certain subject … and how preparation is important" because in high school you could get away with everything, you know? If you don't prepare, you still pass".* (Student #1, lines 104-106)

These detailed views are in contrast to what Student #3, who used the programme once, recalled:

> *"Okay, it is telling you about 'varsity life and how you should handle it. That's what I liked about it". (Student #3, line 114)*

Table 7.4 Outline of what is in *Bioskills* and what students (n=8) remembered during the interview

Section	Sub- section in *Bioskills*	Student number							
		#1	**#2**	**#3**	**#4**	**#5**	**#6**	**#7**	**#8**
	Number of times student used programme	**3x**	**1x**	**1x**	**4x**	**4x**	**2x**	**1x**	**3x**
Challenges of 'varsity life	*'Varsity life (an exciting experience; social environment)*	v		d		d			
	Academic activities (as a science student, end of year pass rates)			f	v				d
	Factors affecting academic success (attitudes, work-habits)								d
	Things lecturers mentioned as important (taking good notes in lectures; being able to listen and understand what is said, studying every day etc.)		v						d
	Summary of views on success (having good work-habits, having positive attitudes to studies, knowing how to learn effectively, applying advice on effective learning)				d				
	Behaviours which affect academic success (setting goals for year, drawing-up a study time table; managing work loads)								
Factors affecting behaviour	*The importance of academic behaviour (importance of intentions on behaviour)*								
	Factors affecting intentions (exercise on attitudes, perceived behavioural control, locus of control)								
	Recognizing your current strengths and weaknesses	d							
Improving work-habits	*Improving work-habits (importance of work-habits*	v							v
	Setting goals to improve work-habits (SMART tips, motivation to achieve goals)					d			
	Preparation for success (managing your time preparing for lectures, processing information, preparing for practicals, preparing for tests)	v					f		
	Learning how to learn				d				
	Some useful web sites				v	d v			
Frequency	*Vaguely worded information*	**3**	**1**		**2**	**1**			**1**
	Detailed information	**1**		**1**	**2**	**3**			**3**
	Information falsely attributed to Bioskills			**1**			**1**		

v = vague; d = detailed, f = information falsely attributed to *Bioskills*

Student #3 seemed to have learned things from the early sections about 'varsity life and she seemed not to have learned much from the later sections of the programme.

The other section of *Bioskills* from which students said they learned new things from was on "*Improving work-habits*". There was a pattern in terms of things learned. Those who used the programme three or four times reported more detailed information in the interviews than those who did not, as seen in the accounts of students #4, #5 and #8. Student #5, who used the programme four times, recalled:

> *"But there was … like ... some new stuff about how you internalize stuff that was new. And the different types of reading … how you should actually read, like using the acronym for MURDER.. That was different".* (Student #5, lines 108-110)

Student #5 said although some of the information presented, such as making summaries, was familiar to her there was, however, some new type of reading for comprehension and retention, with the acronym MURDER[84] (see Dansereau *et al.*, 1979) which she learned.

Two students who did not use the programme more than twice made inaccurate claims about what they learned from *Bioskills*. For example, Student #3, who used it once, thought *Bioskills* was about:

> *"How you should behave. Don't go to parties. Study. These are the things people tell you all the time".* (Student #3, line 126)

Bioskills highlighted the opportunities for social outings and certainly did not say they should not go to parties. The opinion *Bioskills* offered was that students should make sure they led a balanced life style, as mentioned on screen #10: *However, maintaining a balance between your academic work and social activities is important if you are to graduate and get your degree.*

Student #6, who used *Bioskills* twice, said:

> *"…the things that you wanted to know are from the start like for the first thirty minutes I think that is … important that you have to learn."* (Student 6, lines 116-117)

The programme attempted to raise awareness of factors that influenced academic success, and encouraged attitude and behaviour changes where students' behaviours were not in accord with education literature. *Bioskills* required more than 30 minutes to read and complete. The student was therefore making an assertion that was not based on what was in *Bioskills.*

Six screens of *Bioskills* were on attitudes and how they affected academic behaviour. In the sample of eight students, only three (Student #1, Student #2, and Student #7) said they learned things on attitudes during the interview, although they did not provide much depth about them. For example, Student 1 said:

> *"…. there was a section that talked about how having negative attitudes actually affects the way you work, and how you see things, and the results you get".*
> (Student #1, lines 212-214)

Student #7 said he learnt not to give up on difficult material:

> *"You should always be positive in everything you do, like ... never say "that is too hard for me to do" 'cause you never know. That is one of the things I learned from changing your attitudes towards something".* (Student #7, lines 199-200)

Student #2 claimed:

> *"… it helped me to have positive thoughts, and to be a positive person about my studies … in the university".* (Student #2, lines 106-107).

[84] The steps in MURDER include setting the **mood** to study; reading for **understanding; recalling** the material without referring to the text, amplifying and storing the material to **digest it; expanding** knowledge for self-enquiry; **reviewing** mistakes.

This apparent paucity of comments on attitudes by respondents may not necessarily be a poor reflection of the impact *Bioskills* as a programme but could be as a result of the researcher's lack of probing. Reeves & Hedburg (2003) claim people often find it difficult after they have used programmes to report on attitudes, and tend to be discreet about it. As a way to address this paucity of information, students may, in subsequent revisions of *Bioskills,* need to be specifically questioned about their attitudes.

Discussing the effectiveness of *Bioskills* with data limited to eight respondents presents difficulties in judging or making inferences about a larger population. Results would be more convincing from a larger sample. As a result, data from a larger population of first-year students (n=53) using *Bioskills* the following year are presented. These students, as they worked through *Bioskills* responded, to items from an activity-based questionnaire which asked them to write down the new things they learned from each section after using the programme. Table 7.5 shows the results grouped as *important messages, affective factors* and *appropriate behaviour*s.

The most frequently mentioned items (contributed by at least ten percent of the sample) were about:

- the importance of maintaining a balance between academic and social goals (n=29; 54.7%)
- positive attitudes are important for success (n=25; 47%)
- attitudes affect academic behaviour (n=13; 24.5%)
- setting long term and short term goals (n=13; 24.5%)
- intentions drive a person to perform or succeed (n=12; 22.6%)
- Motivation leads you to achieve (n=7; 13.2%)
- It is important to accept responsibility for success and failure (n=7; 13.2%)

Compared with the new things the eight students learned (Table 7.3) the larger sample mentioned, and with higher frequencies, various factors such as attitudes, intentions and setting of goals that influenced academic success. The larger sample also pointed out messages from *Bioskills* which the case-study sample had not listed.

For example:

- Use advice on effective learning (n=8)
- It is important to be aware that the pass mark is 50% (n= 4)
- Understanding the differences between high school and 'varsity work is important for success (n=3)

It is important that students understand the demands the new university environment places on them in contrast to high school if they are to be successful. The advice on effective learning provided by experts in *Bioskills* are strategies and skills students could apply to their studies. These included learning to *take good lecture notes, being able to listen and understand what the lecturer says*, and *studying every day at regular hours*. In effect, it is the responsibility of students to be aware of such strategies and use them in their studies.

Table 7.5 Summary of what students (n=53) learned immediately from using *Bioskills*

IMPORTANT MESSAGES	frequency	%
Use advice on effective learning	8	15.0%
It is important to be aware that the pass mark is 50%	4	7.5%
Understanding the differences between high school and ‘varsity work is important for success	3	5.7%
Adapting and adjusting to ‘varsity life is important	3	5.7%
AFFECTIVE FACTORS (BELIEFS AND ATTITUDES)		
Positive attitudes are important for success	25	47.0%
Attitudes affect academic behaviour	13	24.5%
Intentions drive a person to perform/succeed	12	22.6%
Motivation leads you to achieve	7	13.2%
It is important to accept responsibility for success and failure	7	13.2%
Taking responsibility for your learning	6	11.3%
Having interest in a chosen course is important	6	11.3%
Beliefs (perceived behavioural control and subjective norms) influence behaviour	5	9.4%
APPROPRIATE BEHAVIOURS (WORK-HABITS)		
Maintaining a balance between academic and social life	29	54.7%
Setting goals (short- and long-terms goals)	13	24.5%
Attendance		
Attend (all) lectures	5	9.4%
Attend all pracs	1	1.9%
Attend all tuts	1	1.9%
Preparation		
Prepare for pracs	3	5.7%
Prepare for lectures	3	5.7%
Concentrate at lectures	4	7.6%
Take good notes	4	7.6%
Ask questions to clarify doubts	6	11.3%
Read your work regularly	2	3.8%
Do extra reading from textbooks	2	3.8%
Managing activities		
Keeping up to date	6	11.3%
Planning in order to be successful	5	9.4%
Using a study time-table	5	9.4%
Being organized	3	5.7%
Form learning groups for discussion	3	5.7%
Use the right strategies and behaviour can lead to success.	3	5.7%
Change ineffective behaviour and use new behaviours if you want to succeed	4	7.6%
Managing time effectively	2	3.8%

7.4.2 Gains in metacognitive control

Metacognition is not only a product (metacognitive knowledge) but also a process (Desautel, 2009). The ‘process’ component of metacognition is what I have explained as “what is done with the knowledge” or the application of such knowledge to learning situations. I have called the process aspect “metacognitive control” as it is self-explanatory and offers brevity.

Research question 3b:
What metacognitive control (application of metacognitive knowledge) did the students say they use before and after working with *Bioskills*?

In answering this question, I will be discussing four areas, which I call "factors," prior to working with and after going through *Bioskills,* where students applied the control.

FACTOR 1: Metacognitive control in implementing behavioural intentions

As part of determining the gains in students' metacognitive control, and also to evaluate the effectiveness of *Bioskills* in terms of *affect* and academic behaviours, I determined changes in students' intentions before and after the use of *Bioskills*. This is because, as Ajzen & Madden (1986) explain, intentions are key determinants of behaviour. If goals or intentions are not made explicit one may not be able to judge or accurately assess any behaviours that follow.

Implementation of behavioural intentions before using *Bioskills*

Students were provided with a list of statements on academic intentions in activity-based questionnaire 1 and asked to tick "*Yes"* or "*No"* only boxes which applied to them. The methods were outlined in Chapter 6, Figure 6.7 page 152.

Table 7.6 is a summary of the eight students' intentions at the start of the year, and a visual presentation of the intentions that were kept (as shown by the shaded boxes). It can be noted from Table 7.6 that at the beginning of the year all eight students said that they intended to *work hard from the start* and *to hand all work in on time*. Seven students intended *to attend all lectures and practicals* and six students intended to file notes regularly. Four out of eight students planned to *rewrite notes after lectures.* Half of the students (50%) did not plan *to rewrite notes after lectures.*

Thus, even before using *Bioskills* most students intended to follow the five appropriate behaviours asked about in the activity-based questionnaire. I must say of the five appropriate behaviours *rewriting of notes* may not be considered appropriate unless notes are sketchy.

Out of the five items listed (Table 7.6) the first three were 'easy to implement' and the other two were 'not so easy to implement'. The last two which were neglected could possibly impact on their performance.

If *Bioskills* is to be helpful to students, it would have to target these 'not so easy intentions', and help students take it upon themselves to accomplish their intentions as early as possible in the year. It is also important students note the consequences of ignoring them. Ajzen (1991) states that individual's perceived behavioural control must be strong enough to accomplish their planned intentions, which suggests students may have to be encouraged to see the importance of intentions and to take more control.

Understanding students' reasons for non-compliance may be necessary in order to structure any intervention. This section deals with students' attendance at lectures and preparations for practicals and identifies reasons why the intentions were not implemented.

Table 7.6 Summary of students' academic intentions at the start of the year

Items in questionnaire	**Intentions at start of the year**									**Intentions kept**
	Student #1	Student # 2	Student #3	Student #4	Student #5	Student #6	Student #7	Student # 8	**Total**	**Total**
I intended to file my notes regularly	T	T	T		T	T	T		**6**	5
I planned to attend all lectures and pracs	T	T	T	T		T	T	T	**7**	6
I intended to hand all work in on time	T	T	T	T	T	T	T	T	**8**	7
I planned to work hard from the start	T	T	T	T	T	T	T	T	**8**	2
I planned to rewrite my notes after lectures	T	T	T	T	x	x	x	x	**4**	0

T= indicates students ticked "Yes"
x = indicates the students ticked "No"
Blank spaces denote no data was recorded
Shaded boxes indicates students did carry out the intention

Six students' answers during the interview sessions on lecture attendance contradicted results in Table 7.6. The question posed to the eight participants during the interview was: *what percentage of lectures would you say you attended during the first semester?* Six students said they missed few lectures with their lecture attendance varying from 80% to 95%. Student #2 said she attended all lectures for the first block but could not attend all in the second block.

Three students who missed lectures gave the following reasons during the interviews and these provide possible reasons why some students did not attend all lectures.

The reason one student gave for skipping lectures was pragmatic:

> "*Cause I was far behind, so … I thought if I missed lectures I would catch up, but only to find that I have a lot to still catch up with".* (Student #2, lines 20-21)

Pragmatic reasons for skipping lectures in the end do not help students to meet their academic goals of being successful. This student did not realize she would have to find time outside lecture periods to catch up if she missed lectures. Students have to be aware that copying notes from friends or seeking their explanations for topics missed may not be accurate or adequate when compared to those given at lectures.

Two students' reasons for missing lectures showed deep underlying attitudinal problems:

> *"Those would be the ones in the morning … I found that I am asleep … and couldn't get to school on time".*
>
> (Student #1, line 28)

> *"Sometimes I didn't feel like going to lectures because … sometimes I didn't hear what the lecturer was saying … especially when we were doing … um … DNA".*
> (Student #3, lines 29-30)

It could be deduced that Student #3, in relation to beliefs, about attending lectures is at the contemplation stage in behaviour change model (Figure 5.3). Missing lectures is not helpful for students (Romer, 1993; Moore, 2003). Reasons which show underlying negative attitudes students have for skipping lectures need to be dealt with (Friedman, Rodriguez & McComb, 2001) and corrected right at the start of the year, especially for those at risk of failing. *Bioskills* provided views from academics on the importance of attending lectures and good lecture note-taking habits which could help students cope with the increasing amount of work experienced at the university.

Implementation of behavioural intentions after using *Bioskills*

The eight students were asked during the interview seven weeks after using *Bioskills* about academic goals they had set for themselves. This question was based on an activity in *Bioskills*, and I have used this as an indication of their intentions and goals after using *Bioskills*. Students were also asked *how serious were you when you set those goals?* Students' responses enabled me to comment on the changes in their awareness of this behavioural intention of goal-setting. Seven of eight students said they were serious in their setting of goals and worked hard at implementing the goals set. But there were mixed results in their ability to follow through their intentions. For example, there were those who were able to set goals after using *Bioskills*.

> *"It* [*Bioskills*] *helped me to set goals that are more specific"….* (Student #5, lines 187)

She went on to provide reasons about herself why she needed to implement the goals:

> R: *... Because I am a goal-orientated person. So I am not gonna set something that I am not going to try and achieve.*
>
> *I: And are you putting in any effort to achieve?*
>
> *R: Umm … at the moment … I could have been putting in more. So its like I've just gotta sort myself out. I mean … I am putting in … like I am attending lectures. And I'm going over my lecture notes, but I know it is not enough. I know I have gotta like actually take out the text-book and consolidate, and … like I am going to ADP but I must just make time to actually go through the ADP questions before we do with our tutor.* (Student #5, lines 118-124)

She seemed to have implemented a number of new behaviours and was working to follow through her goals and intentions. Student #5 had, before using *Bioskills*, intended to attend all lectures but did not (see Table 7.6). From the interview, she said that in block 3 she attended all lectures, read over her notes and realized she still needed to consolidate those that were sketchy. She was aware she was not working at her optimum and needed to do more.

Another student stated:

> R*: I work hard and consulted where I did not understand. And I did all my tutorials. ….*
>
> I*: Alright. Now let's move on. You tell me you have achieved all your goals. Alright. Now, let's now discuss how you carried out your intentions for Block 3. Umm … How did you follow through with your intentions?*
>
> R*: Well. One thing that helped me to achieve my goals … or do them as I said I would ... in my room I have this … I made a page and I have put it at the back of my door. It*

contains the results from my first block and my second block. Every time when I look at that page I feel bad and it makes me to work hard. (Student #2, lines 124-129).

She is trying to accomplish her goals and has an item to motivate and to pep herself up to do better. A third student, a repeat, is more determined than before and had this to say:

R: *Umm …I would say very serious … because last year I had goals and I didn't see them through. So this time I actually want to make sure that I achieve what I want.*

(Student #1, lines 128-129)

One student started implementing the instruction on setting goals from *Bioskills* and following them but could not continue for long:

I: *Okay, when you set those goals, how serious were you about trying to achieve them?*

R: Yes. [laughs] I tried for the first week, and then I fell back … on my bad self.

I: Uhum. Did you take any action again?

R: No. I didn't again.

I: Now, do you think there were benefits from setting goals?

R: Yes. Definitely. There is benefits from setting goals. You just have to ... it's not just the setting of the goals; it's actually going after the goals. Actually, doing the goals, not just setting them. (Student #4, lines 105-111)

This student after experiencing a setback in his intentions, claimed he did not pick up from where he 'fell'. Although the results indicate students were aware of the importance of setting goals and carrying out their intentions, two students gave up on this. Velicer, DiClemente, Rossi & Prochaska (1990), in the theory of behaviour change, set out the stages involved in accomplishing permanent behaviour changes and suggest ways for dealing with relapse. Results of students after the use of *Bioskills* are similar in some respects to those reported in the first quarter of the year. This suggests *Bioskills* could still be refined to help students set goals which could be properly followed through the year.

FACTOR 2: Metacognitive control of behaviours promoting academic success

Implementation of appropriate behaviours before using *Bioskills*

Although students may have knowledge of appropriate work-habits, they may or may not apply such knowledge in their studies. The activity reported in this section was to help students reflect on how much they applied their knowledge of factors promoting academic success during the first half of the year (prior to using *Bioskills*) and to generate data to help me understand their practices. Reflection could induce metacognitive experiences which would lead to metacognitive development, as suggested by Desautel (2009). The twelve items on work-habits in Table 7.7 were part of activity-based questionnaire 1, in which students reflected on how they learned before using *Bioskills*. The instruction to the question was: "*Carefully read the following statements. Place a tick in each of the boxes that you think apply to you. You may tick more than one option in each case".* Each option to a statement for the research purposes was scored either as +1 (appropriate) or as -1 (inappropriate). The total number of appropriate and inappropriate behavours selected by each student were determined, which gave an indication of the extent to which they applied appropriate behaviours before using *Bioskills*. Additional evidence on students' behaviours was also gleaned from the interviews.

Out of the 132 possible responses[85] from the eight students, 88 (67%) were considered, based on research literature, to be appropriate practices enabling academic success. There were 44 out of 132 practices (33%) ticked which were practices unlikely to result in academic success. For students to be successful, they would have to be made aware of inappropriate behaviours and to take it upon themselves to apply practices that are more appropriate.

There were specific practices in which all students ticked the *appropriate* responses and scored +1, suggesting no remediation would be needed. For example:

> ***Studying for tests and exams.*** All the students ticked "*used textbooks and lecture notes"* in studying for tests and exams. This indicated they were aware of the importance of both sources of information and made use of both. This practice may therefore not need much emphasis in *Bioskills* .
>
> ***Completing and handing in work on time.*** Completing an assignment to the best of students' ability and handing in the work on time is considered one of the yardsticks to measure a successful university student (University of Cape Town, 2004). Would-be successful students are expected by academics to consider it their responsibility to ensure that tasks are handed in on time. This would be part of students' accepting responsibility for their own learning. All the eight students ticked *on time* which suggested they handed in work on time even before using *Bioskills*.

There were items in the questionnaire with two or more appropriate options. However, most students only ticked one of such options, which suggested either that they applied only one of the many appropriate practices before they used *Bioskills* or that they had not read the questionnaire instructions that they could tick more than one response carefully. Not practicing the other appropriate behaviours could have a negative effect on students' performances. For example:

> ***Regarding work during the term***: Out of the nine responses, only three options were each applied at least two times. Two important options that were ticked by only one student were "*started working when the term started*" and "*rewrote notes after lectures"*. "*Setting goals"* and "*drawing up a study time table"*, which were two of the options ticked, are motivational strategies that keep students focused. Less than half of the sample did not tick those behaviours, which suggested they were not sure of their importance. It is therefore important that students are reminded of such motivational strategies that promote academic success. Rewriting sketchy notes and updating the content, may be considered an appropriate practice. But rewriting notes *per se* is often time-wasting (Cook Counseling Centre, 1994). One desirable practice, for academic success, which was not ticked by any of the respondents was *I usually read over work before lectures.*

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[85] These were counted based on the total appropriate responses the literature reviewed indicated for the questionnaire items.

Table 7.7 Students'(n=8) reflections on their work-habits for the first half of the year (before using *Bioskills*)

Statements	Options	Student number							
		#1	**#2**	**#3**	**#4**	**#5**	**#6**	**#7**	**#8**
I started preparing for exams	near the start of the term								
	about two weeks before exams		+1	+1			+1		
	about a week before the exams				-1			-1	
	a few days before the exams	-1				-1			-1
To help me remember lecture notes	I summarized the work in point-form	+1		+1	+1	+1	+1		+1
	I made mind maps to study from					+1	+1	+1	
	I wrote notes a number of times								
	I read the work many times over	+1	+1	+1		+1			+1
When topic was boring	I just kept working until I finished								
	I spent less time on that section	-1		-1	-1	-1			
	I left the section out						-1		
	I worked harder		+1					+1	+1
When the topic was difficult	I tended to give up studying it	-1			-1	-1			
	I studied only the easy parts			-1			-1		
	I asked friends for help						+1		
	I asked the lecturer for help								
	I went to ADP	+1	+1		+1			+1	+1
Regarding practicals	I missed one of more practicals								
	I missed one or more pre-lab tuts								
	I usually read the pracs before hand	+1	+1	+1		+1	+1	+1	+1
	I sometimes left pracs early					-1			
	Sometimes I arrived late						-1		
Regarding tutorials	I attended all the required tuts	+1	+1	+1		+1	+1	+1	+1
	I missed one or more tuts								
	I usually did all the tasks								
	I often asked questions in tuts				+1	+1			
Regarding lectures	I missed one or more lectures			-1	-1	-1	-1		-1
	I was sometimes distracted in lectures	-1	-1		-1	-1			-1
	I sometimes chatted to friends and didn't listen to the lecturer			-1	-1	-1			-1
	I sometimes sent or received SMS's during lectures				-1	-1	-1		
	Sometimes I was late for lectures	-1		-1	-1				-1
Regarding work during the term	I started working when term started							+1	
	I usually read over work before lectures								
	I usually rewrote my notes after lectures								+1
	I set goals at the start of the term	+1	+1			+1		+1	
	I drew up a study time-table	+1		+1		+1			
I usually completed and handed in work	On time	+1	+1	+1	+1	+1	+1	+1	+1
	Slightly later						-1		
	Very late								
I prepared for each practical I attended by	Reading the lab manual	+1		+1		+1	+1		+1
	Reading the manual and find relevant diagrams							+1	
	Attending the pre-lab tutorials	+1	-1	+1	+1	+1	+1	+1	+1
	Bringing reference books to the tut		+1						
When I read the textbook	I asked my self questions to make sure I understood		+1						
	I usually made notes as I read	+1		+1	+1	+1	+1		+1
	I tended just to skim read						-1	-1	
	I read thoroughly								
When I studied for tests and exams	I used only my notes								
	I used only my textbook								
	I used textbook and lecture notes	+1	+1	+1	+1	+1	+1	+1	+1
	I made my own notes to learn from								
TOTAL SCORE	**inappropriate (-)**	**-5**	**-2**	**-5**	**-8**	**-8**	**-7**	**-2**	**-5**
	appropriate (+)	**12**	**11**	**11**	**7**	**13**	**11**	**11**	**12**

Preparing for exams: Educationists, such as Entwistle & Entwistle (2003), have pointed out that preparations for examinations should begin early in the academic year. In their preparations, students should seek clearer understanding from their lecture notes, practicals and other learning experiences which impact on their examination performance. None of the eight students, according to the options ticked, *started preparing for exams near the start of the term*. Three students only started preparing for exams about two weeks before the exams, and two just a week before the exams. Students needed to work consistently the whole term and not wait until a week or two before exams. It is paramount that this information is highlighted in any instruction that seeks to help students improve on their academic performance.

There is a possibility students could have interpreted preparation for exams differently. It could mean the final preparation. However, there is anecdotal evidence from my observation that students have not realized that preparation for exams at university often takes longer than those they experienced at high school.

To help me remember lecture notes: Students ticked one of the appropriate responses more than others in this item too. For example, six students said they *summarized the work in point form*, three students *made mind maps to study from*, whilst five said they *read the work many times over*. Mind mapping, which was used by three students, is recommended in the literature as a strategy for visual learners to use, as it promotes active construction of knowledge and meaningful learning. In addition, the use of mind maps and the presentation of information verbally promotes greater learning of information, and this is based on the dual-coding theory of Paivio (1986).

There were statements with options which gave indications of underlying negative attitudes and which had been acted on by the students before using *Bioskills*. Attitudes may predispose individuals to act either appropriately or inappropriately (Shrigley, 1983; 1990). As a result, students' negative or inappropriate attitudes needed to be pointed out to them and they need help to correct them.

When the topic was boring: Five students indicated that they either *spent less time on that section* or *they left that section out*. Such behaviours do not help students to master the subject. It was encouraging that three students indicated *they just kept working until they finished* or *worked harder*. This portrayed a higher level of self-efficacy, which could promote a higher level of academic performance. Such behaviour should be emulated and practiced by students if they are to do better.

***When the topic was difficult*:** Three students tended to give up studying when the topic was difficult, and two said they studied only the easy parts. Perceptions influence intentions and impact on academic behaviour. When students' perceptions are negative and inaccurate they must be shown how to work on such perceptions to achieve more positive results. A positive attitude-related behaviour practiced by five students was *I went to ADP*[86] (Student #1, #2, #4, #7 and #8). Incidentally, only two of the students who said *when the topic was difficult I gave up studying* used this facility. Seeking help in order to master a topic is considered an appropriate mastery-

[86] Academic Development Programme tutorials

orientated behaviour (Hidi & Harackiewitz, 2000) which should stand students in good stead to be successful.

There was some contradiction, however, in the number of students reported above who actually attended ADP prior to using *Bioskills*. Three students, rather than five, indicated during the interviews they attended the ADP sessions in the block prior to their use of *Bioskills.* My interpretation is that the other two students, although they attended, were not regular attendees or gave wrong information. Unfortunately, registers were not available to ascertain if the other two students did attend ADP prior to using *Bioskills*.

Attending lectures was one particular behaviour-related item where seven students showed inappropriate behaviours prior to using *Bioskills*. These included those students who:

- missed one or more lectures (n=5)
- were late for some lectures (n=4)
- were distracted during lectures (n=6)
- chatted to friends during lectures and did not listen to lecturer (n=5)

Although the options offered in the questionnaire did not contain any appropriate behaviours, by ticking these inappropriate options students indicated they practiced such behaviours prior to using *Bioskills*. These practices do not augur well for successful academic work. This is because they do not create the atmosphere for students to listen to and engage with what the lecturer says, or to concentrate to make complete notes. Such behaviours indicate a deep underlying attitudinal problem.

Preparation for practicals is considered a requisite for successful outcomes at university (see Davidowitz & Rollnick, 2003). They state academics require some form of advance preparation by undergraduate students before the laboratory sessions is essential. These preparations are to help students make better links between the laboratory activities and the material covered in lectures (Domin, 2007). In the biology class at this university students are expected to read their lab-manual, and other relevant texts, and attend a pre-laboratory session before attending the practical session. Such preparations would allow students' to better manage the information and time spent in the laboratories, as noted by Davidowitz & Rollnick (2001; 2003).

All students except one ticked attended the prelab tutorials (Table 7.7). During the interviews, all the eight students responded that they prepared for their practicals by reading lab schedules and going for pre-lab tutorials even before using *Bioskills.* As noted from these two students before using *Bioskills*

I: *Uhum. Uhum. Okay. What about the practicals?*

R: *Yes, I prepared for those*.

I: *How did you prepare?*

R: *I read through the practicals, make sure that I understand the questions that were asked, and knew exactly what I needed to do during the lab.*

(Student 4, line 27-31)

One student went further in his preparation:

> I: *Okay. Now what about the practicals? Did you ever prepare for practicals? This is the first semester.*
>
> R: *Ja, I did. Because during the first semester … if my memory serves me well …we had to do pre-labs tuts and everything, so we had to read before tuts, and everything.*
>
> I: *Alright. How did you go about preparing for the practicals?*
>
> R: *I read the lab manual. If it says you should read references, I sometimes went to the library to look for the references … and did everything right.*
>
> (Student #7, lines 32-37)

It can be seen that when academics insist on good practice, as in the above situation, students are likely to comply.

A different behaviour is noted in how students prepare for lectures. It can be gleaned from their comments that few prepared before attending lectures during the first half of the year. Student #6 reported she did not know that she had to prepare for the forthcoming lectures. Another student had intended to, but explained that

> "*… it was quite tiring in the first block to prepare for lectures. After a long day you would go home and then to have to read for the next day lectures was just not … really … you got things to do and you are tired".* (Student #4, lines 25-26)

Another student who was preparing for lectures in the first block did not continue with this practice in block 2:

> "[I] *started in the first block, and then we were going at such a pace that I just … I didn't have time to prepare at home 'cause we were already doing the work in class. And then in the second block I just … gave up completely".*
>
> (Student #5, lines 26-28)

Student #5 attributed her not preparing to not having sufficient time and the fact that she was told everything in lectures. She said during the interview she stopped this important practice of preparing in the second quarter and this contributed to her poor performance, as reported in Section 7.5.1 page 192.

Students' total scores for the *application of appropriate practices* before using *Bioskills* (see Table 7.7) ranged from 11 to 13 out of a total score of 20, except for student #4 who scored only seven points. In terms of applying inappropriate behaviours to their studies, the figures ranged from minus two (indicating application of two inappropriate behaviours) to eight out of a possible score of 16. It can be seen that whilst many students were practicing a number of appropriate behaviours even before using *Bioskills* some were doing a lot of inappropriate things, especially Students #4, #5, #6 (see Table 7.7). Although *Bioskills* had already been written when this activity was done, such inappropriate behaviours present themselves as obvious areas to be targeted in subsequent revisions of the programme.

Implementation of appropriate behaviours after using *Bioskills*

In this section, an attempt was made to find out the behavioural gains the use of *Bioskills* achieved. Students' perceptions were elicited from the interview and from activity-based questionnaire 5. Directing questions to students during the interview about their work-habits could have made them provide untruthful answers, if they wanted to please me as the designer of *Bioskills*. The question posed to the students to encourage them to contribute enough material was: *What contributions do you think the use of Bioskills made to your work-habits?*

Between them the eight students identified thirteen behaviour changes, ten of which they said were attributable to using *Bioskills*. Each student seemed to have contributed behaviour changes that were particular to themselves. None were considered frequently mentioned factors.

Reviewing of notes: Two students (#5, and #8) claimed they now reviewed the notes taken in class as soon as possible, correcting mistakes. This work habit helped them to remember better what was said. This behaviour is metacognitive in nature as it means students are aware of their cognition and able to monitor and assess new knowledge they have acquired:

> *"But now I know that every time the lecturer goes through something… go through it at home, go through it at home, go through it at home. And I have done that for my other subjects as well, and it is also working"*
>
> (Student #8, lines 117-119)

> *"I try to go over the lecture notes straight after the lecture. Because during the lectures you are just copying stuff down".* (Student #5, lines 191-192)

Started attending ADP: Student #5 said she was attending Academic Development tutorials and was **active** at tutorials and apparently enjoying it:

> *"… and then ... what else do I do? … Like ADP. I hadn't done … I didn't do ADP at all during the first block, so I am doing that. And I am just trying to be … I am quite active in the class, and so it makes me feel like I have learnt something".*
>
> (Student #5, lines 192-194).

Preparing for lectures: Student #4 claimed he now read his notes and a textbook at home in preparation for the next day's lectures. Student #4 in the previous semester did not prepare for lectures because he was tired after the day. Of the third academic quarter he said:

> *"I knew what we were doing, and it was of interest for me I read through it the night before. I read through the things that I had, not just the notes … the actual notes I had from high school, or the books I have at home".*
>
> (Student #4, lines 115-117)

Although this student did not disclose his source of new knowledge in the above quotation, he was reminded about preparations and so put it into practice.

***Working efficiently*:** Working efficiently, in this context, involves students' working regularly and not spending "free time" at the Matrix[87] idling about. Two students (Student #6 and #8) had this to say about the use of their free time.

> *I realized how to work more efficiently … 'Cause last block I would just try and do all the work together. I mean I would sort of date, essays, games, study … all the work … which became too much because you couldn't understand that*.
> (Student #8, lines 115-117)

> *Oh … Like when I have … a free period or something, don't just … like stay in the Matrix or something……Now, you have time to get to do work… understand it more, so that when you study for exams you don't have too much work to go through..* (Student #6, lines 211-213)

***Making proper use of available time*:** *Bioskills* offered instruction on how to set goals and plan a weekly and a daily time table schedule, and offered suggestions on the use of time. Three students (Students #5, #7 and #8) said it helped them plan the time they spent on campus properly. For example, Student #5 stated it clearly where she said

> *"I try to plan my time more efficiently using what I have learnt in Bioskills. But it's not always that easy".* (Student #5, lines 187-189)

In terms of the detailed behaviours implemented, Students #5, #7 and #8 seemed to make appropriate use of available time either on campus or at home. Students #5 stated on her use of time:

> *"So what I do is like whenever I have small breaks … I try and highlight something or read through a subject, or do a tut here or a tut there. So I try to use my time efficiently. Sometimes it works, sometimes it doesn't. And then I still try and make sure that I still give myself a break and a time to relax"*
> (Student #5, lines 142-144).

Student #7 also comes up with a similar strategy based on the knowledge from *Bioskills*, and sets out plans to make maximum use of time available:

> *"It made me be aware of the time that I used in doing nothing on campus and I compared it to the time that I used to do something. I realized that I had more free time on campus than I had at home. So actually I should use the time I had on at campus to study a lot, 'cause I didn't have time to study at home".*
> (Student #7, lines 195-197)

My interpretation of his statement is that he should be using the time on campus profitably as travelling home after school takes away the study time available.

Another aspect of the impact of the use of *Bioskills* was in Student #8 working consistently, not allowing his behaviour to be determined by the schedule of classes he has the following day. Students #8 claimed he now worked on a daily basis:

> *"… because now I work every day. I work every day. At some point* **[**before the introduction of *Bioskills] I will just go to sleep without even looking at the book. 'Cause at some point I used to work with the time table that I have. Let's say, okay*

[87] Matrix is a building complex that houses food chains and other recreational facilities of the University. It is a student complex for fun and entertainment.

> *tomorrow I am attending lectures only and there is no practical and whatever. So okay, I just go to school and come back. But* **now** *I work everyday, I always find something to do and read".* (Student #8, lines 162-165)

These three students (#5 and #7, #8) are trying to take charge of their academic situation. I did not establish the extent to which this was accomplished, but *Bioskills* had raised their awareness and they were trying to be in control of time for studies.

***Consulting with tutor*:** Student #2 claimed she consulted her tutor over difficult topics as a result of learning this behaviour from the use of *Bioskills*.

Skim reading is a valuable technique for overviewing, previewing and reviewing text. Skimming has the benefit of allowing readers to locate information in order to preview, and also to focus on key facts. Two students (#4, and #2) found the concept important and claimed to have used it in their reading.

> *"…. Before I go to class, the stuff that we are going to do in the lecture, I skim read before I go to the lecture so that I can have an understanding of what is going to happen in class"* (Student #2, lines 23-28)

> *"I can just skim and see the important things and cut my reading time in half".* (Student #4, lines 87-88)

Doesn't bunk classes: Student #3 claimed she no longer wants to skip lectures as she had done prior to using *Bioskills:*.

> "*Ah ... I don't want to bunk classes any more ... it's a habit".* (Student #3, line 268)

In making the above statement and in terms of behaviour change theory (Prochaska & DiClemente (1983), one could infer Student #3 has moved beyond the contemplation stage and considered to take the necessary action needed to keep her attending lectures regularly without "bunking" or skipping lectures.

Making summaries to study from: The use of word summaries by students is often not the most appropriate resource for revision purposes. Because in making word summaries students tend to leave out important details which may be relevant for obtaining good grades (Locke, 1977). Various forms of transforming of texts are available in which details of the text are not sacrificed. These include appropriately constructed mind maps, and hierarchical maps. Although in *Bioskills* readers were reminded of the importance of summarizing their lecture notes, it did not offer students ways of summarizing notes.

Student #7 claimed he started summarizing his notes for revision.

> *"But in block 3 I learnt to summarize my work. You see when I go home, if I have time on weekends, let's say, I take … I will read it through and then take out the important bits and put it aside. And that I studied for the test and everything … comparing with the text book".* (Student #7, lines 166-168)

Student #7 seemingly identified the appropriate ways of making good summaries: that of identifying important points and comparing what is in his summary with the textbook.
Students' knowledge of appropriate work-habits in their third quarter of the year could come from a number of sources. As noted by Leggett *et al.* (2004), students' perceptions may change in response to assignment demands or due to the culture of the university in which they find themselves. Mathias (1980) calls it an adaptive reaction to the hidden curriculum and controlling course demands.

Student #2 claimed she learned some of the things in *Bioskills* from an external source:

I: *Are you suggesting you got this from using Bioskills?*

R: *Ja. Some of them I got it here, but some of them I was told by my sister*.

I: Uhum. *Who is that sister?*

R: *She is studying at the University of Pretoria.* (Student #2, 186-189)

Student #7 also claimed he first heard about skim reading from school and one of his lecturers had used it in lecture preparation:

R: Ja. *I skimmed though the textbook … using the … they gave us like … in the lab manuals … the headings for the weeks and everything, before that week. Ja. So I used that one … the headings, to skim through the headings, so I can understand the lecture*.

I: *Skim? Where did you get that word from?*

R: *I think it was high school.*

I: *So you know about it? Skimming through?*

R: *Ja.*

I: *You did not meet it any where else?*

R: I *think Prof Straker the first lecturer for bio even mentioned it during the first lecture for bio this year.* (Student #7, lines 148-156)

It is therefore realistic to add that although *Bioskills* introduced new things to students not all the things students claimed to have learnt could be attributed to *Bioskills* alone.

I did not explore for how long students kept on with these behaviours. Obtaining accurate, indisputable views from students on the issues raised is surrounded with difficulties of confirmation. As explained by Norman (1983), a person's perceptions are not available for inspection. It was therefore possible that some students' verbalized responses may not be what they actually did but what they thought I might want to hear.

FACTOR 3: Metacognitive control of attitudes likely to promote academic success

The focus of this section was to investigate the changes students reported in their attitudes after using *Bioskills.* An attitude, as explained in Chapter 2, is *…a complex mental orientation, a state of mind,* *often judgmental, based on the way a person views things about them. Attitudes predispose people to act in particular ways* (see Chapter 2, page 43).

The question students were asked during the interview was: "*what contributions do you think the use of Bioskills made to your attitudes in the second half of the year?"* Framing interview questions on attitudes, directed at students for whom English is a second or third language, without making them leading questions, is ridden with challenges.

In order to look at the attitudinal gains, attitudes that students displayed before using *Bioskills* were identified first so that these could be compared with their attitudes after using *Bioskills*.

Students' attitudes before using *Bioskills*

The eight students displayed various inappropriate attitudes prior to using *Bioskills*. Since attitudes predispose individuals to act in specific ways (Shrigley & Koballa, 1992), it can be expected that these inappropriate attitudes would have disposed them to inappropriate behaviours and could have kept students from doing well at their university courses. The following are instances when students displayed inappropriate attitudes:

> ***Inappropriate attitudes to lectures.*** Inappropriate attitudes are often detrimental to good academic performance (Koballa *et al.,* 1990). As mentioned on page 183, many of the eight students exhibited behaviours in lectures which showed deep underlying attitudinal problems. There were those students who, in response to the activity-based questionnaire 1, indicated they were sometimes distracted in lectures (n=5); they sometimes chatted to friends, didn't listen to the lecturer (n=4); and they sent or received SMS's during lectures (n=3).
>
> It can be inferred from these behaviours that they did not value the lectures as important sessions where valuable information and skills are learned. If students continue with this attitude they are unlikely to learn anything. Such inappropriate attitudes will influence their performance negatively and must be corrected.
>
> ***Inappropriate attitudes underlying perceptions about heavy work-loads, and difficulty of the work.*** Two perceptions were prevalent about work-load and difficulty of work. These perceptions were identified from Likert-format items in activity-based questionnaire 1. Five students (#1, #3, #5, #7 and #8) ticked the "agreed" option that there was "*far too much work to cover for the exam*". Such a perception implies an underlying attitude of placing blame on the work load rather than taking responsibility for coping.
>
> The reality of university life is that there is a lot of information taught or a lot of work to do. Students need to be helped to realize those perceptions are not appropriate for academic success at the university, and to develop more appropriate perceptions and attitudes for coping. For example, they need to be equipped with appropriate skills to cope with the perceived heavy workload and to accept responsibility of learning (Grayson, 1996; Downs, 2005). Students need

to study regularly rather than wait until a few days before the exams and start to *cram* (Moore, 2003).

In addition, some students felt some topics were difficult. Five students (#2, #3, #6, #7 and #8) indicated that they thought *that some topics in biology are too difficult* for first-year students. This perception could hinder students' studies and could negatively influence their performance. If students' perceptions on the other hand were accurate, there could be two possible reasons for this: either students were not exposed to that particular topic in the past, or they have not studied to keep up with new materials taught.

Students' attitudes about topics being difficult could be an area *Bioskills* should be structured to address. It is interesting that five students reported *that they went to ADP* as a way to get better understanding of difficult topics. Other students should be encouraged to follow suit.

Being lazy, and unable to concentrate at lectures: One student mentioned these two factors as reasons for her poor performance in the June examination. The enormity of work at the university may overwhelm students. They can either ignore the load of work or find strategies to overcome the problem. Student #5, claimed she was lazy, and secondly could not concentrate at lectures, as reasons for her poor performance. Students needed to be reminded that it pays to concentrate at lectures, and when they cannot, should seek early medical or psychological help, which is provided, by the Campus Health Centre, and the Career and Counseling Development Unit of the university. These inappropriate psychological states are beyond the ambit of *Bioskills* but students need to be made aware of support units to consult when they are in such situations.

Negative attitudes or perceptions towards lectures: Lecturing continues to be the common teaching method at tertiary institutions. Most lecturers have, through experience, learnt the skills of how to lecture effectively and to cover a lot of ground within the allotted period. Students come into the lecture theatre with their own perceptions of how lecturers should teach, based on their experiences at school. Wrongly construed educational beliefs could hinder students not to take accurate notes and pay attention at lectures. Student #5 claimed "… *like the lecturers, were … they were going fast"* (Student #5, line 44). This presupposes the student expected the lecturer to teach at her pace. What she forgets is that as part of the syllabus materials must be completed and it is her responsibility to learn the skills to take down notes at a faster rate.

Student #3 claimed in the first half of the year that she could not hear what the lecturer was saying and *did not understand the lecturer* (lines 34-35) and went on to say how this affected her attitudes.

> R: *Sometimes ... a lot depends on the lecturer … honestly speaking. If I do not get*[88] *the lecturer, I have a negative attitude.* (Student #3, lines 28-29)

By shifting the blame onto an external source, Student #3 is avoiding taking the responsibility of being the "architect of her own future". It is unfortunate this student at this stage did not seek clarity of things she did not understand (e.g. by attending ADP). If she has to be successful at the university she has to find solutions and deal with her attitude of laying blame on others for her

[88] She means "understand"

failures. Student #3's statement above seem to suggest that hearing was also confounding her understanding of the subject matter.As a contributing solution she would need to sit in the front rows, to be closer to the lecturers in order "to get" them properly.

Student #4 wrote in the activity-based questionnaire 1 "…*some lecture notes where* [sic] *useless and could not be filled from textbook,* [sic] *like embryology the notes consists of random words picked from somewhere . It was not in the textbook"*

The statement of Student #4 criticizing the lecture notes he had taken, and by implication the lecturer, suggests he either did not understood the notes he took down or was expecting the summary of notes to be tailored to match his understanding. He forgets it is his responsibility to take "notes" at lectures, to develop them into more comprehensive notes which could be used to study for tests and examination. It is important that students are made aware that it is their responsibility to find all the necessary resources and be in charge of the learning situation.

***Lack of interest in the topic*:** Hidi (2006, p.70) identifies interest as an affective variable. She defined interest as *" predisposition to reengage with particular content"*. Students' interest in the topic as a result of their experience with the course varied depending on the topic. Whilst work for the first quarter of the year was interesting to some of them, this was not the case in the second quarter. For example:

> *"The first block... it was general and I enjoyed it. The second block I just lost interest"..* (Student #5, line 43)

She mentioned "…*the work wasn't interesting (Student #5, line 44)* as one reason for losing interest in the block's work. She said she was:

> *"just despondent. I gave up and then before the exams I **tried** to study, but it was too much work and also I didn't have the understanding".*
> (Student #5, lines 54-55)

Her attitude of giving up manifested in unproductive academic behaviours as she recollected:

> *"I tried to work hard on the test … but it wasn't as good as the first one. And then the exam for the second block was even worse. It just went all wrong"*
> (Student #5, lines 58-62)

This student, because of not having interest in the topic, relinquished her responsibility for studying. Students cannot hope to be selective in the topics they study and still pass at the end of the year.

Development of appropriate attitudes after using *Bioskills*

Bioskills stressed the harmful impact of negative attitudes on students' behaviours and the need to adopt positive attitudes. However, not many statements on attitudes were volunteered during the interviews after students had used the programme. Some pre- and post-*Bioskills* attitudes were deduced from the comparative words used. For example, Students #5, and #8 used *more* and *now* in their replies, from which I inferred the impact of *Bioskills.*

Seven of the eight students reported that during the third quarter of the year that they developed different attitudes from those of the first quarter. These included:

Being more determined*:** Three students (Students #5, #7 and #8) said they were more determined in the second half of the year. Student #8 stated "…Umm … *I am* ***more *determined* ***now"*** (Student #8, line 155). Although he did not mention *Bioskills,* its influence could be implied from the context of the question which asked. *What contributions do you think the use of Bioskills has made to your academic studies in the second half of the year*?

Student #5 explained in more detail what she meant:

> *"I think block 3 I was* **more** *determined, because it was like … for me it was like a new beginning. And … like … having the Bioskills".* (Student #5, lines 128-129).

She ascribed the change to the influence of *Bioskills.* It would be recounted that Student #5's perceptions and judgments of the topics in the second quarter led her to lose interest in the course. She projected blame on an unappealing topic and to the fast pace of lectures. In block 2 she relinquished her control over aspects of her learning. However, in block 3 she became more focused and experienced an attitude change, which she attributed to the use of *Bioskills* as discussed in the earlier paragraph.

***Interest in the subject*:** It is also important to note that interest in the topic studied in the third and fourth quarter also had a contributory effect for the revival of determination to study, at least for two students. Student #5 claimed:

> *",.. the work was also more interesting. So it was just … it just made it seem easier to just actually apply the Bioskills to it. It was easier it apply to something that you enjoy".* (Student #5, lines 128-130)

Student #4 says "*my interest in it* [biology topic]. *That helped a lot*".(Student #4, line 155).

Given the role interest seemed to have played in influencing better learning outcomes in these two students, it is important other students realize the role sustained interest plays in influencing academic achievements. Lecturing skill and enthusiasm obviously play a major role in stimulating interest. Lecturers need to be aware of topics students do not find interesting, and encourage them to take greater interest but students must accept the responsibility for learning uninteresting topics as well to become academically successful.

***More positive attitudes*:** Five students (#1, #2, #3, #5 and #7) claimed they developed more positive attitudes in the third quarter of the year than they had in the first half, as a result of using *Bioskills*:

> *"It helped me to be positive towards my science"* (Student #2, line 121)

> *"I have tried to adopt a more* **positive** *attitude towards everything"* (Student #1, 213)

She went on to explain:

> *"It has, actually. Because there was a section that talked about how having negative attitudes actually affects the way you work, and how you see things, and the results you get. So I have tried to adopt a more positive attitude towards everything".* (Student #1, lines 212-213)

Student #3, had negative attitudes towards the lecturer in the first half of the year. However, of the third quarter:

> R: *Honestly speaking ... and I am trying to cure that attitude.*
>
> I: *Cure that*?
>
> R: *… that attitude ... that negative attitude, because that is what makes people to fail most of the time.* (Student #3, lines 263-267)

Student #7 stated the contributory influence of *Bioskills* to his attitudes in terms of what he learnt:

> *"You should always be positive in everything you do, like ... never say "that is too hard for me to do" 'cause you never know. That is one of the things I learned from changing your attitudes towards something".*
>
> (Student #7, lines 199-200)

Although the answers students #1, #2 and #3 provided showed an awareness that negative attitudes hindered academic progress, their awareness cannot be solely ascribed to their use of *Bioskills*. Student #1 and #7 attributed the change to the use of *Bioskills*

FACTOR 4: Metacognitive control of attributions

The term *attribution* is about causes individuals identify as affecting their successes and failures, and is associated with Weiner and his attribution theory (Weiner, 1979). However, it should be mentioned that *locus of control* (Rotter, 1966) was Rotter's one-dimensional notion which was split into three more specific attribution dimensions by Weiner (1979; 1985) (see Chapter 2). Both constructs try to explain individuals' perceptions of causes. Weiner (1979, p. 6) explains attributions, as a "*search for understanding of the causes*" of events by individuals. The construct is used in this section to analyze students' perceptions of factors that influenced their performance in the first half of the academic year, and to determine if such perceptions of causes persist even after students used *Bioskills*.

Attributions of success and failure by students before using *Bioskills*

To determine how the use of *Bioskills* affected students' attributions, their perceived causes for their performance in the June examination (prior to using *Bioskills*) were investigated first using the activity-based questionnaire (see Appendix G) which had two items: one with an open-ended format, and the other a closed-ended format. I have used these data as an indication of students' causal attributions before students started using *Bioskills*. The open-ended question asked respondents to *"list the factors (positive or negative) which you think contributed to the mark you got*". Open-ended questions were used as the first line of questioning because respondents are not restricted in their contributions, and their answers.

The eight students identified 31 factors as having affected their performance. The factors mentioned by the students have been clustered as "*attitudes*", "*behaviours*", *"exam skills'* and "*other*" factors (Table 7.8). Twenty-nine of these statements were worded by the students as factors which impacted negatively on their academic performance. Only two out of the 31 statements were worded as positive factors (see "effect" column in Table 7.8).

Table 7.8 Summary of factors students (n=8) said influenced their June marks (open-ended question)

		Students' suggestions	**Effect**	**Student #1**	**Student #2**	**Student #3**	**Student #4**	**Student #5**	**Student #6**	**Student #7**	**Student #8**	**Frequency**	**Attributions**
Attitudes		Not enjoying the work	-					T				1	i/ú/u
		Being lazy	-					T				1	i/c/u
		Not being able to concentrate and focus	-					T				1	i/c/u
Behaviours	**Work habits**	Attending ADP	+								T	1	i/c/s
		Not working hard enough	-						T	T		2	i/c/u
		Skipping lectures	-								T	1	i/c/u
		Not consulting lecturers over difficulties	-			T						1	i/c/u
		Not following appropriate practices Not reading the textbook (enough)	-	T					T			2	i/c/u
		Not using additional books	-			T						1	i/c/u
		Not using all the ADP work	-	T								1	i/c/u
		Not preparing for lectures	-							T		1	i/c/u
		Not preparing for exams early enough	-				T			T		2	i/c/u
	Study habits	Not studying hard enough for the exam	-			T		T				2	i/c/u
		Not studying all sections for the exam	-	T								1	i/c/u
		Making notes while studying for the exam	+								T	1	i/c/s
	Other	Arriving late for lectures	-								T	1	i/c/u
Exam skills		Not reading questions correctly	-						T			1	i/c/u
		Not understanding what exam questions required	-						T			1	i/c/u
		Not answering exam questions appropriately	-			T						1	i/c/u
Other		Only understanding work superficially	-	T				T				2	i/ú/u
		Unable to adapt to university life Not adapting to the difference in teaching from school	-		T							1	i/c/u
		Not getting used to university environment quickly	-		T		T					2	i/c/u
		Not adjusting to amount of time studying needed	-				T					1	i/c/s
		Medium of instruction	-				T					1	i/c/u
		Too much new terminology	-		T							1	e/ú/u
		There being too much to learn	-		T							1	e/c/s
		Textbook not covering all sections	-				T					1	e/ú/s
		Not enough materials for studying	-								T	1	e/c/u
		Having useless lecture notes (his)	-				T					1	e/c/u
		Travelling taking up study time	-								T	1	e/ú/s
		Did not use the resources available well enough	-	T								1	i/c/u

e or i = external or internal locus
ú or c = uncontrollable or controllable
u or s = unstable or stable
+ indicates factors students mentioned explaining their 'success'.
- indicates factors students mentioned explaining their 'failure'.

Table 7.9 provides a summary of factors students selected from the close-ended check-list of 14 statements showing factors which they felt influenced their performance in the June examination, before using *Bioskills*. The factors are those either explaining their failure or their success (see – and + signs in the effect column).

It is interesting to note that 25 out of the 31 attributions were internal or personal factors (Table 7.8). These implied students saw themselves as likely causes for their successes or failures and seemed ready to accept responsibility.

From the close-ended responses five of the 14 statements were classified as personal, and nine could be said to be environmental (Table 7.9). In terms of numbers there were 18 who perceived the cause as internal and 26 who blamed external factors. What is evident is that when students volunteered causes for their success or failures many mentioned more frequently internal factors. They accepted responsibility that their behaviours or attitudes led to the poor performance. However, when offered choices many selected external factors as contributing to their failure. The differences in students' perceptions can be resolved when it is realized that an open-ended format taps into what is uppermost in their minds. The close-ended responses should be seen as additional factors individuals may not have thought about initially.

Table 7.9 Summary of factors students selected as having influenced their June marks

		Effect	**Student #1**	**Student #2**	**Student #3**	**Student #4**	**Student #5**	**Student #6**	**Student #7**	**Student #8**	**Frequency**	**Attributions**
Personal	Me not studying hard enough	-			T	T	T	T	T	T	6	i/c/u
	Starting too late to prepare for the exams	-	T		T		T	T	T	T	6	i/c/u
	Preparing for the exams in good time	+	T	T				T			3	i/c/s
	I made good notes to study from	+		T			T				2	i/c/s
	I studied very hard	+		T							1	i/c/u
Environmental factors	Too much work to learn in biology	-	T		T		T	T	T	T	6	e/ú/s
	Too little time to study biology	-			T	T	T	T		T	5	e/ú/s
	Help from my friends	+	T	T				T			3	e/ú/u
	My friends distracting me from work	-					T	T			2	e/ú/u
	My family not supporting me when I studied	-				T	T				2	e/ú/u
	Not being given study notes for the course	-						T	T		2	e/ú/u
	Biology being a difficult subject	-					T				1	e/ú/s
	Support from my family when I wanted to study.	+		T							1	e/ú/s
	My lecturer going too fast	-		T	T		T			T	4	e/ú/u
Constructs			**Frequency**									
Locus of causality	internal		**2**	**3**	**2**	**1**	**3**	**3**	**2**	**2**		
	external		**2**	**3**	**3**	**2**	**6**	**5**	**2**	**3**		
Controllability dimension	controllability		**2**	**3**	**2**	**1**	**3**	**3**	**2**	**2**		
	uncontrollability		**2**	**3**	**3**	**2**	**6**	**5**	**2**	**3**		
Stability dimension	stable		**2**	**3**	**2**	**1**	**4**	**3**	**1**	**2**		
	unstable		**2**	**3**	**3**	**2**	**5**	**5**	**3**	**3**		

e or i = external or internal locus
ú or c = uncontrollable or controllable
u or s = unstable or stable
+ indicates factors students mentioned explaining their 'success'.
- indicates factors students mentioned explaining their 'failure'.

The data I want to discuss now is from the last columns of Tables 7.8 and 7.9 which show how I classified[89] students' attributions. Studies have shown that these three dimensions of attributions have important consequences for individuals expectancy of future goal attainment or expectancy for success beliefs (Weiner, 1985; Pintrich & Schunk, 2002). The attribution theory dimensions can be used in different ways to explain both the failure and success situations, as explained in Chapter 2. These categories are used to discuss students' responses.

Attributions can be categorized along three dimensions *locus of causality (internal or external), control (controllable or uncontrollable),* and *stability (stable or unstable)* (Weiner, 1979 as explained in Chapter 2, Section 2.3.3). As noted by Weiner (1985), attributions as perceived causes may or may not be the actual causes. Thus these data need to be cautiously interpreted.

Studies have shown that these three dimensions of attributions have important consequences for individuals expectancy of future goal attainment or expectancy for success (Weiner, 1985; Pintrich & Schunk, 2002). The attribution theory dimensions have been used to explain both the failure and success situations of learners (Pintrich & Schunk, 2002). I now apply these general principles, discussed in Chapter 2, Section 2.3.3, page 47, to the results shown in Tables 7.8 and 7.9

From Table 7.8, 29 of the 31 factors seemed to be linked to doing worse than expected. Twenty-five out of the 31 factors I graded as being of "*internal*" dimensions; 26 out of 31 were of *"controllable*" dimensions; and 25 out of 31 were of "*unstable*" dimensions. The dimensions of students' attributions indicated in the above sentence suggest the perceived causes for students' failure could be remedied in the future, as long as they perceived them as controllable and unstable, and put in effort to correct them.

Table 7.9 presents nine reasons students selected for their failure which I have categorized using the three attribution dimensions of *locus, control* and *stability*. For attributions explaining poor results (negative sign), four statements which I categorized as *external, uncontrollable* and *unstable* (e/ú/u) dimensions were:

- My lecturer going too fast (n=4)
- Not being given study notes for the course (n=2)
- My family not supporting me when I studied (n=2)
- My friends distracting me from work (n=2)

Although these attributions classified as *external* and *unstable*, are perceived to be beyond the control of the student, such situations can be remediated, as suggested by Pintrich & Schunk (2002), if students are helped to think over the attributions and are required to take control by putting in place solutions to overcome perceived problems. For example, students could learn better note-taking techniques and concentrate more in class to cope with the pace at which lectures are delivered. They could also engage family and friends to provide more supportive environment. The onus is on the student to do that.

[89] In practice the dimensions are usually obtained from students' reported beliefs. I have, however, classified students attributions based on my perceptions of what their attributions would be. Herein lies the danger of this classification: some of my dimensions may not tally up with what students might have said. Validation for the classification of these dimensions were sought from another researcher.

The “stability” dimension, as mentioned earlier, is the most critical for students’ expectations for success (Pintrich & Schunk, 2002). Three perceived causes for failure which I categorized as of *external, uncontrollable* and *stable* (e/ú/s) dimensions were selected (Table 7.9) by the following number of students:

- Too much work to learn in biology (n=6)
- Too little time to study biology (n=5)
- Biology being a difficult subject (n=1)

All these factors could be exacerbated for students whose language of instruction is not their home language. I have classified these causes as stable because students, in their perceptions, often hold such factors as fixed (i.e. do not change through the period of their studies). A change of mind-set would be required if students with inappropriate perceptions expect to do well in future. They would have to see the accomplishment of the task they initially perceived as beyond their capabilities is in reality doable. Alternatively, if their perceptions are accurate a necessary action of the part of the lecturer would be to help students to take control of the situation. Students can be helped, for example, to learn techniques to cope with perceived stable situations which they see as negatively affecting their results. In the above-mentioned situation, speed reading skills would be helpful for students to learn to cope with the volume of reading.

Finally, there were two attributions I categorized to be of *internal, controllable* and *unstable* (i/c/u) dimensions. Twelve out of the possible 16 responses for failure situations fitted into this category:

- Me not studying hard enough (n=6)
- Starting too late to prepare for exams (n=6)

The high number of students who attributed these two factors as likely causes for their performance suggests the prevalence of these factors. A classification of *internal locus*, *controllable* and *unstable (i/c/u)* dimension is indicated. Students seem to be acknowledging that they are responsible for their situations, and as such can be offered solutions which would help them to take control and overcome such limitations.

In attribution studies, what is important for future expectancies of success or failure is how the individuals perceive the dimension of the attribution (Pintrich & Schunk, 2002). The results suggest the students could benefit from instruction directed to make them more aware of perceptions and attitudes that are more appropriate for future academic success.

The dimension of *locus of causality* (or locus of control) is an important ingredient in determining students’ performance. Of the 31 statements in Table 7.8, I classified 25 as indicating internal causes and six as external causes. From the close-ended question, there were five statements out of 14 that fitted with beliefs of *internals*. What is evident from Table 7.8 and Table 7.9 is that of the total of 45 statements only 15 were statements that could be attributed to have external causes. This implies a greater cause of their success and failures were within the ambit of the student to influence.

From Table 7.9, the frequencies of students’ locus of causality for statements perceived to be external were summed for each individual and these were between 2 to 6. Students #5 and #6, for example, contributed higher numbers of external locus of causality factors, suggesting they were more likely to blame others or external events for their poor exam marks. Students #5 and #6, however, also seemed to have attributed causes not only to external factors but also to internal factors. This shows these students were also likely to acknowledge responsibility, and could take control of their academic situations.

Attributions of success and failure by students after using *Bioskills*

The inferences students made as causes for their performance after using *Bioskills* were deduced from the interviews, specifically discussions around their performance in a class test. Weiner (1985) noted after extensive research, the causes provided by students to explain their success or failure in academic situations usually have to do with ability, effort, task difficulty and luck.

Four students (#4, #5, #7 and #8) performed reasonably well in the third quarter (see Table 7.10) and ascribed their success to the effort they put in. For example, Student #7 claimed he worked really hard:

> *"You see when I go home, if I have time on weekends, let's say, I take … I will read it through and then take out the important bits and put it aside. And that I studied for the test and everything … comparing with the text book"*.(Student #7, lines 167-169)

Student #8 claimed he revised regularly, unlike times before using *Bioskills*:

> *" because now I work every day. I work every day. At some point* [before using *Bioskills*] *I will just go to sleep without even looking at the book. ….. But now I work everyday, I always find something to do and read. And in the long run I have realized that there is always something to do … something that I didn't know, something that I have left behind, and am picking it up"*. (Student # 8, lines 162-167)

Student #5 presented a more complex picture on her attributions and expectations. Although she is doing well, she continues to blame external factors for her situation:

> *It could be more interesting, but the lecturer's just don't really catch all my attention. But I still go and I still try and hand in the work. And I am gonna use this … as a final chance to make up for the rest of the year.* (Student #5, lines 132-133)

This student would have to alter her external attributions about the lecturer's performance if she is going to be successful. Prior to using *Bioskills*, from nine attributions presented in Table 7.9, she selected only three internal causes, but six external causes. She seemed to realize she could do something about it, after using *Bioskills*. That she is realistically coming to terms with the university situation, and looking at what could be done to cope with the university situation is found in the statement she made later:

> R: *… I think I could have worked … maybe ahead like maybe a few weeks ahead instead of just in that week. Because I had a week when I was writing ... I had three labs to survive and four tests and an essay. I wrote the ILS and Stats on the same day, so it was … it would be nice if the university could plan it separately. But obviously you need venues, so it's just one of those things that you deal with.*
>
> I: *What will happen if the university didn't play your ball … your ball game?*
>
> R: *It's like the last part … I mean you have a boss that you don't like, so you just deal … you just deal with what you are given and you just do it to the best of your ability.*
>
> (Student #5, lines 163-166)

Student #5, although she mentioned some external attributions, realized it may not be possible to continue to lay blame on external sources. She has become more realistic as noted in the above quotation and is hoping to take control of her own situation to the best of her ability.

Two others (Students #3 and #6) continued to fail and attributed this to external factors. One student had this to say:

> R: *Ja. And when I was writing, I felt I was writing the right things. I don't know what happened. Maybe 'cause the structure of the questions. I don't know. 'Cause sometimes you can prepare for a test and when the test comes ... the way they structure their questions. Yo ... Not like ... I don't know.*
> I: *So as far as your readiness for the test was concerned you were much much ready?*
> R: *I was ready.*
> I: *But then you go into the exam ... the test hall ... [did not complete question]?*
> R: *The way they structure their questions. I think maybe I should look at the past questions as well. Maybe if I look at those past questions so I can know what they want from you, and all that.* (Student #3, lines 229-236*)*

The other student who also failed the test was hoping to pass in block 3. Her perceived cause for the poor performance was the length of the test:

> R: *The test that we wrote. To be honest, I failed it.*
> I: *What did you get?*
> R: *Like Thirty-three. I think what made me get that mark is…. I…the test was long. The multiple-choice was long. So I didn't finish. I didn't even start the multiple-choice, which was carrying like most of the marks like fifty-percent of the whole test*.
> (Student #6, lines 176-180)

A look at the attribution dimensions of Student #6 provides the following: She made five external *locus of causality* attributions and three internal *locus of causality* attributions before using *Bioskills*. (see Table 7.9) She has blamed external factors for her academic woes even after using *Bioskills*. By blaming external circumstances or factors for their performance, Students #3 and #6 have not accepted full responsibility for their failures which are needed if they are to begin to fully work on their performance. These two students used the package only once and twice respectively. Student #6 did not take *Bioskills* seriously, as will be shown later in her opinions.

By way of summary, of the six students whose attributions were obtained four students seemed to have made some gains and seem to be taking responsibility for their studies. Two students still attributed causes to external factors, and do not seem to have taken personal responsibility for their situations. This suggests more improvement to *Bioskills* need to be considered to help students learn to take personal responsibility for their studies.

7.5 STUDENTS' PERFORMANCE EXPECTATIONS BEFORE AND AFTER USING *BIOSKILLS*

Assessment of students' academic performance is often based on their marks. Whilst high marks may not always result from students displaying appropriate academic behaviours, they serve as a yardstick to gauge performance. Some first-year students tend to have unrealistic expectations about their academic performance and this affects their adaptations to the university environment and their academic achievement (Moore, 2003). Andrews, Swanson & Kugler (2007) point out that when students are unrealistic about their grade expectations and set them too high and fail, they become discouraged and put forth less effort. Setting unrealistic goals may result in a relatively poor course performance. Studies have suggested the importance of interventions designed to bring students perceptions more in line within reasonable performance expectations (Rickinson & Rutherford, 1995; Andrews *et al.*, 2007) to help them maximize their performance in the course.

Students' expectations, before and after using *Bioskills*, and the results they obtained were used to explore their beliefs about their abilities. The data used for this analysis were the eight students' course and exam marks, supplemented by data from three items from activity-based questionnaire 1.

7.5.1 Students' academic performance before using *Bioskills*

In the *Introductory Life Sciences* course students are assessed on class and exam marks for each quarter of the academic year. The course mark for each quarter (see Table 7.10) is a composite mark from test and practical assessments and constitutes 40% of the total.

An item on their June mark in activity-based questionnaire 1 was:

Thinking about your June mark: My mark was
☐ *better than I expected* ☐ *about what I expected* ☐ *(much) worse than expected.*

Seven out of the eight students expected a higher June mark (Table 7.10). The June exam mark for each of the eight students was low, ranging from 32% to 59%. Their poor performance could be a reflection of the difficulty of the topic, failure to study properly, or failure to prepare for the exams.

A factor which could have contributed to students' high expectations was the course mark, which in most cases was substantially higher than the exam mark (see Table 7.10).
This is a typical pattern in first-year biology at this university, so students tend to have high expectations too for the exam mark. High course marks have often cushioned a student with poor exam marks from failing, as shown with Student #4 and Student #5 who secured a pass due to the high course mark in block 2 (see Table 7.10). Six of the eight students, failed to obtain a pass mark at the end of the second quarter[90] and four of these had also failed based on their the class mark.

Young (2002) found that some students at the university, often feel that the same effort that produced their high grades at high school would entitle them to the same high grades at the university. Svanum & Bigatti (2006) found that poorly performing students often fail to recognize the difference between the effort they put into learning a subject and lecturers' assessment of the quality of work produced. Stated in another way, such students tend not to appreciate the quality of the effort required at tertiary institutions to justify pass marks.

[90] It was as a result of low June marks that students were asked to attend ADP tutorials.

Students' beliefs about their input and the mark obtained was checked using activity-based questionnaire 1 before they worked on *Bioskills.* The results provided a basis for comparing their self-efficacy beliefs before and after using *Bioskills.* The statement they responded to was:

Table 7.10 Biology class record and examination marks of students who participated in the interviews

Student	No. of times *Bioskills* was used	First quarter (Block 1)			Second quarter (Block 2)				Third quarter (Block 3)			Fourth quarter (Block 4)			Final mark for the year %
		Course mark %	Exam mark %	Final mark %	Course mark %	Exam mark %	Final mark %		Course mark. %	Exam mark %	Final mark %	Course mark. %	Exam mark %	Final mark %	
#1	3	71	55	62	60	31	43	**Students used *Bioskills***	73	54	62	54	58	56	55
#2	1	52	42	46	37	38	37		55	48	51	54	54	54	47
#3	2	38	17	25	48	21	32					deregistered			
#4	4	62	53	57	78	46	59		71	55	61	79	69	73	62
#5	4	78	74	75	70	49	57		72	78	75	81	72	75	71
#6	2	36	36	36	49	34	40		43	23	31	44	43	43	37
#7	1	55	34	42	48	35	40		56	27	38	69	61	64	46
#8	3	61	70	67	55	35	43		58	49	52	81	72	76	59

The shaded region denotes post-*Bioskills* period.

In terms of the work I did in the first half of the year I think that my mark is
□ *a very good reflection* □ *a reasonable reflection* □ *a poor reflection.*

Only two students (Students #1 and #5) felt their mark was "a reasonable reflection" of how they worked in the first half of the year. The other six students, who obtained marks below 50% for the second quarter, felt the marks they achieved were a poor reflection of the work they did. Davidowitz & Rollnick (2003) have suggested that at university it is the quality of work and not effort exerted on a task which lecturers assessed. The responses of the six students seem to suggest they are not aware of this. It is important students are helped to be fully aware of what work is appropriately rewarded and this seems to be an area *Bioskills* could address in future.

Students often are not able to estimate fairly accurately the marks they will get from tests or other written assignments (Moore, 2003). When students are able to estimate these marks reliably, it reflects on the accuracy of their self-efficacy beliefs (Linnenbrick & Pintrich, 2002).

Results to the item, shown under Section 6.3.1, page 151, are summarized in Table 7.11. Students were asked to:

" indicate how strongly you agree or disagree with the statement: My estimate of what I would get for my June mark was very accurate"

Of the five students who ticked the *disagree* box on the accuracy of their prediction of their June mark four also stated the mark was worse than they expected and one received a better mark than expected. One student also stated the mark was much worse. Thus over 75% of the students, before using *Bioskills* were not able to estimate accurately the marks they obtained for the June exam. Their perceptions of their self-efficacy were inaccurate.

I have been cautious in interpreting these results, as two inconsistencies were noted, for Student #1 and Student #6, over their estimation of their marks. Whilst they said in one item that their June mark was better than expected they disagreed with the estimate of the June mark being accurate.

Table 7.11 Accuracy of students' (n=8) prediction of their June mark

student	SA	A	NS	D	SD	Comment on answers to item 1 and item 3
#1				T		Disagreed, which meant her estimate of the mark she would get was inaccurate. She said the mark she got was better than expected
#2		T				Agreed, which meant she felt her estimate of the mark earned was accurate. However, she also said the mark was worse that expected (inconsistent answers)
#3				T		Disagreed, which meant her estimate of her mark was not accurate. She said her mark was much worse than expected
#4				T		Disagreed which meant his estimate of the mark was not accurate; he said his mark was worse than expected
#5					T	Strongly disagreed, which meant her estimate of the mark was way out not accurate. Her mark was far worse than she expected
#6		T				Agreed, which meant her estimate of the mark was accurate; she said her mark was much worse than she expected (inconsistent answers)
#7				T		Disagreed, which meant his estimate of his mark was not accurate. His mark was much worse than expected
#8				T		Disagreed, which meant his estimate of mark got was not accurate; his mark was much worse than expected
Total	-	2	-	5	1	

SA = strongly agree; A = agree; NS = not sure; D = disagree; SD strongly disagree

7.5.2 Changes in students' performance after using *Bioskills*

The eight students' performance after using *Bioskills* was analysed from the data presented in Table 7.10. The following trend is found in terms of students' usage of the programme and the final marks they obtained at the end of the year.

- Three students (#1, #4, #5) scored marks over 50% in both the third and fourth quarter and obtained pass marks for the final mark of the year. Of these students one had used the programme three times and two had used it four times. My interpretation for their performance is that they have been committed and hardworking all year, even more so after using *Bioskills*.
- Two students (#2 and #8) scored below 50% for the third quarter but passed in the fourth quarter. Although both passed the fourth quarter exam, Student #2, due to a poor second quarter mark, failed the biology course with 47%. She was close to passing. Student #2 used the package once, whilst student #8 used it three times.
- Two students (#6 and #7) obtained exam marks below 30%, even after using *Bioskills*. Student #6 however, never passed any of the tests and exams before or after she used *Bioskills* twice. Student #7 failed all the exams in the first three quarters, used *Bioskills* once and passed

the course work and exams in the last quarter. His marks were, however, not adequate for a final pass.

From Table 7.10 what can be noted is that the course content for the second quarter seemed to have presented greater challenges to most students. Students (#1, #4 and #5), whose course mark for block 2 suggests they could have passed block 2 did not do well even though they predicted they would pass. Students #5 and #4 gave reasons such as the unfamiliarity of the work and lack of interest as partial reasons for their performance. There are a number of confounding influences, some being students' perceptions of the difficulties entailed in mastering the topic and their poor background knowledge of the topic. Interest in the course seems to be a positive factor students seem to have used as "a crutch" to do well.

For 'tough[92]' courses, I would suggest that students are proactively made aware of avenues to help them deal with possible negative attitudes, to seek help from tutors and to take greater responsibility for their studies. *Bioskills* could possibly be revised to carry the information.

7.6 STUDENTS' OPINIONS [93]ABOUT *BIOSKILLS*

The opinions of the eight students about *Bioskills* were sought as part of the investigation of effectiveness. Students' opinions, when they first used *Bioskills*, were solicited using activity-based questionnaire 3, and again seven weeks after using *Bioskills* by way of interviews. Responses from these two 'tools' were used to answer research question 4.

Research question 4
What are the students' opinions about *Bioskills* as a teaching tool targeting academic success?

In activity-based questionnaire 5, students (n=8) provided opinions about what they learned from using *Bioskills*. Although opinions, by definition, refer to personal viewpoints, judgments or evaluations, other recollections about *Bioskills* which were of relevance were accepted as probable 'opinions'. Readers are reminded that seven of the eight respondents were English second-language speakers (as shown in Table 6.2) and some struggled to give explicit responses to the questions posed.
The opinions of students were classified into the following themes:

Good and helpful
There were those who said *Bioskills* was a *good* programme (n=3) and others said it was *helpful* (n=3). Students used various terms to describe what was 'helpful' or 'useful' about it. For example, Student #8, who passed his end-of-year exams, and could have been reporting an accurate opinion, felt

[92] These are courses (or topics) that by their very nature are difficult for students to master, or for which students do not have previous background knowledge

[93] The term *opinions* used through out this chapter should be interpreted as students *beliefs* in line with the theoretical framework.

> *" ...It taught me how to manage my time, how to do my studies well ... how to work efficient".* (Student #8, lines 147-150)

Two students mentioned that they found the section on university life helpful:

> "*… it helps first year students to get used to environment of the university".*
> (Student #2, lines 95-96).
> *"What I liked? Okay, it is telling you about 'varsity life and how you should handle it. That's what I liked about it".* (Student #1, lines 113-114*)*

Ease of use and promotion of interaction

Students' experiences with the structure and navigational features of the programme are important if they are to derive benefits from using the package. It is important that users are able to identify the sections and subsections of the package 'easily' and are able to navigate systematically over the many screens without getting 'lost in hyperspace'.

Two students commented on the design features. One student felt "... *it was easy to use"* (Student #1, line 92.) This comment came from a repeat student.

Student #3 mentioned the package gives advice as one interacted with it.

> *"It encourages you do things, by telling what you should do, what kind of person you are ... um, what kind of life is lived in the 'varsity, how can you tackle things like that".*
> (Student #3, lines 113-115)

This highlights the interactive aspect of *Bioskills* which was to foster longer engagement with the content, and promote interest and increased usage of the package.

The newness of information in *Bioskills*

Students were divided in their opinion on the newness or otherwise of the information. Three students commented they had been introduced to some of the information before:

> *Some of it was* [new] *and ... other bits, I have heard before ... I was just reminded of it. And the importance of it was emphasized more clearly now* (Student #1, lines 107-108).
> *:*

Student #4 drew attention to the unfamiliar aspect of the information it provided

> *It is things you never thought about before. You always hear people saying you have to do certain things to prepare yourself for 'varsity, but you never really know what they are. You never really know what is really expected of you* (Student #4, lines 73-75)

To Student #2 the information was not all new and when probed to provide further information with the question *Are you suggesting you got this from using Bioskills?* she mentioned alternative sources:

> R: *Ja. Some of them I got it here, but some of them I was told by my sister*.
>
> I: *Uhum. Who is that sister?*
>
> R: *She is studying at the University of Pretoria.* (Student #2, lines 186-189)

Relevance of information

Six respondents commented on the relevance of the information in *Bioskills*. Of the six, three (Student #1, #4, #5) felt the information touched on aspects of university life which were important for them to know. For example, Student #4 said.

> *"I got a better understanding of what was expected of me this year, and which should I improve on next year".* (Student #4, lines 75-76)

Student #1 felt information in *Bioskills* made an important contribution to her knowledge:

> *"when you get here no one tells you that 'okay. This is the amount of time you're supposed to spend on this subject ... or a certain subject ... and how preparation is important' because in high school you could get away with everything you know? If you don't prepare, you still pass".* (Student #1, lines 104-106)

> *"I think it's relevant ... it's not just biology but any other subject ... so the suggestions there were very realistic and relevant. Ja".* (Student #1, lines. 98-100)

In terms of relevance of the information, Student #5, based on what was discussed under *academic activities,* felt the information was an eye- opener to her:

> *"Like if I had known how many students pass and fail, and ... the pressure. Because ... I really didn't expect all of that".* (Student #5, lines 205-207)

The comments of Student #1and #4 are all the more important when it is realized that despite the relatively good high schools they attended they did not have the necessary information on what pertained on university campuses and the preparations needed to survive the first-year experience. Student #1 also mentioned *Bioskills* would be useful across disciplines.

Three students (students #3, #1, #8) found the information on work-habits section useful. Student #8 related how he applied the information from *Bioskills:*

> *"And one of the points they made was that you should consult many textbooks. And that has helped me because the textbook that we are using now ... Campbell and Reece ... I use it but I also collate it with some other textbooks that contained the exact kind of topic... like animal physiology. I would go and find a text book in the library that is about animal physiology, 'cause the Campbell they only do some sections and sub-sections. So I would get good textbooks which concentrated on the subject. That helped".*
> *(Student #8, lines 84-90)*

Another student stated:

> *"...I learnt how to improve work-habits, and ... ja ... preparations for success was one. And there was a bit ... ja, it taught us how we can improve our study habits. And there was that link on ... on ... I think it was linked to some other university study that was done in matric year. I think that was very helpful"l.* (Student #1, line 112-120)

These two quotations highlight some of the benefits the students derived from the content of *Bioskills.*

Time available to use *Bioskills*

Students commented on the limited time to work through the package. Four students found that despite the time spent using *Bioskills* they could not complete all the content. For example, Student #1, who used it three times, felt there was more to be looked at.

> *I would go through it again just to get ... um ... what? Because there were like some pieces of information, chunks of information, that either if I wanted I had to ... like jot it down on a piece of paper so that I had it with me all the time ... and just to revisit it once in a while, to remind myself.*
> (Student #1, lines 113-114)

Four students (Students #4, #5, #8, #1) said they would continue to use it. One student, when asked whether the four times he used it were sufficient stated *"I am not done with it."* (Student #4, line 97) This suggests if *Bioskills* is to have greater impact, a lot more time would have to be allotted for its usage; it may have to be integrated into the mainstream tutorial sessions of the course.

What students did not like about *Bioskills*

Students' opinions about what they did not like were also solicited during the interview in order to have balanced viewpoints on the package. It is also important to realize students of their own volition may not give disparaging comments about a programme in the presence of an authority figure. Thus the question "*What did you not like about Bioskills*" was crucial to uncover possible negative feelings.

Neutral responses

Three students (students #1, #2 and #4) said they had no negative comments about *Bioskills*.

For example, one student who had used the programme three times said of it: "*I did not like nothing"* (Student #1, line 97). Another, who used it four times, initially responded with 'nothing' but added

> *"… I don't really like answering questions about myself. But there is nothing really that I didn't like about it".* (Student #4, lines 80-81)

The concerns raised by Student #4 related to the off-line supplementary materials that asked students to reflect on their performance in the first semester and then offered suggestions for them to use more appropriate behaviour. Student #4, incidentally, based on his responses to the activity-based questionnaire, did not know much, prior to using *Bioskills,* about the appropriate knowledge and behaviours needed for academic success (Table 7.7, page 183) and therefore was likely to benefit from the content of *Bioskills*..

Negative responses

There were students who had negative opinions. Two students (#3 and #6) referred to the programme as being too long. Student #6, although she acknowledged the package was of benefit, felt:

> *"It helps much. But I think it takes too much of our time, or something. 'Cause the things that you wanted to know are from the start, like for the first thirty minutes. I think that is … what is important that you have to learn. Like… after the thirty minutes …ja, you know about it, so there is nothing we could change about it. We are finished, and everything". (Student #6, lines 116-118).*

Based on the time students spent using *Bioskills*, it is estimated that in thirty minutes, they would probably have completed the *Home page* and then proceeded to the section on *Challenges of 'varsity life.* The student would probably not have reached sections on "*Factors affecting behaviour*" or the important sections that provided "*Strategies for improving work-habits".* Incidentally, she was one of the four students who did not give me her activity-based questionnaire at the end of the quarter. This information would have been important to find what she found important about *Bioskills* and how far she got in the package.

Student #3 seemed to support the view of Student #6 on the length of the programme:

> *"It's too long. You listen to things many ... like it repeats things many times. That's what I didn't like about it".* (Student #3, line 119).

When I was designing the programme I was aware of items which needed to be incorporated to make it effective in raising students' awareness of factors likely to increase academic success. These, of necessity, made *Bioskills* a long package. The experts' formative evaluation of the package, reported in Chapter 5, did not suggest sections were repetitive and this casts doubts on the student #3's views Our first-year science students' situations are also important to note. They do not have many free periods due to the practical-oriented nature of their courses.

There were other students who, after using *Bioskills* felt there was still more to learn. Students #4 and #5 continued to use it an attempt to explore the content. When Student #4 was asked why he kept coming his response was:

> *"I went the first time … and in the end, when I stopped there was an interesting paragraph and I thought "I need to know what the rest of the paragraph says" and when I went back I just continued. It was ... it really had me going. It was really interesting. I wanted to know more".* (Student #4, lines 94-96)

Thus each participant had to take into consideration other competing academic demands on their time. However, it must be pointed out that attitudes that students hold about *Bioskills* are important if they are to use it for a longer period. When students hold negative attitudes, being judgemental about a programme, they are unlikely to use it for long periods. Students #4 and #5 were committed, and ensured they benefitted. For future usage I would, as mentioned earlier on, recommend that the package to be incorporated into the tutorial or lab activities to ease the constraints on students' spare time.

Feedback for improvement of the programme

Two students provided feedback for improving the usefulness of the programme. One commented on the structure

> *"… I couldn't distinguish between the different sections. For me … like … one section that said "this is the end of section B" or something, you know?"*
>
> *(Student #1, lines 92-93)*

It must be recalled that one expert had, during the formative evaluation felt: "… *but there is no clear indication of when I have finished a section*" (Expert B).

Her suggestion was that the end of sections be delineated clearly so that it could allow students to work systematically through the programme (even if they left off without completing sections they could still come back and continue). In spite of her suggestion being implemented (see Table 5.10 page 128), Student #1 still had problems identifying with the end of the sections:

Another student made a request for allowance of print outs:

> *"if you ...like … had a print out that you can …uhm … like … if there was a summary on … um … for example like today, I was looking at reading. So like … if there was a summary that you can take with after you have done it. So that when you do read … you*

can say "Okay. This is how I should make sure that the mood is right" or "I am doing active reading". So that would have been nice". (Student #5, lines 97-104).

These suggestions of Student #1 and #5 will be considered for implementation.

The timing of implementation of the programme

The implementation of the programme was scheduled for the first-quarter of the academic year but was delayed, and eventually was used by students only during the third quarter of the year. Students provided opinions over the appropriateness of the time at which they used the programme. Six of the eight participants suggested the package be introduced to first-year students at the beginning of semester 1, and provided reasons for their recommendations. One of their reasons was that it was a more appropriate time if there were students who had to change their outlook on university academic life:

> *"Yes, definitely* [I would recommend it to first-year students]. *But just earlier in the year, in the beginning of the year while you still have time to change your whole life and not getting …* [and] *getting used to the routine and start implementing the things that you learn in Bioskills. Rather than getting used to the routine and then trying to adjust it".*
>
> (Student #4, lines 167-170)

> *"I think it should be introduced to first years during their first week of their 'varsity life so they could see that this is. … I just think that adjusting from school to 'varsity life is something that is quite difficult".* (Student #7, lines 108-110)

A second reason for the early introduction of *Bioskills* is to warn students of the reality of university life so they see the relevance. This was mentioned by two students:

> *"I would have benefitted more if I had had it at the beginning of the year. Because when you come in to 'varsity don't know what to expect. So that would have helped me a bit more. Like if I had known how many students pass and fail, and … like … the pressure. Because like I really didn't expect all of that".* (Student #5, lines 205-207)

> *"… but I would say the programme needs to be introduced to them as they are … in the first block, not in the third block, because in the third block they are almost done with the year. So in the first block they will know the university is bad. It applies to them".*
>
> (Student #2, lines 96-98)

The programme was ready half way into the year, however, when many students failed in the second quarter of the year; I saw it as a favourable opportunity. It could possibly motivate students to find solutions for their poor performance and seize upon all the available resources. The six students' suggestion will be implemented in future.

Students provided both positive and negative opinions about *Bioskills.* In general, more positive opinions about the package were provided. Students when they were invited to use *Bioskills* came with different expectations. As recollected by Student #8*:*

> *"I thought we were going to get a quiz where you are supposed to answer questions and help you understand topics … but then it taught me about the experiences at university".*
>
> (Student #8, line 63-64)

> *"It made a huge difference. And it did not only contribute to bio but to all the subjects. It taught me how to manage my time, how to do my studies well".*
>
> (Student #8, line 149-150)

7.7 SUMMARY AND CONCLUSIONS

The results and discussion section of the therapeutic phase of this study has attempted to answer a number of research questions that relate to changes in students' knowledge, attitudes, and behaviours, as a result of using *Bioskills*.

Some students seemed to have adequate knowledge about some, but not all, of the specific behaviours that they were questioned about at the start of the year before they used *Bioskills*. Some of these gaps in their knowledge of appropriate behaviours, it would seem, were addressed during the use of *Bioskills,* as reported in the chapter. Some positive attitudinal and behavioural gains mentioned by some students were attributed to the use of *Bioskills*. These included academic behaviours such as *going over lecture notes*, *taking better notes* and *keeping up to date with work, and* attitudes of renewed *determination to work hard*.

Students attributed their poor performances during the first semester to causes which I classified to come mainly from their internal milieu. This suggested that if students are to do well in their studies they (students) have to be guided to take more responsibility for their behaviours and overcome the causes for their failures.

In terms of their opinions about *Bioskills*, students who used it three or four times reported a greater level of preference of the package. Some of such students reported a level of appeal about *Bioskills* that encouraged them to use it on a number of occasions. The package was administered when students had a need, but six students would have liked the programme to be implemented at the start of the year. The third block was probably was too late to be helpful to students with inappropriate habits, and at risk of failing.

Based on the results discussed, a number of areas associated with the package design and its implemention could be worked upon to improve students' future engagement with the package. Three possible areas to be considered are: the time users spent on the package, engaging with students' beliefs and students' attributions.

The usefulness of the package, no doubt, is related to how much time students' spend on it. The time spent on the package was limited by the scheduled time-tabling in place. Four students, during the interview session, wanted extra sessions to use the package after class hours. In future an extra class period made available could expose like-minded students to specific areas and improve their engagement with the package.

A second area of the package that could be re-designed should focus a lot more on how to engage students on the certainty of their beliefs that promote academic success. Appropriate academic behaviours are needed if students are to work at their optimum at academic tasks (Pajares, 1992). As noted by Pajares (1992) the strength of an individuals beliefs often disposes an individual to act. Students lack of certainty about academic beliefs often lead them to compromise appropriate academic behaviours for inappropriate ones. The transtheoretical model (Prochaska & DiClemente, 1983) could be given more prominence in the package to highlight the stages of change as students go through the various stages to embrace more appropriate behaviour.

Students' attributions or explanations or perceptions of causes for their success or failure also seem an important area to highlight in the package. The dimensions of attributions, locus of causality, control and stability as discussed in section 7.4.2 have important consequences for students expectancy of future academic success. Some students seem not to realise how important the dimensions of locus of causality and locus of control play in their studies. By giving it a lot more prominence in the package students in turn could be helped to take more responsibility for their studies.

Computer packages may be fashioned according to the best instructional strategies, but as noted by Scholl (2002), it requires a lot of desire and commitment from students to achieve academic goals set. The use of *Bioskills* was meant to increase students' awareness of factors that contributed to successful learning. I cannot claim the use of *Bioskills* alone contributed to some students' improved performance at the end of the year. There are other factors, both external and internal to individuals, that may have influenced any metacognitive gains students' reported. These are highlighted and summarized in Chapter 8.

CHAPTER 8
LIMITATIONS OF THE STUDY, GENERAL DISCUSSION, AND CONCLUSIONS

In concluding the thesis it is appropriate to return to the initial research questions and the inferences I have drawn from the data gathered. The inferences made from the data collected and findings from a study, where properly validated, as noted by Donald (2001), are ingredients in the development of robust educational theory.

8.1 VALIDITY CONSIDERATIONS AND IMPLICATIONS FOR THE STUDY

Validity, according to Fraenkel & Wallen (1990, p. 127), constitutes an important aspect of any study because it affects the "*appropriateness, meaningfulness and usefulness of the specific inferences researchers make based on the data they collect*". Equally important is the validity of the instruments used. I have, in various sections of the thesis, addressed questions relating to what the instruments claim to measure. Sanders & Mokuku (1994) highlight the need for researchers to address validity in their studies so that readers do not lose confidence in the products of academic inquiry due to untrustworthy research. Research is considered useful, only if researchers and consumers of the research are able to have confidence in the inferences made from the study.

There are always threats to validity in research, which even the most meticulous researcher cannot control. Law (2003, p.7) explains that although researchers wish to be comprehensive to know things fully there will be difficulties as not everything "can be brought to presence" or explained. The study, reported in this thesis was, from the onset, expected to assume a clear-cut "hygienic form" (Law, 2003, p.7). However, in practice it turned out, in the words of Law (2003), to be "messy and heterogeneous" and I had to sanitize it and "determine what was relevant data" (Mellor, 2001) in order to write a coherent account. In conducting the study, there were some failings, within and beyond my control, and these constituted limitations or likely sources of error. I addressed aspects of such threats within my control in order to minimize their impact on the study, but they must be borne in mind by the reader when the summary and conclusions of the research are considered.

8.1.1 Timing

Several aspects relating to time constitute possible limitations to the study. The first was the timing of implementation of the intervention, which was only possible halfway through the academic year. This was due to technical problems experienced in developing the package, which took much longer than anticipated to be resolved. The package *Bioskills*, developed during the therapeutic phase of this study, was designed to be used by students at the start of the academic year to introduce them as early as possible to factors that influence academic success. Introducing students early in the year to the factors that influence academic success, it was believed, would help them identify early enough inappropriate attitudes, behaviours, and take steps to work on such. The package, however, was not ready for use at the beginning of the year for the necessary data to be collected.

The late administration of *Bioskills* was a limitation in timing for the study as students had experienced a semester of academic life and possibly formed work-habits or the work-habits could have been taught them much earlier. However, this late intervention had an advantage. Some students' performance in the June exams was poor, which was a shock to them, and implementing the package at this later time had the advantage of helping some to chart a way forward using ideas in the package. For some students, however, it probably was too late to adjust or change their inappropriate attitudes and behaviours and adopt the knowledge and skills introduced. There was ultimately nothing I could do to change this in the year of study, but this has been changed in the subsequent years after the study.

The second time-related factor was the limited time students had available to use *Bioskills*. First-year students in the Faculty of Science have very full time-tables. A typical first-year biological sciences student has four three-hour practicals and 20 periods of lectures a week to attend out of a possible 25-period timetable. Students therefore had very little spare time to work on *Bioskills*. Given the pace at which different students work on computers, as reported in Chapter 7, it would seem that some students might not have seen the whole programme. Students' computer use is linked to their beliefs and attitudes. Those with negative attitudes may have skimmed or gone through it superficially and therefore not benefitted fully. Students' on-line time, where inadequate, constituted a limitation to the possible benefits to be derived from using *Bioskills*. Only the more motivated, or more desperate, were likely to spend adequate time to access all sections of the programme. Thus, the full impact of *Bioskills* may have been limited even if the package was well designed and effective, due to students' time constraints. Although students' access to the programme was limited due to the limited time available during university hours, the programme was available after-hours for those who had access to internet resources. This after-hours facility was not utilized by the students despite their being aware of its availability.

8.1.2 Subject attrition

Subject attrition occurs when respondents drop out during an investigation. Subject attrition is acknowledged as a common threat to the validity of studies that last over several weeks or months. McMillan & Schumacher (1993) point out that the differential loss of subjects may result in bias when the dropouts have definite characteristics and constitute a subset of the sample. This could be a threat to the internal validity of a study when their views are not taken into account.

In the case of my study, bias could have been introduced as a result of the attrition of subjects during the diagnostic phase of my research, where a sample of only 83 students, from a class of 132, could be used to provide comparative data at the start and the end of the year. This subject attrition occurred because some students were not at one or other of the lectures when the questionnaire was administered. Many students missed the lectures at the end of the year because of an impending test, for which they were doing last-minute preparation. It is possible, therefore, that the students who did attend the lectures and completed the questionnaire were those who valued attending lectures or who had managed their time more effectively. The views of students who were not present on either day did not feature in this account. The absence of their views in the account, if they happen to be different from those students present, could likely constitute a threat to the validity of the data for the whole class.

Another case of subject attrition occurred when only eight of the fourteen students who used Bioskills reported for the scheduled interviews. Some students, due to social or academic commitments, were not available during the period of the interviews. Data on the six students who had used the programme but dropped from the interview had to be deleted because their data sets were incomplete, and missing crucial data needed to answer the research question on changes after using *Bioskills*.

8.1.3 Experimenter effect

This refers to both deliberate and unintentional influences that the researcher has on subjects. Researchers indicate that experimenter effects occur when characteristics of researchers, such as their age, sex, educational background or race, affect students' responses (McMillan & Schumacher, 1993). In my study, wearing the cap of a tutor and researcher, I was perceived as an authority figure who could possibly penalize students for critical comments. Students, to avert possible repercussions, may have been untruthful in their comments. If so, this was a potential threat to the validity of the results.

To minimize this threat to the validity of the results I was careful to inform students, both during the diagnostic and therapeutic phases of the study (see sections 3.4.1 and 6.4), about the intent of the study and why honest answers were valued. Participating students were also told during the interview of the importance the information they were contributing, and its value in the future to the teaching and learning in the School. The eight case-study students who used *Bioskills* (therapeutic phase) were told of the research team's readiness to help them improve on their performance and the importance of providing honest answers. By participating and contributing ideas to the issues raised in the study, students were assured they would benefit from the instruction contained in *Bioskills*.

8.1.4 Missing data

In the analysis of activity-based questionnaire 2 (Appendix F) students were requested to return their questionnaires to me at the end of the block. Four of them did not do so. I therefore relied on responses from four out of the eight students to answer one aspect of the activity-based questionnaire. The data contributed by the four students in this particular context was not fully representative of all students involved in the case study and constituted a threat to the validity of the data obtained if the views of the other four students were different from the whole group involved in the case-study. Drawing on larger numbers of students at the onset could have possibly led to the retention of larger numbers of students on which to base the conclusions. However, it should be noted that participation in the study was voluntary and it was beyond my control to determine what number of students would continue to use *Bioskills*, and become involved in the study. I therefore had no option but to use the data available from the four students.

8.1.5 Problem of not using the same data-gathering tools before and after *Bioskills*

In order to measure the changes in students' attitudes and behaviours after using *Bioskills*, it would have been easier to use the same instrument. Two different instruments, a questionnaire and an interview schedule, were used as reported in Chapter 7, to answer research question three. The data was required to compare students' attitudes and behaviours, before and after using *Bioskills*, to see if the use of *Bioskills* did influence them. This introduced challenges in finding comparable data. Despite this difficulty, attempts were made and views compared from equivalent statements in the questionnaire and interview questions as reported in Chapter 7.

Although this is cited as a limitation, it needs to be pointed out that some authors (e.g. McMillan & Schumacher, 1993) have cautioned researchers against administering the same instrument over a short period of time to collect pre- and post-test data for evaluation studies. They explain that the effect of pre-testing informs or conditions people on responses to give. So in a sense it can be justified why the same instrument should not be used over a short period of time by the same sample (Reeves *et al.*, 2005).

It may however interest the reader to note, as mentioned in Chapter 7, that in design research that evaluation need to go beyond just experimental pre-test and post-test designs (see Reeves, 2003; Reeves *et al.*, 2005) because such evaluations usually give no significant difference (NSD) results. This is probably because controlling one variable in a context where there are many variables impacting on learning has little effect (Clark, 1983; Cuban, 2001; Russell, 1999). In order to overcome weaknesses surrounding evaluation of design research, Reeves *et al.* (2005) strongly advocated, amongst other measures, that design research should involve long term engagement and continual refinement of protocols and questions.

8.1.6. Shortcomings of the package, *Bioskills*

Although a number of theories and principles were considered in the design stage to use multi-media and make the package interactive I could not apply all of them. I had planned, as indicated in Table 5.3, to provide different perspectives for students on the strategies needed for academic success, but these were not strongly emphasised in the package. *Bioskills* was envisaged to provide coaching on academic tasks and various work-habits and help students reflect on academic work done. These were not fully addressed in the package and constitute a limitation to the study.

8.2 SUMMARY OF THE FINDINGS, AND THE RESULTING CONCEPTUAL MODEL

The findings reported in the results chapters were long and detailed and the reader could possibly have lost track of the essential findings. I have therefore attempted to summarize the results without being repetitive, and being careful not to overgeneralise the findings. To do this I have put the data in different formats to those used in Chapter 4 and 7, which should help to analyse them from different perspectives.

8.2.1 The diagnostic phase of the research

Two research questions directed this phase of the study, and the results for each will be discussed separately.

Research question 1:

What factors do lecturers teaching first-year biology, Honours students, and first-year biological sciences students perceive to be important for academic success in first-year biological sciences at the University of the Witwatersrand?

To answer this question I used interviews, followed by questionnaires with a larger sample. The interviews involved 10 lecturers teaching first-year university courses, 8 Honours students, and 17 undergraduate first-year students. In addition, questionnaire responses were obtained from two groups of first-year students (n=145; n=83). These results were discussed in Chapter 4. Table 8.1 is a summary of the views of these stakeholders on the various factors. In order not to repeat sections of earlier chapters this summary is reported using consensus indices.[94] which makes comparisons between the data earlier reported.

Killen *et al.* (2003) believe it is necessary to identify and clarify differences in perceptions about factors influencing academic success when they occur between students and lecturers. They note that in as much as lecturers' perceptions influence their teaching, students' perceptions influence their approaches to learning, even if these approaches deviate from good practices reported in the literature. It is therefore important to address differences in perceptions when they occur, either through instruction to reduce divergence in opinion, or to bring students in line with expert opinion, so that teaching and learning at institutions can be enhanced. Thus, the factors with high consensus indices mentioned by the experts but not by the first-year students were considered as important areas to target in the intervention designed in the therapeutic phase.

The items mentioned or agreed to by the stakeholders are categorized into four clusters of factors in Table 8.1 (affective factors, academic behaviours, skills/competencies, and "other" factors). Indices equal to or greater than 0.50 (items with high level of consensus indices) are discussed as what the stakeholders considered important. The following observations can be made about the consensus indices calculated from the stakeholders' responses. It is interesting to note that out of the 21 responses (Table 8.1) contributed by first-year students during the interview session only seven were above the 0.50 consensus index level. These low levels of consensus contrast with the higher agreement within the two groups of experts (9 out of 18 for lecturers, and 11 out of 27 for Honours students).

Items with high consensus indices for all three groups of stakeholders

There were only two items where high consensus indices were obtained from all three groups of stakeholders about factors that influenced academic success. Both of these related to the importance of affective factors for academic success, and that to be successful students should:

[94] The consensus indices are the proportions of the sample which made or agreed with the statements. Such indices range from 0 to 1 on each item and allow easy comparison of viewpoints to be made between the samples.

Table 8.1 Views of lecturers, Honours students and two groups of first-year students about factors important for academic success in first-year biology (reported as consensus indices)

	Specific factors mentioned	Interviews			Questionnaire
		Lecturers (n=10)	Honours' students (n=8)	First-year students (n=17)	First-year students (n=228)
		Consensus index			
Affective factors	Having (unspecified) positive attitudes to studies	0.60	0.50	0.53	-
	Being motivated in their studies	0.80	1.0	0.76	-
	Being interested in the subject	0.20	0.25	0.47	0.08
	Being committed to one's work	0.20	0.63	0.12	0.03
	Being self-confident	0.30	-	0.29	-
	Being responsible for one's own learning	0.10	-	-	-
Academic behaviours	Preparing for lectures	-	0.38	0.53	0.16
	Preparing for practicals	-	0.50	0.41	0.08
	Attending all lectures	-	0.38	0.35	0.32
	Asking for help and clarification when necessary	0.30	0.50	0.76	0.17
	Revising lectures as soon as possible after the lecture	-	0.13	0.71	0.43
	Reading textbooks	0.30	0.13	-	0.23
	Working hard and consistently	-	0.38	0.53	0.21
	Being well organized	0.40	-	-	0.05
	Managing time effectively	0.50	0.50	-	0.10
	Discussing and studying in groups	0.10	0.63	0.06	0.11
	Using various (appropriate) study habits	0.60	1.0	0.12	0.06
Skills / Competencies	Ability to listen carefully at lectures	-	0.12	-	0.13
	Ability to take good notes	0.80	0.25	0.12	0.13
	Ability to make good summaries from which to study	0.60	0.50	-	0.14
	Ability to integrate knowledge from lectures and pracs.	0.60	0.13	-	0.02
	Ability to use library to find information	-	0.63	-	0.02
	Ability to write good essays	-	0.50	-	-
	Ability to draw accurately	-	0.36		0.07
	Ability to use laboratory equipment properly	-	0.36		-
	Ability to cope with the language of instruction	0.60	-	0.12	-
	Ability to memorise and recall information	0.40	-	-	-
Other factors	Having prior experience and knowledge of subject	-	0.13	0.18	0.03
	Understanding the work	0.50	0.13	0.41	0.13
	Having a quiet area to study	-	0.13	0.35	-
	Attending, and taking ADP[97] seriously	-	0.25	0.29	0.18
	Having access to computers with which to study	-	0.25	0.12	-
	Having no financial problems	-	-	0.23	-

Data on skills (shaded) were analysed together with a co-researcher, and a paper was presented at a conference.

[97] ADP is the Academic Development Programme in the School, taught by tutors to support students in need of academic scaffolding.

- have positive attitudes to their studies (0.60, 0.50, 0.53) and
- be motivated in their studies (0.80, 1.0, 0.76).

Stakeholders' views on affective factors could be summed up as stated by one lecturer:

> "*…if they give up on themselves that is fatal … I say you must never give up. I mean even students who see in the first half of the year they are border line,… to below border line They've still got a half year".* (Lecturer 6, lines 977-980)

Fraser & Killen (2005), in a study from a contact university in South Africa, also found that affective factors were reported a lot more than others by students and lecturers to influence students' academic success. In terms of the theory of planned behaviour (Ajzen & Madden, 1986), one factor influencing behaviour is the individuals' attitudes, which form part of the cluster of factors identified as important. Behaviours, which are the outcomes in a chain of four causal factors in the theory of planned behaviour (Ajzen & Madden, 1986), and were the most-mentioned of factors as discussed below.

Items for which only lecturers and Honours students yielded high consensus values

A number of items from lecturers and Honours students, who were considered to be "experts" in academic studies (see Chapter 4 for discussion and reasons), yielded high consensus values (see Table 8.1). However, the first-year students showed less agreement for these items and the consensus indices were lower than 0.50. Those items with high consensus indices mentioned by the two experts were:

- using various (appropriate) study habits (0.60, 1.0).
- managing time effectively (0.50, 0.50).
- ability to make good summaries from which to study (0.60, 0.50).

The first two of the items were academic behaviours, whilst the third was a skill but could be worded as a behaviour: "making good summaries from which to study". The consensus indices of the two groups of "experts" reported were similar (0.60; 0.50) and point to the level of agreement between the two groups of respondents. Studies (e.g. Leggett *et al.,* 2004 and Fraser & Killen, 2005) suggest that senior students' views on important factors required at the university tend to be closer to those of lecturers than those of first-year students.

Differences in perceptions between experts and the first-year students, as shown in Table 8.1, could suggest likely differences in first-year students' approaches to their academic work which, according to the experts, may tend not to be in line with the best practice. It is in the interest of first-year students to be aware of the behaviours lecturers and senior students mentioned and acquire and adopt such behaviours if they are to be fully encultured into, and successful within, the academic society.

Items mentioned by more than half of only one group of stakeholders

There were 12 items, which received high consensus indices from just a single group of stakeholders as important for academic success, and which fewer than half of the other groups mentioned. Only lecturers emphasized:

- ability to take good notes (0.80).
- ability to integrate knowledge from lectures and pracs (0.60).
- ability to cope with the language of instruction (0.60).
- understanding the work (0.50).

All these factors may be viewed as inter-related to a students' cognition. Taking good notes requires that students listen attentively, select important ideas, and record them in a personally meaningful way (Grabe & Christopherson, 2005). Students who are coping well with the language of instruction, are more likely to take good notes than those who are not. The factors listed suggest a high agreement amongst lecturers of the importance of these specific cognitive abilities for academic success, of which the other groups were less aware. Because lecturers have years of experience about factors affecting academic success these are obvious areas to target in an intervention programme, as fewer students seem to be aware of their importance.

For the Honours students, more than 50% of them mentioned the following factors which did not receive a high consensus index in the other two samples (see Table 8.1):

- ability to use library to find information (0.63).
- discussing and studying in groups (0.63).
- being committed to one's work (0.63).
- being able to write good essays (0.50).
- preparing for practicals (0.50).

As can be observed, the items which occurred more frequently in the responses shown above are split between academic behaviour and skills. The Honours students' mentioning of factors important for academic success seem to reflect the stage they have reached in their academic careers, and the academic behaviours and competencies they are being required to use in their studies. The above items selected by the Honours students stand in contrast to a list comprising mostly of academic behaviours which were mentioned as important for academic success by 50% or more of the first-year students interviewed. The factors mentioned by the first-year students, which did not receive commensurate emphasis from the experts, included:

- revising lectures as soon as possible after the lecture (0.71).
- working hard and consistently (0.53).
- preparing for lectures (0.53).

Although it would seem that what was uppermost on the minds of the undergraduates for success was sometimes quite different from that of the experts (Honours students and lecturers), one should not be dismissive of the factors mentioned by the first-year students. All three factors are identified in the literature as important for success. For example, Kuh (2001; 2007) found that in a study in the USA that the majority of students were not spending enough time preparing for lectures to perform at acceptable levels set by their lecturers; a factor mentioned as important by the first-year students in this study. Revising lecture notes regularly was identified as an important ingredients in students' success. Lazar (1995) observed that many students in one university in the USA did not feel pressured to keep up with the reading and review of their lecture notes after examinations, and as a result, they often fell behind their work.

Items from the first-year students' reponses in the open-ended section of the questionnaire

The views obtained from the larger sample (n=228) from the open-ended questionnaire data did not yield any consensus index above 0.50. The consensus indices from two consecutive end-of-year samples reported in the last column of Table 8.1, ranged from 0.43 to very low values (0.02). Not many affective factors were mentioned. The low consensus indices reported are indicative of the lack of agreement of views among this bigger sample. The three factors with the highest consensus indices were about academic behaviours (e.g. *revising lectures as soon as possible* 0.43; *attending lectures* 0.32; *reading textbooks*, 0.23). These were the factors uppermost on the minds of the first-year students at the time of responding to the open-ended questionnaire statements. As these factors were not suggested by the researcher, as in the closed-ended questionnaire items, one can assume these responses are what the respondents really think and believe (Foddy, 1993).

Relationship between the data from my study and the summary of factors from the literature reviewed

Numerous factors influence academic success and they interact in complex and dynamic ways (Schmelzer, Schmelzer, Figler & Brozo, 1987). Evans (2000) reported that findings from studies on factors influencing academic success are not always consistent, and two reasons have been suggested. One of the reasons may lie with the national and institutional contexts of the studies. Evans (2000) points out that whilst some tertiary institutions in some overseas countries, such as the United States of America, have an open-door policy on admissions from high schools into two-year community colleges; institutions in other countries have highly competitive and selective admission policies. These different contexts of admission point to different variables that could influence retention and success. A second reason why findings on factors influencing academic success may be inconsistent has to do with factors incorporated in the design of newer studies and the resulting complexity of such studies (Schmelzer *et al.,* 1987). Evans (2000) points to the importance of taking into consideration factors such as the nature of the institution, its size, and its policies, when making comparative studies. It is important to be reminded that my study is situated in a university in South Africa, a country that over 17 years ago enfranchised the majority of its population and is now dealing with how best to ensure both equity and success for all in education. The study was based in an institution with a competitive admission policy (University of the Witwatersrand, 2011). South Africa, as a young democratic nation gradually disentangling itself from the injustices of the past experiences, one would expect social and political pressures, and their influence on academic success to be overtly expressed, but interestingly no such issues emerged during the interviews.

In Chapter 1 the factors that influenced academic success from the literature reviewed were summarized into eight categories, exerting influence from three levels (national, institutional and personal), as shown in Figure 1.3 on page 10. In Figure 8.1, I have superimposed the consensus indices from my study on the factors found in the literature reviewed, to provide a summary of my results within the context of the literature reviewed. The consensus indices have been displayed but due to space constraints the leading zeroes have been omitted and factors with low indices (such as three decimal figures, 0.002 and zeroes) have not been displayed but are indicated with a dash (-).

The area bounded by the dotted oval represents the *internal milieu*, and represents factors within the influence of the individual learner which affect academic success. Beyond the dotted line is the external milieu. As shown in Figure 8.1, factors within the internal milieu were those frequently mentioned by the three groups of stakeholders.

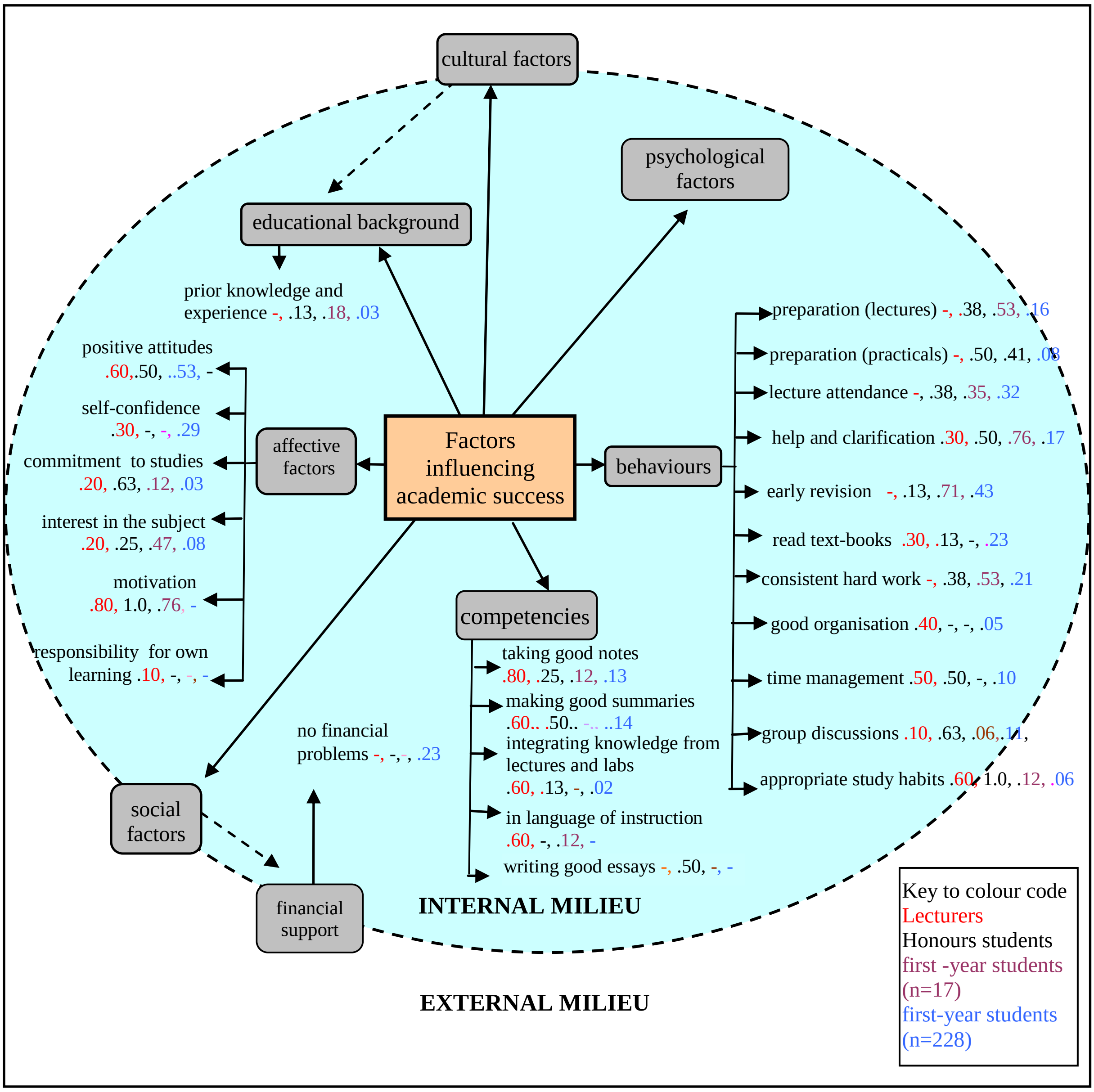


Figure 8.1 The major factors that the stakeholders mentioned which influence academic success

The first cluster with the most consensus indices factors was academic behaviours which included seeking help and clarifying difficulties, attending lectures, preparing for lectures, working hard and consistently and managing time effectively. The next cluster with second-most consensus indices, was the affective cluster which included students; being motivated for their studies, having positive attitudes to studies and having commitment towards studies. It is, however, important to recall the causal link between affective factors and academic behaviours as shown in the theoretical framework (Figure 2.1).

Whilst these cluster of affective factors are important they are not the only influence on achievement. Ajzen & Madden (1986) list at the start of a chain of factors three types beliefs (behavioural, normative and control beliefs). It is interesting to note that self-confidence which in another word for self-efficacy beliefs (Kristjanson, 2008) was mentioned by about a third of each group of lecturers and the larger sample of first-year students (Figure 8.1).

The third most-frequently mentioned cluster of factors, classified as competencies (skills), included taking good notes at lectures and making good summaries to learn from (Table 8.1).These are important skills students need to apply at tertiary level (Fraser & Killen, 2005).

Students' prior knowledge and educational experience was mentioned as a factor influencing academic success under students' educational background. A number of South African studies (e.g. Grayson, 1996; Downs, 2005; Kirby 2010; Lubben *et. al.,* 2010), identified this factor as an important determinant of academic success, and it is also mentioned in studies in institutions in the United States of America (e.g., Kuh, 2007 and Roksa & Calcagno, 2010). Kuh (2007) points out that it is the level of engagement in a range of productive learning activities in high schools that prepares them to do well at tertiary institutions. Fredricks, Blumenfeld & Paris (2004) provide a broader conceptualization of the concept of "engagement" to include *behavioural*, *emotional*, and *cognitive* engagement. Behavioural engagement refers to students' positive conduct and participation in academic-related activities. Emotional engagement refers to student's affective reactions at lectures, and includes interest, motivation and anxiety. Cognitive engagement, according to Fredricks *et al.* (2004) refers to students' depth of processing information and their ability to self-regulate their learning activities. This conceptualization of engagement therefore links the three factors (behaviours, affective, and competencies) which were identified most frequently by the three groups of stakeholders in my study, as shown in Figure 8.1.

If students are to be successful at tertiary institutions the cognitive and affective gaps between the interface of secondary and tertiary education need to be bridged (Mumba *et. al.,* 2002; Rollnick, 2010). Students from disadvantaged backgrounds have wider academic gaps to catch up with, and by implication, a lot more competencies to develop at tertiary institutions than those from advantaged backgrounds, if they are to be successful (Downs, 2005).

Positioned on the boundary between the internal and external milieu is the factor 'financial support" available to the student. It is shown (with dotted lines in Figure 8.1) to be influenced by social factors. It can be deduced that in the absence of bursaries and government financial aid, a parent's socio-economic status often determines the financial support available to the student at the university.

The only group raising this issue was the large sample completing a questionnaire, and this issue was raised by about one in four students.

Three factors from the literature review, social, cultural and psychological, were not explicitly mentioned by my respondents as contributing to success but one was mentioned as contributing to failure (Table 4.2) i.e. students being emotionally unstable. I would have expected social and cultural factors to be uppermost on the list of factors mentioned in the light of the political history of the country, but they were not. Evans (2000), in a review of factors influencing academic success, noted factors change with time and vary in different countries due to different cultures and policies in place.

Lecturers trying to offer help to students on academic success may well note that students' success or failure depends to a large degree on what students feel or do. This viewpoint about factors within the internal milieu of the student as being critical in students' learning endeavours is supported by studies both international (Schmelzer *et al*., 1987; Pargetter *et al.*, 1999; Kuh, 2001) and local (Fraser & Killen, 2005). It is important for students to come to the realization that a lot depends on them, as it would enable them to take responsibility for their studies, to plan and work towards achieving their academic goals.

Conceptual model of factors influencing academic success

The study was conducted in just one university. If other institutions are to benefit from the study, the results have to be made applicable to other academic contexts. I have attempted to do this by means of a model, Figure 8.2, which is based on my results as well as ideas from the literature. The model, as mentioned, was developed to put the results in a more general form to allow the reader to come to a heightened understanding of the relationship between the constructs involved in students' academic success. This model, therefore, should be seen as a new contribution of the study to the understanding of factors influencing academic success, and could help others in their contexts plan their own studies and interventions.

Students' learning occurs within an environment and, as the literature shows, such environments are influenced by a number of external factors. In the model, I have clustered the influences from the external milieu into five main categories of factors that impact on academic success (Figure 8.2). These are political, cultural, social, historical and educational factors. External factors are usually influences beyond the students' control. These factors were not explicitly raised by the stakeholders in my study, but they do emerge from the literature and need to be included. It is necessary for readers to realize their importance as they affect the internal milieu and continue to influence academic success in institutions (e.g. St John *et al*., 2005; Okhee & Luykx, 2006).

The area enclosed by the dotted oval in Figure 8.2 represents the *internal milieu,* which denotes the area within the students' influence. Based on the data, the model shows this region to comprise four nested layers (depicted by increasingly darker shades of blue), representing i) *beliefs* ii) *attitudes*[98]

[98] I have used attitudes here to include *affect* or the affective factors that influence students' success

iii) *academic behaviours* and iv) *skills* (*competencies*). The causal pathways between these factors is indicated by the yellow arrows in Figure 8.2. This starts with factors in the *external milieu*, all of which influence students' beliefs, as observed in the theoretical framework distilled from the literature and shown in Chapter 2, Figure 2.1 on page 42.

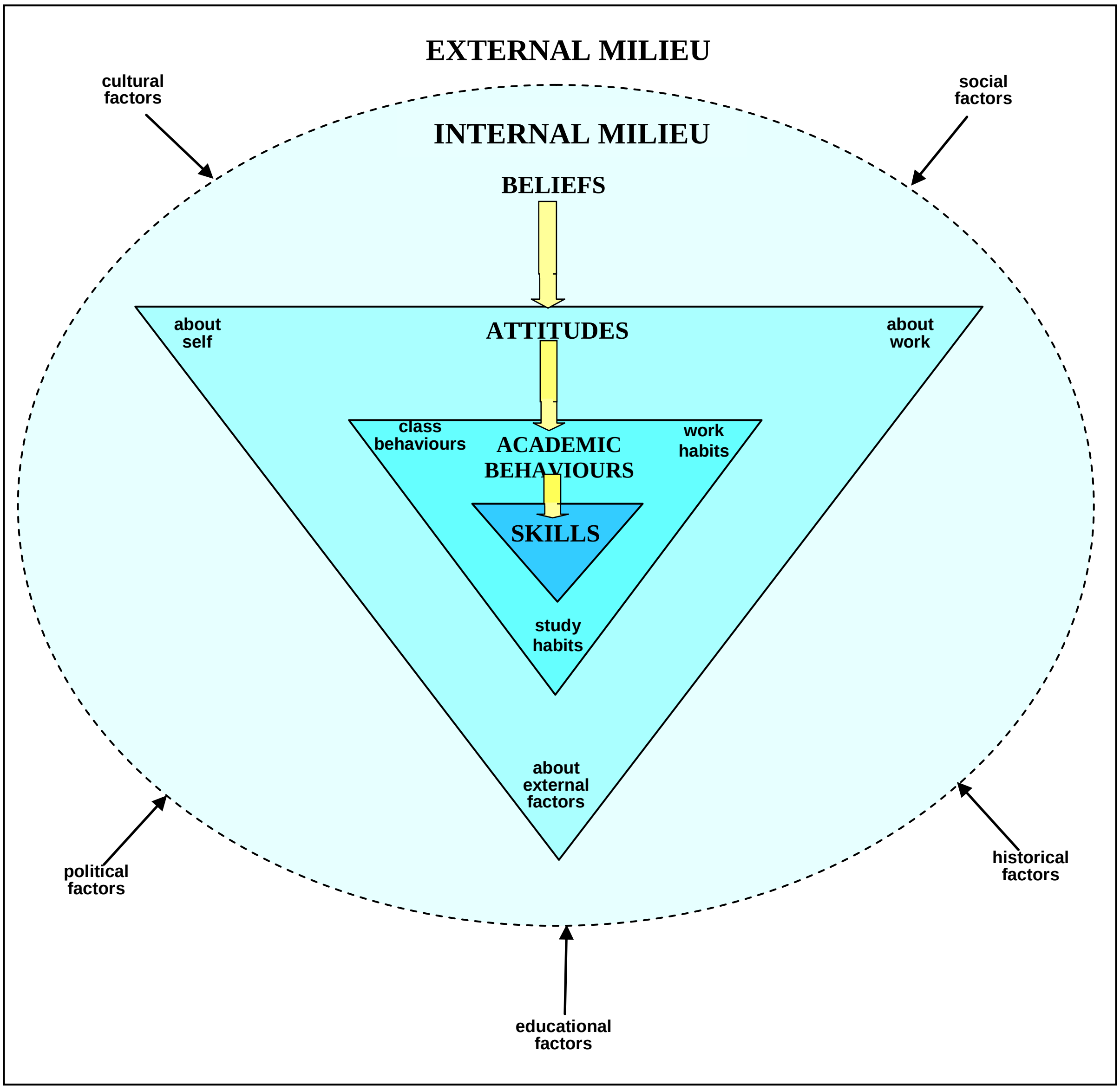


Figure 8.2 Conceptual model of factors influencing academic success

The first category of the internal factors influencing success is students' beliefs about academic success. Beliefs are sometimes communally-based values which are passed on to individuals and accepted by individuals as personal beliefs (Pajares, 1992). In other instances beliefs are individually constructed, based on a person's perceptions about environmental factors. Individuals often attach various levels of significance to these beliefs which may constitute either core beliefs (firmly held) or beliefs that are loosely held by the individual. The strength of the beliefs held by the individual is important (Pajares, 1992; Ertmer, 2005) and this is reflected by those beliefs that are resistant to change and those that are not. There is a causal from the external factors, which influence belief and beliefs in turn will affect the learner's attitudes.

As noted by Ajzen & Madden (1986), beliefs influence students' attitudes (or *affects),* which are represented by the outer triangle in Figure 8.2. These attitudes can be clustered in three categories: (shown at the vertices of the triangle in the model) *attitudes about self, attitudes about work,* and *attitudes about external factors.* Examples of attitudes about self from the data include *being self-confident* and *being self-motivated;* attitudes about work include *having positive attitudes to studies, being committed to ones' work* and *being interested in the subject*. The attitudes categorized as being about external factors include *being motivated by others*, and *attitudes about lecturers' instructional practices*.

As shown in the model, attitudes influence students' academic behaviours (factors represented in the next triangle). Three groups of academic behaviours are shown, one at each vertex of the inner "academic behaviours" triangle (Figure 8.2). Represented at one of the vertices are what I have termed *class behaviours*, such as *asking for help and clarification when necessary*. The second group of academic behaviours shown in the model is *work-habits*, which are regular behaviours students' use to modify or structure their learning environment or manage their time. These include *organizational skills, time management* and *textbook-reading habits* and *regular reflection on work done* students would need in their studies. The third group of behaviours, which influence academic success represented in the model, is *study habits*, which are specific habits students demonstrate in preparation for tests and examinations. These include using *appropriate study habits, working hard and consistently,* and *discussing and studying in groups.*

These three groups of academic behaviours represented in the model are important in the causal chain of factors that promote academic success. When academic behaviours are appropriate (close to those mentioned in the literature as good student practices), students are more likely to develop skills or competencies, the terminal factor, in the causal chain of factors promoting academic success. The development of appropriate skills, which is one of the ultimate goals of education (McGrath & Akoojee, 2007), demands that students first have appropriate beliefs and attitudes towards their studies and this is why skills are put at the heart of the model.

Researchers in countries such as Britain and Australia (e.g. Oliver & McLoughlin, 2001; Leggett *et al.* 2004) have supported calls for academic institutions to focus on skills training and development as outcomes of university education. It does seem, based on this model, that if students are to be successful learners or become active participants in the learning act, such students need first to have appropriate beliefs and attitudes. Secondly, as learning is a process, students need to continually reflect on their learning, monitor their thought processes; and from that standpoint develop the necessary skills or competencies. From a student development perspective, lecturers and tutors need to be aware of the causal factors and address students' difficulties using interventions aimed at helping them to develop more positive beliefs and attitudes towards their studies.

8.2.2 Answering research question 2

Before designing an intervention, I investigated if changes occurred in students' perceptions during the academic year, without a targeted intervention. This information was needed to inform the content and design of the intervention. The research question addressed was:

Research question 2:
What changes in students' perceptions occur after a year at the university?

The data analysed to answer the research question were from three questions posed to the same students at the beginning and end of an academic year. Question 1 was an open-ended question: What strategies help students to do well? Students' (n=83) responses at the start and at the end of the year to the statements in the questionnaire, coded and ranked, showed the following: Ten out of thirteen statements were associated with behaviours whilst only three were about affective factors.

Differences in ranking of the statements at the start and end of the year were noted in nine out of the thirteen volunteered (open-ended) responses (Chapter 4, Table 4.8 page 100).

- four statements of rank differences 1 or 2.
- three statements of rank differences 3 or 4.
- six statements of rank differences of 5 and greater than 5.

When comparing the ranking of responses at the start, and end of the year, small changes in ranking could be a matter of chance and very likely to happen. Large rank differences could be attributed to factors other than chance such as students' knowledge and beliefs. The large rank differences, noted from the volunteered statements suggested that a year's experience at the university could possibly have changed the importance the same group of students attached to those factors over the academic year.

Question 2 and 3 were a set of closed-ended questions. Question 2 had a set of twelve statements with a Likert-format response option indicating strength of agreement or disagreement. Students were given the statements on strategies that helped other students to do well and asked: *To what extent do you agree or disagree with them*?

Index of Agreement consensus values calculated and ranked, from the first set of 12 statements in the first set of data, for the start and end of year responses revealed the following: three items had identical rankings on Index of Agreement, six out of twelve were within one ranking of each other and a further three items were within two rankings of each other (Chapter 4, page 95). A more rigorous statistical analysis was required to show if the differences in ranking were statistically significant or could be a matter of chance.

Students' responses when analyzed statistically, using Rasch analysis, showed three out of twelve statements were statistically significantly different at the 5% level between the start and end of year. All three had higher values at the end of the year than at the beginning (Figure 8.3) and implied such factors were considered significantly different by the students at the end of the year.

The third set of question in the questionnaire, with 15 statements, also using closed-ended Likert-format responses, was about attitudes and behaviours. *What attitudes and behaviours do you think top biology students adopt in studying general biology?*

The Index of Agreement scores calculated for these 15 items ranged from 0.17 to 0.72. Five of the items showed identical ranking on Index of Agreement, four out of the 15 showed a ranking difference of only one or two, and two out of 15 items showed a ranking difference of three.

These rankings, based on the Index of Agreement, suggested students' views had changed little over the year. However, a statistical analysis carried out on these closed-ended Likert-format statements with Rasch transformation using Winsteps showed there were significant differences between the mean scores of the group at the start and end of the year for eight out of 15 (53%) of the items at the 5% level.

Three of the eight responses to the statements, based on the Rasch measure, were significantly more important at the end of the year, whilst five were significantly less important as attitudes and behaviours that top students would adopt (Figure 8.4).

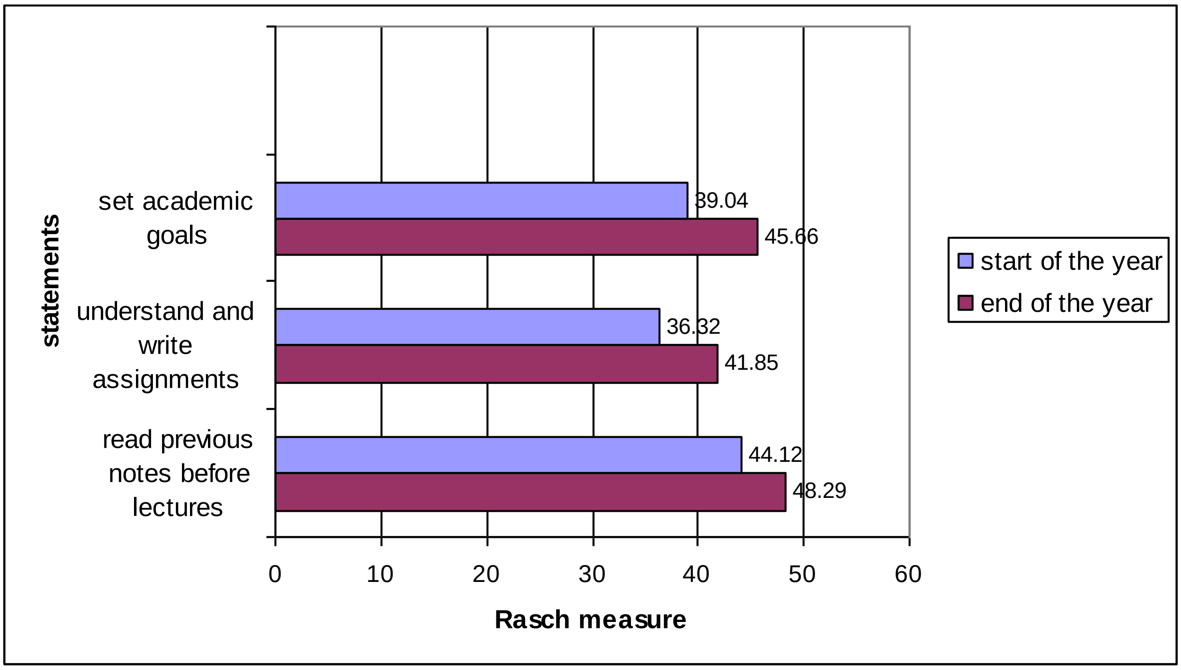


Figure 8.3 Statements responded to at the start and end of year, which showed significant differences (p=0.05) in students' level of agreement, measured in Rasch units (n=83)

The responses to the five statements considered significantly less important at the end of the year as attitudes and behaviours top students of biology have or adopt are:

- having a good command of the English language.
- finding ways to understand the subject.
- studying to please their parents.
- believing in the relevance of the subject and
- believing their success comes naturally.

A good command of the English language is seen by educators as necessary catalyst to academic success. It is disturbing that students' responses to "having a good command of the English language of top students" were significantly less important at the end of the year. Whilst the phrase a good command may be interpreted by individuals differently, it is important to address the implied issues of understanding and communicating scientifically well in English. The issue of language in the life of many tertiary-level students especially, those who speak two or more languages is more complex and a nuanced understanding of students' 'language background' (Rollnick, 2010) is necessary to understand why they scored it to be of less importance at the end of the year. Students' language issues can be explained from two perspectives, the cognitivist and socio-cultural (Boughey, 2000; Rollnick, 2010). Gee (1996) in his exposition on discourse of a discipline points out that language must first be 'acquired,' and then 'learned' in terms of the social practices and ways of communication if students are to be successful in its usage. Some students it would seem may not be aware of the differences between ways of speaking and writing in the dominant discourse (Boughey, 2000). Rollnick (2010, p. 158) points out that, at university, students from advantaged educational backgrounds often may only be "learning the language", whilst students from disadvantaged backgrounds may be engaged in both "language acquisition and language learning" due to their "… *ineffective start with the second language*". Studies cited by Rollnick (2010) show that most often English-second-language speakers tend to display oral fluency but fail to have competency in written English. This lack of awareness of the English language depending on the context, as an every day discourse or a scientific discourse, may perhaps be at the root of students' perceptions and needs to be addressed.

The responses to two other statements considered less important were the beliefs that the success of top students come naturally' and they 'study to please their parents'. That these statements were considered less important by the group of students was encouraging in the light of calls for students to set high academic goals and to work hard to achieve them (Volet, 1997). Results also suggest students realize studying for their own goals is important.

Three of the eight responses to the statements students thought affected success of top students and which were perceived significantly more important at the end of the year were all about metacognitive strategies of top students. More students agreed at the end of the year that top students:

- plan well ahead and work consciously to complete class assignments on schedule.
- test themselves to be sure they know the material they have been studying.
- try to determine which topics they do not understand well and work on them.

Planning well ahead to meet class deadlines encapsulates setting academic goals and working to achieve them which was mentioned under figure 8.3. Academic goals according to Schunk (2003) may be short-term, proximal or long-term and they are important components of motivation and learning. One important factor necessary for achieving academic goals is the individual's thought and beliefs (Schunk, 2003). A students' self-efficacy or beliefs about their capability to perform at certain levels are therefore pivotal to achieve goals (Bandura, 1997). As the academic year progresses, students are believed to react to their perceptions of achieving their goals (Schunk, 2003). They determine and reflect on topics they do not understand well and work on them. Such reflections are important aspects of metacognition. Accomplishing their proximal goals (e.g. passing class tests) often motivate students to exert extra effort, and use extra strategies that will help them achieve their long term goals, such as pass end of year exams.

If students became aware of these metacognitive strategies (and possibly others not discussed) quite early in the year and applied them to their studies, they would more likely improve on their performance. An intervention may be required if students do not become aware of these metacognitive strategies early in the year. Some of which were considered in the computer package developed. It does not serve the university's goals of promoting access if students only recognized the importance of these factors later in the year. It may perhaps be too late for some.

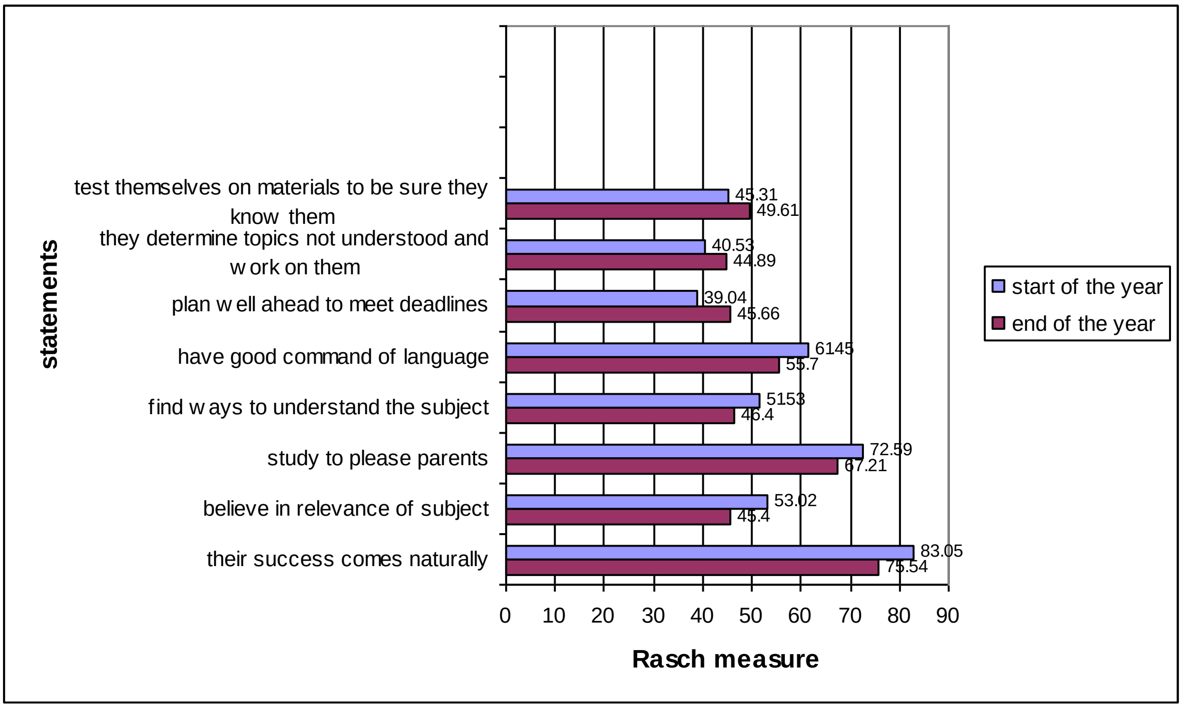


Figure 8.4 Attitudes and behaviours of top students which showed significant differences in students' perceptions at the start and end of the year (n=83)

8.2.3 The therapeutic phase of the research

In the therapeutic phase, using the results from the diagnostic phase and research literature, an instructional package, *Bioskills*, was designed as an intervention and students' perceptions about its use were investigated. The first research question addressed was:

Research question 3:
What metacognitive gains did the students derive from using Bioskills?

Metacognition, using the conceptualization of Desautel (2009), was considered to consist of metacognitive knowledge (what people know about successful learning and how it happens) and metacognitve control (the application of the knowledge). This led to the sub-division of the research question 3 into two sub-questions. The first of these was:

Research question 3a:
What metacognitive knowledge did the students say they have about factors promoting academic success, before and after using Bioskills?

As discussed in Chapter 7 there were challenges by not using the same instruments before and after students used *Bioskills* to establish their gains in metacognitive knowledge. The initial data was obtained from the small sample of eight students, chosen because they had used *Bioskills* and were willing to be interviewed. Some additional data on what students learned from *Bioskills* was obtained from a sample of 53 students, each of whom had used *Bioskills* only once. Even before using *Bioskills* five of the eight students had reasonably good metacognitive knowledge of factors affecting academic success (see page 167 in Chapter 7), achieving "scores" of between 19 and 22 out of a possible 24 scores for appropriate metacognitive knowledge. Three students had weaker scores (between 8 and 13). As there was no identical "after-use" measure which could be used to determine gains I used statements made by students of both groups (n=8; n=53) about what new knowledge they believed they gained from *Bioskills* (Table 8.2), recorded in an activity-based questionnaire as they completed for each section of *Bioskills* (see pages 171-178 in Chapter 7).

Comparing the two samples, it is noticeable that the average number of responses per student (for all four sections) is higher for the sample of eight than for the sample of 53 students. This is initially puzzling since both groups completed the questionnaire during their first exposure to the package. However, the larger group of students was using it at the start of the year (in the second year of use of *Bioskills*), while the smaller group of eight were involved in the first year of use, when *Bioskills* was used in September. These students had therefore experienced seven months of university. In addition, it should be remembered that the eight students were volunteers who subsequently continued using *Bioskills,* so their motivation, commitment, attitudes and behaviours might have been more positive than those of the average student.

It appears that *Bioskills* introduced many new ideas to students, which they said (they) were previously unaware of. Looking at the average number of responses per section (Table 8.2), in terms of new knowledge students wrote they had gained from each section of *Bioskills,* it is noticeable that the small sample of eight students reported having learned more from the section on "Improving work-habits" and "Model to change behaviour" than the group of 53 students who used *Bioskills* only once. It would seem that this difference could be related to the smaller group having spent more time at university (but not on how long they used it) and they possibly have recognized the importance of work-habits for academic success.

The ratios calculated for both groups, despite differences in the period spent at university, after answering the questions, were similar on things learned from "*challenges of 'varsity life*", section which discussed themes on:

- Changes in lifestyle between school and university.
- Lecturers' and past students' views on factors affecting academic success.

This suggests that it might be important for students to be reminded time and again of the differences between school and university and what lecturers' expectations are from them.
Looking at the two samples of students, the smallest numbers of average responses per person for a section were from the last section named "*model to change behaviour*". This could possibly be due to either their having not sufficient time to finish the last section, or because the section was short and therefore contained less information.

Table 8.2 Summary of average number of new things students said they learned per section of *Bioskills*

Sections of the package			Sample			
			n=8		n=53	
	Sub-sections of the package	Number of screens	No. of responses	Average no. per student	No of responses	Average no. per student
Challenges of 'varsity life	'Varsity life Academic activities Summary of views on success	12	10	1.25	61	1.15
Factors affecting behaviour	Factors affecting intention Importance of behaviour Recognising current strengths and weaknesses	16	6	0.75	38	0.72
Improving work-habits	Setting goals Motivation to achieve goals Learning how to learn	16	14	1.75	45	0.85
Model to change behaviour	How behaviour changes Stages of behaviour change	6	3	0.38	4	0.08

The eight students were also asked directly (in interviews) how *Bioskills* contributed to improving their attitudes, as discussed on pages 193-195, in Chapter 7. The gains in attitudes students mentioned after students used *Bioskills* were not detailed and not many. They said very little, five just referring to the importance of positive attitudes. It would seem that many attitudes mentioned by the students depended on the topic being taught at that point in time during the block, and how much they liked it.

The second sub-question relating to metacognitive gains was:

Research question 3b:
What metacognitive control (application of metacognitive knowledge) did students say they use before and after working with Bioskills?

This research question was used to identify gains in metacognitive control of behaviour and attitude changes emanating from students applying such controls. In spite of intending to behave in ways which they knew would promote success, several of the eight did not implement the appropriate behavioural intentions, as discussed on pages 178-181 in Chapter 7, and summarized in Figure 8.5 below. That is, they did not successfully demonstrate metacognitive control for certain intended behaviours.

Figure 8.5 shows that before using *Bioskills* at least 50% of the students intended to implement each of the five behaviours asked about in activity-based questionnaire 1. Four behaviours (*hand in work on time, attend all lectures, file notes regularly*, and *work hard from start of year*) were implemented, whereas one was not implemented, by those who intended to do so. The one intended behaviour not achieved by any of the (four) students who intended to do something was *rewriting their notes after lectures*.

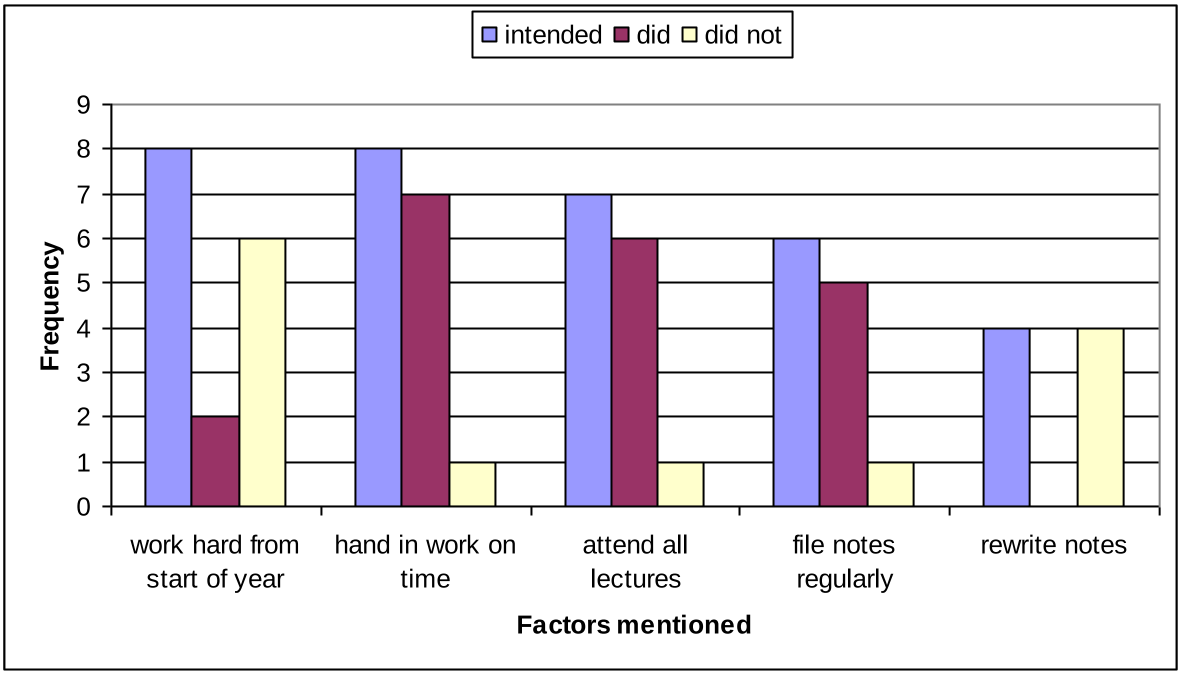


Figure 8.5 Students' intentions and the number of students who did or did not implement their intentions during semester one, before using *Bioskills*

The theory of planned behaviour (Madden & Ajzen, 1986) provides some understanding why some of the intentions were performed and other not. The theory states that the performance of an intention depends on the combined effect of three factors, attitudes towards the behavior, social pressures and influences and the degree individuals believe they can control the performance. Ajzen (1991) notes that when these underlying factors are high in an individual they allow for the performance of the intention. It can be observed that none of the students was able to rewrite their notes although they had intended to do so. Perhaps this is an idealistic goal to achieve; given the heavy workload first-year science students have to contend with (see section 7.4.2, Chapter 7, pages 177-181).

How students implemented their behavioural intentions after using *Bioskills* was explored in terms of the academic goals they had set for themselves, and the commitment they attached to these goals. During the interviews, seven of the eight students said they were serious about the goals they had set and intended to work hard to implement them. Four students said they were able to implement all the goals they set, and three said they were not (Chapter 7, pages 180-181).

A direct comparison of the gains in intentions students achieved before and after using *Bioskills* could not be assessed due to the different instruments used to collect the data. At least four students out of eight, before and after using *Bioskills* however, reported that they were able to achieve their intentions on each occasion. I am therefore not able to attribute conclusively gains on intentions to the use of *Bioskills*.

Students' use of appropriate behaviours (or reported best practices) for promoting academic success before and after using *Bioskills* was explored further. Students' responses to twelve items on existing work-habits, provided the *before* data. Scores for the use of appropriate practices ranged from seven to 13 out of a maximum of 20, indicating individual differences in the level of use of such behaviours. Use of inappropriate behaviours was deduced from the scores for inappropriate behaviours obtained by two of the students. Whilst some said they were already practicing a number of appropriate behaviours before using *Bioskills*, others were behaving in ways likely to negatively affect their chances of academic success (see Section 7.4.2, p 180-190).

Comparing gains in appropriate academic behaviours after using *Bioskills* is not so clear-cut due to the different instruments used to gather the data. Many factors including beliefs and attitudes are found to impact on behaviour so that despite students mentioning and using some of the behaviours before *Bioskills,* there were still other factors that could possibly influence their academic behaviour. There was, however, the realization of the need to use behaviours to achieve goals, as this student revealed after using *Bioskills*:

> *"But now I work every day, I always find something to do and read. And in the long run I have realized that there is always something to do … something that I didn't know…"*
> (Student #8, lines 164-165)

Changes in students' attributions

I discussed in *Bioskills* the characteristics of individuals with internal and external locus of control. *Bioskills* emphasized the need for students to accept responsibility for performance and not blame outside factors (showing external locus of causality). I hoped students would learn from *Bioskills* the importance of taking responsibility for their studies and would start to exhibit more internal locus of control tendencies than external. I had data on students' locus of causality prior to using *Bioskills* (see pages 186-187 and Figure 8.6) but did not have corresponding data using the same instrument on their locus of control after *Bioskills*. This is an area needing further investigation.

Figure 8.6 is a graph based on causes students' (n=8) perceived as reasons for failure in their June examinations, which was before they used *Bioskills.* These responses from 38 statements, analysed, have been grouped under the three dimensions of locus of causality and showed in all cases that the most frequently reported causes were of *internal* and *controllable* but *unstable dimensions* (see pages 195-199).

This suggests that the possible causes for students' performance shown here and categorized as due to personal, unstable but controllable factors could be remediated much more easily than had the causes been seen as external, stable and uncontrollable (see Chapter 2, pages 47-49 for an in-depth explanation).

The eight students' performance after using *Bioskills* in the third quarter was different (much improvement) from their earlier performance reported in the second quarter[99] (see Chapter 7, section 7.5.1 page 204-205). Four students achieved 50%, which is the pass mark for the course, and another two scored above the 40% sub-minimum mark (see Table 7.10 in Chapter 7). Whilst a causal link was not implied between the improved performance and the use of *Bioskills*, it is worthwhile to consider students' reasons for their improved performance. Their reasons included *renewed interest* in the *subject or* [new] *topic taught*, *motivation*, *self-efficacy*, *use of consistent academic behaviour*, which suggested the possibility of these students now taking more responsibility for their studies, a feature of individuals with an internal locus of control.

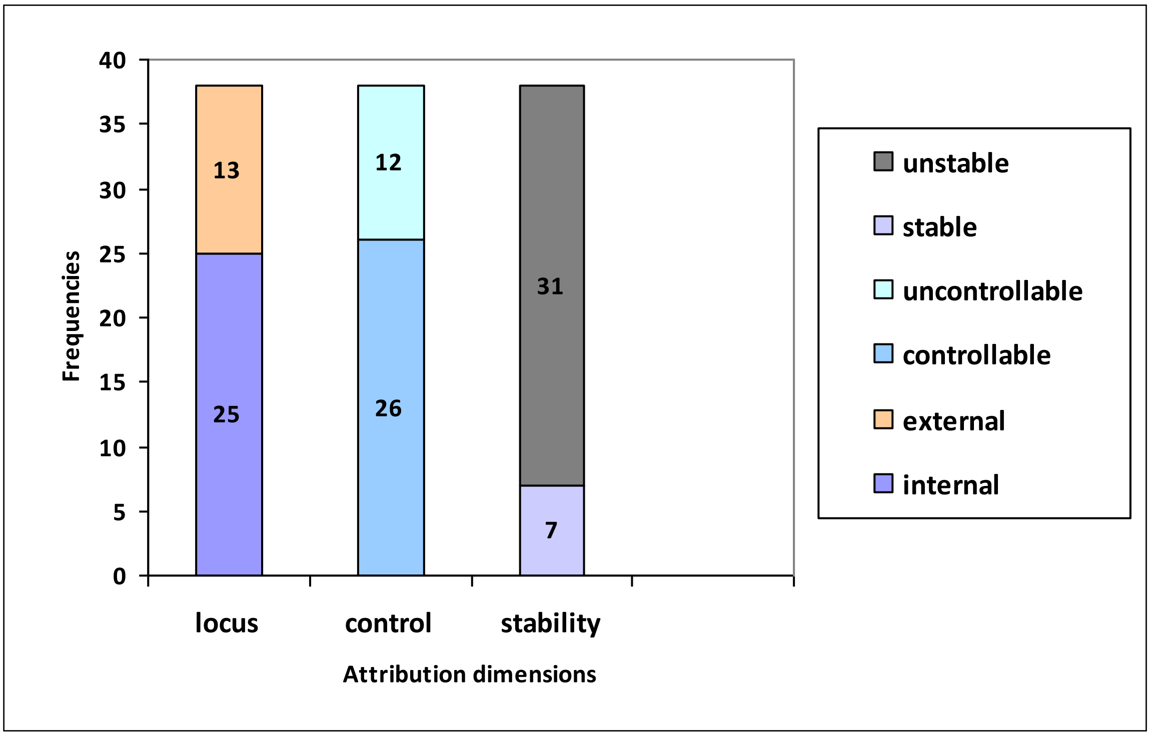


Figure 8.6 Attribution dimensions for poor performance in the June examination based on students' reported causes for 38 statements (n=8)

The different instruments used to capture data on their performance prevent ascribing the gains reported here to the use of *Bioskills*. *Bioskills* did create some awareness about factors that influence performance, as attested to by three students (see Chapter 7, pages 200-201) using the package.

Research question 4:
What are students' opinions about *Bioskills* as a teaching tool targeting academic success?

The volunteers who spent extra time going through *Bioskills* were generally positive about it. The value of information in *Bioskills* was acknowledged by four students, who said they would continue

[99] It must be stated that every year, for most students, the marks for block 2 tends to dip. Students' reasons for their poor performance is often ascribed to the nature of topic taught. It can be expected there will be some renewed interest in the topic of block 3 for some students and increased motivation to do well as reported by the students interviewed.

to use it. Three saw it as a good programme and two said it was helpful. Two students commented on the ease of use, whilst one student mentioned the interactions it encouraged.

Students' were divided in viewpoints over the novelty of the content, two saying it was new to them whilst three said they had heard aspects of it before. However, Student #4, one of the three, said it helped to be reminded of the information, and the importance of such information was emphasized in *Bioskills*.

Despite the positive opinions about *Bioskills*, two students felt the programme was too long. It was the opinion of six students that the programme should be used in the first rather than the third quarter of the year.

It was my intention to provide a model of what students stood to derive after using *Bioskills* and to make the results more generally applicable. However, due to the small sample and the eclectic nature of the research instruments, it would be premature to suggest such a model at this stage. Instead, I have gone on to make recommendations on work that needs to be done to improve *Bioskills* and to promote further research.

8.3 IMPORTANCE OF THE STUDY

This study is important in many respects: it can be said to have been done in response to needs expressed in the education literature or requests made on behalf of tertiary institutions, and proposes ways in which the needs can be addressed. The following areas are some of the important needs this study addressed.

8.3.1 The need for research into the affective factors that affect academic success

The thrust of aspects of the study into the affective domain is important. Grayson (1997), over a decade ago, with reference to South Africa, mentions the affective domain as an area that has not received much investigation in this country. I began this study and highlighted from the literature problems that had to do with meanings and definitions of constructs associated with the affective domain, work-habits and metacognition. I have provided a theoretical framework, which showed the web of relationships that, exists among the many constructs that influence academic success of students. By focusing on students' attitudes, motivation, work-habits and metacognition, this study explores areas beyond those indicated by Grayson (1997). The findings, which are context-specific to the University of the Witwatersrand because of the selection criterion, used in the admission processes and the characteristic nature of students that are generally drawn to the university (University of the Witwatersrand, 2006) when implemented, have the potential to help more first-year students to improve on their academic performance.

8.3.2 The importance of increasing success rates is crucial for the country

The policy of the Ministry of Education in South Africa demanding an increase in the proportion of high-school leavers entering higher education institutions from 15 percent to 20 percent (Ministry of Education, 2001, p. 16; Ntshoe, 2002) is vital for the country's economy in terms of numbers of students studying in the various disciplines, as discussed in Chapter 1.

However, increase in numbers admitted to undergraduate degrees has not resulted in substantially greater numbers of students passing, at least in the biological sciences (Table 1.2; University of the Witwatersrand, 2010a). To ensure the success of increasing numbers of first-year students at the end of the year would require additional support early enough for those students identified to be at-risk of failing (Killen, Marais & Loedolff, 2003). The package made available in this study, if used by a larger number of first-year students, has the potential to increase students' awareness of the factors that promote academic success. Awareness leads to the improvement of metacognitive knowledge and metacognitive control that are prerequisites, for enhanced academic performance (Desautel, 2009).

This study is of potential interest to policy-makers and educationists who advocate that new ways be sought to increase retention of the increasing numbers of students admitted to tertiary institutions (Carmichael *et al.*, 1993; Fraser & Killen, 2005). It is also of potential interest to tutors and lecturers and, by extension, students, as they (students) are made aware of the factors that are believed to promote academic success.

8.3.3 Support for this university's equity, transformation and expansion initiatives

The increase in student numbers registered in the Faculty of Science over the past decade is laudable and represents a demographic shift to students from previously disadvantaged social groups. To be able to fully address equity and transformation initiatives the university must continue to implement strategies and interventions which permit university entrants the necessary institutional support for improved chances of success.

The University of Witwatersrand has recommended that a pass rate of over 80% for each course at the university would be required to meet the 2010 to 2014 Teaching and Learning Plan of the university (University of the Witwatersrand, 2009). "Most lecturers just teach, and often do not think about the students" (S. Hanrahan[100], personal communication, July 2010). If this comment is true, it is important that lecturers become sensitized about the different backgrounds of each cohort of students in a class. Using factors that are identified to influence academic success among the first-year students, this study gives a line of direction which, when implemented could contribute to the university achieving the goals stated in the Teaching and Learning Plan.

[100] Former head of the Department of Zoology, Universty of the Witwatersrand

8.3.4 The development of a research-based instructional resource

Appropriate interventions driven by research-based evidence are needed to address problems in science education (Sanders & Mokuku, 1994). Killen & Fraser (2002) claim that orientation programmes at South Africa's universities which should serve to inform students of the "roadmap" into tertiary education have become increasingly "fun-filled", conveying limited academic information to students of what university life really is. I have taken note of the concern expressed by Killen & Fraser (2002) and portrayed in *Bioskills* the social and academic challenges new first-year students are likely to face.

This study is important as I have explored the various constructs within the affective domain associated with academic success, identified gaps in the literature and clarified the relationship between the constructs. The theoretical framework I developed was an effort to provide a more extensive summary of the various findings in the literature on affective factors, work-habits and metacognition. The model provided an interpretation of how academic success can be achieved within the university context. In the construction of the conceptual model use was made of case-specific results obtained in this study and as a result, brings new evidence to bear on the problem of students' underachievement.

One of the outcomes of the present research is an interactive computer-based instructional and learning resource (*Bioskills*[101]). The design, content and effectiveness of its usage were investigated by a number of stakeholders of the university. The programme, which is now in use by first-year Extended Curriculum students at this university, introduces students, especially those who have never used computers before (first-time users), to the capabilities of computers. On using the package students are made to come to an understanding of appropriate academic behaviours and their responsibilities on the academic road as they strive to access university certification. By taking cognizance of these factors it is expected they will be able to negotiate their way through the academic courses with fewer problems, thus addressing one of the concerns raised by Killen & Fraser (2002).

8.4 RECOMMENDATIONS FOR FUTURE USE AND FURTHER RESEARCH

There are a number of areas of this study that can be further explored to provide additional understanding of the impact on academic success of some of the factors already discussed. Some of these areas have to do with the design of the study.

8.4.1 Research on *Bioskills*

The use of *Bioskills* by the students during the therapeutic phase revealed some potential benefits it can offer to promote academic success. However, the small sample of students used in the case-study

[101] *Bioskills* is now used as a supplementary self-tuition tutorial resource for the Extended Curriculum students at the University of the Witwatersrand in the first semester of study.

does not justify an immediate large scale application of the results. A more comprehensive investigation with a larger sample of students is necessary.

Academic success, according to the literature reviewed, is influenced by many other variables (Pintrich *et al.*, 1986; Fraser & Killen, 2005). In design research it seems inappropriate to investigate the influence of one factor using a simple intervention. A more appropriate approach, as suggested by Reeves & Hedburg (2003) and Reeves (2005) about similar cases, would be to undertake a design research that is broad-based, long term and capable of testing and refining them in multiple design environments. This could well be the next phase I would recommend for investigating the effectiveness of *Bioskills.*

The package, although was designed with first-year biology students in mind, is not discipline-based, and it could well be used for other first-year science laboratory-based subjects.

8.4.2 Areas of *Bioskills* requiring further development and modification

I have identified the following sections and items as areas that could either be modified or introduced in the next version to benefit students:

- **Students' intentions**. Whilst some students were able to accomplish some of their intentions, there were others who could not, possibly due to time constraints or not realizing fully their importance. It is important in the modification of the package that students are made aware of the consequences of not accomplishing their intentions for the year.
- **Accessing students' beliefs, attitudes and behaviours**. Students' beliefs, attitudes and behaviours as they used the package were not captured. This was due to a glitch in the data capturing programmes installed. However, insights gained from the interviews after they had used *Bioskills* gave indications that their beliefs and attitudes were influenced. To correct this lapse in the design a functioning audit trail which captures user responses to tasks in the package could be a valuable source of data when analyzing the effect of the package on students' attitudes and behaviours. The data captured on line whilst students used the package could be a more readily available source than those captured later from paper-based questionnaires administered.

8.4.3 Recommendations for using *Bioskills* as a teaching tool in the School of Biology

Recommending solely *Bioskills* for usage as a solution to poor academic performance would not resolve all the underlying causes of failure reported in the School of Biology. *Bioskills* could be used as supplementary instructional material to augment tutorial instructional materials currently in use in various departments. It should be recognized that because students' performance, as depicted in Chapter 1, is informed by multiple factors of context, no single approach or practice is likely to bring success for all students,. A multi-faceted approach may need to be adopted for effective solution of the problem.

I am recommending that when *Bioskills* is introduced in a university setting, when appropriate, a modified form of *activity-based questionnaire 1* should be included as a supplementary material. Activity-based questionnaire 1 has questions that promote students' self-reflection of their learning process. This is important so that students would have materials that encourage reflection and which, according to Desautel (2009), develops their metacognition. Some students did not work through to the end of the programme, which probably influenced their perceptions of *Bioskills*. It would be appropriate that sufficient time be allocated for students to work to the end of *Bioskills*. It may also be necessary for students to return to the programme after their first time-tabled session. Tutors would have to devise strategies to encourage students to return to the programme, especially when a difficult course is to be taught.

One student requested a printout option of the screens to be to be available to users. Whilst the provision of this functionality could lead some students not to be diligent in going through the screens and various topics when they have the opportunity, it could be a useful reference material for students who do not have regular access to internet-linked computers. Thus, I would consider favourably this request to be made available in the next version of *Bioskills*.

Locus of control: This area is a critical area to be addressed if students are to develop responsibility for their studies. The section of *Bioskills* with a locus of control survey could help students identify their locus of control beliefs and the associated merits and demerits of such beliefs. Having the appropriate knowledge about their strengths and weaknesses is a necessary step for them to address their inadequate academic behaviours. Teachers and tutors need to be aware of its influence on students' attitudes and academic behaviour and to engage students to apply what they learn.

8.5 CONCLUDING REMARKS

I have made the call in Chapter 2, section 2.2, for the standardization of definitions about constructs across disciplines that would allow relevant constructs to be easily used with less ambiguity in meaning in the construction of conceptual frameworks. These conceptual frameworks are a necessary step towards the development of robust theories in research.

Part of the literature reviewed was about factors within the affective domain that influence academic success of students. The contributions of this study that set it aside to have made an addition to the existing stock of knowledge on academic success are: a) an expansion of existing attitude-behaviour models by the addition of other constructs and showing relationships between them, b) the presentation of a conceptual model of the factors that contribute to academic success and the pathway involved, c) a multimedia package based on the theoretical framework has been developed and its effect investigated. It is now ready for a final comprehensive evaluation and implementation to other contexts.

An essential area contributed by stakeholders to influence academic success was shown to reside in the internal milieu of the student. This area constitutes a target, which can be explored by academic counsellors, tutors and lecturers to better understand some of the reasons why some students struggle with their academic work and others do not. Counsellors can open up conversations about the conditions in which students find themselves and can help those who struggle to overcome their difficulties. When students are engaged in discussions about their beliefs, attitudes and academic behaviours, they can articulate and evaluate them from an informed position and be able to see alternative beliefs, practices. This internal milieu of the student is important for instructors to address as they build on the educational foundation for the improvement of academic performance at tertiary education institutions.

APPENDIX A

THREE INTERVIEW SCHEDULES (A1, A2 & A3)

These interview schedules (Appendices A1, A2, & A3) were used as a general model of reference during the diagnostic phase of the study. Interviewees were 10 lecturers teaching first year biology courses, 8 Honours students and 17 first-year biology students during the diagnostic phase of the study (see Chapter 4).

APPENDIX A1

SEMI-STRUCTURED INTERVIEW SCHEDULE

E. Ayayee and J. N. Linkonyane

1. LECTURERS' PROFILE

Courses/Topics taught presently to first years...............

Introduction. Thank-you for agreeing to talk to us. As we explained to you, the university is very keen to try to improve the pass rates of its students, especially those in the first year. I am sure you will have noticed that while some students struggle to cope with their studies, others tend to cope and pass their exams easily.

We are involved in a research project to find out what makes some students successful whilst others struggle. We are hoping that if we can identify factors which contribute to success, we might be able to teach these to weaker students, thus helping improve the pass rate.

As a lecturer with many years of experience, you would have seen successful and unsuccessful students going about their studies, and may have developed some ideas about factors which contribute to academic success. It is this we want to ask you about.

QUESTIONS	PROBES AND EXPLANATIONS
1. What **factors** do you think make students successful in their study of biology?	Silent probe, allow interviewee to list as many factors as possible. *To encourage interviewee to list more factors ask:* Can you think of any more factors? *This will be done in order to lead interviewees in other areas of interest as highlighted in questions 2-6, if they have not mentioned them.*
2. Do you think that there are any **skills** biology students need in order to succeed in biology?[1] 3. I will read you the skills you have listed. Could you please tell us **how important** you think each skill is?	*As the skills are mentioned, one of the researchers will be writing them down on a prepared form which will allow the interviewee to rate them later in the interview.* *If yes, the informant will be asked*: Could you tell us which abilities/skills those are? *If very few skills are mentioned, the informant will be asked*: Can you think of any other skills? *Reasonable time will be allowed for* 'silent probes'. *If they are not sure, ask:* Is it not very important, important, or not so important? *The informants will be allowed to include some skills that they happen to remember as they are rating those that are already mentioned.*
4. Do you think **students' attitudes** to studies are important for academic success?	*If response is YES*, ask: Could you elaborate? *If the response is NO*, ask: In what ways? Do you have anything else to add?
5. Do you think that **students' motivation** plays an important role in their being academically successful?	*If the response is Yes/No, ask*: Could you elaborate? 'Can you think of any thing more?' *to welcome more contributions from the lecturers.*
6. Do you think that **study habits** are important for academic success?	*Whether the response is 'Yes/No', ask:* Could you elaborate? *To welcome more contributions, ask:* Is there any thing else you want to add?

1 This question in practice does not follow immediately after Q.1 but after Q.6 when Ellis' is finished with his set of questions

APPENDIX A2

SEMI-STRUCTURED INTERVIEW SCHEDULE A2

E. Ayayee and J. N Linkonyane

1 HONOURS STUDENTS' INTERVIEW SCHEDULE

2. INTRODUCTION TO THE INTERVIEW

Thank-you for agreeing to talk to us. As we explained to you, the university is very keen on finding ways to improve the pass rates of its students, especially those in the first year. I am sure you will have noticed that while some students struggle to cope with their studies, others tend to cope and pass their exams easily.

We are involved in a research project to find out what makes some students successful whilst others struggle. We are hoping that if we can identify educational and attitudinal factors which contribute to success, we might be able to teach these to weaker students, thus helping improve the pass rate.

As a senior student of this university, you would have seen both successful and unsuccessful students going about with their studies, and may have developed some ideas about factors which contribute to success. It is these we want to ask you about.

QUESTIONS	PROBES AND EXPLANATIONS
1. What **factors** do you think make students successful in their study of biology?	X Silent probe, allow interviewee to list as many factors as possible. X *To encourage interviewee to list more factors ask:* Can you think of any more factors? *This will be done in order to lead interviewees in other areas of interest as highlighted in questions 2-6, if they have not mentioned them.*
2. Do you think that there are any **skills** biology students need in order to succeed in biology?[1] 3. I will read you the skills you have listed. Could you please tell us **how important** you think each skill is?	X *As the skills are mentioned, one of the researchers will be writing them down on a prepared form which will allow the interviewee to rate them later in the interview.* X *If yes, the informant will be asked*: Could you tell us which abilities/skills those are? X *If very few skills are mentioned, the informant will be asked*: Can you think of any other skills? X *Reasonable time will be allowed for* 'silent probes'. X *If they are not sure, ask:* Is it not very important, important, or not so important? X *The informants will be allowed to include some skills that they happen to remember as they are rating those that are already mentioned.*
4. Do you think **students' attitudes** to studies are important for academic success?	X *If response is YES*, ask: Could you elaborate? X *If the response is NO*, ask: In what ways? X Do you have anything else to add?
5. Do you think that **students' motivation** plays an important role in their being academically successful?	X *If the response is Yes/No, ask*: Could you elaborate? X 'Can you think of any thing more?' *to welcome more contributions from the lecturers.*
6. Do you think that **study habits** are important for academic success?	X *Whether the response is 'Yes/No', ask:* Could you elaborate? X *To welcome more contributions, ask:* Is there any thing else you want to add?

1 This question in practice does not follow immediately after Q.1 but after Q.6 when Ellis' is finished with his set of questions

APPENDIX A3

SEMI-STRUCTURED INTERVIEW SCHEDULE A3

1. INTERVIEWEE ACADEMIC PROFILE DATA

Course registered for …………………………………………..
Year of study …………………………………………..
Academic ranking …………………………………………..

2. INTRODUCTION TO THE INTERVIEW (FIRST-YEAR STUDENTS)

Thank-you for agreeing to talk to us. As I explained to you, the university is very keen to try to improve the pass rates of its students, especially those in the first year, and would want to see more students graduating at the end of the year. I am sure you will have noticed that while some students struggle to cope with their studies, others tend to cope and pass their exams easily.

A whole group of staff and PhD students in the Department of Botany is involved in a research project to find what makes some students so successful, and why some others struggle. The factors you identify will help us to develop programmes which will benefit in-coming students, by helping them become more successful as students.

You have been a first-year student for almost a year now. You have experienced what it is like, and you have seen successful and unsuccessful students around you going about with their studies, and may have developed some ideas about factors which contribute to success. It is these we want to ask you about …

QUESTIONS	PROBES
1. In your opinion what factors make students academically successful in first-year biology courses at this university?	Interviewee will be encouraged to list a number of the factors. When factors mentioned are not clear, interviewer will ask: "Could you explain that a bit further"? Or "how does that contribute to academic success"? To make student continue with the listing of factors:(ASK) "What other factors do you think make students academically successful?"
2. Can you think of any factors that could lead to a student being unsuccessful in first-year biology?	Interviewee will be encouraged to list a number of the factors. Nodding of head to show the views expressed are being followed. When factors mentioned are not clear, interviewer will ask: Could you explain that a bit further? Or, how does that contribute to academic failure? To make student continue with the listing of factors: What other factors do you think make students academically unsuccessful?

3. **QUESTIONS DIRECTING THEM TO ATTITUDES, STUDY HABITS, WAYS OF WORKING AND PREPARING FOR LECTURES/PRACTS/EXAMS.**

MAIN QUESTIONS	PROBES
Do you think attitudes are important for academic success? (may have to clarify attitudes as attitudes to studies, attitudes to the subject)	If response is YES, Could you elaborate? If the response is NO, please explain further.
Do you think that study habits are important for academic success?	If the response is YES. (ASK) In what ways? How? Anything more! (to encourage further contributions).
Would you agree that motivation (inner drives) are necessary to be academically successful?	If response is YES. Could you explain further how motivation affects ones academic success? To confirm student's earlier statements on motivation (ASK) What motivates you to study?
Do you agree that one needs to prepare for lectures in order to be successful?	If YES, How do you prepare for a lecture?
Do you know of some ways of preparing for tests/exams that have proved to be rewarding academically?	If YES what are they? (to be patient to allow them to reflect on the ways of preparing for lectures) To encourage them to list as many ways they can remember. Any more?
Do you use any particular strategy to study biology?	If YES What are they? Any more? When do you use them? What strategies do you use to remember difficult topics, say: the chemical structure of glucose, photosynthesis, DNA replication.
Some students struggle to complete their practs on time. How do you explain that?	Allow student to account for other students' inability to cope. If student does not offer solutions for coping ask (next question Do you...)
Do you have any particular strategy in preparing for biology practicals?	If YES What are they? When do you use them?

APPENDIX B

THE QUESTIONNAIRE FOR INTRODUCTORY LIFE SCIENCES STUDENTS

This questionnaire was administered to Introductory Life sciences students over two subsequent academic years. This was done to elicit views on academic success during the diagnostic phase of the study (see Chapter 4, pages 93-108)

QUESTIONNAIRE FOR INTRODUCTORY LIFE SCIENCES

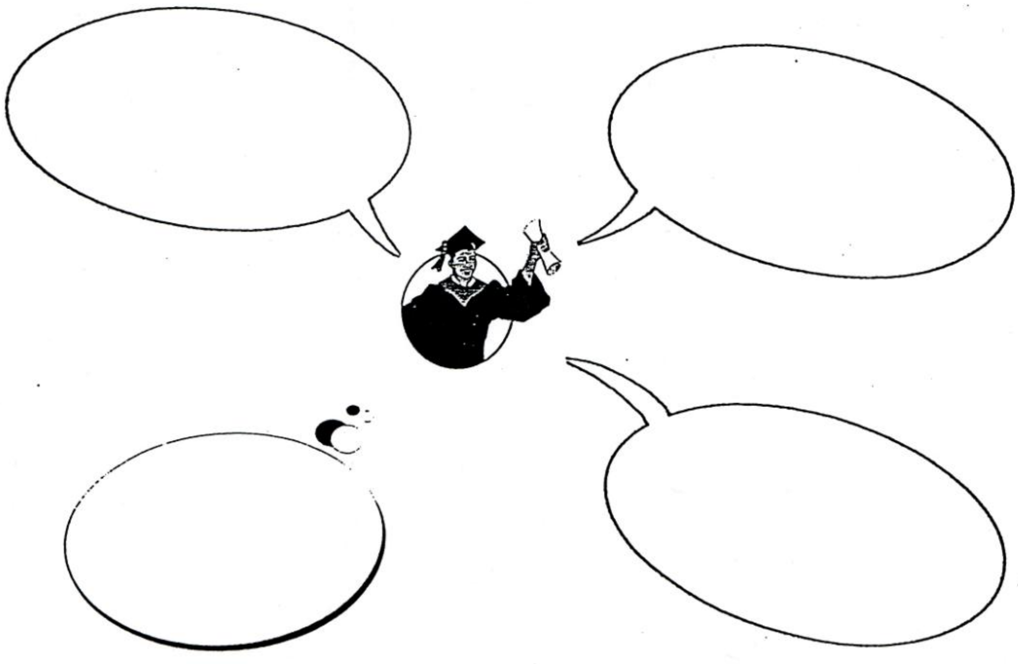
This study seeks to find out your personal views on what contributes to students' success in first- year biology. Academic success refers to learners being able to manage and cope with the practical and theory aspects of the discipline and doing well in their courses.

The information you provide will greatly help us in developing learning and teaching materials for students, especially those who struggle with academic work, when they come to study biology at this university. We ask you to provide honest and accurate responses, and to answer ALL questions.

Student's Number ....

1 **At the university, whilst some students struggle to cope with work, others are able to cope and do well in their courses.**
In your opinion what are some of the ways of studying that help some students to succeed in first-year biology courses?

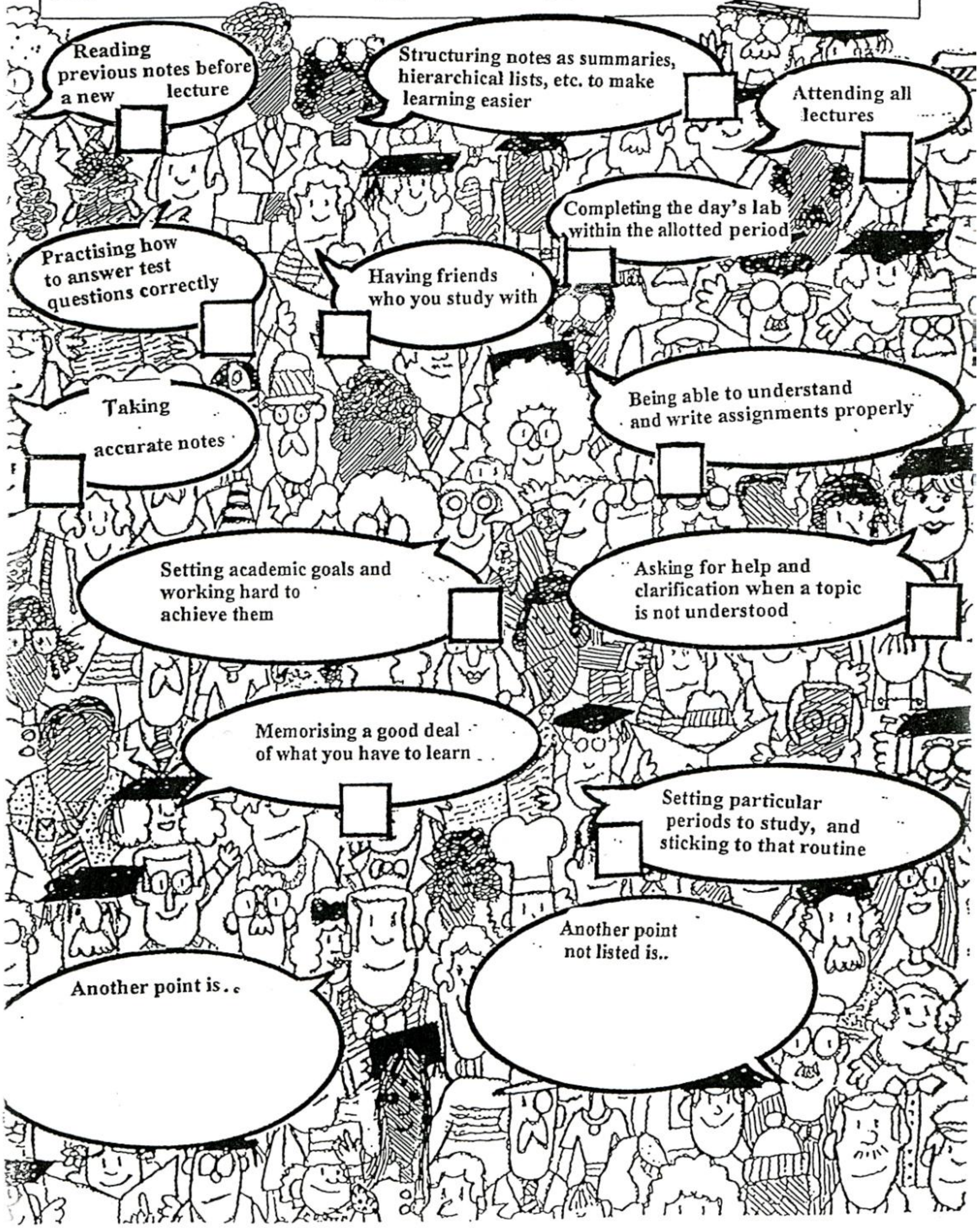
Please write your responses in the speech bubbles provided.



Views of other students and lecturers on academic success

2 **Here are some reasons given by lecturers and last year's students when asked the same question (see question 1). To what extent do you agree or disagree with them?**
Please indicate your views by writing the appropriate code in the box next to EACH speech bubble.

SA = I strongly agree A = I agree NS = I am not sure D = I disagree SD = I strongly disagree



3). **What attitudes and behaviour do you think top biology students adopt in studying Introductory Life Sciences?**

Read the statements below and place a × in the appropriate box to indicate how much you agree with each statement with the following responses:
SA= I STRONGLY AGREE; A= I AGREE, NS= I AM NOT SURE;
D = I DISAGREE; SD= I STRONGLY DISAGREE.

STATEMENTS	SA	A	NS	D	SD
They generally have a positive attitude towards their studies					
They do not work hard at the subject, their success comes naturally					
They believe the subject will be of relevance to them in their future careers					
They generally try to please their parents or guardians by working hard					
They enjoy being the best in what they do					
They enjoy finding the meanings of scientific words in biology					
They find ways to understand the subject on their own					
They spend a lot more time studying biology than others do					
Generally, they have a good command of English language					
They find the subject interesting and put extra effort into it					
One way or the other they manage to get hold of all the prescribed and recommended books for biology					
They plan well ahead and work conscientiously to complete class assignments on schedule					
They try to determine which topics they do not understand well and work on them					
When they have to memorise new information they make meaning cues, mind maps or tables to help them remember them					
They test themselves to be sure they know the material they have been studying					

4). **Another attitude or behaviour of top students not mentioned** is ....

....

....

Thank you for sharing your views with us.

APPENDIX C

PAPER PRESENTED AT THE SAARMSTE 2008 CONFERENCE (FLETCHER, SANDERS & AYAYEE, 2008)

This paper presented at Southern African Association for Research in Mathematics, Science and Technology Education conference highlights some of the problems associated with analyzing Likert-format data (see Chapter 3, section 3.4.2).

A comparison of different techniques for analysing Likert-scale data: do they make a difference?

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Likert scales are frequently used when gathering data about attitudes and behaviours. Although data derived from instruments using Likert scales do not conform to certain of the assumptions required by parametric statistical tests, researchers in the social sciences have commonly used parametric tests to analyse this type of data. Opinions in the literature are divided about the validity of results obtained in this way. Techniques to overcome this problem include data transformations (such as Rasch) which convert ordinal data from Likert scales to interval data which is normally distributed and allows for the use of standard parametric tests, which are more powerful. In view of the heated debate in the literature, education researchers using data derived using Likert scales are likely to be interested in whether use of transformations makes a difference in the answers obtained to research questions which attempt to look at whether differences in the scores of different groups, or pre- and post-scores involving an intervention, are statistically significant. In an attempt to establish the effects of transformations, this paper compares results of analysis of Rasch-transformed data and analysis of untransformed data obtained from a questionnaire using Likert scales, to see if differences exist in the results obtained. At the presentation we will encourage discussion about the implication for researchers.

The use of Likert scales to measure attitudes

Instruments measuring attitudes and behaviours (such as the one in this study) frequently involve the use of Likert scales, developed by Likert in 1932 (Waugh, 2002). Likert scales usually have between 3 and 7 response categories, which are used by respondents to express the extent of agreement or disagreement with a statement presented to them. The responses provide nominal data, which is usually converted to ordinal data by allocating scores such as 4 for 'strongly agree', 3 for 'agree', 2 for 'disagree', 1 for 'strongly disagree'. These scores are then used in various ways. For example, total scores can be calculated if all items measure a common construct – e.g. attitudes to studying science. Traditional statistical procedures are then often carried out, e.g. descriptive statistics for mean scores, correlations with other variables such as academic performance, or t-tests for comparing differences between two groups or for pre- and post-intervention differences.

The debate about appropriate statistical tests which can be used for data derived from Likert scales provides the theoretical framework which underpins this paper. However, we first need to discuss the context of the study.

The context of this paper

The data used in this paper was derived from 27 items in a questionnaire designed to determine students' perceptions of attitudes and behaviours associated with successful academic studies in a first-year university biology course. Their perceptions formed the basis for developing appropriate teaching and learning strategies which would be more effective in promoting academic success.

The questionnaire items had Likert-type response scales of *strongly agree*, *agree*, *not sure*, *disagree* and *strongly disagree*. In order to ascertain whether students' perceptions changed after a year in the academic environment, the questionnaire was administered at the beginning of the year and again at the end of the year. A complete data set was obtained from 83 students.

In order to quantify the extent of agreement of the students with each of the items in the questionnaire, an Index of Agreement was calculated using the formula:

$$\text{Index of Agreement} = \frac{2 \text{ x [no. of strongly agree scores] + no. of agree scores}}{\text{maximum possible score (2n)}}$$

Values for the Index of Agreement can range from 0 (if no students agree) to 1.0 (if all students strongly agree). These Indices of Agreement were calculated for responses to each item at the beginning of the year and at the end of the year, allowing easily interpretable ‘visual comparisons’ to be made about changes in students’ perceptions. However, they do not allow the researcher to make claims about the statistical significance of such differences for each item (could they have occurred by chance?). The calculations required to do that are described in the “methods” section of the paper.

Concerns about commonly-used analyses of Likert-scale data

A heated debate, dating back to the 1930s, exists about what statistical techniques are ‘legitimate’ to use on what types of data. It hinges on two types of arguments – philosophical ones based on mathematical theory, and pragmatic ones based on how useful the resulting inferences of the research are.

The mathematical arguments: These are summed up by Stevens (1946), who discusses problems that arise with measurements (the assigning of numbers to phenomena) and the statistical procedures which can legitimately be applied to measurements of different types. He outlines the appropriate procedures for the four major ‘scales’ of measurement (often referred to in the later literature as ‘levels of measurement’).

- For *nominal data* the categories are named, although numbers can be allocated as names for the categories. The only permissible statistical treatments are to look at frequencies in each category, and the category with the most responses (measured by the mode). Stevens (1946) points out that it is also possible to use contingency methods to test hypotheses about distributions, but only under certain conditions.

- *Ordinal data* involves the allocation of numerical scores in a way which preserves the rank order of the categories. This practice is commonly used in studies using Likert scales to investigate attitude or behaviour. The conversion of Likert-scale data (which is essentially nominal data) by allocating scores results in ordinal data. Stevens (1946) points out that the intervals between numbers on such scales are not equal. For example, allocating +2 for ‘strongly agree’ and +1 for ‘agree’ implies that ‘strongly agree’ has twice the value of ‘agree’, which is unlikely. Parametric statistics cannot be used on ordinal data as a requirement for their use is at least data at the “interval” level of measurement, and Stevens (1946) says that the only legitimate treatments of ordinal data are to describe medians and percentiles.

- *Interval data* contain measurements where the gap between numbers is equivalent. This means that it is permissible to use descriptive statistics (e.g. to describe means and standard deviations), as well as parametric statistics (which assume the data is normally distributed).

- *Ratio data* is considered to be the highest level of measurement, and is amenable to all the tests permissible for interval data, ordinal data and nominal data, as well as examinations of the coefficient of variance.

One of the assumptions which must be met before using parametric tests is that the data is at least at the interval level of measurement. Mathematical purists insist that to use parametric tests on ordinal data means that the validity of inferences drawn from such studies can be questioned. Several authors (e.g. Binder, 1984; and Zumbo & Zimmerman, 1993) point out that Stevens’ rules (Stevens, 1946) have found their way into research methods textbooks. For example, Siegel (1956, vii) is adamant that the rules should not be violated. He claims that “Non-parametric tests of hypothesis testing are uniquely suited to the data of behavioural sciences”, using the arguments that they are distribution free (do not require normal distributed data) and because most use ordinal data (which cannot be analysed with parametric tests). Later work using mathematical methods supports contention that interval data is necessary for parametric tests, and that if ordinal measurements are used “only relatively weak conclusions, if any, can be drawn from the data” (Wilson, 1971, 415).

Pragmatic arguments: Whilst many researchers in education (especially novices) apply these rules in an algorithmic fashion, without really understanding the reasons behind them, others knowingly violate the rules and use parametric tests for ordinal data. Stevens (1946, 679) says that 'pragmatic sanction' could be permitted in some cases because even though the rules are violated, the resulting inferences have led to 'fruitful results'. This argument is repeated by others (e.g. Wilson, 1971) although he recommends caution in interpreting the results of such studies, and Binder (1984, 475) who says such research has resulted in 'rich empirical knowledge' which has led to important advances in the field of psychology.

Whilst some researchers may use parametric tests simply because they are not aware of embargos, or because such tests are easier to use, others justify the use of parametric tests on the grounds that i) they are more powerful than non-parametric tests, and ii) they are more versatile, with more different types of tests available than is the case for non-parametric tests (Anderson, 1961; Wilson, 1971). Numerous authors (e.g. Kerlinger, 1986) claim parametric tests are 'robust', which means that they operate well even under assumption violations. Some (e.g. Binder, 1984) dismiss the need to consider non-parametric tests; claiming that the mathematical arguments used by many researchers are 'clear nonsense' (p. 468) and that many parametric and non-parametric tests are essentially equivalent procedures mathematically. Other authors have conducted empirical comparisons to see whether the type of test makes a difference, and either claim that the differences are negligible (e.g. Labovitz, 1967, 1970; Binder, 1984) or that the results give the same statistical decision (e.g. Zumbo and Zimmerman, 1993). Binder (1984) maintains that the philosophical arguments relating to scale type are not upheld by empirical studies. Generalized comments about 'negligible differences' are often used by other authors to justify using parametric tests on ordinal data (e.g. Anderson 1961). However, it should be noted that there are often caveats to the research which are not widely repeated. For example, in the study by Zumbo and Zimmerman they claimed that parametric and non-parametric methods in their study resulted in the same decisions. However, further reading of their paper reveals that they used a 10% probability level as their cut-off point rather than the more conventionally used 5% or 1% level. They also disallowed three values which were close ("barely outside the tolerance band"), qualified their claims with the caveat "in general" (implying that there were exceptions), and admitted that others have alternative interpretations of their data. Wilson (1971) showed that the conclusions of Labovitz (1970) "may be defensible with univariate data", but that it was "untenable in a strict sense when more than one variable is involved" (Wilson, 1971, 416).

However, some authors are more cautious in their claims. Henry (1982) showed that the differences in statistical significance are larger, under some conditions, than previous studies suggested.

A number of recommendations have been provided for researchers who do use parametric tests. For example, Labovitz (1970, 521) advises that researchers weight scores if they are aware that the intervals between their categories are unequal. He also advises that researchers do not collapse categories (e.g. by combining *strongly agree* and *agree* into one category) as having more categories (e.g. 7 options rather than 5 in the original nominal scale used) provides "greater confidence". Zumbo and Zimmerman (1993) recommend that the normality of the data be used rather than scale type, to decide whether to use parametric or non-parametric tests.

The Rasch model as a solution to the problems

The Rasch model allows ordinal data, such as that produced by assigning values to nominal Likert scale data, to be transformed to interval data. It is then permissible to use parametric statistics on the transformed data, thus obviating the problems associated with analysis of nominal data. For a detailed explanation of the rationale underpinning the Rasch model and Rasch transformations, see Boone & Rogan (2005) or Bond & Fox (2001).

Although the Rasch model was developed in the 1960s (Bond and Fox, 2001), researchers have been slow to adopt its use, and have continued to use traditional methods of analysis (Bond & Fox, 2001, Boone & Rogan, 2005). Rasch-based computer software is available that not only carries out the nominal to ordinal data transformations but also provides a wide range of statistical procedures and graphical outputs based on the transformed data.

Aim of this paper

The aim of the paper is to compare the use of a non-parametric test and a parametric test on un-transformed nominal data and a parametric test on the same data after Rasch-transformation to determine whether these three types of analysis provide different answers to research questions.

Methods

In an attempt to determine whether differences in overall response to the questionnaire are significant, the nominal, Likert-type data from the original questionnaire, were first converted to ordinal data by assigning values of 4, 3, 2, 1, 0 to *strongly agree, agree, not sure, disagree* and *strongly disagree*, respectively. Statistical tests for significance were then carried out using this ordinal data. The tests used are described below. Two-tailed tests were used in all cases.

Tests on untransformed data

Non parametric test

The sign test was chosen as the non-parametric test for this study because it is a paired test which could be used to directly compare the score of one student at the beginning of the year with the score of the same student at the end of the year (Fridjhon, P., *pers com*). This is a standard statistical test described in most statistics textbooks (e.g., Spiegel, 1988). In this study, the calculations for the sign test were carried out using Microsoft® Office Excel 2003 (Excel).

Parametric test

The parametric test used was a standard two sample Student's t-test. This is a standard statistical test described in most statistics text books (e.g., Kerlinger, 1986). Calculations for this test were carried out using Excel's built-in t-test function.

Test on Rasch transformed data

Rasch transformations were carried out using the Winsteps® Rasch measurement program (Linacre, 2006). The t-test results and associated probabilities were taken from output Table 30.1 (one of Winsteps standard output tables), which provides a two-sample t-test on the Rasch–transformed scores.

Results and discussion

The results of the significance test on the untransformed and Rasch-transformed data are shown in Table 1 and Table 2. These tables also show the questionnaire items and the indices of agreement. This information is included to orientate the reader and gives an indication of how the students' perceptions changed during the course of the year.

What is of importance in the present study is the significance level of the difference between the beginning and end of year responses, as indicated by the various significance tests performed for each item.

If we compare *the non-parametric and parametric tests on the untransformed data* different conclusions (significant or not significant) would be drawn at the 5% level for two of the 12 items (items 1 and 12) in Table 1 and for two of the 15 items (items 10 and 11) in Table 2. If we compare *the parametric tests on the untransformed and Rasch-transformed data* different (significant or not significant) would be drawn at the 5% level for three items (items 6, 13 and 14) in Table 2, but there are no differences for Table 1.

These differences in assessment of significance are important as they affect the conclusions that would be drawn about the results of the survey. For example, if the result of the non-parametric test on the untransformed data was used, it would be concluded that students *had not* changed their opinion of the importance of "asking for help ..." in the case of Table 1 item 1. However, if the result of the parametric test on the untransformed data is used, it would be concluded that they *had* changed their opinion. With the untransformed data agreement is reached no matter which test (parametric or non-parametric) is used in the case of Table 2 item 13, both tests yielding a non-significant difference (that students *had not* changed their degree of agreement with the statement "... have a good command of English ..."). However, Rasch-transformed data for that item yields a different result — that they *had* changed their degree of agreement with the statement.

Table 1. Indices of agreement and significance of differences between beginning and end of year for questionnaire items about importance of ways of studying that help students succeed in biology

Questionnaire Item	**Index of agreement**		**Probability and significance of differences**					
			Untransformed data				**Rasch transformed data**	
			Non-parametric		**Parametric**		**Parametric**	
	B*	**E***	**Sign test**	**Sig****	**t-test**	**Sig****	**t-test**	**Sig****
1. Asking for help and clarification when a topic is not understood.	0.84	0.77	0.0135	S	0.1524	NS	0.0892	NS
2. Attending all lectures.	0.82	0.74	0.2295	NS	0.0955	NS	0.1426	NS
3. Being able to understand and write assignments properly.	0.82	0.69	0.0009	S	0.0019	S	0.0267	S
4. Setting academic goals and working hard to achieve them.	0.78	0.61	0.0007	S	0.0012	S	0.0046	S
5. Taking accurate notes.	0.76	0.78	0.3616	NS	0.4822	NS	0.1919	NS
6. Practicing how to answer test questions correctly.	0.72	0.67	0.4869	NS	0.2532	NS	0.5663	NS
7. Reading previous notes before a new lecture.	0.68	0.56	0.0016	S	0.0056	S	0.0376	S
8. Structuring notes as summaries to make learning easier.	0.64	0.60	0.4296	NS	0.5437	NS	0.9834	NS
9. Setting particular periods to study, and sticking to that routine.	0.60	0.54	0.1189	NS	0.4064	NS	0.8973	NS
10. Completing the day's lab within the allotted time.	0.54	0.53	0.6358	NS	0.8775	NS	0.9977	NS
11. Have friends who you study with.	0.39	0.36	0.2529	NS	0.3261	NS	0.7648	NS
12. Memorising a good deal of what you have to learn.	0.37	0.30	0.0328	S	0.2485	NS	0.5542	NS

* B = beginning of year; E = end of year. ** Significance at 5% level. S = significant; NS = not significant.
Shading indicates differences of significance at the 5% level within rows.

Table 2. Indices of agreement and significance of differences between beginning and end of year for questionnaire items about attitudes and behaviours adopted by top biology students when studying

Questionnaire Item	**Index of agreement**		**Probability and significance of differences**					
			Untransformed data				**Rasch trans-formed data**	
			Non-parametric		**Parametric**		**Parametric**	
	B*	**E***	**Sign test**	**Sig****	**t-test**	**Sig****	**t-test**	**Sig****
1. They generally have a positive attitude to their studies.	0.77	0.70	0.1102	NS	0.1556	NS	0.4172	NS
2. They plan well ahead and work conscientiously to complete class assignments on schedule.	0.77	0.62	0.0000	S	0.0008	S	0.0046	S
3. They try to determine which topics they do not understand well and work on them.	0.75	0.61	0.0022	S	0.0035	S	0.0452	S
4. They find the subject interesting and put extra effort into it.	0.73	0.62	0.0807	NS	0.0900	NS	0.3183	NS
5. They test themselves to be sure they know the material they have been studying.	0.65	0.54	0.0037	S	0.0038	S	0.0273	S
6. They find ways to understand the subject on their own.	0.55	0.60	0.1934	NS	0.2762	NS	0.0448	S
7. They enjoy being the best in what they do.	0.52	0.49	0.6271	NS	0.7191	NS	0.7060	NS
8. They believe the subject will be of relevance to them in the their future careers.	0.50	0.61	0.0113	S	0.0173	S	0.0018	S
9. They manage to get hold of all the prescribed and recommended books for biology, one way or another.	0.48	0.48	0.6587	NS	0.6929	NS	0.2311	NS
10. When they have to memorize new information they make meaning cues, mind maps or tables to help them remember.	0.45	0.36	0.0402	S	0.0847	NS	0.3293	NS
11. They enjoy finding the meaning of scientific words in biology.	0.34	0.25	0.0186	S	0.0531	NS	0.2133	NS
12. They spend a lot more time studying biology than others do.	0.31	0.31	0.6440	NS	0.3892	NS	0.0655	NS
13. Generally, they have a good command of English language.	0.31	0.37	0.1439	NS	0.0954	NS	0.0066	S
14. They generally try to please their parents or guardians by working hard.	0.10	0.11	0.0534	NS	0.0509	NS	0.0054	S
15. They do not work hard at the subject, their success comes naturally.	0.00	0.04	0.0003	S	0.0041	S	0.0003	S

* B = beginning of year; E = end of year. ** Significance at 5% level. S = significant; NS = not significant.
Shading indicates differences of significance at the 5% level within rows.

It is clear from the above that *for untransformed ordinal data* whether a non-parametric or parametric test is used can lead to differing interpretations and differing conclusions being drawn in 4 of the 27 cases. The use of *Rasch transformed data* can also lead to differing interpretations and differing conclusions being drawn in some cases. Using the same test (a t-test) with transformed and untransformed data results in 3 of the 27 cases giving different results.

The question as to which test is the more appropriate for use is even more difficult to answer. As previously indicated, there is considerable debate in the literature over this issue. The non-parametric test used here, the sign test, although easy to use and appropriate for paired data is generally considered to be a weak test. Although parametric tests such as the two sample t-test are considered to be robust and more powerful, their use may be suspect because ordinal data do not meet the requirements for parametric tests. Rasch-transformed data solves the problem of using ordinal data thus allowing for the use of parametric tests, which are more powerful. This suggests that use of parametric tests on Rasch-transformed data may be the most appropriate option.

Conclusions

Use of different data transformations but the same test of significance for analyzing Likert scale data (a t-test) did make a difference to the conclusions drawn from the data in 11% of the cases. Using different tests (parametric and non-parametric) on the untransformed data led to different conclusions in 15% of the cases. We would recommend that caution be exercised when analyzing this type of data.

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APPENDIX D

TWO QUESTIONNAIRES FOR EXPERTS: YOUR VIEWS AND COMMENTS ABOUT *BIOSKILLS*

This questionnaire was responded to by the six reviewers as part of the formative evaluation of the package. The questionnaire had two sections. Questionnaire 1 (Appendix D1) was for their comments as they worked through the package. A print out of all the 64 screens was provided[102] (and due to its large size is **not** included in this section and may be viewed on World Wide Web). Questionnaire 2 (Appendix D2) was for comments on the interface design; navigation, cognitive load and the achievement of goals of the programme (see Chapter 5, pages 135-139).

[102] *Bioskills* is presently being temporarily hosted on http://146.141.47.24/bioskills

APPENDIX D2

YOUR VIEWS ABOUT *BIOSKILLS*

Dear Reviewer

Bioskills is a computer-based programme designed to help promote academic success among first-year students. It does this by attempting to raise students' awareness of some of the factors which promote academic success, and suggesting ways in which students can enhance their chances of success.

We are asking you to review the *Bioskills* programme and provide your honest comments on aspects of the package detailed in the questionnaire overleaf. Your comments will subsequently be used to modify any problematic aspects of the package, and thus contribute to producing materials that are more likely to have an impact on students' attitudes, work-habits and metacognition.

Thank you for the time you will be investing in this exercise.

Ellis and the Team.

WHAT WE ARE ASKING YOU TO DO

- Read through this questionnaire to get a feel of the questions we want you to address later on. (The questionnaire deals with four issues viz. *interface design, navigation, cognitive load*, and *the achievement of goals of the programme*.)
- Then work through *Bioskills* as would a student, but using your insights as an educator.
- We have provided a printed version of the screens. This is for you to write your comments as you work through the package.
- The programme has five main sections: *home*, *challenges of 'varsity life, factors affecting behaviour*, *improving work-habits*, and *model to change work-habits*. You might like to review the package in phases in order to make the task less burdensome.
- Once you have reviewed the whole programme, please complete this questionnaire.

ACCESSING *BIOSKILLS*

To access the programme:

- Open your Internet browser (e.g. Explorer or Navigator)
- Type in the following website address
  http://hermes.wits.ac.za/www/Science/APES/Bioskills

You need to log in as a user. Please use the following user name and password

User name	7777777B
Password	7777777B

COMMENTS ON THE INTERFACE DESIGN

In order for web-based materials to be easy to use, legibility is an important factor.

Screen design

Please examine the screen design elements, and comment on the extent to which you think the features listed below have been addressed in the programme in order to make the text legible.

- *Font sizes and choice of colours (to promote legibility of text)*

- *Contrast present between letters and background (to promote legibility of the text).*

Media integration

Please comment on the degree to which the range of multi-media applications (text, graphics, sound, animation, motion video) used in the programme have helped to capture your attention.

Layout

An effective layout in a package makes complex information easier to understand.

Please comment on the layout in Bioskills and, whether in your opinion, it would be effective in helping students to visualize and understand the information presented.

COMMENTS ON NAVIGATION

A number of navigational aids have been built into the programme to help users work systematically and easily through the programme. These include:

- a system of *tabs* along the top of the screen (for the main sections) and *buttons* down the left for the sub-sections
- *navigational buttons* (to take you to places e.g. *back* and *next*)
- *hotspots* (linked words which take you to a more detailed screen)
- *mind map (*giving an overview of what is available)
- *colour changes* (to show you where you have already been)

Learners are more likely to engage in meaningful ways with programmes which are easy to use and are less likely to get lost in cyberspace.

To what extent do you think ***students****, after working through the "Home page", will know what is in the package?*

To what extent do you think the package is easy to use without getting lost? (Please describe any difficulties you had)

Were there times when you seemed to get stuck? ☐ No ☐ Yes

If "yes", please write the specific screen titles below and briefly explain the problem.

How easy is it to see if you have already visited a section of the package*?*

What helped you to keep track of the sections you visited?

Please explain any difficulties you had, and make suggestions of what could be done to alleviate the problem.

COMMENTS ON THE COGNITIVE LOAD

The working memory of the human mind has limited capacity to store and process information. When there is too much *information to be processed cognitive overload is likely to occur. Contributing to the general cognitive load of the programme are:*

- *the nature of the material (amount, readability, novelty of ideas, unfamiliarity of readers with content),*
- *its structure (complexity, organization, navigation), and*
- *the response options available (what users have to do, and how).*

To prevent cognitive overload these attributes must be well attended to in the design of the programme. *It helps the student if the briefs are clear and not too long so that they can be integrated in the working memory.*

Bearing in mind this information on the cognitive load, what is your opinion about the terms, the explanations provided, and their organization in the following **sections** of *Bioskills*:

Factors affecting behaviour

Improving work-habits

Model to change work-habits

ACHIEVEMENT OF GOALS

This computer package is intended to be used as a supplement to traditional first-year tutorials. Its goals are

i) to raise first-year students' awareness of factors affecting academic success including:

- attitudes,
- appropriate work-habits, and
- aspects of metacognition.

ii) to suggest ways in which students can enhance their chances of success at the University.

Please comment on the extent to which you believe the package gives sufficient insights ***to help students understand the effect and importance of attitudes, work-habits and aspects of metacognition*** *on academic success.*

Please comment on the extent the package in its present form is likely to have an impact on students' attitudes, work-habits and metacognition i.e. how likely is it to promote changes in the students. (Please give your reasons)

What other modifications would you suggest could be made to enhance the structure and content of the package, so that it meets its goals?

APPENDIX E

TWO QUESTIONNAIRES FOR FIRST-YEAR STUDENTS

These two questionnaires *(Tell us what you think about Bioskills* [Appendix E1] and My observations about the screens of *Bioskills* [Appendix E2]) were administered to students as part the formative evaluation of the package. (see Chapter 5, pages 140-144).

The package, *Bioskills*, was made available to students in a computer laboratory during a scheduled first-year biological sciences tutorial session. Thereafter, students could log onto the website during their free periods and work through the sections of interest to them.

APPENDIX E1

TELL US WHAT YOU THINK ABOUT THE *BIOSKILLS* PROGRAMME

Dear Student,

What Is *Bioskills*

Bioskills is a computer-based programme designed to promote academic success by:

- raising awareness of some of the factors which affect academic success.
- suggesting ways in which students can enhance their chances of academic success.

Why we need Your comments

The programme is in its testing stage, and your comments will help us to improve its quality will benefit all future users.

It is crucially important that you are honest about the comments you make. Tell us what you *really* think not what you think we may want to hear. Only honest answers can help to improve the programme.

Please, fill in your student number. This will help us in analyzing the data collected.

Student number -------------------- Course code -------------

Computer skills and experience

How long have you been working with computers?
Tick (✓) the appropriate box.

I am a first-time user	Less than a year	About one year	More than one year
☐	☐	☐	☐

If you have used computers before, what did you use them for?
(You can tick (✓) more than one box).

E-mail	Work- related Internet searches	Typing assignments	Surfing the web for fun	Playing games
☐	☐	☐	☐	☐

Other: (Specify): ______________________________

Your thoughts about Bioskills

As you go through *BIOSKILLS* for the first time your opinion of it may change. It would help us to know about this. We will remind you every 30 minutes to complete the following THREE questions.

How easy do you think *BIOSKILLS* is to use?

	Very easy	Easy	Not sure	Difficult	Very difficult
After 30 minutes	☐	☐	☐	☐	☐
After 1 hour	☐	☐	☐	☐	☐
After $1^1/_2$ hours	☐	☐	☐	☐	☐
After 2 hours	☐	☐	☐	☐	☐

What's your opinion of *BIOSKILLS*?

	I really like it	I like it	I'm not sure	I don't like it	I really don't like it
After 30 minutes	☐	☐	☐	☐	☐
After 1 hour	☐	☐	☐	☐	☐
After $1^1/_2$ hours	☐	☐	☐	☐	☐
After 2 hours	☐	☐	☐	☐	☐

How useful did you find *BIOSKILLS* in helping you to think about improving your chances of academic success?

	Very useful	Useful	Not sure	Not useful	Not very useful
After 30 minutes	☐	☐	☐	☐	☐
After 1 hour	☐	☐	☐	☐	☐
After $1^1/_2$ hours	☐	☐	☐	☐	☐
After 2 hours	☐	☐	☐	☐	☐

Thank you!

APPENDIX E2

My observations about the screens of "*Bioskills*".

Student number -------------------------

We are interested in knowing some of the problems you encountered going through the programme.
Please, indicate by placing a tick (✓) under the column headings, and provide an explanation if you experienced a problem.

Screen number.	Title of Screen	Navigation problems				Explanation – related problems				Detailed explanation of problem encountered and suggestions for improvement.
		Buttons (links) not working	Buttons (links) not easy to find	Could not return to *Bioskills*	Could not get to where I wanted to be	Explanation not clear enough	More explaining needed	Language problems	Others?…	
	HOME									
1	What is *Bioskills*									
2	How to use *Bioskills*									
3	How to use *Bioskills* 2									
4	How to use *Bioskills* 3									
5	Overview (e-mind map) of *Bioskills*									
6	Contacting us									
CHALLENGES OF 'VARSITY LIFE										
1	'Varsity life									
2	'Varsity life (cont'd)									
3	Academic activities as a science student									
4	Academic challenges									
5	Academic challenges									

Screen number.	Title of Screen	Navigation problems				Explanation – related problems				Detailed explanation of problem encountered and suggestions for improvement.
		Buttons (links) not working	Buttons (links) not easy to find	Could not return to *Bioskills*	Could not get to where I wanted to be	Explanation not clear enough	More explaining needed	Language problems	Others?…	
	(continued)									
6	Factors affecting success									
7	What other students think									
8	Views of top students									
9	Views of lecturers									
10	Summary of views									
FACTORS AFFECTING BEHAVIOUR										
1	Behaviours which affect academic success									
2	Importance of behaviour									
3	Importance of behaviour (continued)									
4	Factors affecting intentions of behaviour									
5	Attitudes about study-related behaviour									
6	Exercise on attitudes and behaviour									
7	Attitudes and beliefs									
8	Subjective norms									
9	Perceived behavioural control									
10	Locus of control web survey									

Screen number.	Title of Screen	Navigation problems: Buttons (links) not working	Navigation problems: Buttons (links) not easy to find	Navigation problems: Could not return to *Bioskills*	Navigation problems: Could not get to where I wanted to be	Explanation – related problems: Explanation not clear enough	Explanation – related problems: More explaining needed	Explanation – related problems: Language problems	Explanation – related problems: Others?…	Detailed explanation of problem encountered and suggestions for improvement.
11	Internal locus of control									
12	Internal locus of control and 'varsity									
13	External locus of control									
14	External locus of control and 'varsity									
15	Recognising your current strengths and weaknesses									
	IMPROVING WORK-HABITS									
1	Improving work-habits									
2	Important work-habits									
3	Setting goals									
4	Long-term and short-term goals									
5	Long-term and short-term goals (cont'd)									
6	Motivation to achieve goals									
7	Exercise on work-habits									
8	Managing your time									
9	Preparations required for success									
10	Preparation for practicals									
11	Preparation for tests									

Screen number.	Title of Screen	Navigation problems				Explanation – related problems				Detailed explanation of problem encountered and suggestions for improvement.
		Buttons (links) not working	Buttons (links) not easy to find	Could not return to *Bioskills*	Could not get to where I wanted to be	Explanation not clear enough	More explaining needed	Language problems	Others?…	
12	Processing information									
13	Forming learning groups									
14	Learning how to learn									
	MODEL TO CHANGE WORK-HABITS									
1	How behaviour changes									
2	Stages of behaviour change									
3	Steps in the change process (*PowerPoint*)									
4	Where are you in the change process?									
5	Final word									

APPENDIX F
ACTIVITY-BASED QUESTIONNAIRE 2:
TELL US WHAT YOU LEARNT FROM USING *BIOSKILLS*

This activity-based questionnaire 2 was administered to three groups of students. College of Science students (n=61) at the start of the year in the formative evaluation of the package, and used by two other groups, College of Science (n=53) and Introductory Life Sciences students (n=8) in the investigation of the effectiveness of the package. (see Chapter 6, page 153). Although denoted here as activity-based questionnaire 2, it was used much earlier (than the instrument under Appendix G) in the formative evaluation of the package and therefore classified as Appendix F.

TELL US WHAT YOU LEARNT FROM USING BIOSKILLS

Bioskills is a computer programme designed to promote academic success. It attempts to raise students' awareness of some of the factors which affect academic success, and suggests ways in which students can enhance their chances of success. A section of the programme is devoted to setting tasks and monitoring students' work-habits during Block 3.

We value your contributions as students involved in this study and in order to help us return your scripts to you, we would appreciate it if you would write your student number in the section below.

Student number:____________________

Log in information in order to use *Bioskills* programme

Open to your Internet browser (Explorer or navigator) and proceed as follows.
Type the following as the URL or web page address:
http://hermes.wits.ac.za/www/science/apes/bioskills

Wait for the *Bioskills* home page to be uploaded, then type

- User ID: Type in your student number in full
- Password: Type in your student number in full

What you have learned from working through *Bioskills*

These activities are to be answered after completing each section of the *Bioskills* programme.

As you worked through the sections of *Bioskills* you may have learned some new things. Write these out in the "callouts' provided. This handout will be collected at the end of the Block.

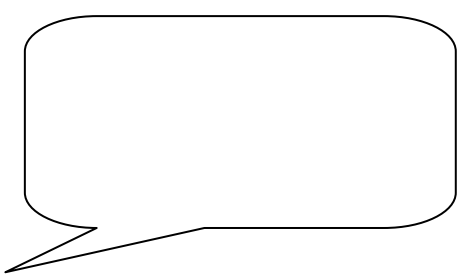
Section 1: Home

Section 2: Challenges of 'varsity life

Section 3: Factors affecting behaviour

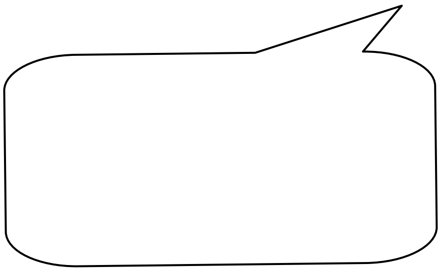
Section 4: Improving work-habits

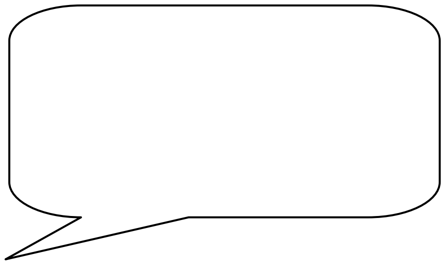
Section 5: Model to change work-habits



Student's number ____________________

Section 6: Taking action





APPENDIX G

ACTIVITY-BASED QUESTIONNAIRE 1: TAKING ACTION TO IMPROVE YOUR MARKS

This activity-based questionnaire was administered at the beginning of Block 3 to Introductory Life Sciences students (n=60) attending ADP tutorials (see Chapter 6). This was the first of the activity-based questionnaires used and therefore denoted questionnaire 1 as reported in Chapter 6, page 149.

TAKING ACTION TO IMPROVE YOUR MARKS

Student Number______________________

The June biology results are out, and many ILS students were disappointed with their mark. Even students with good marks could do better.

We are willing to work with interested students to improve their academic performance. A number of ADP sessions in the next few weeks will focus on ***improving students' chances of academic success.***

The first step in taking action to improve your mark requires you to think about HOW you worked in the first half of the year. Doing this will help you:

- to identify factors which contributed to the mark you earned
- and will help you to consider a way forward.

It is important that you answer the following questions honestly, otherwise you will not benefit from the exercise.

Thinking about your June mark

My June mark was ☐

My mark was

☐ better than I expected ☐ about what I expected ☐ worse than expected ☐ much worse than expected

In terms of the work I did in the first half of the year I think that my mark is

☐ a very good reflection ☐ a reasonable reflection ☐ a poor reflection of the amount of work that I did.

List the factors (**positive** or **negative**) which you think contributed to the mark you got.

Some important things to think about

Indicate how strongly you agree or disagree with each of the following statements by placing a tick (☑) in the appropriate box.	***Strongly agree***	***Agree***	***Not sure***	***Disagree***	***Strongly disagree***
a My estimate of what I would get for my June mark was very accurate.					
b It is not important to attend **all** lectures as you can catch up later					
c Setting academic goals and working hard to achieve them makes **NO difference** to a student's mark.					
d Studying in a group is a useful way to cope with biology.					
e It is important to work extra hard if you find the work boring .					
f Successful students often read up on a topic before the lecture.					
g My study skills are excellent.					
h Preparing for practicals beforehand makes **NO difference** to how well students manage in the practicals					
i I am well able to cope with first-year biology.					
j Understanding what an assignment requires is important for getting a good mark.					
k Successful students do not have to work hard because their success comes naturally.					
l I was very well prepared for the June exams in biology					
m Preparation for the exams should start near the beginning of the term.					
n Some topics in biology were too difficult for first-year students.					
o Students who revise their lecture notes and make summaries to study from do better in exams					
p Setting aside a particular time to study, and sticking to that routine, affects academic success.					
q It **does not really matter** if you hand work in a little late.					
r Taking complete and accurate notes in lectures is important for academic success.					
s It does not matter if you leave the lab before finishing the practical because you can complete it later.					
t You are only young once so it is more important to have a good time while at 'varsity than studying all the time.					
u There was far too much work to cover for the exams.					
v Good students ask for clarification and help when they do not understand a topic.					
w It will not help me to work harder – I do badly anyway.					

Factors which affected your June mark

Which of the following factors do you think affected your mark (either made it **worse** than is should have been or **improved it**)? Tick all the boxes **which apply to you**.

☐ Help from my friends
☐ Biology being a very difficult subject
☐ Too much work to learn in biology
☐ Too little time to study biology
☐ Me not studying hard enough
☐ My family not supporting me when I studied
☐

☐ Starting too late to prepare for the exams
☐ My lecturer going too fast
☐ Not being given study notes for the course
☐ My friends distracting me from work
☐ I studied very hard
☐ I made good notes to study from
☐ Preparing for the exams in good time
☐ Support from my family when I wanted to study

Regarding your intentions at the start of the year (tick only the boxes which applied to you)

	Yes	No
I intended to file my notes regularly		
I planned to attend all lectures and pracs		
I intended to hand all work in on time		
I planned to work hard from the start		
I planned to rewrite my notes after lectures		
Most things I intended to do I actually did		

If you had intentions, indicate (by ticking the relevant *yes / no* box on the right) whether or not you kept your intentions

Yes	No

Reflecting on your work-habits

Carefully read the following statements. Place a tick (☑) in each of the boxes that **you think apply to you.** You may tick more than one option in each case.

I started preparing for the exams

☐ near the start of the the term ☐ about two weeks before the exams ☐ about a week before the exams ☐ a few days before the exams

To help me remember lecture notes

☐ I summarized the work in point-form ☐ I made mind-maps to study from ☐ I rewrote the notes a number of times ☐ I read the work many times over

When the topic was difficult

☐ I tended to give up studying it ☐ I studied only the easy parts ☐ I asked friends for help ☐ I asked the lecturer for help ☐ I went to ADP

When I studied for tests (or exams)

☐ I used **only** my lecture notes. ☐ I used **only** my textbook ☐ I used textbook and lecture notes ☐ I made my own notes to learn from

When I read the textbook

☐ I asked myself questions to make sure I understood ☐ I usually made notes as I read ☐ I tended just to skim read ☐ I read thoroughly

Regarding practicals

☐ I missed one or more practicals ☐ I missed one or more pre-lab tuts ☐ I usually read the prac beforehand ☐ I sometimes left pracs early ☐ Sometimes I arrived late

I prepared for each practical I attended by

☐ reading the lab manual ☐ reading the manual and finding relevant diagrams ☐ attending the pre-lab tutorials ☐ bringing reference books to the tut

Regarding tutorials

☐ I attended all the required tuts ☐ I missed one or more tuts ☐ I usually did all the tasks ☐ I often asked questions in tuts ☐ Tuts did not help me

Regarding work during the term

☐ I started working when term started ☐ I usually read over work before lectures ☐ I usually rewrote my notes after lectures ☐ I set goals at start of the term ☐ I drew up a study time-table

When the topic was boring

☐ I just kept working until I finished ☐ I spent less time on that section ☐ I left the section out ☐ I worked harder

Regarding lectures

☐ I missed one or more lectures ☐ I was sometimes distracted in lectures ☐ I sometimes chatted to friends and didn't listen to the lecturer ☐ I sometimes sent or received SMSs during lectures ☐ Sometimes I was late for lectures

I usually completed and handed in work

☐ On time ☐ Slightly later ☐ Very late ☐ Very late

Regarding today's session

☐ I felt it was a waste of time ☐ I think it **might** help me do better ☐ I **am sure** it will help me do better

APPENDIX H

ACTIVITY-BASED QUESTIONNAIRE 3: SETTING GOALS FOR BLOCK 3

This activity-based questionnaire was administered at the beginning of block 3 to Introductory Life Sciences Students attending ADP tutorials. (see Chapter 6)

GETTING READY FOR BLOCK 3

TAKING ACTION TO IMPROVE YOUR PERFORMANCE

ACTIVTY 1: WEEK ONE

Welcome back to the university after your first semester break. I hope you had a restful period. This block is equally going to be challenging, and steps need to be taken at the outset to help you achieve good and better results.

I am working on a research project which aim to help students to do better at university studies. So I will be working closely with you (if you will allow me to) to help you meet your goals.

All of you should have seen your June results by now. In order to draw up a winning strategy for the block look at the questions **below** and provide honest answers to them. I will look at your self-assessment and hand back the sheet to you later to keep.

AN OVERVIEW OF YOUR JUNE RESULTS

1	What was your June examination mark		
2	How did you feel on getting such a mark? (*Write your response in the space below)*		
3	Did your performance at the June examination meet your expectation?	Yes	No
	If your response was **No**, write in the space below why you were not expecting that result.		
	If your response was **Yes,** write what you **did/did not** do to achieve those marks.		

4	Are you willing to be helped to achieve better grades?	Yes	No
5	Will you be willing to commit two hours each week, **on your own,** to look at your **attitudes, work-habits and "learn how to learn"** for this block?	Yes	No

The aim of this section is to get you familiar with the topic for Block 3, and get you to plan NOW for the forthcoming practicals, tests and assignments. By being ready for the block, you will be able to work consistently and be more focused.

What you will need for this activity

- Obtain a "course outline" from the course coordinator
- Obtain a year planner from your Academic Development tutor (if you do not have one).

What you need to do

To find out what you know about the block, go over the questions below, and provide short responses to them in the spaces provided.

What is the title of the course in Block 3?

____

How many weeks of work do we have in **Block 3** ________________________

To make you aware of the academic workload and keep you focused, take out your year planner and fill in the following dates:

- Practical dates
- Due dates for any assignment
- Test dates

Lecture venues

Students often get lost finding their way to the lecture venues. On your year planner write down all the lecture venues for the first week.

SETTING GOALS FOR THE BLOCK

In order to keep you energized on your biology studies it is important that you set some achievable and realistic academic goals for the year(e.g. the marks you want to attain). Think about the goals you want to attain at the end of the Year and write in the space below at least two of your goals.

My goals for the year

____

____

Short-term goals

You also need to set short term goals for Block 3. In order to compose your short-term goals, think about the laboratory sessions and tests for the block. Remember goals are more easily met if they are worded as SMART goals. The following descriptions should help you:

	Term	**Explanation**
S	SPECIFIC	The goals must be stated clearly and exactly
M	MEASURABLE	They should be described in measurable terms
A	ATTAINABLE	The goals set must be such that they are within reach, and possible to achieve
R	REALISTIC	The goals based on personal assessment are likely to be achieved. Do not be over optimistic
T	TIME-BOUND	The goals must be achievable with a specified time frame

My goals for Block 3

Can you provide at least two supporting reasons why you have set such goals?

This is the end of Activity 1.
You may continue with Activity 2 if you have sufficient time available. Activity 2 is a take home assignment to be completed against next week.

ACTIVITY 2: PREPARING YOUR WEEKLY "TO-DO LIST"

Planning for the week is an activity most academically successful students do. Not only does it help them to identify where to focus their learning energies, but it also frees time for them to do other equally important activities and as a result the experience less **stress.**

Aims of this section

At the end of this section, you will:

- Write out a list of things you intend to do after each lecture during the week.
- Set deadlines for completing each one of them.
- Check to see if they have been done on schedule

What you will need for this activity

A copy of the following documents:
- "Course outline and learning objectives" and
- "Schedule of practical work"
- Time table for Block 3

What you must do

Examine the time table for Block 3, Week 1

Note the lecture topics and the dates they are to be delivered.

Now turn to the table on the next page.

- Observe the lecture topics written under column 1
- Under column 2 are a list of things **you** have to do.
- Under column 3 indicate when (date and time) you will do the stated actions in column 2.
- Leave column 4 blank for now.

Week 1 lectures	**Things I have to do**	**Date and Time**	**How many have I done?**
Homeostasis Lecture #1	e.g. read notes, text book pages 832-835 and summarize them in point form		
Homeostasis Lecture #2			
Nervous system Lecture #1			
Nervous system Lecture # 2			
Nervous system Lecture #3			

Let's remind ourselves why we have done these tasks. Research tells us that learning must be directed towards the achievement of personal goals which have been determined by the learner. Ensure that the tasks are done on time.

RECOGNISING WHAT YOU MUST LEARN AND UNDERSTAND FROM YOUR LECTURE NOTES

Lecturers often give cues as to what is important to study. It is therefore necessary to keep your eyes and ears open for them if you want to be successful at the end of the block.

AIM: To help you recognize lecture objectives for each week

The learning objectives describe things you must be able to do by the end of the lecture.

What you will need

To help you spot some of the learning objectives for the week, Turn to the lecture 'Outline and objective document'.
How have the lecture objectives been written?

At the end of the week you should check that you CAN do all these things. If not, you have not done enough WORK and need to take further action.

MURDERing THE TEXT

Understanding a text/passage is the key to answering and passing test questions.
What does the term "understand" means (to YOU)? Write it in the space below

---

"Understanding" a passage implies a thorough knowledge of the subject. If you understand a topic or passage you should be able to explain it meaningfully (and in detail) to someone else.

The acronym MURDER provides a set of useful steps to follow in order to fully understand a text or passage. This is what each letter stands for:

Letter	**Explanation of the letter**
M	This means get into the MOOD. Get into a frame of mind to read (apply your mind to the learning task. Are you ready to read? Find a quiet spot and concentrate on what you are about to do. Get a pencil or pen and take down bits of **notes** as you read. This is called "active reading", and it implies applying your 'mind' and 'hand' to the reading).
U	This implies read for UNDERSTANDING (read the passage at least twice to get a good grasp of it. Make mind maps out of it. It is important to include all necessary details).
R	This letter tells you to try and RECALL the material you have read without referring to the text. It is a pointer to how well you have mastered the text.
D	To DIGEST the material means to turn it around, think over it. Find the key concepts, define and explain them further.
E	This tells you to EXPAND your understanding by inquiring further, check from other textbooks, discuss with study group members, tutors. Check to see if there are mistakes in your understanding.
R	This means to REVIEW your understanding through self-tests and practice exercises, and correct the necessary mistakes.

What you need to do

After the lecture:
Revise the two lectures on homeostasis from your notes and textbook using the letters to the acronymn MURDER to guide you .

Some questions to think about after reading your notes and textbook.

Did you:

- Actively Read your textbook and notes?
- Check your understanding (and made corrections?)
- Fill in missing bits, and added to your notes where necessary?
- Prepare study notes to use later for tests and exams?
- Answer some of the questions set on the text from your text book?

Go back and work on those sections to which you answered "negatively".

ACTIVITY 3: Week-by-week planning of activities

Student No: _______________

The skills you have learnt from Week 1 can only benefit you if you apply them to other weeks of the block. You need to use them for **all activities** for them to become a sub-conscious part of your academic life. The rewards will be immense if you stick to these study habits and use them regularly.

A table for Weeks 2 to Week 7 has been prepared for this exercise. Fill in the activities for each week. I will be checking on your prepared weekly activities regularly and give you feedback.

What you will need for this activity

- A timetable of all lectures and practicals for the block

What you need to do

Examine the lectures and tutorials in the timetable for Week 2.

- Write down your plans (intentions) for the week, in the column "things I intend to do". These should include preparations for lectures, practicals, topics you did not understand and need to read up; discuss with friends or raise at ADP tutorials.
- Fill in the second and third columns
- As you review the weekly schedule you are likely to find that some obvious tasks have been left out. Update and include such tasks in your list.

Week 2	Things I intend to do	Day and time	Done	Not done
	Before lecture ▪ Skim read p.1011-1017			
Lecture topic: Nervous system (L #4)	**After lecture:** ▪ Read lecture notes ▪			
Nervous system (L #5)	**After lecture** : ▪ Read lecture notes Read textbook p.			
Muscle structure (L #1)	Before lecture ▪ Skim read in text book to get rough idea of what will be covered			
Muscle structure (L #2)	*After lecture*			
Muscle structure (L #3)				
Practical: Nervous action potential	*In preparation for practical*			
	▪ Read lab. manual ▪ Read textbook			
Week 3	Things I intend to do	Day and time	Done	Not done
Lecture topic: Circulatory system (L #1)	**Before lecture**			
Circulatory system (L #2)				
Circulatory system (L #3)				
Circulatory system (L #4)				
Circulatory system (L #5)	**Test in 2 weeks time**			
Practical 3: Nerve action potential				

Week 4	Things I intend to do	Day and Time	Done	Not done
Lecture topics: Circulatory system. (L #6)				
Respiratory system. (L #1)				
Respiratory system. (L #2)				
Respiratory system. (L #3)				
Respiratory system. (L #4)				
Practical 4:				
Dissection of the rat	Prepare for practical			
(external features and viscera)				
Week 5	Things I intend to do	Day and Time	Done	Not done
Lecture topics:				
Temperature (L #1)				
Temperature (L #2)				
Temperature (L #3)				
Respiratory system (L #3)				
Respiratory system (L #4)				
Test				
Practical 5 topic				
Dissection of rat: urogenital system				

Week 6	Things I intend to do	Day and Time	Done	Not done
Lecture topic				
Temperature (L #1)				
Temperature (L #2)				
Temperature (L #3)				
Temperature (L #4)				
Practical 6 topic:				
Venous and arterial system				
Week 7	Things I have to do	Day and Time	Done	Not done
Lecture topic:				
Endocrine system (L #1)				
Endocrine system (L #2)				
Endocrine system (L #3)				
Excretion (L #1)				
Excretion (L #2)				
Practical topic:				
Human sensory perception				

APPENDIX I

ACTIVITY-BASED QUESTIONNAIRE 4: PREPARING FOR PRACTICALS

This activity-based questionnaire was administered during Block 3 to Introductory Life Sciences students who worked through *Bioskills*. (see Chapter 6, page 155). It was used to check on specific work-habits students used in preparation for science practicals.

ACTIVITY 4: PREPARING FOR PRACTICALS.

Student No___________________

Scoring good marks for your practical work is one way to keep your marks high. Completing the practical and correctly doing the tasks set are therefore important if you intend to score high marks. As an example of how to prepare for each practical, let us go through the necessary steps. The instructions provided here should become part of how you should prepare for every lab session. I hope you find it useful and endeavour to use the steps in other practicals. Additional information is available in the *Bioskills* programme and should be consulted.

STEPS TO TAKE TO PREPARE FOR A PRACTICAL SESSION

Each practical is based on a set of lectures. So you should begin by examining your attitude towards the topic on which the practical is based.

Step 1: Examine your attitude towards the practical topic. [Tick (✓) the column of your choice]

	Yes	No
Did you find the topic interesting?		
As a way of promoting further understanding, did you read any section of the topic on your own?		

Remember, people with more **positive attitudes** to a topic are more likely to do well.

What can you do to make sure you appreciate the lectures for this week?

Step 2: Set a goal for the practical. Remember to word it as a SMART goal. (e.g. What mark do you want to score in this practical?) Write it in the space provided below

1	

Step 3: In the table below, list all the things you need to do to "understand" and complete the practical on schedule. Remember you have set a goal to achieve in the previous exercise.

1	
2	
3	
4	

What you need to do

Now examine the check-list of things to do in preparation for Practical One. Place a tick (✓) against all the items you have done and not done. Then GO back and complete all tasks you have not done if you intend to score good marks on this practical. The check-list should be completed at least one day prior to the practical.

Check list of things to do for the practical

	Tasks to do	Done	Not done
A	I have read the lecture notes on the topic		
B	I have read the relevant section in the prescribed text book		
C	I have read the topic in the lab manual thoroughly		
D	I have looked at the tasks in the lab manual and divided my time accordingly in order to finish on schedule.		
E	I have answered questions which can be pre-answered before the practical		
F	I have graph sheets to take along with me to the practical		
G	I have got a text book with relevant diagrams to take with me to the practical		

After completing the practical work, here are some questions to reflect on and answer.

Did you enjoy working through the practical?
(Enjoying the practical is a necessary source of self-motivation to keep you focused) To learn more on motivation see the activity in *Bioskills.*
Do you think you will get your expected mark?

APPENDIX J

ACTIVITY-BASED QUESTIONNAIRE 5: *BIOSKILLS* AND YOU

This activity-based questionnaire 5 was administered during Block 3 to Introductory Life Sciences students who worked through *Bioskills*. These questions sought to establish the level of reflection students undertook after going through *Bioskills* (see Chapter 6, page 155).

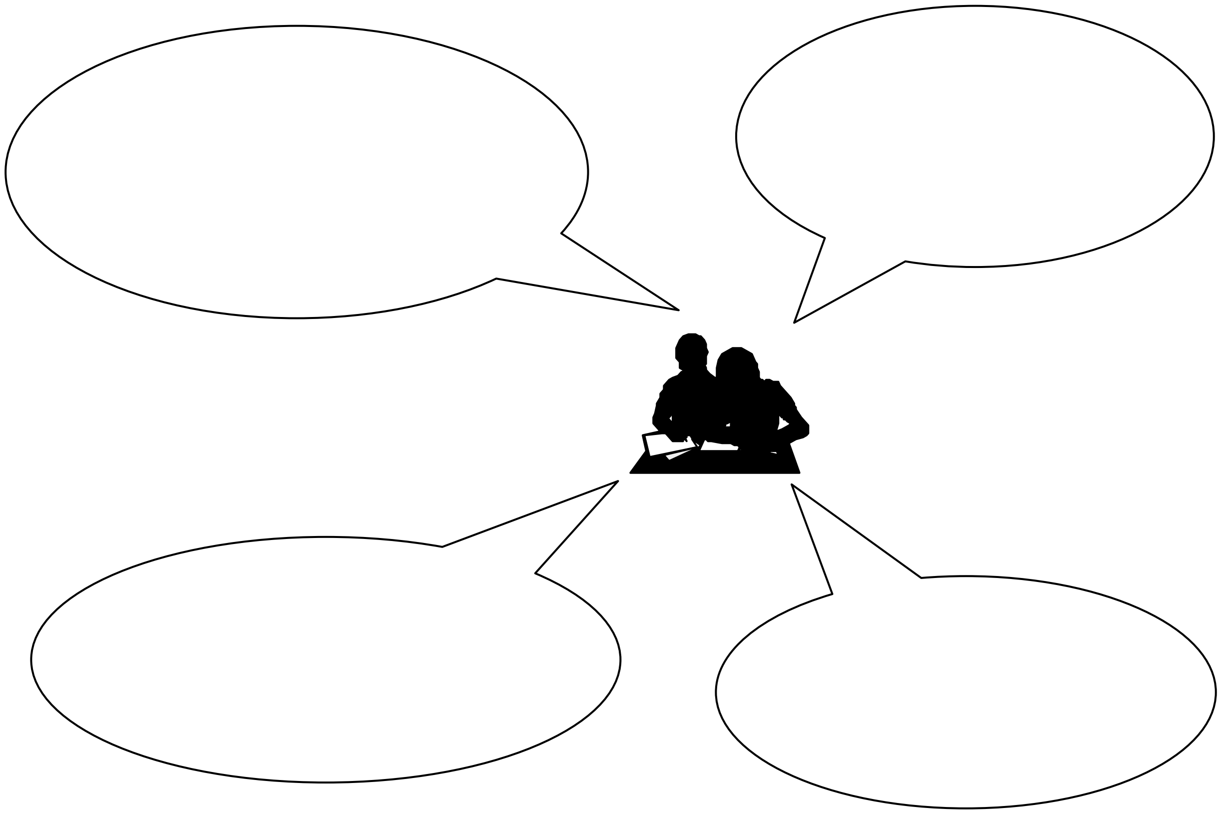
BIOSKILLS AND YOU

Student number ___________________

Which of the things you learned from working through *Bioskills*, have you put into practice during this block?

Write in the call box below ALL the things you learnt from using Bioskills, which you could NOT put into practice during this block?

Please, state the reasons why you could not put those things you learned from *Bioskills* into practice during the Block.



APPENDIX K

SEMI-STRUCTURED INTERVIEW SCHEDULE

This schedule was used as a general model of reference during the therapeutic phase of the study. Interviewees were eight first-year biology students (see Chapter 6, pages 157-158).

Interview schedule for students who have used *Bioskills*

Introduction.

- Thank you for agreeing to talk to me about your experiences with using the *Bioskills* package during the third block.
- I am trying to find out about students' experiences with the package, and any effects the package had on their studies. What you tell me will be used to improve the package for future students.
- It is therefore important that you are completely honest in your comments.
- In order to help me keep accurate records of our conversation, I would like to record it. Is that okay with you?

Information about /Reasons for seeking information	**Main questions**	**Follow up situations and probe questions**
Establishing students' pre-*Bioskills* attitudes, behaviour and perceived behavioural control	I would like you to tell me a little about yourself. Let's consider the **first-half** of the year. Which was your favourite subject at 'varsity?	Do you consider yourself as someone who likes studying biology more than other subjects?
	Let's consider how you engaged with lectures and practicals etc. in the first half of the year. ▪ What percentage of lectures would you say you attended? ▪ Did you ever prepare for lectures? ▪ Did you ever prepare for practical classes? ▪ How did you prepare for the practical classes? How well did you understand the topics taught in the first-half of the year? ▪ If you did not understand a particular topic what did you do? For each test did you set a target mark you hoped to get? When you did not achieve the mark, how did you react? What do you think was the reason that you did not get the mark you expected?	*If "Yes"* Tell me how did you prepare for the lectures? Tell me what you did? *If "No"* Tell me "What were your reasons" *If "Yes"* How did you prepare for practical classes? Tell me what you did? *If "No"* Tell me "Why not- What were your reasons" (*If they did not understand ask)* Did you just leave matters or did you take some action? • Tell me about any efforts you made to understand a topic in the first-half of the year …. Tell me why did you make efforts to … .. Tell me why you did not make efforts… *("Yes" or "No"*) What did you think? What did you do? (*That is very interesting*) Is there any thing more?

Information about /Reasons for seeking information	***Main questions***	**Information about /Reasons for seeking information**
To obtain background information about students' computer experience. Justification : Their computer skills could influence their success in using the package.	I would like you to tell me a little about your experience with using computers. Are you a first-time user or you have used computers **before** working through the *Bioskills* package?	*If not a first time user….* How long have you been using computers? What have you used computers for in the past? *If a first-time user…* Did you have any dificulties using *Bioskills* **because** of your lack of computer skills? (*If "Yes")…*Tell me about them… Anything else?
Motivations for getting involved with the package Justification: To establish students' reasons for working through the programme .	What were your initial feelings when you were invited to use the computer package? Did you **consider** turning down the invitation? What were your reasons for coming to use the *Bioskills* package?	What did you think? If "Yes" Could you tell me why? Any thing more…?. *(If they seem stuck)* Why di d you decide you would come to use it?
Establish extent of usage and method of access	How many times did you use the programme? Which computers did you use to access *Bioskills?* Were there any other computers from which you could used Bioskills? Did you have any problems in getting to use a computer with Bioskills on it? Did you attempt using *Bioskills* from the other places you mentioned?	(If not clear) Where were the computers located at? If "Yes" ask which ones Why did you/…. Or did n't you use them? What were they? Tell me more.. *If Yes* Tell me which place was that?
Establishing students' opinions about *Bioskills* and how useful it is to them	**Now,** having used *Bioskills* X times…. • What is your opinion about *Bioskills*? • What is your opinion about the	What did you like about *Bioskills* (if anything?) What did you not like about *Bioskills* (if anything?) How relevant was the info to you?...

	information provided by *Bioskills*? • What other information do you think should have been included in *Bioskills*? Let's now talk about the times you used *Bioskills* What were your reasons for using the package again? Would you say those X times were sufficient to go through the whole package?	How relevant will you consider the info to a new first-year student? (*If stuck*) Would you say the information was new.to you/. (If Yes)Which aspects were new to you.? How important is it to you?) During your second use, please tell me the sections which interested you. (If Yes or No) Why do you think that? Please explain that to me.
Establish any change, post-*Bioskills* knowledge To explore further what students remember and have done with information from the package.	What do you remember from using *Bioskills?* The package asked users to set goals… I noticed that from the 'hand out' you submitted, you set the following goals… When you set those goals, how serious (committed) were you about trying to achieve them? Which of these goals were you able to achieve/accomplish during the block?	 Do you remember them? (*Get student's goals from handout)* *If they did not understand,* Did you really intend/ to try to take actions to achieve these goals? Tell me about them… How were you able to achieve them? What did you do
	What benefits, if any, did you gain from setting those goals? Tell me how you went about doing what you set out to achieve.	*If they do not understand*..How helpful was setting those goals to you.
	Which of these goals were you **not** able to accomplish?	Was it your intention to achieve those goals? Tell me why you could not achieve those goals? (*Encourage student to provide as much information as is possible*).
Intentions for Block 3	Let's now discuss how you carried out your intentions for Block 3. Did you follow through with your intentions? (i.e how well did you manage to do those things) ▪ Did you ever prepare for lectures ? ▪ How did you prepare for lectures? What about the practicals in Block 3? • Did you ever prepare for practs in	How much work did you find in Block 3? *If not understood*, I mean the lectures and practicals and things to read.. *If "Yes"* Tell a bit more…? *If "Yes"* ..Tell me about any efforts you made to prepare for

	Block 3?	practicals in Block 3. *If "No"* Tell me why you did not…. Any other reasons.
	You have told me about how you handled work in the first half of the year and Block 3… • In your opinion were there any differences in how you handled/managed the work-load … **before** and **after** the July vac. What will you do if you find that the work-load increases considerably in Block 4?	Please tell me about them…What were they? Tell me about the steps you will take if you found that...
Preparations for test To explore student's preparations for the class test. To explore students beliefs and *attributions* about the class test and their preparations during the block for the test in Week 5 of the block	You have just written a class test. Did you set a mark to achieve? What preparations did you make concerning the test? Compared to the (second block's test) ▪ What would you say was your level of readiness or preparedness for the test ? ▪ How difficult or easy was the paper to you? ▪ What factors would you say influenced your readiness for the test you have just written? Have you received your test mark? How close was the mark to what you set to achieve? (*If the mark was close to what was expected*)What helped you to achieve the mark? (*If it was lower than expected*) What prevented you from getting the mark you expected for the test?	When was the test? (*If Yes*)What was it? (*If No*). Why did you not? Please tell me what you did. When … Why…did you do those things Were you ready for the test?….More/less prepared for the test? Could you think of other factors that have helped you to get into this stage of preparedness/ unpreparedness? Are there any other factors? Please tell me about them.. (Pause…..) How close was it to what you expected? *(Was it a good mark or terrible)* *If they seem stuck…* What would you say caused you to get such a mark? Please explain that further.

Preparations towards exams	Let's look at the end-of-year (exam and class) final mark. ▪ What mark have you set for yourself as a final mark for the course? ▪ What are you doing **now** to help you to achieve that mark?. In the circumstance of not getting the mark you wanted for the year, what will you do?	We are considering Block 4….Ok What are your plans for Block 4?
	What contributions do you think the use of *Bioskills* has made to your academic studies in the second half of the year (if anything)	What new attitudes have you learnt? What new behaviours have you adopted? Is there anything else you can say?...
C:/interview schedule31/09/06		At the end, thank the **respondent** for their time and and the **useful** contributions they have made.

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