IMPROVING THE ACADEMIC LITERACY LEVELS OF FIRST-YEAR NATURAL SCIENCES STUDENTS BY MEANS OF AN ACADEMIC LITERACY INTERVENTION

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Declaration

I hereby declare that this study is my own, original work and that all sources and references have, to the best of my knowledge, been accurately acknowledged. This document has not previously in its entirety or in part been submitted at any academic institution in order to obtain an academic qualification.

Ilse Fouche November 2009

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Abstract

Over the past years, there has been a consistent call from Government and industry for South African tertiary institutions to deliver more graduates in the fields of science and technology. This, however, is no mean feat for universities, as the pool of prospective candidates delivers very few students with the necessary academic literacy abilities, and very few students who passed mathematics and science at the right levels to succeed in science higher education. This puts tertiary institutions under mounting pressure to accept students who are under-prepared and to support these students appropriately.

The plight of Open and Distance Learning (ODL) institutions like the University of South Africa (UNISA) is even more desperate, as they are often left with those students who are either unable to gain entrance into, or to afford the study fees of, residential universities. These students are often in greater need for face-to-face interaction than are their counterparts at residential universities, yet they generally receive very little of this.

The intervention examined and critiqued in this study is an attempt at raising the academic literacy levels of first-year students at UNISA in the fields of science and technology by means of a 60-hour face-to-face workshop programme. As its foundation, it uses the principles of collaborative learning and authentic material design. It also treats academic literacy abilities as interdependent and holistic.

This study starts with a broad overview of the context. This is followed by a review of the literature. This review focuses on concepts such as collaborative learning, academic literacy, English for academic purposes, English for specific purposes and English for science and technology. Thereafter, a needs analysis is done in which students' Test for Academic Literacy Levels (TALL) pre-test results, as well as a sample of their assignments, are examined. In addition, the workshops in this intervention programme are analysed individually. To determine the effectiveness of the academic literacy intervention, students' pre- and post-TALL results are scrutinised, and a feedback questionnaire filled in at the end of the year is analysed. Subsequently, recommendations are made as to how the workshop programme could be improved.

Findings show that the academic literacy intervention did improve students' academic literacy levels significantly, though the improvement is not enough to elevate students from being considered at-risk. However, with fine-tuning the existing programme, the possibility exists that students' academic literacy levels might be further improved. This calls for a careful examination of the areas in which students' performance did not improve significantly.

Student feedback indicated a positive attitude towards the entire intervention programme, as well as a marked preference for collaborative learning and face-to-face interaction. In the redevelopment of the current workshop programme, such preferences would have to receive attention, so as to integrate students' wants, together with what they lack and what they need, in subsequent interventions.

In conclusion, the limitations of this study are discussed, and recommendations are made for future research, as the current study must be seen as only the beginning of a process of action research that could lead to a sustainable intervention programme in future.

Key terms:

academic literacy; authentic materials; collaborative learning; English for academic purposes (EAP); English for science and technology (EST); English for specific purposes (ESP); language support; open and distance learning (ODL); tertiary education;
undergraduate reading and writing; writing course design.

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CHAPTER 1 Background and purpose of the study

1.1 Background

1.1.1 Context

In 2007, 65.2% of the 564 775 students who sat for the Grade 12 examinations passed. Only 25 415 (4.5%) passed mathematics at higher grade, and 28 122 (5%) passed science at higher grade (Pandor, 2007). Although the pass rate has increased in the past decade (the pass rate in 1998 was 50%, with 3.6% of students passing mathematics at higher grade, and 4% passing science at higher grade [Collings, 2000]), it is still alarmingly low, especially in subjects such as mathematics and science, which are in high demand in a country where there is a skills shortage in the fields of science and technology (see, for example, Department of Science and Technology [2007] and National Research Foundation [2009]). According to Phillips (2004), one of the reasons for this poor pass rate is that many science and mathematics teachers in South Africa are English additional language (EAL) speakers themselves, with inadequate language abilities. Since science and mathematics are often taught through the medium of English in previously disadvantaged schools, difficult subjects become even more difficult due to the teacher having to teach, and the learner having to learn these subjects in a language neither is fully proficient in. Phillips (2004:3) states that the only way many of these students learn "is by rote memorisation of concepts they barely understand". According to Phillips (2004:108), statistics indicate that "South Africa seems to be producing a frightening number of largely illiterate matriculants", especially in black schools, where "[l]ittle practice in reading and writing takes place" (McCallum, 2000:4). This perpetuates a cycle of inadequate literacy, especially for students from previously disadvantaged areas, since they acquire poor language abilities from their teachers (and often develop a negative attitude towards language, since little or no value is given to adequate language abilities in subjects such as science), which then does a disservice to the fortunate few who do make it to university.

Meanwhile, the Department of Education and the private sector want increasing numbers of students to be qualified in the sciences, and in response to such appeals, the number of students registering for science-related courses at tertiary level is escalating (Phillips, 2004). Already, the pool of students with the necessary secondary school subjects and marks to ultimately succeed at university is very small. The fact that increased numbers of students enrol in science-related courses at the Department of Education's insistence does not mean that more students are able to successfully complete their studies. The increase of students enrolling for science and mathematics related courses at tertiary level is thus not a reflection of an increased quality of matriculants. Rather, students who do not have the necessary language, academic and cognitive abilities to succeed at tertiary level are accepted by universities. "[T]o further complicate the situation, [these students] (...) are seldom adequately prepared for the demands of tertiary institutions with regard to language ability in Science/Maths and they consequently fail or drop out" (Phillips, 2004:4).

In spite of increasing enrolments in science-related courses, "fewer Science students are graduating and the pool of qualified Science personnel is dwindling in an expanding economy" (Phillips, 2004:100) – surely never a good sign for any country. The problem of too small a number of students graduating seems to be specifically pronounced in South Africa. According to a report by the United Nations Educational, Scientific and Cultural Organization (Unesco) (2001), South Africa had 633 918 tertiary students in 1998 – the highest number of students in Sub-Saharan Africa. Yet, the "graduation rate of these students was only 15%, compared to the ideal graduation rate of 33%" (Cape Times, 2003:5). Particularly natural sciences departments at universities currently have a considerable problem with student throughput (Council on Higher Education, 2004). In 1999, the national throughput rate (i.e. the number of graduates in any year as a percentage of total enrolment) for students of science, engineering, technology, commerce and business was only 16% (Collings, 2000). One study cites completion rates at UNISA for science as low as 5% (Collett, 2002). One of the reasons for the low graduation rate, according to Phillips (2004), is poor reading and writing abilities. As will be argued in Section 2.5, to succeed in a science-related course, competency in reading and writing is of the utmost importance.

The Department of Education has made it clear that it expects universities to take measures (such as institutionalised academic development programmes) to improve the current situation (Ministry of Education, 2001). Many South African universities have started initiatives aimed at improving throughput rates for students studying science-related subjects. Poor academic literacy has often been cited as a contributing factor to poor throughput rates (discussed further in Chapter 2) – therefore academic literacy is addressed in many interventions to improve throughput rates. Language proficiency might be argued to be the most important aspect of academic literacy, though it cannot be separated from visual literacy, information literacy and numerical literacy (see Section 2.1.1).

In 2006, UNISA for the first time launched a foundation course for students studying science-related subjects, called the Science Foundation Programme (SFP). The SFP is not an access course, as students in the foundation programme have already obtained access to the University. The aim of the SFP is to give students a thorough foundation in the subject matter of science-related subjects, from the fields of "engineering", "mathematical sciences and statistics", "chemistry and physics", "computing", and "mathematics, science and technology education" (UNISA, 2006). This is done by means of a three-legged approach: extra tutorial classes in the 18 identified high-risk subjects, Peer Collaborative Learning (PCL) classes, and reading and writing assistance (facilitated by the Reading and Writing Centres). This study focuses specifically on the additional reading and writing assistance.

It has long been accepted that the nature of additional language support for the natural sciences must be different from language support given to students of the social sciences (Bazerman, 1988; Becher, 1989). Students studying natural sciences must learn to use language in an objective, precise and structured way – often to a greater extent than students in other faculties. The texts that these students deal with are also generally written in a very different (and less reader-friendly) style than texts encountered in other fields of study. Perhaps this difference in the type of language needs has caused students of the natural sciences to be hesitant to join traditional, generic language support programmes (see, for example, Phillips & Shettlesworth [1988], Hyland [2002] and Kavaliauskiene [2004]). It is, therefore, very important to develop a language support programme that specifically focuses on the needs of students in the natural sciences. Students involved in the present study mainly come from the fields of science and engineering. Braine (1995:114) argues that the natural sciences and engineering "share sufficient characteristics to be considered a single discourse community", for example, the type of writing activities expected as well as their shared "basic knowledge of mathematics and science" (also see Braine, 1989). The importance of developing a language support programme for specific disciplines is explored in Section 2.4.

1.1.2 Open and distance learning (ODL)

Traditionally, distance education has automatically implied a distance between student and instructor, as this definition by Holmberg (1977:9) indicates:

> The term 'distance education' (...) covers the various forms of study at all levels which are not under the continuous, immediate supervision of tutors present with their students in lecture rooms or on the same premises, but which, nevertheless, benefit from the planning, guidance and tuition of a tutorial organization.

UNISA's definition of distance education also stresses the importance of distance: "In distance education there is a distance – a separation, whether of time or space or something else – between the student and the institution, their teachers and their peers" (UNISA, 2006:6). Keegan (1980:33) adds characteristics such as "the influence of an educational organisation which distinguishes it from private study", "the use of technical media, usually print, to unite teacher and learner and carry the educational content", "the provision of two-way communication so that the student may benefit from or even initiate dialogue", and "the possibility of occasional meetings for both didactic and socialisation purposes".

According to Richards (1994:10), the term 'correspondence education' has often been used as an umbrella term. However, this term does not encapsulate distance education. On the contrary, this is only one method of distance education, and arguably one that does not at all realise the potential that distance education has, since it focuses mainly on print-based education. Although it is true that distance education could, to a large extent, be described as correspondence education before 1969, it has developed in a very different direction (and has gone through various stages) since then, with the founding of the Open University in the United Kingdom (Richards, 1994).

At the start of this "second phase in the history of distance education (...) technological intoxication caused some temporary blurring of vision" (Richards, 1994:12). It might be argued that there was an overemphasis on technological media, such as telephone-, satellite- and videoconferencing. Once this initial intoxication wore off though, the Open University, and many other traditional distance education institutions, moved towards what is now generally known as 'open learning'.

Escotet (1980:264) explains the difference between open learning and distance learning:

> *Open education* is particularly characterized by the removal of restrictions, exclusions and privileges; by the accreditation of students' previous experience; by the flexibility of the management of the time available; and by substantial changes in the traditional relationship between professors and students. On the other hand, *distance education* is a modality which permits the delivery of a group of didactic media without the necessity of regular class participation, where the individual is responsible for his [*sic*] own learning.

The two are thus not in any way mutually exclusive. It is possible to combine both distance education and traditional contact education within a philosophy of open education. The international trend, however, seems to be to rather use open learning in combination with distance learning. Internationally, the term 'open' often "means access for equity, and the 'distance' is the ways in which the education is delivered. So 'open' has to do with a paradigm or philosophical underpinning while 'distance' has to do with methods of delivery" (UNISA, 2006:8). Collett (2002:31) comprehensively sums up the interrelatedness between open and distance learning:

> The term open learning is commonly used to describe a mode of education which places a high value on flexibility in a range of areas: the recognition of prior learning (...); the mode and pace of learning; and forms and timing of assessment (...). Open education is concerned primarily with facilitating students' achievement of exit standards by removing obstacles to this achievement. (...) The terms open and distance are often used together to designate a class of non-traditional learning methods usually characterised by being managed by the learner rather than by the teacher.

Richards (1994:16) adds further characteristics of open learning such as accessibility (related to academic background, age, financial constraints or physical location) and the need for a "range of options [to be] available in terms of means of study and methods of support".

It must be remembered that open learning is not an absolute term. An institution can rarely be described as being 'open' or 'not open'. Instead, "there are varying degrees of openness" (Richards, 1994:16). However, if open learning (in its ideal state) had to be defined by one term, it would probably be 'flexibility'. Collett (2002:221) states that such flexibility should ideally give students the choice between "a mix of contact and self-study options as their individual needs dictate." (Collett, 2002:221). Lewis (1990) also argues that open learning offers the student a wider choice with regard to content and modes of delivery. Such modes of delivery should give students a choice between traditional print-based material, telephone-, satellite- or videoconferencing, or contact classes.

In line with the international move of distance education towards open learning, several models have been proposed, such as Rumble's (1986) transactional model, which describes the transactions of learners with materials, with the institution and with intermediaries such as counsellors and tutors. It is these intermediaries who are of particular interest for this study, since they are the ones who bridge the gap between student and institution, are often the only 'face' of the institution that students ever experience, and are more often than not the ones who provide the option of contact classes in an ODL institution. As Richards (1994:15) argues, failing to take into consideration the "crucial balance between independence and support is a recipe for failure".

Paul (1990:85-86) points out that learner independence (often seen as the basis of distance education) cannot be accepted as a given – in fact, "large numbers of students (...) do not cope effectively with the demands for independence, time management and self-direction posed by open learning". Paul (1990:83) argues that for open-learning institutions to reach the ideal of breaking down barriers to access education, they "must improve their capacity to develop independent learners". Richards (1994:17-18) argues that this is often only achievable by means of a "process of negotiation and dialogue (however mediated) between tutor and student" - a process during which students are guided from the point of entry, where they are often still completely dependant on tutor guidance, towards a point where the student can consciously decide what media of study are most effective. According to Richards (1994:18), "[t]he potency of language in the process of empowerment is self-evident, and the implications of open access for language learning need not be spelt out".

Of course, an open approach to learning also implies greater costs, since various modes of learning have to be available to students. Richards, however, stresses that if educational institutions allow finances to determine their response to students' needs, they should not pretend that their stance is an educational one (Richards, 1994). The needs of the student must always be paramount.

1.1.3 The University of South Africa (UNISA) as an ODL institution

In 2000, almost 30% of all South African higher education enrolments were at distance education institutions (Collett, 2002). Distance education thus plays a vital role in the South African higher education arena.

UNISA is by far South Africa's biggest distance education provider (even more so since its merger with the former Technikon South Africa). It can be described as an open and distance learning (ODL) institution (although, as mentioned before, this should be seen as a point on a continuum rather than an absolute). It does, as definitions in the previous section imply, recognise students' previous learning experiences[1], change the traditional relationship between student and lecturer, make possible flexible management of time (in terms of pace of learning, though not presently in terms of form or timing of assessment) and flexible utilisation of modes of learning (be that via print-based materials, on-line learning, satellite- or video conferencing, or face-to-face learning). In addition to providing "open access in order to redress inequalities" (as described in Escotet's definition), open learning in South Africa "also includes concepts such as active learning [and] critical thinking" (UNISA, 2006:8).

Internationally, the trend for ODL institutions is to rely mainly on computer technology to decrease the distance between student and institution (Keegan, 1986; UNISA, 2006). Such technology can include 'chat rooms', online learning, video conferencing, etc. (UNISA, 2006). Although UNISA is broadening its use of such technologies, the majority of undergraduate students do not have access to the Internet (in fact, many of the students I see have never worked on a computer before). Therefore, UNISA still to a large extent has to rely on print-based materials as a main method of communication and education. In addition, UNISA relies on face-to-face tutorials and Peer Collaborative Learning (PCL) to bridge the gap between student and institution.

Face-to-face tutorials at UNISA are usually facilitated by someone who already has a degree in the relevant field of study. Research has proven that face-to-face tutorials "at intervals in the learning cycle add tremendous value to the students' learning-at-a-distance" (UNISA,

[1] This is accomplished mainly through the Department for the Recognition of Prior Learning, which assesses and acknowledges such learning experiences.

2006:7). PCL "refers to small-group learning that is managed and run by students themselves with the purpose of improving their chances of academic success" (UNISA, 2006:11). In PCL groups, learning occurs by means of collaboration, where knowledge, experience, skills, competence and feelings are shared by groups of students (UNISA, 2006).

Intermediaries such as tutors or PCL leaders play an invaluable role at UNISA, since, according to research done by Collett (2002:227), "[c]onstructive contact between lecturers and students and between students themselves appears (...) to be relatively rare, with many students experiencing isolation in their studies". Contact facilitated by such intermediaries has the potential of taking the risk of isolation out of distance learning.

1.1.4 Justifying contact classes at an ODL institution such as UNISA

In the past, communication in distance education has been mostly mediated through technology, consisting mainly of satellite broadcasting, audio-conferencing, telephone, e-mail and other Internet-based communication (Schrum & Ohler, 2005). In the past few decades, online learning has taken precedence over all other technology-based communication methods (Berge, 2004; Wheeler, 2004; Oravec, 2005; Schrum & Ohler, 2005). Whilst technology-based communication is often seen as a viable replacement for face-to-face contact, several objections can be raised against this.

Firstly, a vast number of South African first-year students making use of distance education do not have access to the Internet (or are not computer literate). This often immediately excludes students who need additional support the most – especially in the South African context where students who never had the opportunity to become computer literate are those who consequently cannot access most of the technological communication methods provided for distance learners.

Secondly, much of the depth associated with face-to-face contact is often lost when communication has to occur through technology. For example, in a study by Kanuka and Anderson (1998), it was found that in an on-line conference, much of the interaction was limited by relatively superficial sharing and comparing of information, with little in-depth engagement with issues. George (1994:84) describes communication via phone, though instant, interactive and quick, as “only the skeleton of our normal communication; the bare bones, stripped of the visual padding (...) [which strips] the communication of all the comfort and personal warmth of visual contact”.

This over-dependence on technology at the expense of face-to-face contact has always been one of the greatest disadvantages of traditional correspondence distance education, since students are forced to study in a way that they often do not like, isolated from peers and teachers. Since students often have no choice but to study in isolation, they usually do not have any indication of how their current level (be that knowledge of a subject or the level of their academic literacy) compares to that of their peers. According to Walandouw and Penrose (1994), this is precisely what a move towards open learning should redress. Students should be able to choose from a variety of learning modes, and should be able to measure themselves, and specifically their language ability, against their peers. It is often only when one does this that one realises that more work in certain areas might be needed in order to succeed at tertiary level. Walandouw and Penrose (1994:71) suggest that “the time is not yet right, in distance language learning, to look for complex electronic solutions to what is still an issue of human environments”.

This ‘issue of human environments’ is illustrated vividly by George (1994:85) when he describes face-to-face teaching as an ideally rich and satisfying medium, “with the possibility of effective interaction within all the domains – psycho-motor, cognitive, affective and interpersonal”. He describes the factors that make this such a rich medium of communication:

> The welcoming smile or glance, the body language of attention and interest, the eye contact to maintain engagement, the feedback both ways on the rightness of the pacing and structure of what is happening, the evidence of the students’ understanding and involvement, of the tutor’s enthusiasm for the subject and for what is being created in the class – all of these are communicated largely by visual means. Subtle visual language builds the atmosphere of a class, and sharpens its effectiveness. You can so easily take the edge off a critical comment by a smile, welcome a latecomer into discussion with a friendly nod, raise an eyebrow to steer a speaker to think more carefully about what she is saying, or pick up the contradiction between what is being said and how it is being said – and spot the underlying uncertainty which needs addressing before you all move on (George, 1994:85).

The concept of distance education changing to facilitate more personal contact between student and institution is a recurring theme in the literature, and is thus not important only in the South African setting, but also internationally[2].

> [T]here is a progressive convergence between [contact and distance education] (...) which is being hastened by increasing needs for flexibility in the delivery of courses and by developments in information and communications technology (...). So, for example, distance education, as it is implemented in many institutions, now typically includes activities which are usually associated with traditional 'contact' education – lectures, tutorials, practicals and cooperative learning opportunities (Collett, 2002:37-38).

Wheeler (2004:15) notes that "the successful university of the future will go to the students". For this to happen, the gap between institution and student must be bridged; a feat which, according to Wheeler, can be accomplished by developing the human infrastructure of universities. The Commonwealth of Learning's (COL) first strategic plan (described in Lockwood & Latchem, 2004:160) states that the "artificial and counterproductive distinction" between distance and traditional residential education is weakening due to the continuing "global process of educational reform". Collett (2002) agrees, and states that distance education has moved towards a more learner-centred style of learning which encourages more and better quality contact between the learner on the one hand, and the teacher, institution, learning material and fellow learners on the other. However, despite the convergence between distance and residential institutions, Collett (2002) states that one can still distinguish between institutions whose academic programmes are organised around a schedule of classes, and institutions whose focus is on the production and distribution of learning materials and assessment instruments that students mostly work on independently, in addition to using whatever resources and schedules that fit their particular circumstances best.

The reasons for giving students the opportunity of interacting with each other and with teachers is well documented in the literature. According to Cross and Steadman (1996), one of the basic principles of good educational practice is quality contact between learners and teachers – this seems to be advantageous to both students and teachers. Collett's (2002) study also clearly shows that South African distance learners have a patent need for personal contact. He argues that "only the very mature student with a high degree of academic literacy (...) is able to study effectively in complete independence", but even in such a case "social constructivist theorists [would argue] that learning is a socially mediated process. Isolated,

[2] It must be noted that the converse is also true. Traditional 'residential' universities are increasingly supplementing their teaching approaches with distance learning strategies.

independent learning (...) could be considered incomplete or alienating, as learning is dependent on the interchange between people" (Collett, 2002:43-44). In addition to students having little or no contact with peers, it also seems as though very few students have regular contact with lecturers – at least as far as in-depth engagement with subject matter is concerned (Collett, 2002).

Moore (1993) categorises interaction in an educational context into learner-content interaction, learner-instructor interaction, and learner-learner interaction. In distance education, there has traditionally been an overemphasis on learner-content interaction. Moore (1993) argues that distance education should redress this overemphasis, and make available a greater variety of methods which students can use to enhance meaningful interaction. A lack of human interaction in distance education could be a major contributing factor to students not finishing their distance education courses. In fact, some of the reasons Collett (2002) cites for low completion rates of distance education courses include not engaging sufficiently with the learning process and students not interacting adequately with staff.

Collett (2002) also points out that students entering the distance education system on average have lower matric results than students entering residential institutions. This, according to him, often has the following consequences: "less well developed schemas of the academic disciplines which they have studied"; "poorer cognitive skills"; "under-developed metacognitive skills"; and "weaker academic skills such as reading and writing" (Collett, 2002:231). Whilst such inadequacies would become apparent fairly quickly at a residential university with regular face-to-face contact, they are much more difficult to identify in a distance education setting where most students never or rarely see tutors or lecturers. If such inadequacies are identified in a distance education setting, this often only happens by the time the final examination is written, and it is too late to do much about it at that stage (Collett, 2002). Having more contact classes in an institution such as UNISA could identify problem areas in students that would otherwise have gone unnoticed. At-risk students could then be referred to the appropriate learner support section, and consequently retention and throughput could be improved. A further advantage of contact sessions, according to Randell (1998), is that these can encourage students to study independently, if structured carefully. Contact classes can achieve this by motivating and supporting learners – "[a]s students gain more confidence, they will be able to drive their own learning process" (Randell, 1998:15).

Although contact classes have many advantages for (arguably) the majority of students, one must remember that not all students have the same learning style. For example, although the majority of students in Collett's (2002) study felt that contact between student and lecturer is very important, some felt that they did not need such contact. It does seem logical that certain students choose distance education specifically because they do not need contact with others for successful study – in fact, some learners might experience such contact as burdensome, or, as Collett puts it, "a waste of time" (2002:193). However, those students who did have regular contact with peers cited advantages such as that it "[b]reathes life and enjoyment into learning", "[c]ounters the isolation experienced by students in remote areas", and "[e]nables students to discuss study issues" (Collett, 2002:194).

In spite of the clear need for contact classes, as illustrated by the above arguments, distance education institutions have been criticised for not providing enough support in the form of contact classes. The National Commission on Higher Education (NCHE) (1996:120), for example, criticises distance education institutions when saying that "[t]utorials and other forms of learner support are inadequate". UNISA has shown its commitment toward bridging the gap between student and institution by implementing learner support at several regional offices, where students have access to libraries, counselling, tutorial classes, PCL sessions and, most recently, academic literacy support (both reading and writing, and quantitative numeracy). Most learner support initiatives (such as tutorial classes, PCL sessions, and academic literacy facilitation) at UNISA use small-group learning to obtain their objectives. The benefits of such an approach are further discussed in Section 2.2. However, it is useful to note already that, according to Misselhorn (1997), it is important to have a teacher available as facilitator in any effective small-group learning situation, who can give explicit instructions and provide effective and focused feedback.

This section has argued for the importance of contact classes in open and distance learning institutions such as UNISA, and though I believe these contact classes to be invaluable, they cannot be made compulsory. Walandouw and Penrose (1994), for example, point out that trying to make such activities compulsory can be very problematic, especially in an open and distance learning situation where activities should not discriminate against students who are not able to partake in them. Instead of trying to enforce contact classes, such support activities should create a supporting environment that students can easily make use of whenever they feel the need to do so. One impediment to this ideal situation is that students might not be mature enough to realise the need for such support activities, and might consequently not take advantage of these opportunities. This is a concern that falls outside the boundaries of the current study, but which should certainly be researched in future.

1.1.5 Initiatives at the UNISA Reading and Writing Centre regarding the academic literacy of ODL students

According to Hutchings (1998), many students experience difficulty with the transition from secondary school to tertiary education. Students may have difficulty functioning independently at a higher academic level, often away from their communities and family for the first time[3]. Another difficulty that students face is having to function in an additional language. In addition to this, once these students start their education as distance learners, there is a "dearth of formal opportunities, such as assignments, for developing academic literacy" (Collett, 2002:244). Although UNISA does offer various academic literacy courses (presented by the Department of English) in order to address this problem, these courses are not compulsory for all students. Furthermore, acquiring academic literacy solely by means of printed text (without any collaborative learning) is a very difficult task. As is argued in Section 2.2, language is a social construct, and is therefore best acquired in collaboration with other people. Furthermore, developing language proficiency (or more specifically, academic literacy ability), as a social activity, requires immediate and contextual feedback from other language users – feedback which is taken into account with subsequent language usage (although not always implemented immediately). In courses such as those offered by the Department of English, such feedback is usually only received months after assignments were submitted.

In 2004, the UNISA Reading and Writing Centres (as part of the Bureau for Counselling, Career and Academic Development) were created to help students with reading, writing and reasoning abilities. There is currently a Reading and Writing Centre at 13 different regional offices (Pretoria Sunnyside, Pretoria Muckleneuk, Johannesburg Newtown, Johannesburg Florida, Benoni, Polokwane, Pietermaritzburg, Durban, East London, Mthatha, Parow,

[3] Although Hutchings refers to residential universities, the same can be said for UNISA. Even though it is an Open and Distance Learning institution, many students move closer to the various regional centres, and form learning communities similar to those at traditional residential universities.

Kimberley and Addis Ababa). These Reading and Writing Centres present various generic and subject-specific workshop programmes (for undergraduate and postgraduate students), offer individual consultations, and provide various self-study reading programmes. All students can make use of any of these services. Most centres try to accommodate employed students as much as possible by staying open after-hours and on Saturdays. All of the services of the Reading and Writing Centres are free, so as not to discriminate against students who cannot afford the services.

Two of these centres started presenting a series of 20 workshops, specifically aimed at the students of the Science Foundation Programme (SFP), in 2006 and 2007. These workshops (specifically the materials used in them and the impact they had on students' academic literacy) are the focus of the present study.

1.2 Definition of terms

Academic literacy: A "specialized form of reading, writing, and thinking done in the 'academy'" (Zamel, 1998:187).

Access course: A bridging course for students who do not yet have university access, but who wish to obtain it.

Collaborative language learning: In this type of learning, students have a common goal towards which an entire small group must work (Kohonen, 1992). It rests "on the assumption that people essentially construct their own knowledge, and cast what they learn into what makes sense within their own experience" (Salmon & Claire, 1984:238).

English as a foreign language (EFL): Describes English language learning in countries where English is not an official language.

English as an additional language (EAL): Describes English language learning in countries where English is an official language, but not the student's first language. For the purposes of this study, the term English as a second language (ESL), which is used in several quotations throughout this study, is classified under EAL.

English for specific purposes (ESP): "[T]his is a specialisation according to the use to be made of the language by the learner. As an example, [ESP] courses have been prepared for pilots, air-traffic controllers, doctors, scientists, secretaries and businessmen" (Seaton, 1982).

Foundation programme: An extended first-year programme for students who already have university access. Such a programme would include additional classes (either subject related, or support courses such as academic literacy classes) to give the student a thorough foundation in the course s/he intends to do.

Learner support: "[T]he collection of resources and procedures which enhance the learning environment of the distance learner" (Collett, 2002:17).

Open and distance learning (ODL): Learning which allows students to learn without having to attend regular classes. It aims at removing restrictions to learning, allowing more flexibility of time for students, and drastically changes the traditional relationship between lecturers and students (Escotet, 1980).

Throughput rate: "[M]easures the proportion of enrolments graduating in a given year" (Department of Education, 1996:12).

Tutorial letter: Information booklet sent to all students of a specific course, including information regarding assignments, due dates, and other departmental information. Often, several tutorial letters are sent for each course.

1.3 Problem statement and objectives of the study

Ample research has been conducted overseas (especially in the United States of America) on English for Specific Purposes (ESP) courses, but comparatively little research has been done in South Africa, especially in the natural sciences. Since there is a serious developmental backlog in educating and training people for science-related occupations in South Africa (Department of Arts, Culture, Science and Technology, 1996; National Advisory Council on Innovation, 2002; Phillips, 2004; Department of Science and Technology, 2007), an attempt has to be made to rectify this situation. Improving students' literacy abilities by means of ESP courses could be an important contributing factor in this process. According to Collett (2002:259), "on-going research is needed on appropriate methods of inducting students into academic cultures and how these methods can be integrated into the study of a particular discipline. It would be important to monitor the effects of such courses." The objective of this study is exactly that, to examine the effects of a subject-specific academic literacy course on the academic literacy levels of science students at an open and distance learning tertiary institution.

The aim of the study is to investigate how the academic literacy levels of science students may be improved by means of a reading, writing and reasoning intervention (tested by means of the Test of Academic Literacy Levels [TALL]). This study focuses on students who have been identified for the Science Foundation Programme. It uses the conceptual and theoretical frameworks of collaborative language learning and English for Specific Purposes (ESP).

The research questions are as follows:

1. Can an English for Specific Purposes (ESP) intervention improve the academic literacy levels of first-year open and distance learning students studying science-related courses?
2. What areas of academic literacy have been improved most after the ESP intervention?
3. How can the ESP intervention be adapted to further develop students' academic literacy abilities?

1.4 Methodology

This study is structured as follows:

1.4.1 Literature review

A literature review is conducted, examining concepts such as 'academic literacy', 'English for specific purposes' (ESP) and 'English for science and technology' (EST). The elements necessary in an EST course are also discussed.

1.4.2 Empirical study

a) A standardised academic literacy test (the Test for Academic Literacy Levels [TALL]) is administered as both a pre- and a post-test, to determine the target group's academic literacy level before and after the intervention.
b) Student records (available from the UNISA student information system) are used to gather descriptive statistics, for example, students' age and sex.
c) An intervention consisting of ten three-hour workshops is completed with a group of UNISA SFP students.
d) The workshops are critically assessed, based on their appropriateness when compared to the findings of the literature review as well as the TALL.
e) A feedback questionnaire, including both open and closed ended questions, is distributed to students at the end of the intervention programme to determine their opinions of the intervention.

This study uses a mixture of quantitative and qualitative research to ensure that feedback is as rich as possible. Since the researcher also facilitated the intervention, this study involves aspects of ethnographic research (in the sense of a lived through, richly experienced involvement [Butler, 2007]), as well as action research, as findings in this study will be used to improve the intervention in subsequent years.

1.5 Overview of the study

Chapter 1 has provided a brief overview of the context for this study. It has focused on the concept of ODL, with specific reference to UNISA as an ODL institution. It has subsequently justified why contact classes (specifically in academic literacy) are vital at an ODL institution like UNISA. The initiatives implemented by the UNISA Reading and Writing Centre were discussed. Some terms specifically relevant to this study were defined. This was followed by a description of the problem statement and the objectives. Finally, the methodology used in this study was summarised.

Chapter 2 provides a literature review for this study, and is divided into three sections. The first section starts by discussing the need for academic literacy at tertiary level. It examines the difficulty that South African speakers of English as an additional language have with regard to academic literacy, and discusses current initiatives at South African universities to address this issue. The second section focuses on the theory of collaborative learning. It examines the benefits of collaborative learning, firstly with regard to language acquisition, and secondly with regard to learning at a South African ODL institution. The third section gives a brief overview of the importance of ESP, firstly in general, and then specifically in the fields of science and technology.

In Chapter 3, students' needs are analysed in two ways. First, an analysis is done of the types of assignments that natural sciences students at UNISA need to complete in their first year. It focuses specifically on applicable subjects in the Science Foundation Programme. Certain categories of language and reasoning abilities required for assignments are identified, which are subsequently considered in the development of a relevant intervention. In addition, students' results on the TALL are analysed, and the areas in which students need to improve most are identified.

Chapter 4 describes the intervention programme that is used for the SFP academic literacy workshops. The syllabus is discussed, and the types of materials and exercises used are examined, keeping in mind the literature review in Chapter 2 and the needs analysis in Chapter 3.

Chapter 5 aims to determine which aspects of the intervention discussed in the current study were most, and which least, successful. This is done by examining students' TALL results, as well as questionnaires completed by students. Firstly, the results of the post-test are compared to those of the pre-test. The chapter examines the improvement in marks of various TALL sections between pre- and post-test, and discusses the connection between students' TALL results and the intervention. Secondly, this chapter looks at questionnaires that students completed at the end of the workshop programme. Here, students commented on what topics and abilities they believed to be of most value to them, remarked on strong and weak points in the workshop series, and made recommendations towards the improvement of the workshop series.

Chapter 6 critiques various aspects of the workshop series. This includes the principles of collaborative learning and the use of authentic materials, both of which permeate the workshop series. The extent to which the students' abilities in relation to grammar, vocabulary, visual literacy, speaking, listening, reading and writing were addressed in the intervention, and can be improved further in future, is also examined. Throughout, strong points of this workshop programme are highlighted, and extensive recommendations are made for the redevelopment of this intervention.

Chapter 7 concludes the study by summarising the main findings. This is done by revisiting the original research questions. Several implications of this research study are discussed, and limitations are identified. Finally, recommendations for future research are made.

CHAPTER 2 Literature review

2.1 Academic literacy

2.1.1 Academic literacy at tertiary level

Academic literacy can be defined as "a specialized form of reading, writing, and thinking done in the 'academy'" (Zamel,1998:187).

> [A] definition of academic literacy must necessarily include a belief in critical thinking; the value placed on reading and writing to do the work of the university, the emphasis placed on independence, self-reliance, and responsibility; and the close relationship between the work done and the ideas debated [...] and a person's ability to perform a job later on (Boiarsky, Hagemann & Burdan, 2003).

Taylor, Ballard, Beasley, Bock, Clanchy and Nightingale (1988:5) argue for a more discipline-specific view of academic literacy. They state that language must be firmly set "in the context if its users (…) and in the contexts of culture, meaning and knowledge". They further argue that "language learning should be allowed to develop as part of the learning of all other subjects. That means placing language much closer to the centre of learning than most universities nowadays even dream of contemplating" (Taylor *et al.*, 1988:5). They go so far as stating that "there can be no meaning to the term 'academic literacy' outside the quite particular culture and cultures of the university" (Taylor *et al.*, 1988:5). Academic discourse is, on the one hand, a new discourse that students need to appropriate to be accepted into this unfamiliar culture in which they wish to succeed, but it is also a new way of thinking about knowledge and the world that students should acquire.

Limiting academic literacy to reading, writing and thinking (specifically the type of cognition that is necessary for successful communication through the medium of language) might arguably be too narrow a definition, since an ever-increasing number of abilities are also being defined as 'literacies' that are necessary to succeed in the academy, for example computer literacy, numerical literacy and information literacy. Although the arguments to include these abilities as 'academic literacies' might be strong, in the context of this study the term 'academic literacy' will be confined to those aspects related to language and its usage. I agree with Street (2004:12) when he says that should a wider variety of skills be classified as 'academic literacy', "then we struggle to differentiate the reading and writing dimensions of a semiotic practice from say the oral or the symbolic dimensions". He argues that "[k]eeping the labels conceptually separate enables us to describe the nature of the overlaps and the particular hybridity" which are found in various situations, for example the mathematics classroom. Snow and Brinton (1988:555) also point out that "a focus on critical writing and thinking skills appears to be a top (if not the top) priority in the university language curriculum". Thus, for the purposes of the current study, the term 'academic literacy' will refer almost exclusively to the reading, writing and thinking abilities (with some reference to speaking and listening abilities) necessary to succeed in a tertiary environment.

Students entering tertiary institutions without the necessary academic literacy abilities to succeed in their studies is a problem not only in South Africa, but also internationally. According to Raphan and Moser (1993/1994), many students in the United States of America do not have the necessary reading, writing, speaking and listening abilities to succeed in a tertiary environment. Nevertheless, they state that American universities are still accepting these students, even though this lack of academic literacy abilities might well doom such students to failure. Once these under-prepared students are accepted into tertiary institutions, lecturers are often horrified to find that their students never learned at secondary school how to write expository texts – the genre that is used most often in an academic environment (Martin, Peters, Clyne, Borel de Bitche, Eagleson, Maclean, Nelson & Smith, 1985). Thus, lecturers seem to expect that students at secondary school level are exposed to and have mastered the kind of writing that they would have to engage in at tertiary level. However, this is unfortunately not the case, as most of the writing practised at secondary school often consists of genres such as creative writing – genres that are seldom used at tertiary level.

Snow and Brinton (1988:553) also highlight the escalating problem that American colleges and universities face due to underprepared students entering tertiary institutions. According to these authors, students are entering higher education without vital skills such as being able to synthesise oral and written material, and without being able to express themselves clearly in writing. Ostler (1980) mentions other weaknesses that students have at university level such as inefficient note-taking skills and poor performance when writing certain types of examinations. The above difficulties are often experienced by both first-language and second-language speakers. Second-language speakers usually have to struggle with additional difficulties. For example, second-language speakers of English generally struggle with being concise in their writing, often over-specify their theses, and have limited abilities when it comes to using "linguistic devices to engage their readers' attention and help their readers identify the participants, objects, and events about which they write" (Scarcella, 1984:671).

Johns (1991) mentions several reasons for the difficulties EAL students experience, such as students choosing fields of study that require little writing and having had little writing practice in EAL classes focused on grammar acquisition. Furthermore, poor language proficiency in additional languages used as languages of instruction can influence academic success. South African lecturers experience the same phenomenon, but as is the case with their international counterparts, usually do not have the time, energy or language background to try to rectify (or alleviate) this problem. In addition, lecturers may see academic literacy as a 'gift' – a talent that a student has, or will never have, and which therefore cannot significantly be changed positively by means of an intervention by educators. Others believe that the language and writing abilities needed by students are developed sufficiently at school, and hold the consequent belief that if this was not done, it is due to "a failure of the schooling system, and is not a legitimate concern of the academe" (Moore, 1998:84). It is therefore seen as a passing crisis that, at worst, requires some sort of temporary remediation. Furthermore, lecturers are usually not equipped to deal with inadequate language abilities, since the characteristics of academic discourse are seen as being self-evident (Misselhorn, 1997). Thus, lecturers often do not understand why students have difficulties with academic discourse, and consequently do not know how to help them. Although it might be true that each person has a certain potential, and that not all people will be able to achieve the same level of academic success, Rosenthal (1996) points out that proficiency in a language is not always measured by intelligence, academic ability or motivation. Rather, it is something that can be practised and improved over time. Eskey (1983) also points out that although some students will naturally acquire the abilities they need to succeed at tertiary level, lecturers cannot assume that this will always be the case. The majority of learners still need guidance, and even explicit instruction, in acquiring the academic literacy abilities necessary to succeed in their studies.

Academic literacy is certainly not confined to adequate oral communication. In fact, there is often a misconception that if students understand a language and can communicate orally in that language, it is enough for them to succeed in their studies. Therefore, the perception might exist that oral proficiency translates naturally into the ability to read and write at an advanced level. Sometimes faculties do require their students to attend a short English or academic literacy course, and feel that this should be enough to enable students to succeed in their studies. However, as Eskey (1983:319) points out, "acquiring a minimum communicative competence is not the be-all and end-all of [additional] language learning. That's only the beginning of many of our problems". Another common misconception is that only students who speak English as an additional language (mainly black students, in the South African context) struggle with the academic literacy demands of higher education. Again, this is not true – as Snow and Brinton (1988) point out, both language minority and language majority students enter American universities without the necessary academic literacy abilities to succeed in their studies. Although it is dangerous to make the assumption that what is valid for one context might be true for another (in this case, the United States of America and South Africa), personal experience indicates that the same problem (of first and additional language speakers being unprepared for the academic literacy demands of tertiary education) exists in South African universities (see also, for instance, van Rensburg & Weideman [2002] and Weideman [2003b]).

Snow and Brinton (1988:554) point out the low retention rates of specifically language minority students[4] at university level. Retention rates refer to "whether a student continues in study until completion, and includes those who have successfully completed a tertiary qualification" (Ministry of Education, undated). One way that retention rates might be increased is by improving students' academic literacy levels. Due to the vast numbers of underprepared minority and majority language speakers entering universities, the existence of academic literacy courses has become a necessity, not only in South Africa, but also internationally. The existence of many such courses at universities clearly indicates that universities see them as having the potential to contribute to a solution that could address low retention and throughput rates. Pretorius and Bohlmann (2003) also argue that students' reading abilities, for example, benefit from explicit instruction. Thus, if students are explicitly taught abilities such as reading in an academic literacy course, and such explicit teaching improves students' academic literacy, the hope is that such abilities would transfer to other subjects, which would ultimately improve students' performance in other subjects as well.

[4]For the purposes of the current study, all EAL speakers are seen to fall under this category, even though they might be part of a language majority group. Although English is a minority language in South Africa, it is the principal language of education, since it is regarded by many as South Africa's *lingua franca*.

This is unfortunately not always the case with generic academic literacy courses (due to reasons such as lack of student motivation and unclear relevance to other courses, as is argued in Section 2.4.1), and consequently this study argues for English for Specific Purposes (ESP) courses, which are discussed in Section 2.4.

The question that now arises is what exactly should be taught in academic literacy courses. Eskey (1983:322) states that "[e]ven in this age of facilitating learning, humanistic interacting, and coexisting with error, giving students what they need is still what good teaching is all about." He further describes the debate regarding formalist and activist positions in language learning; formalist focusing on the forms of language – essentially the grammar, and activist focusing on the activity of language – how learners meaningfully use a language. Eskey (1983:319) points out that "[w]e used to believe that if students learned the forms, communication would somehow take care of itself. Now we seem to believe that if students somehow learn to communicate, mastery of the forms will take care of itself". I suggest that for true fluency as well as accuracy, formalist and activist positions of language must be combined – learners must be both fluent and accurate to finally succeed in the very demanding tertiary academic environment. Taylor (1990), for example, suggests a variety of abilities that readers of texts in almost any subject field need to acquire to be successful: they need to identify the discourse topic; distinguish between important and unimportant ideas; follow a sequence of directions or logical ideas; draw inferences and conclusions; and finally, extract the gist of a passage. Horowitz (1986) cites some of the most frequent writing tasks at university level, including synthesising multiple sources, connecting theory and data, summarising or reacting to a text, and reporting on a participatory experience. Neither mere fluency nor mere accuracy could, independently, be enough to help students succeed at these tasks. How, for example, can a student follow a sequence of logical ideas if that student does not understand the specialized vocabulary often used to indicate such sequences, and the correct way of using such vocabulary? Furthermore, how can a student synthesise multiple sources without fluency of language in addition to a control of the grammatical structures used to combine and show relations between information? This implies that academic literacy courses must strive to improve both fluency and accuracy. By emphasising both of these, many more students are likely to receive from the course 'what they need' (cf. Eskey, 1983), and the course is also much more likely to be varied enough not to become repetitive, and to stay interesting.

Thus far, I have indicated that a large number of students enter higher education without sufficiently developed academic literacy abilities to succeed in this environment. I have not, however, made explicit the influence that the abilities focused on in typical academic literacy courses might have on improving students' throughput in other subjects – especially subjects that are not usually seen to be connected with language, such as science, mathematics, and business related subjects.

Reading seems to be the ability that has the greatest direct influence on students' success in other subjects. However, Phillips (2004) states that many science or mathematics teachers feel that reading is not really valuable in their subjects. "They treat with disbelief the notion that without the necessary reading skills, the students cannot cope with the demands of their subjects" (Phillips, 2004:6). In a study by Pretorius and Bohlmann (2003:234), the authors argue that:

> [m]athematical discourse is characterised by a high level of abstraction and conceptual density (...), as well as by precision, conciseness and lack of ambiguity. Mathematics texts are also hierarchical and cumulative. (...) A mathematics reader needs to interact with the text, be alert and attentive, integrate information across the text, be sensitive to comprehension failure as soon as it happens, and know what to do when it occurs.

Phillips (2004) also cites studies which indicate that there is a positive correlation between a knowledge of low frequency words and academic success. These studies (and others, such as those described in Pretorius and Bohlmann [2003]) show that students who do not read a lot have lower vocabulary levels since they hardly ever come in contact with low frequency words. This consequently makes them weaker students than their counterparts who read more frequently (Phillips, 2004). According to Ulijn and Salager-Meyer (1998), many researchers argue that the development of reading ability cannot be accomplished without vocabulary strategy training, since vocabulary knowledge is an essential component of reading comprehension.

Pretorius and Bohlmann (2003) show the broader implications of poor reading. According to them, "[p]oor reading leads to a cycle of failed outcomes, poor marks, low self-esteem and high drop-out and failure rates" (Pretorius & Bohlmann, 2003:235). They emphasise the importance of drawing students who come from backgrounds with minimal literacy practices into the world of reading, and teaching them how to construct meaning from textual clues. The difficulty is that most weak readers believe that they are, in fact, average readers

(Pretorius & Bohlmann, 2003). In exposing weak readers to the world of reading, one would have to be careful not to demotivate students even further. A course in which students are taught to read would have to be enjoyable and relevant to their needs of accessing information – the focus would have to be less on 'learning to read', and more on information gathering and processing. It seems as though this would be easiest to achieve if the reading material used in the course were relevant to students' fields of study.

Clearly, adequate reading abilities are vital for success in any subject. Reading, however, is only one part of academic literacy. Students are, ultimately, expected to display their knowledge by means of writing. The causal relationship between reading and writing is a very strong one. Pretorius and Bohlmann (2003:229) argue that "[p]roblems experienced at the receptive level ([e.g.] the reading of mathematics) will affect the productive level ([e.g.] writing, discussing)". Thus, if a student is weak at the receptive level, the productive level will most probably suffer. White (1988) cites an example of students who had to write down only the relevant aspects of a certain scientific specimen. This implies that students first had to identify what was relevant (by means of reading), and subsequently had to produce this understanding by writing a summary. These students were not sure how to organise their writing effectively, which was consequently reflected in the stylistic coherence of their writing (White, 1988). One reason for their difficulty in writing the summary was probably because they did not understand the original information. Had they understood this information, they could have used the organisational structure of the text as a template for their own summaries. Most subjects require students to take from a plethora of information only the relevant, and to produce this in a structured manner in either an assignment or examination. However, if students already struggle at the receptive level, the productive level is very likely to be typical of the incoherent written texts that many lecturers are faced with daily. In addition, there is strong evidence that reading for pleasure "increases general knowledge and conceptual development, improves syntactic knowledge and deepens readers' awareness of text structure and the conventions of written language" (Pretorius & Bohlman, 2003:228).

Of course, if writing is seen as merely instrumental, and students' writing difficulties are simply defined "in terms of errors of grammar and syntax, which can be solved by closer attention to the relevant rules" (Moore, 1998:84), few lecturers outside of English departments are likely to see writing as a vital part of academic literacy. However, if writing is seen as a process “which consolidates – and even advances – thought and learning in unique ways” (Moore, 1998:85), then this ability becomes much more important in an academic literacy context. Odell (1992:86) also stresses that “writing is not only a means of articulating existing ideas (...) but also a process of formulating those ideas, constructing meaning, [and] discovering what one wishes to say” which is done “by critically interpreting, modifying, synthesising and communicating the information available in appropriate ways” (Kuanda, Allie, Buffler & Inglis, 1998:180). It becomes an instrument to guide and focus thought and learning, even “a vehicle for advanced learning” in addition to being “the means by which students are assessed, and the principal medium by which the discipline is constituted” (Moore, 1998:100). It is therefore important that lecturers understand the importance of writing, and use it optimally as a teaching tool.

2.1.2 Academic literacy for speakers of English as an additional language at tertiary level in South Africa

Rosenthal (1996:11) describes the United States of America’s challenges regarding immigrants and refugees who need to learn English for university purposes. South Africa has a similar problem, but here, immigrants and refugees represent a very small fraction of students who are not sufficiently proficient in English to succeed in their studies. In South Africa, it is the overarching majority of native South Africans who speak English as a second, third, or fourth language who have to study in this *lingua franca*. In many cases, students’ poor level of proficiency in this additional language of instruction influences their academic success.

The situation in South Africa is often more problematic than in countries like the United States of America, where the international students (who need EAP courses the most) can be described as the “crème de la crème of their countries” (Holden, 1993:1770). These students are often well supported financially (be it by means of bursaries or own finances), tend to be very hard working, and have a strong academic foundation (Rosenthal, 1996:17). In South Africa, the typical student in need of academic literacy support has a different profile. The student is likely to come from a poor economic background, and is even more likely to come from a poor literacy background (especially in terms of a reading culture). A South African student might come from a language majority group, but still have to study in a minority language in his/her own country. Having to acquire academic discourse at Anglophone institutions can make non-native speakers feel very marginalised (Belcher & Braine, 1995), regardless of how representative they might be of the entire student population[5]. South African students, more often than not, have the additional barrier of inadequate finances, often with entire families contributing so that a student can study at university. In addition to the above difficulties, ODL students are not always the top students in the country – at best, they might have been the 'crème de la crème' of a small rural village, and come to university with unrealistic expectations of their abilities when compared to the expectations of universities. Often, these students have a very weak academic foundation, and lack the basic knowledge and abilities lecturers would expect of university students. Collett (2002:17) confirms that students coming from "relatively deprived secondary school [environments are] more likely to be poorly prepared for higher education studies, and to lack adequate learning and self management skills".

The reasons for students having a weak academic foundation by the time they get to university are numerous. The greatest reason might be that most students are educated in English from an early age, even though the majority of these students use English as an additional language. This is despite the supposed 'right' that students have to be educated in any official South African language – a 'right' which is rarely realised due to the lack of schools teaching through the medium of black African languages. Even if students do have access to schools where teaching occurs in their mother tongues, non-English parents often want their children to be educated in English (De Klerk, 1999). According to Delpit (1995), parents often believe that their children need to be educated in the majority language or dialect of a country, since this would help their children to succeed in such a society. In the case of South Africa, parents often want their children to be educated in English, since this is the language of power in the current South African society. Unfortunately, rather than guaranteeing their children's success, parents might disempower their children by insisting on them being educated in an additional language. Research has shown that it is much more difficult to acquire an additional language at a sophisticated level (i.e. the level necessary for tertiary education) if one is not completely proficient in one's first language (Cummins, 1979; Cummins & Swain, 1986; Bennett, 1999). Thus, if a child is not educated in his/her mother

[5] It should be noted that this study does not suggest that the multilingual nature of many students in South Africa is a hindrance to academic success. Although it is true that students can feel marginalised at Anglophone universities, being multilingual could also be considered to be a great strength, as it empowers students to function within different contexts.

tongue, it becomes much more difficult for that child later on to become a fluent and proficient additional language user. In addition, the South African secondary school system has been widely accused of not developing the language and reasoning abilities that students need to succeed beyond secondary level. Moyo, Donn and Hounsell (1997) believe that the increase of academic development programmes (such as tutorial support, access courses and foundation courses) are indicative of how educationally disadvantaged students are due to derisory secondary schooling.

Universities cannot afford to use inadequate secondary schooling as an excuse for a reduced number of graduates. On the contrary, it is vital that the number of young South African graduates be increased (as is the case world-wide), since the demand for graduates is greater than ever before in today's knowledge-based society, where socio-cultural and economic development are vital (Unesco, 1998). "[K]nowledge and the processing of information will be the key driving forces for wealth creation and thus social and economic development" (Ministry of Education, 2001). Currently, there are widespread shortages in South Africa "in the science and economic-based fields, and especially in information technology, engineering, technological and technical occupations" (Ministry of Education, 2001). Also, graduation rates across all fields remain at an unacceptably low level (Pityana, 2002:4).

Since there are too few graduates (especially from previously disadvantaged backgrounds) in these fields, the Government is willing to invest considerable amounts of money into programmes aimed at increasing throughput rates in such fields. These programmes would, however, have to be aimed at raising the actual performance of graduates, and not just serve as a front whilst standards are being dropped. The Department of Education has made it clear that universities may not drop their standards. Support programmes have to be put in place to address inequalities in another way (Ministry of Education, 2001).

There is furthermore a clear shift in employment patterns in South Africa, which will have to be addressed by universities, "as this is the sector responsible for producing professionals with high level qualifications. The implications for student learning are clear. Those occupations which require higher order intellectual and personal skills are going to be increasingly in demand" (Collett, 2002:19). If South African higher education can cater for developing such higher order intellectual and personal skills, it will be able to better contribute to meeting the country's human resource needs (Collett, 2002). Obviously, the economy of the country will benefit if universities can produce graduates with the necessary skills and knowledge to contribute to this knowledge-based society. In addition to the economic gain caused by a higher throughput rate, universities would also gain financially, since 20% of all students drop out of the higher education system annually, representing a loss of R1.3 billion in government subsidy (Ministry of Education, 2001).

The higher order skills which students need to control in a knowledge-based society cannot be attained without a high level of academic literacy, and academic literacy cannot be attained without adequate language proficiency. In fact, Collett (2002) argues that language is the most basic tool for building academic literacy, and that lacking "basic formal language knowledge and competencies necessarily precludes students from engaging meaningfully in academic discourse" (Collett, 2002:103).

Although it is vital that South African students attain an acceptable level of academic literacy, it must be remembered that not even the most comprehensive EAP programme can ensure that students will be fully prepared for the academic classroom (Rosenthal, 1996). According to Rosenthal (1996), several studies show that the academic language proficiency needed to be successful in the classroom (see the discussion of Cognitive Academic Language Proficiency [CALP] in Section 2.3) can take anything from five to seven years to develop. Therefore, although academic literacy courses are clearly necessary in the current South African situation for a majority of students with inadequate language abilities, these courses cannot be expected to rectify all problems that students experience. Rather, these courses should support students in acquiring the strategies to further develop their own academic literacy as they continue with their studies. The courses can also serve as a safe environment to empower students who need to study in an additional language at tertiary level (one factor which, according to Hutchings [1998], makes their adaptation to the tertiary environment very difficult). The most that an academic literacy course can aim to achieve is to make students aware of their own reading, writing and thinking habits, and thereby change literacy practices.

2.1.3 The difficulty of teaching academic literacy at an ODL institution

Generally, the word that stands out most in the term 'open and distance learning' is 'distance'. This distance, and its accompanying isolation, have often been thought to be definitive of studying at an institution like UNISA. Yet, "from a social constructivist point of view, learning is mediated by interaction between learners and between learner and teacher" (Collett, 2002:31). Holmberg (1986) also stresses how important a personal approach to communication is in distance education. Specifically language proficiency is very difficult to acquire in isolation, since language is such a socially mediated process. Although UNISA, as an ODL institution, does offer language courses, contact with tutors and other learners is scarce, and it could be argued that this would seriously impede the acquisition of language, since there is no (or very little) immediate feedback from which the learner can learn.

It would then seem as though personal contact between teacher (or in the case of UNISA, tutor) and learner, and between learner and learner is the ideal way of acquiring language, and ultimately academic literacy. The UNISA Academic Literacies Centres are an excellent platform for students who wish to improve their academic literacy, since several workshops are held each week where academic literacy can be acquired in a social context, with immediate feedback from a tutor. One stumbling block is that, although this is a free service, it is also a voluntary service. In a study by Collett (2002), the majority of the participants believed that their academic reading and writing abilities were adequate for them to succeed at tertiary level (whilst in fact, the results indicated that EFL students were generally better equipped to succeed at higher education than EAL learners) (also see Coetzee-Van Rooy and Verhoef [2000] for a discussion on students' perceptions of their English proficiency, specifically the discrepancy between students' perceived and actual reading abilities). As long as students believe their language abilities to be of an acceptable standard, they will probably not seek help offered to them. Collett's (2002) study also indicates that students do not engage deeply with the learning process, which according to him weakens their claims that their academic literacy is at an acceptable level. The superficial view that students often have of language and its necessity to succeed in higher education might be their greatest barrier in improving in this field, especially because distance learners have so little contact with lecturers, tutors and fellow students, and are therefore rarely able to measure themselves against their peers, or receive feedback from teachers.

Other obstacles for teaching academic literacy in a distance education setting include what Keegan (1986:44) calls the "quasi-permanent absence of the learning group", meaning that the group of students one works with never remains constant. This makes it difficult to work on larger themes within a series of academic literacy workshops, such as those presented by UNISA's Reading and Writing Centres, and thus becomes a challenge when certain abilities need to build upon each other.

Another difficulty is that many students entering distance education come from a deprived economic background, which almost always goes hand in hand with deprived secondary educational experiences. These students often do not have the finances and/or the necessary entrance marks to be accepted at residential institutions, and thus by necessity choose distance education. While many students at residential universities already have difficulties with learning and self management skills, this becomes even more difficult for the distance learner due to "the increased onus on students to manage their own studies in this mode of study" (Collett, 2002:17).

Collett's study shows that although UNISA appears to be an 'open' educational institution at surface level, there seems to be very little true engagement between student, lecturer and institution at a deeper level – a necessity for true 'open' education. To transcend this superficial engagement, contact between student, teacher and institution has to be established in some way – preferably by means of contact classes. Although such classes in a distance education environment bring along their own set of obstacles, they still seem necessary for meaningful engagement with a subject, and specifically with academic literacy.

2.2 Collaborative learning

2.2.1 Defining collaborative learning

The formal lecture has almost always been the hallmark of the type of teaching provided by universities. In fact, an over-reliance on this method of teaching has been one of the most constant criticisms against the quality of teaching at tertiary institutions (Stewart & McCormack, 1997). It is possibly as a response to such criticisms that universities have used group discussion for a long time in the form of tutorial classes that form part of courses (Misselhorn, 1997). These classes are usually meant to supplement and improve students' learning in a subject, and are generally voluntary. The purpose of such classes is normally to give students a platform to discuss matters freely with each other and with a tutor, and to take ownership of their own learning. Unfortunately, tutorial classes often revert to a lecturing mode, which may inhibit students from true participation (Misselhorn, 1997), and may thus fail their original purpose, namely to give students the opportunity to collaborate in their own learning.

Kohonen (1992) distinguishes between individual, competitive, and collaborative work. In individual work, learners must achieve a pre-set criterion of learning, and can work at their own pace and space. In competitive work, students still work individually, but in relation to others to see who is best. In collaborative work, learners have a common goal towards which an entire small group must work (Kohonen, 1992). Thier and Daviss (2002:75) state that "successful group work is at least as important as individual performance" in the current society and economy.

Salmon and Claire (1984:238) define collaborative learning modes more specifically when stating that these "rest on the assumption that people essentially construct their own knowledge, and cast what they learn into what makes sense within their own experience". This implies that the learner must participate in the learning, not as a passive onlooker, but actively contributing to, questioning, challenging and ultimately, constructing knowledge. The best way of doing this is in collaboration with fellow students, as knowledge is always constructed socially. Biggs (1989) agrees that deep learning is most likely to take place when there is a lot of learner activity and interaction with other students. This is not only the case with learning in a general sense, but also with specific skills. For example, research has shown that writing is not a solitary endeavour in the real world (Murray, 1992). Rather, it is a social act, where writers ask advice and speak to others about their writing, where managers and colleagues comment on, add to and change each other's reports, letters, etc. all the time.

Collaborative learning should ideally be a form of experiential learning.

> [In experiential learning], [i]mmediate personal experience is the focal point for learning, giving life, texture, and subjective personal meaning to abstract concepts and at the same time providing a concrete, publicly shared reference point for testing the implications and validity of ideas created during the learning process (Kolb, 1984:21).

Littlejohn and Windeatt (1989) also suggest that experiential learning (learning through doing) might exert a more powerful influence than referential learning (learning from content). If a student is to collaborate in the construction of his/her own knowledge, surely this would best be done if the student feels as though the knowledge is closely related to him/her or to his/her world, that it personally impacts on the student. An ideal way of doing this seems to be exploring the knowledge in the social environment of a small group, where one can actively engage with the knowledge as one would in the 'real world', thus in collaboration with others. Kohonen (1992) also points out that such experience would ultimately have to be reflected upon, and once again, this is a much easier task if one has the immediate feedback of other students who are also in the process of reflecting and internalising the same knowledge. It must be kept in mind though that not all students function well in groups, and although collaborative learning has great potential in helping students engage more actively with subject matter, all students' learning style preferences must be kept in mind when developing material for any subject. As Felder and Silverman (1988:675) note, "[t]he addition of a relatively small number of teaching techniques to an instructor's repertoire should (...) suffice to accommodate the learning styles of every student in the class").

Academic literacy is generally seen as comprising a complex mixture of reading, listening, writing and speaking. It is unlikely that any of these abilities could ever be taught or learnt in isolation from the others – rather, these abilities can all be integrated effectively by means of collaborative learning. For example, students collaborating on a written text need to employ several abilities at once. The process usually starts through oral discussion (Murray, 1992). At this stage, meaning is negotiated. Students utilise both their listening and speaking abilities by determining the point of view of fellow students, stating their own viewpoints, and at the same time reflecting on all viewpoints to decide whether these are valid (Doheny-Farina, 1986). Pre-writing and organising abilities can then be developed with a group deciding on how to best organise information. Although the final written product is often individual work (Murray, 1992), even this can be done successfully in small groups. More general language issues such as providing sound arguments and structuring of the text, as well as surface editing (Murray, 1992) can then be improved by having students with different strengths work on a text. Such 'editing' can occur either orally or in written form. If the text is to be presented to a larger group, more formal oral and listening abilities can also be developed. Certainly, this is a much richer experience than one student writing a text, or a lecturer providing a few hasty comments. Reading and comprehension skills can also be improved significantly if students analyse a text in a group context. Each student will use his/her own background knowledge and individually acquired skills when reading a text, but when this is done in collaboration with others, students can practically acquire a range of new abilities when it comes to reading a text. From personal experience, students in groups have been observed managing what few would think possible, and what would have been very difficult to achieve alone, thanks to the process of negotiating meaning and exploring a topic with others.

Clearly, students can learn a lot from each other. Does this mean that students should be left to their own devices in such a context? It certainly seems as though a group can construct more knowledge in a collaborative setting than would be possible in student-teacher interaction alone. I do however believe that a teacher should be present to guide students and facilitate the process, if necessary. Misselhorn (1997) has shown that students prefer the presence of an authority figure, be it tutor or lecturer (also see McAllister [1995] and Stewart and McCormack [1997]). This not only helps in regulating the interactional aspects of groups, but also lends authority and legitimacy to the learning process (Misselhorn, 1997). Murray (1992) also stresses the importance of such a presence, and emphasises that it can help students develop different skills. He suggests, for example, that the teacher should "guide students to select leaders and scribes, discuss group interaction techniques, provide sufficient time over an extended period, and have students produce written drafts throughout the process" (Murray, 1992:115). If an authority figure is present to guide the learning process in this manner, students are less likely to get stuck in a comfort zone of always performing the same task, and students stay stimulated as a result of the expectations of the teacher.

Rosenthal (1996:74) states that "many minority students prefer global rather than sequential learning, do better in a supportive rather than a competitive classroom environment, and learn more when working collaboratively/cooperatively rather than competitively". The next section examines the importance of learning styles.

2.2.2 Learning styles

All learners are different, and consequently learners learn in different ways (Willing, 1988). Learning styles can be defined as "they ways in which an individual characteristically acquires, retains, and retrieves information" (Felder & Henriques, 1995:21). Learning styles are generally seen as habits (thus formed by means of social conditioning), biological attributes playing a more minor role (Claxton & Murrell, 1987; Keefe, 1987; More, 1989; Scarcella, 1990; Bennett, 1999). Factors such as schooling and culture seem to have a far more significant influence on learning styles (Rosenthal, 1996).

Since socialisation plays a major role in the formation of learning styles, it follows logically that certain cultural groups prefer certain kinds of learning (Rosenthal, 1996). In a Western culture which often emphasises competitiveness, for example, it is likely that a person would prefer a more individualistic style of learning that is conducive to competition. Rosenthal (1996:85) states that many women and minorities prefer a more collaborative mode of classroom instruction and "a more supportive classroom atmosphere." Misselhorn (1997) argues that black South African students generally prefer to learn by means of group discussion. This is critical for the current study. When developing learning material, it is important to consider Nunan's (1992) suggestion that differences in learning styles must be reflected at a methodological level. Thus, when developing learning material for black South African students, one would have to include a significant number of collaborative tasks, where students can learn by means of their preferred learning style.

In addition to certain cultural groups preferring certain kinds of learning, it would seem that certain subjects are best acquired through specific learning styles. Nunan (1992) argues that language is best acquired through tasks where students have to negotiate meaning, and where there is interaction. Rosenthal (1996) also states that limited English proficiency students learn better by means of collaborative learning. The reason for this might be because such students already feel as though they are at a disadvantage. They might become very anxious in a competitive environment (Rosenthal, 1996), which is not conducive to language learning. Learning in a group where a shared outcome is strived for and where learning occurs through socialisation might reduce much of this anxiety, and thus promote language acquisition.

From the arguments above, it seems as though a collaborative learning style might be specifically beneficial to black South African students in an academic literacy course. Not only do many of these students seem inclined to a collaborative learning style (due to the cultures they have been socialised into), but as limited language proficiency students, the research also suggests that a collaborative environment might be more advantageous to them. There is a further factor that might make collaborative learning a desirable method of teaching and learning. Kohonen (1992:22) states that “there is consistent evidence to suggest that learning attitude and motivation are important predictors of achievement”. Rosenthal (1996) argues that students’ affective filters (i.e. their emotions, motivation and anxiety) are influenced by classroom conditions; for example, continuously correcting additional language errors will raise the affective filter of EAL students, while a classroom environment that encourages self-confidence and reduces anxiety will lower students’ affective filters. Both language acquisition and content learning will increase if students’ affective filters are lowered (Schinke-Llano & Vicars, 1993; Florez & Burt, 2001; Lightbown, 2001; Garcia, 2003). Hutchinson and Waters (1987:129) further state that since learning is an emotional experience, it is necessary to develop positive emotions rather than negative ones, by “making ‘interest’, ‘fun’, [and] ‘variety’ primary considerations in materials and methodology”. Learning in a collaborative environment – if facilitated correctly – can be enjoyable. Students can laugh, socialise, and would rarely become bored, since collaborative and experiential learning allow for a wide variety of language tasks. Enjoying a class would certainly raise the motivation of learners to learn, and few (if any) students would have a negative attitude towards a subject which has enjoyable classes.

On the other hand, forcing students to make use of a learning style that is contrary to their preference could have detrimental consequences. Rosenthal (1996:89) suggests that “[i]ncompatibility of learning style (...) may influence students in their choice of a major”. This could be disastrous in science-related fields, specifically in South Africa where there is a desperate need for black students to become qualified in such fields. These students generally come from a culture of *ubuntu*[6], and might ultimately choose against science, not because they do not have the potential to succeed, but because the learning (and teaching) styles

[6] Ubuntu can be defined as follows:

> [A] metaphor that describes group solidarity where such group solidarity is central to the survival of communities (…), where the fundamental belief is that *motho ke motho ba batho ba bangwe* (…) which, literally translated, means a person can only be a person through others. In other words the individual’s whole existence is relative to that of the group (Mokgoro, 1998:16).

traditionally associated with science related fields can provide yet another obstacle to students who already need to overcome much in a Western-centric learning environment. If one of these obstacles, namely becoming academically proficient in English, is then also taught in a style incompatible with their preferred learning style, this secondary obstacle may further discourage students from science related fields of study.

In spite of the arguments in favour of collaborative learning, Rosenthal (1996) points out that not all individuals in a culture will have the same learning style. Witkin, Moore, Goodenough and Cox (1977) mention that although learning styles are usually stable over time, they are alterable. It is important not to exchange one learning style for another completely, but rather to expose students to a variety of styles, so that firstly, no students' preferences are ignored, and secondly, so that students can get used to a variety of learning styles. Students should have at least some exposure to a variety of instruction methods to acquire a full range of learning strategies, as they will at some point "be called upon to deal with problems and challenges that require the use of their less referred modes" (Felder & Henriques, 1995:28). For students to be successful in diverse working environments, they will have to be able to adapt their learning styles, and acquire a variety of learning styles, to succeed in the long run.

2.2.3 The benefits of collaborative learning with regard to language acquisition

Collaborative learning has several advantages, for educational institutions and students alike.

Letting students work collaboratively means that less interaction is necessary with a teacher. To ensure quality education in traditional classes, the teacher would have to individually interact with each student at some point during the class for the student to receive feedback on work done during the class. In large classes, this becomes impossible. With collaborative learning, the teacher only acts as a guide and facilitator, whilst students receive feedback from peers. The teacher is still there to give students guidelines on the type of feedback that should be given and to answer questions, but the onus is on the students themselves to become critical of their own and others' work. Thus, in this context, it becomes possible to provide quality education in larger classes. Misselhorn (1997:217) confirms that small-group work is increasingly viewed as an effective strategy for dealing with "the problem of increasing student numbers, in the face of the escalating costs of tertiary education, and the resultant need to use the services of teaching staff ever more effectively".

Using collaborative learning merely to decrease the costs of education would be unethical if there were not advantages for the learners as well. However, numerous advantages for students are reported by several researchers. One such advantage is that "[s]tudents routinely attain higher levels of subject matter learning when they work in groups" (Magney, 1996:2). In a study by Stevens, Madden, Slavin and Farnish (1987), the researchers found that students learning through a collaborative style performed considerably better in reading comprehension, decoding, language mechanics, vocabulary, writing, spelling and language expression than their counterparts receiving traditional instruction. Bejarano (1987) also found that small-group methods were much more effective in foreign language teaching than the whole-class method. Although most students at UNISA are not foreign language learners, often the division between additional language learning and foreign language learning is vague at best. Many South African students grow up in rural areas where they have little contact with English outside of the classroom (and even there, the quality of English used is often poor), and hardly ever speak it, and thus for all practical purposes could be considered foreign language learners. It could thus be inferred that Bejarano's (1987) findings would also apply to teaching some South African additional language learners of English.

Other advantages include increased intrinsic motivation and enjoyment (Kohonen, 1992; Magney, 1996), increased self-confidence (Kohonen, 1992; Misselhorn, 1997), developing a critical perspective by discovering another writer's point of view (Murray, 1992), improved negotiation of meaning (McGrath, 2002), building on existing social relationships and improved socialisation (Hutchinson & Waters, 1987; Magney, 1996; Misselhorn, 1997), improved teamwork (Magney, 1996; McGrath, 2002), taking on various roles such as that of leader or scribe (Murray, 1992), improved learning by observation (McGrath, 2002), an increased focus on process instead of product (Hutchinson & Waters, 1987), improved exploratory (spontaneous and informal) and presentational (structured, formal) speech (Thier & Daviss, 2002), and contextualised learning (Misselhorn, 1997).

The benefits of collaborative learning are not necessarily automatic. Kohonen (1992) cites the following factors as necessary for successful collaborative learning: positive interdependence; individual accountability; abundant face-to-face interaction; sufficient social skills; and team reflection. Morrow (1981:62) adds that in real life, participants almost always have different knowledge, and that the purpose of communication is to "bridge this information gap". This should be kept in mind when developing truly communicative and collaborative exercises for the language classroom. It is thus necessary to be careful when going about designing collaborative learning activities, and vital to guide students in this often unfamiliar type of learning, rather than believing that the benefits of this learning style would materialise automatically (also see Felder and Henriques, 1995).

Though it is often easy to forget that students attend tertiary institutions to prepare them for the world of work, it is necessary for lecturers and tutors to remind themselves that their purpose is in fact to prepare students for this 'life after studies'. This is equally, if not more, true for language teachers. As Murray (1992:100) argues, "[i]f we want to ensure that our ESL [English Second Language] writing classes prepare students for their life outside the classroom, we must give them opportunities to experience collaborative writing". Such opportunities may enable students to fully function as writers and language users outside of the English classroom, and also outside of the tertiary environment.

Traditionally, methodology in the science classroom has been aimed at independent and competitive learners. Felder and Silverman (1988:674) point out that if students are forced to use learning styles that are contrary to their own, they are likely to "become bored and inattentive in class, do poorly on tests, get discouraged about the courses, the curriculum, and themselves, and in some cases change to other curricula or drop out of school" (also see Felder and Henriques [1995]). To attract and retain students with other learning styles, one would have to "include a more student-centred pedagogy, cooperative / collaborative small group projects, a warmer, more supportive classroom atmosphere, and improved relations and communication between science faculty and students" (Rosenthal, 1996:89). Admittedly, the language teacher might not be able to do much about changing the methodology in the science classroom[7], but by creating an environment in the language classroom that suits students' learning styles, students might be more motivated to participate in the language

[7] The exception to this would be in cases where the literacy-as-social-practise approach (based on the new literacies studies, as discussed in Jacobs, 2005) is followed. She describes (in her 2005 article, as well as in her 1998 dissertation) the integration of academic literacy into subject-specific courses. Although I believe this to be the ideal way of acquiring academic literacy, this approach was deemed unrealistic in the UNISA context, where it would be impossible to merge the current learner support approach (of one facilitator per region) with the hundreds of subjects that would need academic literacy support.

class, resulting in improved academic literacy levels, and ultimately improved reading and writing abilities outside of the language classroom – all contributing to increased success in the science classroom.

Already there are projects at major South African universities such as the University of KwaZulu Natal and the University of Cape Town "which use small-group learning as part of their efforts to assist second-language students in language and study skills" (Misselhorn, 1997:217). Using Supplemental Instruction (SI) groups at universities like the University of Fort Hare, North-West University, and the Nelson Mandela Metropolitan University, is also a longstanding tradition. According to Hartman (1987), such small-group learning leads to more independent and autonomous learners. Hartman argues that lecturers are often the main cause of learners' intellectual dependence.

In a distance learning environment, it is especially important for learners to be independent learners. If Hartman is correct, then, contrary to the current practice of learners studying and acquiring academic literacy in isolation, it is in fact group work that can help these learners become truly autonomous learners. For UNISA to be the open and distance learning institution that it claims to be, it would be necessary to cater for students who need this type of interaction and learning to reach their full potential – and that means more than providing the occasional tutorial which often reverts to a lecturing scenario. It implies structured and focused learning through interaction with a tutor, learning material and fellow students.

2.3 English for Academic Purposes (EAP)

English for Academic Purposes (EAP) courses have become increasingly popular at tertiary institutions in the past few decades. EAP is generally taught at educational institutions to students who need English in their studies (Kennedy & Bolitho, 1984). Kapp (1994) states that at the University of Cape Town, the EAP course generally services English second-language students who were classified by an English placement test as at-risk in terms of coping with the cognitive and linguistic demands of studying at an English-medium university. Several South African universities have similar courses for students identified as at-risk by placement tests. The University of Pretoria, the University of Stellenbosh and the

North-West University, for example, present academic literacy courses in both Afrikaans and English to students.

EAP is also interdisciplinary (Clark, 1998), often accommodating students from faculties as diverse as the natural sciences and the humanities in the same classroom. The fields of English for Academic Purposes (EAP) and academic literacy overlap considerably, though the first focuses on English specifically, and might be argued to be focused more narrowly on language in particular and its usage for academic success. In the South African context, mastering English, and more specifically EAP, is vital for students, as only through doing this are they enabled "to challenge the social and academic environment" (Bock, 1998:54), and thus become empowered within this environment.

In a country such as South Africa, where English is the *lingua franca* and most students entering university can at least speak English fairly fluently, one often erroneously believes that students will also be able to write proficiently in an academic context[8]. However, "conversational English should not be used as a guide for predicting success in the classroom because the kinds of language skills needed to learn academic subject matter and to carry out the types of assignments demanded of students are much more complex than those used in everyday conversation" (Rosenthal, 1996:48). Cummins and Swain (1986) distinguish between two types of language proficiency. The first type is called BICS – Basic Interpersonal Communicative Skills – which is contextualised everyday language. The second is CALP – Cognitive Academic Language Proficiency. This type of language is abstract and generally not related to students' everyday life experiences and activities[9]. CALP requires language and cognitive skills of a much higher order and far fewer people ever reach this level of proficiency than is the case with BICS, which most people master without difficulty. EAP classes usually address CALP. These classes rarely have the function of 'teaching' students English. Rather, such classes try to equip students with the specific cognitive and language abilities they would need to succeed at tertiary level.

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[8] In fact, students themselves have been shown to have unrealistic perceptions of their own English proficiency (see Coetzee-Van Rooy and Verhoef [2000]).

[9]Although criticism has been raised against the BICS/CALP distinction by, amongst others, Edelsky, Hudelson, Altwerger, Flores, Barkin and Jilbert (1983), Martin-Jones and Romaine (1986), Edelsky (1990) and Wiley (1996), the distinction remains functional, and is used for the purposes of this study.

The necessity of EAP interventions has become more pronounced with the large numbers of foreign and additional language speakers entering universities worldwide. This is even more so in South Africa, where a very small percentage of the population speaks English as a first language, and where the majority of previously disadvantaged students (almost all of them English additional language speakers) have only been able to enter the tertiary environment in the past decade. In fact, those students now busy with their degrees were the first students to have started their schooling under the new government, supposedly with the same access to and quality of education as their previously advantaged counterparts, and who are thus supposed to be fully prepared for tertiary studies. Many university lecturers would insist, however, that this is not the case. Rosenthal (1996:49) states that "poor test grades, ungrammatically written assignments and little participation in class discussions do not necessarily mean that [additional language] students are dumb, lazy, or not studying; rather, these students may still be developing BICS and/or CALP in English". Lecturers often have an unrealistic view of how quickly students are supposed to acquire an acceptable level of academic language proficiency, and usually feel that a one year course should be more than enough to bring students up to par. This is, unfortunately, an unrealistic expectation. In fact, it takes approximately five to seven years to develop CALP (Rosenthal, 1996).

Educators must also be aware that the problem does not necessarily only lie with students' English proficiency. Cummins (1980) hypothesises that CALP can be transferred from one language to another. Therefore, students who have received a good education in their mother tongue are likely to have less difficulty in acquiring CALP in, for example, English, since the literacy and cognitive abilities already exist, and merely need to be transferred (Cummins & Swain, 1986). Similarly, Coetzee-Van Rooy (2000:263) recommends "providing incentives for South Africans to use their L1 [first language] in as many domains as possible (…) [resulting in an] improvement of literacy-related (academic) language proficiency in the L1 that would make these skills available to L2 [additional language] contexts". The problem with most students who struggle with academic English (specifically in South Africa) is that they often lack these literacy and cognitive skills in their mother tongues (due to, for example, a poor schooling background that afforded them little or no opportunities to use their first language extensively as medium of instruction). It is thus not so much English that needs to be taught, but the underlying literacy and cognitive abilities that students need to use English effectively in an academic context. It could be argued that these skills could best be taught through reading and writing activities that are likely to be found in an academic environment.

In terms of content, the EAP classroom must pay attention to the type of reading and writing activities students are likely to encounter in academic contexts. Horowitz (1986:449) created a classification system according to which he classifies student assignments. This includes seven categories, namely: “summary of/reaction to a reading, annotated bibliography, report on a specified participatory experience, connection of theory and data, case study, synthesis of multiple sources, and research project”. One might thus surmise that across faculties, these categories are those most often expected of students, and should ideally also be the types of assignments used in the EAP class. Braine (1995:117) points out that though this is one of the most reliable systems for classifying assignments thus far, it is problematic that Horowitz did not conduct this study according to disciplines, as “[e]ach discipline is a separate discourse community with its own writing conventions”. The next section examines why a discipline specific approach to language learning might be more advantageous than general EAP.

2.4 English for Specific Purposes (ESP)

More than 25 years ago, Robinson (1980:1) already described English for Specific Purposes (ESP) as “one of the most prestigious fashions of recent years”. Today, this is an established branch of English teaching for both academic and occupational purposes. Snow and Brinton (1988) state that the interest in content-based approaches to language teaching has grown in the past years. This is mainly due to the argument that learners need to become part of a discourse community (academic disciplines have been characterised as being such discourse communities [Berkenkotter, Huckin & Ackerman, 1991]) to truly become literate[10] – a process which is both social and cognitive (Collett, 2002). According to Berkenkotter *et al.* (1991:191), “students entering academic disciplines need a specialised literacy that consists of the ability to use discipline-specific theoretical and linguistic conventions to serve their purpose as writers”. Johns (1995) agrees when stating that students are entering a new culture with two sets of academic rules: a generalised set of rules that apply to all discourses, and a more specific set of rules that applies to specific disciplines and even individual classrooms.

[10] Also see Jacobs’ (2005) discussion about the literacy-as-social-practice approach, as well as her arguments regarding collaborative pedagogy.

Becher (1987:273) confirms that various disciplines "display fundamental differences not only between types of evidence and procedures for proof, but also (...) in the modes in which arguments are generated, developed, expressed and reported". This need to belong to a discourse community exists for all students - "[e]ven the cognitively very capable student needs to feel a sense of belonging in a discipline. That sense of belonging comes mostly from the assurance of other people who belong" (Collett, 2002:237)[11]. The most effective way of attaining such assurance is by learning the rules of discourse that set each discipline apart, and thus becoming a member of that discourse community. As Ballard (1984:43) argues, it is through written assignments that students are generally "judged" to have become part of a discourse community or not. Should the student have proven the ability to incorporate the conventions of a specific discourse, the student will have achieved acceptance into the discourse community of the specific discipline.

ESP has come a long way since its inception. After the Second World War, scientific, economic and technical activity grew tremendously. A *lingua franca* was needed, and English became accepted widely as the international language of technology and commerce (Hutchinson & Waters, 1987; Graddol, 2006). Whereas before, learning a new language was seen as a sign of a well-rounded education, it suddenly became a tool with which to obtain access to new information, including textbooks and journals, and with which to communicate with fellow experts in various fields (Hutchinson & Waters, 1987). Not much has changed in the last 60 years. English is still the international language of technology and commerce, and is still the language most people in the world acquire as an additional language (Graddol, 2006). In an era where 'time is money', learning a language for the sake of becoming a 'better' person is no longer the norm. Rather, students of English learn the language to be more successful in their field of study or work. To stay relevant to the ever-increasing market of new English learners, it is vital for universities and other places where languages are learnt to adapt to the needs of the learners. That is the primary purpose of ESP.

[11] It is important to mention Coetzee-Van Rooy's (2006) view of integrative motivation, namely that it is important to be critical about the idea that EAL learners have a desire to become integrated into the culture of the language they are learning. However, I agree with Gardner and MacIntyre's (1993:158) argument which explains integrativeness as reflecting "the individual's willingness and interest in social interaction with members of another group". In the context of this study, students do not necessarily wish to become part of another culture at the expense of their own. However, I do believe that a student who decides to study in a specific field has the desire to become a member of that field. Entering such an additional discourse community does not imply that the students' own culture has to be sacrificed. Therefore, this argument should be seen in the context of gaining access to additional academic discourse communities, rather than choosing another culture above one's own.

After the Second World War, teachers were faced with learners who usually already had some background knowledge of English, and who had a specific purpose for learning the language (Kennedy & Bolitho, 1984). Many first attempts at ESP courses were disappointing. There was little, if any attempt to link topics learned in the English classroom to those of students' subject areas and learning styles. The texts used in these courses were often more appropriate for a literary rather than a scientific audience (Kennedy & Bolitho, 1984:7). Learners were taught grammar in isolation from context beyond that of sentence level, and methods such as drilling were heavily relied upon, with some subject-specific vocabulary added haphazardly (Kennedy & Bolitho, 1984). Kennedy and Bolitho (1984) also list one example of an early approach by Herbert where students had to 'practise' scientific statements in the form of substitution tables. A later approach was that of creating corpuses of vocabulary lists, frequently used grammatical patterns, etc. that are common to a specific discipline (Kennedy & Bolitho, 1984). Books such as the *Focus Series* in the late 1970's were the first to use texts that students actually had to read and write in their studies. The *Focus Series* specifically focused on reasoning processes, or functions, such as defining, classifying, generalising, hypothesising, etc., instead of the traditional grammatical exercises used before (Allen & Widdowson, 1978). This approach has also been criticised in that it supposedly replaced grammatical lists with lists of functions (Kennedy & Bolitho, 1984). Currently a more holistic approach to texts is taken in ESP, examining how longer stretches of language are composed and made sense of, rather than merely isolated functions (Kennedy & Bolitho, 1984:10).

Although the above might show the origins of ESP, a more concise definition of ESP is necessary in the context of this study. Robinson (1980:13) defines an ESP course as follows:

> [It is a course that is] purposeful and is aimed at the successful performance of occupational or educational roles. It is based on a rigorous analysis of students' needs and should be 'tailor-made'. Any ESP course may differ from another in its selection of skills, topics, situations and functions and also language. It is likely to be of limited duration.

Hutchinson and Waters (1987:19) offer this description of an ESP course:

> ESP must be seen as an *approach* not as a *product*. ESP is not a particular kind of language or methodology, nor does it consist of a particular type of teaching material. Understood properly, it is an approach to language learning, which is based on learner need. The foundation of all ESP is the simple question: Why does the learner need to learn a foreign language? (...) ESP, then, is an approach to language teaching in which all decisions as to content and method are based on the learner's reason for learning.

It is important to remember that "ESP is *not* a matter of teaching 'specialised varieties' of English" (Hutchinson & Waters, 1987:18). Just because language is used for a specific purpose and certain aspects of the target language are often related to a specific subject, does not mean that a new language is used (Kennedy & Bolitho, 1984; Hutchinson & Waters, 1987). Robinson (1980:18) also stresses that one should not try to suggest that one feature, for example "the type and sequencing of noun adjuncts, is unique to one type of text or that this one feature uniquely characterizes the text". Typical features of the specific discourse may be focused on, even practised more regularly, but the language remains the same.

ESP should also not be reduced to teaching students specialised vocabulary and grammatical features of a discourse. Students need to be proficient in both performance – "what actually happens in the 'target situation'" – and competence – "the knowledge and abilities required to comprehend this" (Hutchinson & Waters, 1981:58). Although the content of learning may be different in an ESP classroom, it does not imply a separate ESP methodology – rather, methodologies that could have been applied in any other EAL classroom (and which have evolved over decades in EAL classrooms) are used in the ESP classroom (Hutchinson & Waters, 1987). Robinson (1980:70) states that "structural and notional/functional/ communicative approaches have been adopted in the preparation of ESP textbooks".

Dudley-Evans (1995:310) argues that ESP courses are generally "designed for students with less than native speaker competence in using the grammatical and lexical system of the language". Writing Across the Curriculum (WAC) courses, on the other hand, "are usually designed for native speakers"[12]. The academic literacy workshop series developed for students of the UNISA Science Foundation Programme (SFP) is described as an ESP course for the purposes of this study, and indeed, as Dudley-Evans suggests, none of the students who attended the workshops in 2007 are native speakers of English. However, since there are not enough interested mother-tongue English speakers to justify a separate WAC course, this

[12] Marland (1977) mentions two approaches to the curriculation of WAC courses, namely the disseminated approach and the specialised approach. The disseminated approach argues that language permeates the curriculum, and that a variety of staff needs to be consistently involved in the teaching thereof, rather than isolating it by setting aside certain periods on a timetable. The specialised approach argues that if special provision is not made for separate language classes, this will be neglected and will possibly not be taught at all. The approach used in the ESP course discussed in this study would therefore be similar to what Marland describes as a specialised approach.

ESP course is accessible to all UNISA students, whether first, second or foreign language speakers[13].

The next section examines why ESP has become and remained popular during the past few decades.

2.4.1 A justification for ESP

Rosenthal (1996) argues that "[t]raditional ESL instruction does not adequately prepare most students for mainstream, content-area coursework taught in English". As a result, ESP courses have grown tremendously in the past quarter century. Parkhurst (1990) states that science students are often not prepared for scientific writing in generic writing courses, because such courses often focus on teaching students basic academic rhetorical modes, generic academic essays, and models of composing which are often not applicable for scientific writing. Though Parkhurst specifically focuses on science students here, the same could be said for students from other faculties. Ostler (1980) discusses a study at the University of Southern California where students regularly complained that language (reading and writing) assignments were not useful in their studies, and that they did not need any more English training. Leki (1995) describes a study in which students described criteria used by English teachers as only being relevant in the English class, and as being disconnected from the real world. If students feel that a language class does not meet their needs, and thus become so demotivated that they do not believe it necessary to study the language anymore, the language classes they attend may become ineffective. Bridgeman and Carlson (1984) conducted a survey in which different university departments were asked what writing demands they had of students, and what the preferred mode of discourse was for assessing both undergraduate and graduate students. The results indicate that different departments have different expectations of both these issues. It therefore follows that students in an EAP class (which often consists of mixed groups of students) would have different needs, depending on the required writing mode and assessment preferences of their various departments. Such students might be more motivated if doing an ESP course that they felt was meeting their specific needs.

[13] One should however take into account findings such as that of Van Rooy and Terblanche (2009) about differences between L1 and L2 varieties.

Johns (1981) found that faculty had mixed opinions about whether students should rather take ESP courses, or general English courses, with biosciences and physical sciences leaning towards general English courses, whereas engineering and mathematics seemed to prefer ESP courses. Although it might be argued that any language intervention would be beneficial, especially for first-year students whose language proficiency may be at a low level, one must remember that student motivation is a very important factor when it comes to optimal learning, and that motivation alone might serve as adequate justification for ESP courses.

According to Hutchinson and Waters (1987), it is generally assumed that the greater the evident relevance of the English course to the learners' perceived needs, the greater the students' motivation, subsequently increasing students' quality and speed of learning. Proponents of ESP argue that "for successful language learning to occur, the language syllabus must take into consideration the eventual uses the learner will make of the target language" (Brinton, Snow & Wesche, 1989:3). Motivation is increased if students believe that learning English will ultimately enhance employment opportunities (Rosenthal, 1996). Kroll (1979) found that students did not consider personal essays (the most popular class assignment in traditional composition classes) relevant to their present, past or future needs. Rather, business letters of request and persuasion and reports were found much more useful in this study. Zambo and Cleland (2005) describe a study where great success was reported in an integrative learning setting where students had to solve real-life problems in which they had to apply basic skills. They argue that students' motivation increased and retention improved when students had the basic skills necessary to complete authentic tasks. Kroll (1979) concludes that it would not be difficult to motivate students if they feel that a writing task has some practical application for them, and that it is rather difficult to motivate students to "perform writing tasks they consider far removed from the reality of their other courses, to say nothing of their outside lives" (Kroll, 1979:227).

Love (1991) found that first-year geology students at the University of Zimbabwe often resorted to rote learning because they did not understand the frames of reference (content schema) of a particular discipline. This included global structural characteristics as well as specific lexico-grammatical features of texts. These students largely received their schooling in English, yet they still struggled with tertiary texts aimed at mother-tongue speakers. In South Africa, the same situation prevails, but often South African students do not receive their schooling in English. Especially in the rural areas, few teachers are fully proficient in

English, and thus teaching and learning often occur in a mix of languages in supposed English schools (see, for example, de Klerk [1999; 2003]). South African students are therefore even more likely to become reliant on rote learning in an attempt to cope with the often 'foreign' texts they are faced with at tertiary level. Thus, if the academic literacy class at university level uses texts that do not conform (with regard to content schema) to those texts the students encounter in their other subjects, students may continue to struggle with the texts they deal with in other subjects, and may experience the academic literacy class as not meeting their needs. The academic literacy class needs to challenge these students to interact with texts similar to those that they encounter in their other subjects, and needs to guide students to acquire the reading, summarising and learning skills to successfully master such texts.

Horowitz (1986) argues that if writing practice is situated in academic contexts, it is more likely that skills will be transferred to other subjects optimally. This argument can be taken one step further by not only teaching writing in an academic context (i.e. EAP), but more specifically in an ESP context, so that students can practically see how they could transfer skills learned in the ESP class to their other subjects. Rosenthal (1996) states that English as an additional language is best acquired when the new language is used purposefully. It seems that the best place for acquiring new language and cognitive skills is in an ESP course, where the relation to students' other subjects is clear. Rosenthal further argues that "many educators still tend to view ESL instruction as remedial such that ESL courses should be completed and the English language 'mastered' before students can enter into the mainstream classroom" (Rosenthal, 1996:19). Clearly, separating a language course from students' other mainstream courses by expecting students to acquire the language before gaining access to mainstream courses would be a mistake, as language is a social construct that cannot be optimally acquired in isolation – not from other students, nor from a purposeful context, preferably the context of the study field students have chosen.

Some authors remain sceptical of the importance of a subject-specific approach. Hutchinson and Waters (1987) argue that the difference in vocabulary and grammatical or structural forms between generic and subject-specific texts is not nearly great enough to justify the use of subject-specific texts. They claim that the only two reasons for having a subject-specific approach are face validity (in that materials look relevant) and familiarity with such texts. However, these two reasons alone should be enough to justify an ESP approach rather than a generic approach. Even if only the students believe that texts are relevant, this alone could improve student motivation, and ultimately bring about more effective learning. In addition, if familiarity makes students feel more comfortable with texts similar to those they encounter outside of the language classroom, students' attitude towards the language class could certainly be changed for the better. Robinson (1980) makes a useful distinction when arguing that relevance of material (i.e. that students could use the material and abilities in their other subjects) might be more important than authenticity of material (i.e. material taken directly from their study material) in increasing student motivation. Thus, if students can clearly see how the abilities developed in the ESP class could be applied to other subjects (through relevant material, though not necessarily completely authentic), optimal learning is much more likely to occur than if texts were chosen solely on the basis of their authenticity.

2.4.2 Different ESP models

There are many different models that can be used in an ESP framework. Mainly, ESP courses can be defined as being either occupational or educational in nature (Strevens, 1980). Furthermore, one can distinguish between pre-study, in-study and post-study ESP (Robinson, 1980). For the context of this study, only ESP courses that are educational in nature, and that are 'in-study', will be considered. Still, one has to remember that "the undergraduate may (...) have more in common with the trainee secretary than with a postgraduate research fellow who wants English to give a paper on his findings to an international congress" (Kennedy & Bolitho, 1984:5). Ostler (1980:494) also indicates that undergraduate and postgraduate students have very different needs when it comes to academic skills (undergraduate students indicating that they need skills for "taking multiple choice exams, writing laboratory reports, and reading and making graphs" and postgraduate students indicating that they need to "read academic journals and papers, give talks [...], write critiques, research proposals and research papers, and discuss issues") , and that these two groups cannot be seen as variations of each other. The aim of the present study is to equip students with practical language skills that might indeed have more in common with the type of communication expected of a young trainee secretary than with a postgraduate research fellow; thus purely classifying the current ESP course as 'educational' might be somewhat too simplistic.

ESP courses often take on different forms. Robinson (1980) states that the ideal ESP course would have only one student in it, since all learners have individualised needs and purposes. Clearly, this is impossible for the overwhelming majority of students in need of an ESP course, due to practical constraints. Further, if one were to argue that learning occurs best in interaction with peers (as argued in Section 2.2), this might not be as ideal a situation as it might seem at first.

A more realistic model that is often used successfully in ESP is the adjunct model (see Snow & Brinton, 1988; Johns, 1995; and Rosenthal, 1996). In this model, ESP courses and content-area courses are paired and coordinated, with the language and content specialists supporting each other (this is very similar to what Marland [1977] describes as a disseminated approach to language curriculation, as well as the literacy-as-social-practice approach [based on the new literacies studies], as discussed in Jacobs [2005]). In the ESP class, students would, for example, write drafts of essays given to them in their content courses. This model has clear advantages, such as increased motivation of students. Braine (1995) states that although such courses do exist, they are not common. This is probably due to logistical problems, as well as the difficulty in getting content lecturers or tutors to cooperate with language specialists on such an effort. These are certainly the reasons why adjunct courses would not work in the context of the current study. In addition to lecturers being overloaded and often not being willing or able to restructure their courses so as to coordinate them with an academic literacy course, the SFP academic literacy workshops provide a service to 17 subjects, with students spread out across the country, and usually have only one facilitator per regional centre to deal with all these students, in addition to students from other programmes and courses.

Dudley-Evans (1995) describes another ESP model, namely team taught sessions. He states that this type of course is very similar to an adjunct course, with the main difference being "that they involve the actual working together of the subject teachers and language teachers in the same classroom" (Dudley-Evans, 1995:304). He cites several advantages to this approach for students, subject teacher as well as language teacher. Students, according to him, benefit by gaining three types of insight.

> First, they are able to understand more fully what is required in the set tasks in terms of content, organization, and language. Secondly, they learn to apply the general knowledge of genre conventions and other aspects of writing they have gained from the general classes to actual assignments or examination answers. Thirdly, the students gain insights into the particular expectations and definition of the writing task (Dudley-Evans, 1995:304).

Subject teachers, according to Dudley-Evans (1995), are able to see firsthand what tasks students experience the most difficulties in. This also allows subject teachers to identify examination questions or assignment instructions that are potentially confusing, which often leads to them rewriting these more clearly for future groups. Finally, language teachers are given the opportunity of understanding what departments require of students, and what the specific challenges are that students have in fulfilling these requirements (Dudley-Evans, 1995).

Again, the challenge of this type of model would be to get cooperation from subject-specialists. Also, persuading language teachers that this is a productive option might prove difficult. They might, for example, believe that team teaching takes the focus away from the core subject matter and that it is more labour intensive. In addition, finding classes that have a flexible enough curriculum to allow time for a language specialist to co-teach is by itself a difficult task.

If language courses are not coordinated with a specific subject, Braine (1995) states that ideally, academic writing courses should focus on a specific discipline, since each discipline could be seen as a separate discourse community. However, he states that logistical reasons, for example a lack of teachers, often prevent such narrowly focused courses from being feasible. Kennedy and Bolitho (1984:49) suggest an alternative solution, namely “to abandon any approach which may relate to a specific subject and instead to develop a common-core course drawing on material or topics from general interest areas rather than from content that relates to a specific subject”. This is probably very close to what Jacoby, Leech and Holten (1995:352) call a non-adjuncted course, “a free-standing course akin to many composition and ESL courses that base the development of the content and assignments for the course on the language and writing needs of the students enrolled”. Thus, common-core courses which deal with broader disciplinary areas (for example the natural sciences), and where students generally have similar writing and language needs, are much more feasible than courses that focus on a specific subject (Braine, 1995). Kennedy and Bolitho (1984:50) agree in saying that when there are students from various subject groups, “a common-core approach is the logical solution. Texts of a semi-technical nature may be chosen (...) to which students of different specialisms would be able to contribute and which would provide practice in a set of skills, structures, functions and semi-technical vocabulary which the students will meet in their specialist studies” (also see Braine, 1989). Such courses, says Braine (1995), usually work best at the beginning of students' undergraduate studies, where they have not yet specialised too much within their study fields.

Hutchinson and Waters (1987:161) argue that "there is little linguistic justification for having highly specialised texts". According to these authors, no clear relationship exists between specialisation of knowledge and sentence grammar. Kennedy and Bolitho (1984:57) also add that symbols and formulae "generally form part of a learner's knowledge of the subject matter of his [*sic*] speciality and are not, therefore, of direct concern to the language teacher". It is thus not necessary for the teacher to be a content expert, since, as discussed in Section 2.4, no subject uses a different type of language (e.g. "scientific English"), regardless of technicalities. It must be kept in mind, however, that should a text be used that the teacher does not understand, due to its highly technical nature, the teacher could lose face in front of the students. It is therefore important that, as Hutchinson and Waters (1987) argue, a balance be found between the knowledge and competence of the teacher when developing material.

Braine (1995:126) states that though the English teacher might not have a solid background in, for example, report writing, what the teacher "can teach with confidence are the writing skills that are crucial to experimental reports". The concern of the language teacher remains the language necessary for successful learning which, apart from a varying focus on certain features across disciplines, stays largely the same, regardless of subject. Adopting a common-core course was ideal for the purposes of the current study, where 17 subjects are serviced by one reading and writing tutor in each region. Because the texts selected for the course discussed in Chapter 4 of this study are still scientific in nature (thus retaining face validity and contributing to higher motivation, as argued by Hutchinson and Waters [1987]), students from various scientific subjects could relate and contribute equally to the topics.

The last variable that differs from one ESP course to another, depending on the students' needs, is the duration of the course. As mentioned earlier, it can take anything from five to seven years to develop academic language proficiency (see the discussion of CALP in Section 2.3), depending on specific contexts and existing language proficiency. If one takes into consideration the poor schooling background of many South African students, and that academic language proficiency really only starts to develop at secondary school level, one begins to understand why many students are not at the required academic language proficiency level by the time they reach university. Robinson (1980) states that most ESP courses seem to be one-year courses, with teachers often only having a few hours per week available to teach, and thus having to select which skills to teach within this very limited period of time. The present study had the same time-constraints, with students attending the 6-month workshop programme only three hours per week. In addition, since these workshops are voluntary, no homework is given – decreasing the learning time even more.

Whatever approach one uses in an ESP classroom, it would be wise to take heed of Allwright and Allwright's (1977:58) warning that "ESP teachers, in particular, should be conscious of the dangers of generalizing from one learning/teaching situation to another". The goal of ESP is to cater for individual groups of students' specific needs. To generalise between groups of students could potentially achieve the opposite. Learners' needs must continuously be re-evaluated, and the ideal ESP course should accordingly evolve continuously.

2.4.3 Elements of an ESP course

As argued in Section 2.4.2, each ESP course should ideally be developed and adapted depending on the needs (what abilities students need for assignments and tests) and wants (what abilities students believe they should develop) of the students taking the course. Therefore, each ESP course is likely to have a different focus on various academic literacy abilities. The abilities of reading, writing, speaking and listening cannot be, and should not be, treated separately in any ESP course, because they are typically used in combination in the completion of real-life, authentic academic tasks. Still, it is important to examine which elements are vital for a successful ESP course, and since the literature tends to deal with these four abilities separately (for better description and analysis of each), they will also be discussed separately in this section.

First, it is important to decide to what extent students are required to read, write, listen or speak. Subsequently, the nature of each of these activities in students' other courses must be examined, for example, the type of writing or speaking that is expected of students, since "'[w]riting' may refer to note-taking or completing a technical report. 'Speaking' may refer to activities in a seminar discussion (...) or a factory-floor conversation" (Kennedy & Bolitho, 1984:21). Merely focusing on one ability (for example, writing) without taking into consideration the specific aspects of that ability that students need most in their courses, as well as how the ability interacts with other abilities, would probably prove ineffective in an ESP course.

Little seems to have been written about listening and speaking abilities in ESP classes. This might be because listening and speaking are usually not assessed, and are therefore not seen as important outcomes in students' other subjects, and consequently also not in their ESP courses. Yet, it is worthwhile to pay at least some attention to these abilities in the current discussion.

Thier and Daviss (2002) distinguish between two kinds of speech – presentational speech (for example, presenting findings to the rest of the class) and exploratory speech (spontaneous exchanges between students, or between student and teacher). Exploratory speech is used to experiment with ideas, and helps students focus their thoughts. It is thus a very useful tool in preparation for writing. Though presentational speech might be somewhat less important, especially for students in a distance education environment, it still requires students to plan and organise, and as such should not be discarded completely. Listening goes hand in hand with speaking, especially with exploratory speech, since to share one's own ideas with others, it is necessary to listen to their ideas, and accurately incorporate these into one's own ideas to effectively focus one's thoughts. When positioning language learning in a communicative situation, specifically exploratory speech and listening (which are usually more authentic) are very important for effective learning (Hendrickson, 1991; Sato & Kleinsasser, 1999). If learning occurs best in collaboration with others, enough opportunities must be created for students to listen and speak to each other, thereby increasing their reasoning and argumentative abilities.

Though listening and speaking abilities are clearly useful in a small-group, communicative context, and should not be disregarded, the emphasis that the literature awards to reading and writing is even more justified in the UNISA environment, since students rarely listen to lectures, and are almost never tested orally. In addition, Phillips (2004:105) states that "[s]tudents will read and write their way through tertiary courses and by concentrating on giving training in these two areas, tertiary institutions can assist their students in achieving greater academic success".

Misselhorn (1997:64) points out that one of the greatest difficulties confronting students when reading and writing in an academic context is the complexity of these tasks, and specifically "the variety of practices associated with particular disciplines and genres". According to her, it is a problem that students are often expected to discover these practices for themselves, since they are not made explicit to students (Misselhorn, 1997). It thus seems wise to, within each discipline, include a wide variety and a large number of texts students might possibly need to deal with, to clearly show how these texts are constructed, and what norms are expected of writers in the various disciplines (cf. Jacobs, 2005). Misselhorn (1997:64) stresses that students should not merely focus on the subject knowledge in texts, "but also on increasing their skills in the genre and discipline-specific conventions for organising that content".

Johns (1981) also argues that the teaching of receptive skills (i.e. reading and listening) should take precedence over the teaching of productive skills (i.e. writing and speaking). She states that writing could rather be practised in response to a reading or listening task (such as a paraphrase, summary, or rewriting of lecture notes). Phillips agrees when stating that "[r]eading ability seems to facilitate language development in ESL students" (Phillips, 2004:104). Though one should be careful in agreeing with these two authors that reading ability is indeed more important than other abilities, it is clear that writing, and to some extent listening and speaking, should ideally be integrated with reading activities in an ESP course, since all these abilities tend to be based on reading in students' other subjects (e.g. writing an assignment based on readings, having a discussion based on arguments in a textbook, and listening to others' interpretations of what they have read).

There seems to be little consent among lecturers as to the importance of writing skills in various faculties. In an engineering faculty that Bridgeman and Carlson (1984) surveyed, many faculty members stated that they placed very little emphasis on writing. In the civil and electrical engineering departments of that faculty, only 20% believed student writing to be very influential in achieving academic success. Interestingly enough, the majority of departments believed writing ability to be very important after graduation. In addition, even for subjects where there was little emphasis on writing, at least some writing was still required of first-year students (Bridgeman & Carlson, 1984).

Vocabulary is also an element that usually receives much attention in ESP courses. According to Rosenthal (1996), it is a common misconception that students have difficulty with subjects because of technical and scientific words. It seems as though learners generally have less difficulty with technical vocabulary (vocabulary that is solely found in the specific discipline) than with sub-technical vocabulary.

> Subtechnical vocabulary consists of those words which are not specific to a subject speciality but which occur regularly in scientific and technical texts – e.g. reflection, intense, accumulate, tendency, isolate and dense. Learners frequently find difficulties in understanding such words. One estimate puts the occurrence of subtechnical items in scientific texts almost as high as 80 per cent (…). If this is so, such items will have to be accorded high priority in the language programme (Kennedy & Bolitho, 1984:58).

Students often struggle specifically with words that have a more general meaning as well as a specialised meaning (often in a scientific and a technical context) (Johnstone & Cassels, 1978; Kennedy & Bolitho, 1984; Ryan, 1985; Rosenthal, 1996). Kennedy and Bolitho (1984) provide examples such as 'cycle', 'conductor' and 'resistance'. It might be worthwhile for an ESP course to focus on sub-technical vocabulary rather than technical vocabulary, since students from various subjects, but in the same general field of study (e.g. business or sciences), could benefit from such vocabulary instruction.

Bridgeman and Carlson (1984:262-263) show how different skills are required by different departments:

> For example, describing an apparatus is relatively unimportant in MBA departments and relatively important for engineering and computer science. Apparently, describing a procedure is especially important for computer science majors. Arguing for a particular position is very important for undergraduate and graduate business majors but is relatively unimportant for students in engineering, chemistry, and computer science.

In the Bridgeman and Carlson (1984) study, the writing skills needed by students of various faculties are examined. The study indicates that the writing skills that subject lecturers find important are often different from those focused on in many EAP courses. Appropriateness to audience (which is an aspect often focused on in EAP classes), for example, was not considered very important by engineering lecturers. In the same study, lecturing staff across various fields stated that when evaluating students, they focused more on discourse level characteristics (for example, the quality of content and how the paper is organised) than on word- or sentence-level characteristics (for example, punctuation, spelling, and sentence structure). On the other hand, it must be remembered that sentence-level characteristics become more important in all fields as students progress through their studies, and that at postgraduate level, such 'correctness' is non-negotiable. Yet, at first year level, skills and knowledge that are often emphasised in EAP classes might be inappropriate for students of certain faculties (and consequently such classes might bore them, and therefore become ineffective), whereas other writing skills might have to be emphasised and practised more for certain disciplines. The needs of students will change as they progress through their studies – an area that deserves further discussion and research, but which falls outside the scope of this study.

Though different departments may require or emphasise different writing skills, the strategies that Jacoby *et al.* (1995:355) describe as being incorporated into their developmental writing course are universal skills necessary for all students. These skills "include prewriting, planning, and organizing before putting pen to paper [or the so-called process-model of writing, still very popular in most EAL classes, despite recent criticisms from authors such as Johns (1995)]; information review and synthesis; and content and rhetorical analysis of professional and peer text models". These abilities usually transcend the individual skills of reading, writing, speaking and listening, and are much closer related to students' real-life experience of language use at tertiary level.

Clearly, each ESP course would emphasise different elements, but elements such as reading strategies, a focus on sub-technical vocabulary, as well as writing that is relevant to the students' field of study, preferably as a response to reading, seem to be vital for every ESP course. Though listening and speaking may seem less important in a distance education environment, these abilities should not be ignored, as it is often by means of listening and speaking that learners focus their thoughts, which ultimately leads to more successful writing.

2.5 English for Science and Technology (EST)

English for Science and Technology (EST) is one of the major branches of ESP. According to Kennedy and Bolitho (1984:6), "[t]he term EST presupposes a stock of vocabulary items, grammatical forms, and functions which are common to the study of science and technology". It is these mainly stylistic elements that distinguish scientific writing from that in other academic fields (UNC-CH Writing Centre, 2005). EST is also important because it has almost always "set and continues to set the trend in theoretical discussion, in ways of analysing language, and the variety of actual teaching materials" (Swales, 1988:xiv).

In the United States of America, changing demographics have made it vital for science education to be available for all students:

> Race, language, sex, or economic circumstances must no longer be permitted to be factors in determining who does and who does not receive a good education in science, mathematics, and technology. To neglect the science education of any (...) is to deprive (...) the nation of talented workers and informed citizens – a loss the nation can ill afford (AAAS, 1989:156-157).

The same is true for South Africa, where the Government is still engaged in redressing the inequalities of the past, and where specifically black students are encouraged to enter the fields of science and technology. Rosenthal (1996:25) points out that undergraduate students with limited English proficiency (LEP) "represent a large pool of talent; they could be tomorrow's university and industry researchers, high school and college science teachers, technicians, and/or technologically and scientifically literate members of the public". Unfortunately, many of these students come from poor secondary school backgrounds, and although many have the aptitude in mathematics and science to make a success of their studies, few have the language abilities necessary to succeed at tertiary level. EST courses already exist at many South African universities (for example UNISA, the University of KwaZulu/Natal, and the University of Pretoria), but several universities still employ EAP courses as a strategy of 'dealing' with students of limited English proficiency. To successfully address the problem of science students' language proficiency inadequacies, it may be time for South Africa to learn from the example set by the rest of the world, which has long since seen the need for EST, and adapt what has been done internationally to redress this problem. If this is done, there is a possibility that more students will be trained successfully in the sciences, and, as Rosenthal (1996:25) points out, these students could then become "mentors and/or serve as role models for other LEP students moving up through the school system, thereby helping to increase (...) participation in the sciences" (Rosenthal, 1996:25).

Rosenthal (1996:44) states that even though "ESL students enrolled in science classes are ostensibly learning science, we forget that they also are simultaneously both learning and acquiring proficiency in English". Expecting students to have already acquired the latter may prevent them from reaching their full potential in learning science. In fact, several authors claim that many students have not acquired sufficient proficiency in English by the time they reach university. White (1988:9) states that "children learning science at school are not automatically proficient in using the discourse of the subject to interpret their experiences". Thier and Daviss (2002:3) agree when stating that already at secondary level, students in higher grades do not enter science courses with the necessary vocabulary and other language skills "to decode print and draw meaning from language". They further argue that students have difficulty with comprehension, particularly in specific content areas (Thier & Daviss, 2002). White (1988) points out that at secondary level, students usually use worksheets in science-related subjects, and very rarely get to experiment with any type of extended writing, or writing as a means of planning. Thus, though students may enter tertiary education with sound scientific knowledge, they often find themselves out of their depth when expected to communicate this knowledge in anything but one-word answers. To cite one example, in Phillip's (2004) study at a South African college which serves as bridging between Grade 12 and university, most students speak English well enough. However, few students have acquired the level of reading and writing ability necessary for tertiary education. She states that although the students' results indicate that their abilities in science and mathematics are adequate, a lack of English language skills significantly diminishes their chances of success at university level. Thier and Daviss (2002:3) confirm that "the stronger a student's literacy skills, the stronger the student's grasp of science will be. (...) In that way, a student's achievement in science will be directly proportional to the student's ability to use language". This might be oversimplifying the matter, since a student with little aptitude in science might never achieve success in science, regardless of that student's language abilities, but still the argument remains that even students with a strong ability in science cannot perform adequately if they have difficulty in decoding and encoding the information from and into language.

Entering the tertiary environment with these weaknesses is already difficult for students of all fields. But to make matters even more complicated for science students, scientific writing is extremely complex, as Rosenthal (1996:114) points out.

> Unlike other materials that they read, the content of the science textbook is for the most part unfamiliar; the vocabulary is strange, and new words are introduced at a very rapid rate. There is no temporal or predictable sequence to the unfolding of information nor are there familiar themes to which the reader can relate. The bottom-up presentation of information (details before general ideas and concepts) often requires that the text be read several times.

Rosenthal (1996) adds that the information is generally very dense, and is rarely paraphrased or repeated. She states that it takes an EAL student two to three times as long as it would a native reader to read such a text. In *Writing in Science* (1975), Smith (in Johnstone & Cassels, 1978:432) states that the formal nature of scientific texts "leads pupils to believe that their own thinking does not count and that in examinations what is required is regurgitation of someone else's thinking in someone else's language". Students also often believe that they do not have the authority to question textbooks and lecturers. This is clearly an erroneous view, and from my own conversations with lecturers from several scientific fields, it is evident that students' inability to paraphrase, and their tendency to plagiarise, are some of the greatest problems UNISA students face when writing assignments (also see Braine, 1989; Braine, 1995 and Collett, 2002). Students plagiarise for many reasons. The first may be, as Smith states, that students do not believe their thinking has much value, or that they can compete with the complex level of writing they encounter in their study material. Of course, students' difficulty with paraphrasing most probably also contributes significantly to the problem – students often just do not know how to express someone else's ideas in their own words. In addition to these difficulties, students are often unfamiliar with the academic conventions of citing information correctly. It is, therefore, probably the sum of these difficulties that students experience, and their frustration in dealing with these problems, that ultimately lead to plagiarism.

Students who already need to manage the aforementioned problems when they enter tertiary education institutions are then often expected to take generic language classes, which regularly focus on writing tasks that have little to do with students' present reality at university. White (1988) concludes that students are given much more instruction and guidance for writing narrative fiction than they are for expository writing. Braine (1995) states that a research paper is usually the final and most important assignment in most first-year English classes. This is specifically problematic for the fields of science and technology, where narrative fiction is basically non-existent, and research papers, according to Braine (1995), make up a mere 5% of assignments written by first-year science and engineering students. If an academic literacy class were to teach students how to write narrative fiction (with the belief that any kind of writing would improve students' writing, and because many academic literacy teachers often feel more comfortable with such writing) or even research papers, such students may feel demotivated because they see no link between what they do in their other subjects, and what they are expected to do in the academic literacy class.

Conversely, "composition classes consisting only of science and technology students not only create an environment for better simulating academic writing, but also give the students an opportunity to share and evaluate subject matter information, an experience that they rarely encounter in academic courses" (Braine, 1989:14). Here, students have the opportunity to compose the types of texts they need for their specific disciplines in a focused, constructive environment.

2.5.1 Science and English

Without the discourse of scientific language, scientists would not be able to express their findings in the concise and precise fashion that characterises the field of science.

> Language is essential for the teaching of science. Oral language is used to lecture, to ask and answer questions, to conduct discussions, and to direct classroom and laboratory activities. Written language is used to place information on the chalkboard, to prepare exams and quizzes, for laboratory directions and reports, to record experimental results, and to respond to test questions. (...) Language is so central to the teaching of science that it is impossible to imagine a 'language free' science classroom (Rosenthal, 1996:104).

Montgomery (2004:1333) argues that "[w]ords are the primary medium by which technical work is embodied, added to the corpus of professional understanding, and passed on". Scientists have to be masters of these words, and the language structures that hold the words together, to maintain and expand the field of science.

Scientists use language every day, though often for somewhat different purposes than, for example, a businessperson. Mackay and Mountford (1978:129) state that scientists are explicitly conscious of acts such as "defining, identifying, comparing, differentiating, [and] classifying". Latour and Woolgar (1979:49) describe the majority of scientists' daily activities as consisting of "coding, marking, altering, correcting, reading, and writing". Montgomery (2004:1335) goes so far as saying that "science is today the most active area of language creation".

English has become the *lingua franca* for scientists across the world in communicating with each other. This has reached a level where physics, chemistry, mathematics and engineering are internationally studied mainly through the medium of English (Robinson, 1980; Graddol, 2006). Scientists use this *lingua franca* for presenting papers, exchanging views informally, participating in international meetings, being involved in corporate science and multinational research programmes, setting up official web sites, reading relevant literature or writing scientific papers (Kennedy & Bolitho, 1984; Montgomery, 2004; Graddol, 2006). Montgomery (2004) estimates the current amount of scientific scholarly writing in English on the Internet as between 80% and 90% of the total amount of such writing – in spite of the Internet becoming more linguistically diverse each year.

Language plays another important role in science. According to Montgomery (2004:1335), "[m]aking science comprehensible to general audiences has literally become an effort of translation". Science has little value if scientists cannot 'translate' their highly technical knowledge into language that politicians, students and the general public can understand. This 'translation' requires a high level and range of linguistic skills.

Montgomery (2004:1335) states that "language training is now a critical fact and compelling factor in modern science". As shown above in the number of cases in which scientists use language, this seems very true for scientists already active in their professions. Yet even at university level, this seems to be very much the case. It would seem that science lecturers are less tolerant of writing errors typically made by EAL students than are lecturers in the social sciences, education and humanities (Santos, 1988; Vann, Lorenz & Meyer, 1991). Science lecturers also have misguided notions about how quickly students of limited English proficiency can master English (Rosenthal, 1996) – placing an even greater burden on students who are struggling to acquire the language that will give them access to the scientific world.

Johnstone and Cassels (1978) state that students can be prevented from demonstrating their knowledge in, for example, chemistry, because of a lack of language skills. Even scientific subjects that seem to have little to do with language skills can benefit from students achieving a higher level of CALP (as discussed in section 2.3). For example, Zambo and Cleland (2005) argue that mathematics and language are both problem-solving processes that employ symbol systems to represent ideas. If students' ability to understand and manipulate one symbol system improves, surely their ability to understand and manipulate another could only benefit (see also Bohlmann & Pretorius, 2002). In a study by White (1988:1) it was found that "[p]upils who were most highly rated in both science and language were found not only to have a good understanding of the science involved, but also their language was well structured to communicate the understanding to listeners or readers". Thier and Daviss (2002:6) explain this phenomenon by arguing that science and language "seek to develop reciprocal skills in students – skills that complement and strengthen each other". They continue by saying that "[l]iteracy skills strengthen science learning by giving students the lens of language through which to focus and clarify their ideas, conclusions, inferences, and procedures" (Thier & Daviss, 2002:6).

Thier and Daviss (2002:121) relate anecdotal evidence where teachers who combine science and literacy abilities believe that "[s]tudents are able to communicate their ideas and understandings more clearly, so teachers are better able to detect what students know and have learned". Another teacher claims that "[t]he quality of the writing improves; it's more precise. When they present data, ideas, or arguments, they give more extensive background information and evidence. They're asking questions that carry them to a higher level of thought and performance" (Thier & Daviss, 2002:122). Thus, including language education in science students' curricula may, in addition to improving their actual language usage, also develop the higher thought processes necessary in a discipline where new knowledge is created by asking questions about existing knowledge.

Though many teachers and researchers see the importance of language skills for science students, underprepared students entering tertiary institutions are still a great problem:

> Even at the university level we can surely not assume as do Mackay and Mountford (...) that 'students will have an advanced conceptual knowledge of objects, substances, processes and operations'. Many students do not have much knowledge of science in their own languages because it does not exist in those languages. That is why they are learning science in English (Robinson, 1980:25).

This is certainly the case in South Africa, where little, if any scientific vocabulary exists in any of the black African languages (Dlodlo 1999), which are the mother tongues of approximately 80% of the population (Statistics South Africa, 2001). Studying a subject in an additional language is already very difficult, and even more so if your language skills in that additional language (and sometimes even in your first language, as suggested by Robinson [1980]) are weak.

Clearly, language is vital for the comprehension of scientific knowledge, and subsequently the expression which demonstrates such comprehension. Students need to learn how to use language for their own purposes, rather than to resent it as something 'outside' of their studies, an extra burden that they have to take on in addition to their studies. Only when students see language as instrumental to their studies will they be able to exploit its full potential. They are unlikely to see this, though, if their English course is not moulded to suit their needs. Johnstone and Cassels (1978) state the importance of knowing where students' linguistic weaknesses lie, so as to teach skills useful to them – maybe unknowingly, they already describe the importance of creating a course around students' needs, the essence of ESP. Teachers must understand how pupils "take possession" of scientific information, and pay attention to the role of language in this knowledge acquisition (Johnstone & Cassels, 1978:434). In order to understand how students of a specific subject field acquire knowledge, it is necessary to look at the type of assignments they are expected to do (as the cognitive processes required to complete an assignment will, out of necessity, determine how students learn). This issue is emphasised in Chapter 3, where a sample of UNISA first-year SFP assignments is examined.

Without a doubt, language proficiency plays a significant role in students' ability to do well in science. However, leaving language acquisition to subject specialists might be a mistake, because as White (1988:34) points out, they do not know "how to communicate the explicitly linguistic demands that certain genres of writing entail". Even if they had this knowledge, in an educational system that emphasises that students should learn as much as possible in as short a time as possible, it is unlikely that subject-specialists would take a significant amount of time out of the curriculum to teach students how to write, for example, acceptable paragraphs.

2.5.2 Characteristics of scientific discourse

Science students usually deal with different types of texts than those in other disciplines. For example, students in the sciences typically encounter laboratory reports, project proposals and reports and fieldwork notes during the course of their studies, as opposed to critical analyses, projects and even translations that are often critical in other faculties (Coffin & Hewings, 2003). Braine (1995) distinguishes between five categories of assignments generally given to science students, namely a summary or reaction, an experimental laboratory report, an experimental design report, a case study and a research report. In his study at the University of Texas, he found that almost 75% of the sample of assignments examined fell under the category of experimental reports. In another study, Braine (1989) discusses several studies that surveyed assignments in the sciences, all of which found that laboratory reports constituted between 57% and 93% of the total assignments given to students.

In addition to specific types of texts frequently encountered by science students, it has been well documented that scientific language has certain characteristics that sets it apart from other discourses. Firstly, "scientific reasoning is **linear** and **inductive**. The basic facts are first laid out, and from there a case is built. All extraneous information and unnecessary words are omitted, producing a tightly knit argument and a style of writing which is **concise** and **precise**" (Rosenthal, 1996:105; see also UNC-CH Writing Centre, 2005). Science texts are generally considered to be very **dense**, and contain a lot of conceptually complex factual information (Phillips, 2004). Such texts are **not as predictable as narrative texts**, and also have a very **formal structure** (Phillips, 2004). Often, structures such as nominalisation are used (Halliday, 1998; Banks, 2005), which increase formality. White (1988) states that writers of scientific texts must link any new set of observations to a pre-existing pool of knowledge, and that one therefore often finds generalising classificatory statements at the beginning of such texts. Becher (1987:273), in an examination of the linguistic features of physics, states that "physics knowledge is not only **cumulative** but **tightly structured** and **atomistic** (in the sense that it is capable of fragmentation and of being assembled in relatively small pieces)". He adds that "[t]heories and methods are for the most part firmly established (...) and modes of argumentation are well-established and unquestioned. Physicists deal in quantifiable and universal entities and value neatness and simplicity of explanation". Coffin and Hewings (2003:49) agree that scientific texts should be "clearly written and easily read". In fact, **precision**, **clarity** and **objectivity**, though by no means uniquely characteristic of scientific writing, are possibly even more vital for scientific writing than for writing in other fields (see, for example, UNC-CH Writing Centre's [2005] description of scientific writing).

To achieve the appearance of **objectivity** and **neutrality**, scientific texts frequently use the passive voice instead of the active voice (Robinson, 1980; White, 1988; Phillips, 2004; UNC-CH Writing Centre, 2005), generally use the present tense (White, 1998), and are written in an impersonal style (Myers, 1991): "when experiences are written about in science, all reference to persons is characteristically deleted, signifying that what is reported has a general, abiding quality, not tied to the peculiarity of the observer" (White, 1988:5). In addition, **quantitative descriptions** are preferred in a scientific context, whereas qualitative descriptions should be kept to a minimum, if not avoided completely (UNC-CH Writing Centre, 2005). Scientific texts also "make frequent use of **semantic relations**, for example, causal relations signalled by conjunctives such as *since*, *therefore*, which the students need to recognise and understand but seldom do" (Phillips, 2004:8).

Kennedy and Bolitho (1984:19) stress that scientific English "uses the same structures as any other kind of English but with a different distribution". 'Scientific English' is thus not a separate language, and should not be treated as such. Yet making students aware of the linguistic features frequently found in scientific language firstly enables students to become aware of the reason behind these features (and thus to become aware of the characteristics of the discourse community they are entering into). Secondly, it has the potential of helping them see the link between the language classroom and the science classroom, and the relevance that language has for scientists, and thus for themselves.

2.5.3 Essential skills for science students

An ESP course can be organised around abilities, functions, topics or situations (Robinson, 1980). The workshop series in the present study is designed around abilities, mainly identified as insufficient by the Test for Academic Literacy Levels (TALL) that students wrote during the first workshop. Although the workshops in this study are built around abilities which are often discussed separately in this study, it must be remembered that these abilities are treated holistically in the workshops, and no claim is made that any ability can be taught in isolation from the rest. The rest of this section examines which language abilities, according to the literature, are necessary for science students to be successful in their studies.

In a study by Johns (1981), lecturing staff from the sciences (bio-science, engineering, mathematics and physical sciences) all considered receptive abilities (reading and listening) to be the most important for their students to succeed at university (with reading, on average, being considered the more necessary of the two). Writing was consistently viewed as the third most important ability. Speaking was, for most of the lecturers (with the exception of the mathematics department, where 8% of the staff found this skill important), considered not to be important at all (Johns, 1981).

The American Language Institute at the University of Southern California conducted a survey amongst students of all faculties to determine what language needs the students believed they had (Ostler, 1980). Reading texts obtained the highest score, with 95% of soft science and 100% of hard science[14] students believing they needed this skill. Reading journal articles was another ability that students believed they lacked, with 77% of soft science students and 53% of hard science students claiming they needed this. Taking class notes also rated very high, with 86% of both soft and hard science students citing this as necessary. Certain skills varied widely between soft and hard science students, for example, writing down a laboratory experiment (only 14% of soft science students felt this necessary, whereas 60% of hard science students believed this to be a crucial ability). Other skills that students found important were answering multiple choice and essay examinations, discussing issues, and asking questions. Clearly, the students identified reading as the most important ability necessary for them to successfully complete their studies, followed by writing (specifically writing for study purposes such as taking class notes), and then speaking abilities.

The literature in general seems to agree with Johns' and Ostler's studies that reading is the most important ability for a science student to acquire. UNISA (2006:53) also views reading abilities as paramount for science students:

> The ability to read with understanding, know the meanings of keywords and the ability to use the words in the correct context are vital skills that students must have. When a student does not have adequate reading skills and a limited knowledge of science vocabulary he or she will find it difficult to follow written text and even spoken lessons and tutorials. This will undoubtedly lead to stress which will impair his or her chances of success.

Phillips' (2004) study shows a strong correlation between reading abilities and performance in science. She also shows that explicit reading instruction improves students' performance in science, whilst students seem to be prevented from reaching their full potential in science because of poor reading abilities (Phillips, 2004). Though not proven statistically, Phillips' study also indicates that consistent reading contributes to an improvement in writing ability. She argues that students began imitating the style and structure of expository texts in their own writing after having read several well-written expository texts. She also claims that

[14] Both 'hard science' and 'soft science' students refer to natural science students. The distinction between the two groups is made by the authors.

students' spelling ability improved due to regular reading. This is merely one example of the crucial connection between abilities, and how improvement in one language area (e.g. reading) may result in an improvement in other language areas (e.g. writing).

According to Phillips (2004:23), "the study of Science relies heavily on word problems and explanations which in turn involve both general reading and vocabulary skills". The importance of both vocabulary and semantic knowledge (e.g. understanding the relationship between words and between parts of the text) for reading science texts, which she describes as containing an "information overload", is highlighted in Phillips' discussion of word problems. She states that for students to understand reading texts, they must have a sound knowledge of technical words (for example 'gravity'), academic vocabulary (for example 'exemplify'), and general words (for example 'cliff') (Phillips, 2004).

> In addition to vocabulary knowledge, word problems also demand semantic knowledge, (…). The student has to be familiar with the structure of the text as well as the conventionalised way in which word problems are presented. The student has to be able to understand the logical relations between phrases, sentences and paragraphs in order to grasp what is being presented in the text (...) Students also need background knowledge or a mental framework (schema) to interpret word problems. They have to learn to anticipate information and then place it in context when they are reading texts, especially expository texts. An inappropriate schema would lead to a misinterpretation of a word problem or statement (Phillips, 2004:25-26).

Though Phillips specifically discusses the reading and understanding of word problems here, the same can be said of any scientific text. "Because of their conceptual density, the reading of Science texts also requires attention to detail and accurate reading. Without precise reading, many important details in a scientific text could be overlooked by an unskilled reader" (Phillips, 2004:24). Rosenthal (1996) also argues that texts with particularly high reading levels and instructors speaking rapidly and using unfamiliar vocabulary tend to cause a lot of difficulty for EAL students. Though few first-year students in an academic literacy class are at the level of being able to cope with the complexity of texts they are expected to read, understand, interpret and synthesise with previous knowledge, students can gradually be helped to attain the required level if texts are properly 'scaffolded' (i.e., by using easier texts at first, and gradually progressing to more difficult texts, or by guiding students by means of increasingly challenging exercises – see, for example, Brown [1999]). Krashen (1992) stresses that language proficiency can only improve if students receive enough 'comprehensible input' – that is, if the messages or 'input' that students receive is just a little beyond their current level of competence. It is the task of the language classroom to scaffold texts for students, and to always provide them with texts just beyond their competency level, so as to continually stimulate and challenge them.

Regular reading and subsequent critical discussions (preferably led by a facilitator) achieve another very important outcome for science students. When students view information analytically, "they are cultivating the habit of a 'healthy skepticism' that [is] essential to the nature of science", since "[s]cience distinguishes itself from other ways of knowing (...) through the use of empirical standards, logical arguments, and skepticism [*sic*]" (Thier, 2005). Scepticism can, to some degree, be said to be definitive of science, and is an ability which must be fostered from an early stage in science students through intensive and extensive reading, and subsequent critical discussion and interpretation of such reading.

Students are unlikely to develop many of these reading abilities (and gain their accompanying advantages) on their own, especially if they are not regular readers. Phillips (2004) suggests that reading and vocabulary strategies should be explicitly taught. Apart from teaching students vocabulary and comprehension strategies, students should also be shown how scientists in the field approach a text. Berkenkotter and Huckin (1995) studied the reading strategies adopted by scientists, and found that there was a relatively fixed way in which most scientists would read a research article, namely firstly the title, then the abstract, then tables, graphs or pictures, then the results section and finally the content of the article. In addition, Bazerman (1985) demonstrates how reading techniques such as scanning have become completely automated for successful scientists. Phillips (2004) suggests that these strategies for reading scientific texts should be taught to students. In addition to the explicit teaching of reading strategies, students should also have enough opportunity to practise these abilities, so that ultimately the abilities will become automated, as is the case with successful scientists.
Clearly, the benefits of acquiring adequate reading (and accompanying vocabulary and semantic) strategies are invaluable. A word of caution is given by Pretorius and Bohlmann (2003) though, in a study on the impact of explicitly taught reading strategies on mathematics students' success. They believe that one should not have unrealistic expectations about the possible impact of a reading intervention programme in a short period of time. This is a skill that needs to be developed consistently over time.

This study does not focus on improving listening abilities. Many listening exercises in EAL course books focus on formal listening and consequent note-taking, which students in the

UNISA context seldom, if ever, need. Whatever listening abilities the students in this study need to acquire for their specific purposes, they would acquire through practice with fellow students. Moreover, one must remember that South African students are in a somewhat different situation than many other students having to learn science through the medium of English. South African students are not foreign language speakers, and hear English on a daily basis (in shops, at work, at school, and on television). Whereas foreign language speakers are often able to read and write before being able to listen to a foreign language effectively, South African students often have greater difficulty with acquiring adequate reading and writing abilities (possibly due to an inadequate primary and secondary schooling system), whilst they have more practise in listening and speaking than foreign language speakers generally have. It is specifically the abilities of writing coherently and reading critically that South African students, and UNISA students in particular, often still lack by the time they reach tertiary level.

Although writing is often not considered very important by science lecturers (Johns, 1981), and little extensive writing is done in science students' undergraduate studies (especially in their first year – see Chapter 3), it remains an important skill. It has been found that science students' learning is enhanced if they write about their thinking, since the very act of writing often integrates new ideas and previous knowledge (Fellows, 1993), thus ensuring more effective learning. Such synthesising is vital for all students, regardless of the amount of writing they need to do in assignments.

Though science students are generally not considered to do a lot of extensive writing in their undergraduate studies, even writing that is not considered extensive can be very complex. As mentioned in Section 2.5.2, most science students' assignments can be classified under the genre of the experimental report. "The scientific research report (...) is certainly one of the mainstays of the natural and physical sciences" (Jacoby *et al.*, 1995:352). A laboratory report, however, is by no means a straightforward writing task, as it "requires a complex mixture of writing skills such as summary, paraphrase, seriation, description, comparison and contrast, cause and effect, interpretation of data, analysis, and the integration of mathematical and scientific data into a text" (Braine, 1989:9-10; Braine, 1995:115). Thus, though science students may never need to write a descriptive essay, the ability to describe (and the same can be said of all the other abilities, such as paraphrasing, comparing and contrasting, etc.) is still vital for their writing purposes.

Another important writing ability in the sciences is summarising, and implicit in that, paraphrasing (Braine, 1995). Being able to summarise is possibly the most useful and relevant writing ability that undergraduate science students can acquire, since this can be used for summary assignments, as a study aid, and for more complex assignments where material needs to be summarised and incorporated into students' own arguments (Kirkland & Saunders, 1991). This is, however, a highly complex "reading-writing activity involving constraints that can impose an overwhelming cognitive load on students" (Kirkland & Saunders, 1991:105). To prepare students for this complex task, they could be trained to effectively underline, colour code or create mind maps or diagrams (Kirkland & Saunders, 1991). These abilities are an important point of departure for an adequate summary, but can also be used in isolation as studying techniques. One could even let students present oral summaries before writing these summaries. "Oral group activities seem to develop a greater awareness of the cognitive and metacognitive operations being used" (Kirkland & Saunders, 1991:115). Black cultures in South Africa traditionally come from an oral background, and thus students may also prefer first expressing themselves orally before going on to the written equivalent. This emphasises the importance of speaking abilities for science students.

Though the development of speech is rarely, if ever, an outcome in science classes, and seemingly not important to science lecturers (as shown by Johns, 1981), its importance should not be overlooked completely. As discussed in Section 2.4.3, Thier and Daviss (2002) distinguish between presentational speech and exploratory speech. "The importance of exploratory speech – what appears to be simple conversation – in science classes cannot be overestimated. We discover and sharpen our own ideas by talking about them and seeing how other people react, a crucial element of learning" (Thier & Daviss, 2002:76-77). Robinson (1980) states that ESP is generally thought to subscribe to the communicative approach. If communication is indeed necessary to acquire language and thinking abilities, then speaking is a vital ability for students to focus, organise and refine their thoughts. In addition, in a collaborative learning environment it is necessary to give students enough practice to orally negotiate meaning with fellow students.

Many of the abilities that science students need to acquire transcend the boundaries of the individual skills of reading, writing, speaking and listening. Thier and Daviss (2002) mention activities that students regularly engage in, for example: reading and following instructions on data sheets; reading and understanding informational texts; developing analytical skills;

participating in collaborative learning groups where information is primarily shared and co-constructed by means of speaking and listening skills; speaking to others to explain their understanding of a subject; and writing data sheets, reports, narrative procedures and persuasive documents. Students need to be guided in all of these activities, and be empowered to complete them through a mix of receptive and productive skills. Focusing on authentic academic tasks that students need to complete may be one way to accomplish the integration of abilities.

Rosenthal (1996) suggests that science lecturers need to explicitly teach their students to present arguments that are reasoned and scientifically acceptable. As Ballard and Clanchy (1991) point out, being able to construct an argument is not equally important in all cultures, and what lecturers might take for granted (i.e. students' ability to present an argument) might be a very foreign concept to the student. Rosenthal (1996) further argues that science students also need to be taught to take their audience into consideration, to provide evidence that is appropriate for scientific discourse, and to distinguish between relevant and irrelevant information. Furthermore, students need to acquire linguistic skills enabling them to define, identify, compare, differentiate, and classify– acts that Mackay and Mountford (1978) state scientists use often and are explicitly conscious of. These abilities show a strong similarity to Weideman's (2003a) definition of academic literacy, which is the blueprint for the Test of Academic Literacy Levels (the pre- and post-test used in the present study). This definition is discussed more fully in Chapter 3. Murcia (undated:10) argues that science students should be made aware of the fact that science keeps changing through the process of research and critical questioning, and that "observations of the world are made from a personal perspective built up by prior knowledge, beliefs and theories". Students should also be able to make "connections within the discipline and with larger social problems and endeavours" (Murcia, undated:10). Using more generic texts within a scientific discipline could potentially help students to deal with the issue mentioned above, as students from various disciplines could give input on such topics, ensuring a wider variety of viewpoints. Murcia (undated) also suggests that students should be made aware of the relationship of science with society – specifically the ethical dimensions associated with such a relationship – to ultimately become accountable professionals.

Students further need to be made aware of how their lecturers are likely to evaluate them (as Spencer [2007:311] states, students are entitled to "clear, apt, polished and consistently applied teacher criteria in grading work and models that exemplify standards"), and be supported to develop strategies to improve in the areas their lecturers view as most important[15]. Johns (1991) found that lecturers from engineering and science departments ranked criteria for student evaluation different from how English lecturers would rank such criteria. The engineering and science departments believed that quality of content was paramount. After that, they found the following important, in this order: assignment requirements, addressing the topic, development of ideas, paper organisation, overall writing, paragraph organisation, sentence structure, punctuation / spelling, and finally vocabulary range. For them, global features were thus much more important than local ones.

For an ESP course to be fully responsive to students' needs, it also needs to take student preferences into account (these are the 'wants' that are discussed in Chapter 3). Students generally have at least some idea of what they need and want to learn to be successful in their courses. For example, in a study by Bridgeman and Carlson (1984), students had a choice among ten writing samples. Engineering and science students clearly preferred the topic on describing and interpreting a graph or chart. This shows both an awareness of and a preference for the type of writing that they might be required to do in their studies. An ESP curriculum should take such preferences into account. One way of doing this could be by doing a needs analysis with the students at the beginning of a course, and to incorporate students' perceived needs with those shown by means of other measures (for example, an academic literacy test) into the curriculum. These other measures are vital because, as shown by Coetzee-Van Rooy and Verhoef (2000), students often have inaccurate perceptions of their own English proficiency levels, and therefore it is vital to investigate students' English proficiency from various perspectives.

Finally, White (1988:35) argues that students need to be informed "about the linguistic structures that constitute 'science'". Coffin and Hewings (2003:46) agree:

> [S]tudents have greater control over their writing if they are helped by lecturers to develop an explicit awareness of how different disciplines employ different text types and how these text types construct and represent knowledge (both through their text structure and through their use of register)".

[15] Unfortunatly, as Louw (2006) shows, lecturers very rarely provide such feedback, and often seem so overwhelmed by the plethora of surface errors that they tend to ignore textual organisation as well as students' writing strengths. Students, on the other hand, are often confused by, unable to use, and uncertain of the purpose of feedback.

If this is not done, they will have difficulty with understanding the subject, and will not have the linguistic resources necessary to critique such knowledge.

Whether or not grammar should be taught has been a matter of controversy in linguistic circles. Ellis (2006:84) defines grammar teaching as involving "any instructional technique that draws learners' attention to some specific grammatical form in such a way that it helps them either to understand it metalinguistically and/or process it in comprehension and/or production so that they can internalize it".

Most researchers agree that "a traditional approach to teaching grammar based on explicit explanations and drill-like practice is unlikely to result in the acquisition of the implicit knowledge needed for fluent and accurate communication" (Ellis, 2006: 102). As a reaction against such traditional grammar teaching, theorists such as Thompson (1969) and Krashen (1981) have argued that grammar instruction does not play any role in language acquisition. According to Krashen, learners would automatically internalise important structures, as long as sufficient comprehensible input (language just above their current proficiency level) is provided. While subsequent studies (such as White, Spada, Lightbown & Ranta, 1991) have shown that instruction does not necessarily guarantee language acquisition, other studies such as Ellis (2002, 2006) have indicated that instruction at least contributes to learned as well as acquired knowledge. Although there is enough evidence indicating that learners learn a lot of grammar without having been instructed in it, students cannot learn all grammar on their own; in fact, recent direct and indirect evidence supports the teaching of grammar (Ellis, 2006), and consequently "there is now much more enthusiasm (...) for the idea that conscious grammar (resulting from formal teaching) could have the useful benefit of improved writing" (Hudson, 2001:1). Burgess and Etherington (2002) agree, saying that grammar is an essential component of both language learning and language use. It is not only researchers who are enthusiastic about teaching grammar as part of a language learning syllabus; students as well as teachers also indicate that poor grammar is an obstacle to adequate writing and believe this to be an essential part of language learning (Burgess & Etherington, 2002).

There are two types of grammatical knowledge, namely explicit knowledge ("facts that speakers of a language have learned" [Ellis, 2006:95]) and implicit knowledge ("procedural, [unconsciously held] knowledge, [which] can only be verbalised if it is made explicit [Ellis, 2006:95]). Although theorists still debate whether "explicit knowledge has any value in and of itself, it may assist language development by facilitating the development of implicit knowledge" (Ellis, 2006: 96), and in that carries enough value to justify the instruction thereof.

Though many researchers would agree that some explicit grammar teaching is necessary for fluent writing and speaking, it is important to take early research (indicating that grammar teaching does not lead to grammar acquisition) as a warning that any grammar teaching would not be better than no grammar teaching (Hudson, 2001). The way in which grammar teaching is dealt with should be based on careful consideration.

Hudson (2001) suggests that grammar exercises should concentrate on the production of language, rather than focusing purely on the grammatical form. He further suggests that the underlying theory of grammar should be made clear, without focusing too much on grammatical terminology. Hudson (2001:3) quotes various studies that support such "modern grammars" as opposed to more "traditional ones". Burgess and Etherington (2002) argue that teachers prefer to present grammar by means of discourse-based approaches, using authentic texts and a communicative approach. The workshop material used in the present study also incorporates grammar at various sections, though only to support students in improving their writing abilities, and therefore almost always in context.

Finally, it is important to note that students are unlikely to acquire all of the structures of English necessary for their studies if they do not become fully aware of what science lecturers find most important and expect of them. Language teachers must explicitly teach students language functions, explain expectations, and finally give students enough opportunity to practise and internalise any skills or rules necessary for them to make a success of their studies.

2.6 Conclusion

This chapter started by defining academic literacy as the reading, writing and thinking abilities necessary to succeed in a tertiary environment. It has been argued that language development courses should be situated in the context of a tertiary environment, and that it is necessary for students to acquire the discourse of the academe to be accepted into, and be successful in, this 'new culture'. Academic literacy might be acquired naturally by some students – often students who already have an adequate basic proficiency in a language find it easier to acquire the conventions of academic language. However, most South African learners need guidance and even explicit instruction in acquiring the level of academic literacy necessary to succeed in a tertiary environment. Where both first and additional language speakers internationally enter tertiary institutions without being sufficiently academically literate to succeed in their studies, this problem is even more pronounced in South Africa, where the majority of first-year students speak English as a second, third or fourth language. In addition, these students often do not have the literacy and cognitive abilities necessary to function at tertiary level in their mother tongues, much less in English. As argued in Section 1.1.1, throughput rates at South African universities are disturbingly low. This is particularly problematic in South Africa, where there is a widespread shortage of qualified professionals in fields such as information technology and engineering, as well as in technological and technical occupations. Since a low level of academic literacy is commonly accepted as being a major factor in low throughput rates, the hope is that explicitly teaching students reading, writing and thinking abilities would improve their levels of academic literacy, and that these abilities would ultimately transfer to students' other subjects.

It is necessary for academic literacy courses to focus on both fluency and accuracy in language, since it is the combination of these that is needed in 'real-life' situations that students find themselves in (i.e. situations outside of the classroom). Important aspects that need to be addressed in academic literacy courses are students' reading abilities and their writing abilities (a process through which students consolidate knowledge, formulate ideas and construct meaning), with an emphasis on low frequency words.

Teaching academic literacy is particularly difficult in an ODL institution. Firstly, acquiring language proficiency in isolation is very difficult, since language is generally considered a socially mediated process – one where learners need to have contact with teachers (or tutors) and fellow learners. Other challenges include that there are rarely stable groups of students in ODL (as opposed to traditional learning, where there are constant and fixed classes), and that many ODL students, especially in South Africa, come from a lower socio-economic background than those studying at residential institutions. A combination of these factors makes it very difficult for students to work independently, with only very superficial engagement with the institution. One way of transcending such superficial engagement is to establish contact between student, teacher and institution in some way, preferably through contact classes.

An important strategy in acquiring academic literacy is collaborative learning. Many tertiary institutions rely on formal lectures, yet it has been proven that students learn better if they participate in, and actively contribute to, their own learning. In addition, they are more likely to learn better if they find the learning enjoyable – something which is more probable if they participate in their own learning. Collaborative learning seems to be particularly beneficial to black South African students, who often prefer a more collaborative learning style due to their cultural background. By means of collaborative learning, the abilities of reading, listening, writing and speaking can be integrated effectively. Collaborative learning has the potential of providing quality education for large classes. This is something that has been notoriously difficult to accomplish with mere learner-teacher interaction. Collaborative learning therefore holds the potential of improving students' success rates in subjects, increasing motivation and self-confidence, developing a critical perspective, and improving teamwork and social relationships. Although students learn well from each other in groups, an authority figure is still important to regulate and lend legitimacy to the learning process.

English for Academic Purposes (EAP) refers to English language proficiency courses taught at educational institutions. By acquiring language in the context of the academe, students are empowered to challenge this environment, i.e. to question existing knowledge from within the specific field of study. The language and cognitive skills acquired in such classes are specific to the context of academic study, as opposed to those learned in a normal English course (with the sole purpose of learning the language).

English for Specific Purposes (ESP) aims at helping students to learn English so as to be more successful in their specific field of study or work. The argument is that students will acquire language more successfully if it is learned within a very specific discourse community. Since ESP courses focus on a specific group's needs, it should ideally be 'tailor-made' to suit each individual group. The greatest justification for ESP courses is that they improve student motivation, in that the material that is used is likely to be similar to texts that students encounter in their studies of mainstream modules and that the type of tasks in the ESP course would also be similar to those students are expected to do in their other courses.

An ESP course that is 'tailor-made' for a group of students would ideally be designed to be directly applicable to the rest of their studies. Though the material in an ESP course cannot always be material taken directly from the texts used in students' other subjects, the main concern with material in an ESP course is that it must be relevant – students must see the relation between the abilities they practise in the ESP course and their other subjects.

The ESP model supported by the current study is the common-core approach, where students from similar courses (in this case, science-related courses) are grouped together, and material or topics from general interest areas are drawn upon, rather than focusing on one specific subject. Texts of a semi-technical nature are used, which provide practice in the abilities, structures and semi-technical vocabulary that students are likely to encounter in their specialist studies.

As far as elements of an ESP course are concerned, it is essential to incorporate reading, writing, speaking and listening activities. It is important to determine the type of, for example, writing activity that students are likely to encounter in their studies, and to take this into consideration when designing an ESP course. It is also advisable to include a wide variety of texts when designing such a course, so that students can become experienced in how such texts are constructed in their discipline. The research seems to imply that writing, speaking and listening abilities should ideally follow reading activities. Vocabulary is also very important in ESP courses, although it seems that sub-technical vocabulary poses more problems to students than technical vocabulary. Other abilities that students need to acquire are prewriting, planning, organising, synthesising and analysing texts. These abilities encapsulate, but also transcend the individual abilities of reading, writing, speaking and listening. Though it is not possible or desirable to always focus equally on reading, writing, speaking and listening abilities in an ESP class, it is necessary to remember that these abilities are integrated, and should not be practised in isolation from the others.

English for Science and Technology (EST) is the branch of ESP that the current study is based upon. Whilst science-related subjects are already difficult to master at tertiary level, they are even more difficult if students are at the same time still acquiring proficiency in English, the main language of tertiary education in South Africa, and the major *lingua franca* of the scientific world (Graddol, 2006). A lack of English proficiency can be a major impediment even for students who have adequate science and mathematics abilities.

Language is vital in the field of science. Scientific fields such as chemistry, engineering, physics and mathematics are mainly studied in English throughout the world. For scientists to continually maintain and expand the field of science, they need to master the language that makes this possible. Furthermore, they need to be able to 'translate' their scientific findings into understandable English, for those findings to be of any worth to the wider community. In addition, language and science abilities seem to complement and strengthen each other, and an improvement in language often leads to an improved ability to understand and express scientific ideas. Exposure to both language and science improves students' reasoning skills, and these can thus be seen as reciprocal abilities. Unfortunately, although a thorough command of English is essential for science students, few subject-specialists have time to devote to language learning. Therefore, EST courses should be a vital part of any science curriculum.

EST courses can be justified by the unique characteristics of scientific discourse. Scientific texts are particularly difficult in that they are generally very dense, and information is rarely repeated or paraphrased in them. They usually contain large amounts of conceptually complex factual information. Because they are often so conceptually complex, they must be clearly written, so as to be more easily read. They must be precise, clear and objective. The formal nature of scientific texts often leads students to the impression that their own thinking is not important, and that they are required to regurgitate someone else's ideas. Scientific discourse is linear and inductive. It also has certain grammatical characteristics such as frequently being written in the passive voice, and generally using the present tense. The style is always impersonal, with a preference for quantitative descriptions. Semantic discourse markers such as conjunctions are frequently used. Though scientific language is not a language separate from English, it does contain various linguistic features that students must be made aware of, together with the reasons why these features are preferred.

Research indicates that, although the abilities of reading, writing, speaking and listening cannot be separated, science students do rely more strongly on some of these abilities than on others. The most important ability, identified by both students and researchers, is reading. In addition, a knowledge of vocabulary is strongly related to reading. An effective strategy for helping science students deal with complex texts is to scaffold such texts in an EST class. Ideally, these texts should be just beyond the students' competency level so as to ensure their continued interest. It is important that students are taught reading and vocabulary strategies, and to give them enough time to practise both of these regularly. However, it is also important to remember that these abilities cannot be fully developed in a short period of time – they need to be developed consistently over time. Thus, a one-year academic literacy course might not be enough to help students master sufficient reading and vocabulary strategies. The second important ability seems to be writing skills, specifically being able to summarise and paraphrase effectively. Teaching students to take notes by means of, for example, annotating and mind mapping can prepare students for the more complex task of summarising. Speaking abilities are also important for science students, though less so than reading and writing abilities, since speaking to other students often helps students to refine their ideas and explore alternative solutions to problems. Listening effectively, though seemingly the least important of the four basic language abilities, is related to speaking, and forms the basis of effective communicative education.

In EST classes, students not only get to engage in more authentic writing tasks, but they also get the opportunity to discuss subject matter information, an experience that in the context of the current study, namely distance education, is a very rare one indeed.

A successful ESP course, and more specifically EST course, should take all of the above into account. The next chapter describes the target group of the current study in detail, and explores the group's language needs.

CHAPTER 3 Needs analysis

3.1 An analysis of student needs

The previous chapter discussed the concepts of English for Academic Purposes (EAP), English for Specific Purposes (ESP) and English for Science and Technology (EST). It also focused on the typical elements of such courses. The point was made that, ideally, each ESP course should be adapted to the specific group of learners it is intended for.

This chapter focuses on a needs analysis of the current study's participants, so as to determine which aspects would be most important to these learners in an ESP course. The analysis emphasises three critical aspects. Firstly, the target group is analysed. This includes a description of the demographics of the target group as well as their language needs. Secondly, the type of assignments done by UNISA natural sciences students in their first year is analysed. This analysis focuses specifically on applicable subjects in the Science Foundation Programme (SFP). Certain categories of language and reasoning skills required for assignments are identified. Thirdly, an analysis is done of students' Test of Academic Literacy Levels (TALL) pre-test results, and inadequacies in students' academic literacy are identified. The areas of weakness in students' academic literacy, in addition to the type of language skills required from students for assignments in credit-bearing courses, are subsequently used to critique the intervention programme used in this study.

According to Hutchinson and Waters (1987), three important questions should be asked in the process of developing a syllabus for an ESP course: what do learners need (necessities), lack (according to others) and want (according to themselves)? In the current study, an already developed set of workshop materials was used. The study aims at determining whether the existing workshop materials are suited to what students need, lack, and want. Learners' needs are established through an analysis of several subject assignments, and what they lack is established through the TALL. Students' wants are taken into account by analysing a questionnaire that the participants in this study completed. This questionnaire was only completed at the end of the year in which the intervention took place. It is therefore only discussed in the next chapter, and used as a tool to suggest improvements for subsequent workshop redevelopment. In addition to these information gathering techniques, observations from the previous year's SFP workshops, as well as conversations with lecturers, were used to determine what students needed, lacked and wanted. Coetzee-Van Rooy and Verhoef's (2000) advice, that students' English proficiency levels must be investigated from many perspectives, is followed here, since students have shown to have unrealistic beliefs about their own proficiency levels.

Using a variety of information gathering techniques ensured triangulation, which can be defined as "the use of two or more methods of data collection in the study of some aspect of human behaviour" (Cohen, Manion & Morrison 2007:141). According to Jick (1979), "multiple viewpoints allow for greater accuracy". Thus, using several methods of data collection for the current study meant that the information was more likely to be reliable, as relying on only one source could provide skewed information about students' needs.

3.2 Target group analysis

Since every group of students is likely to have diverse needs, it is often necessary to create material for each different ESP group. As Kennedy and Bolitho (1984:22) point out, "[t]he more specific the learners' needs are, the less likely they are to be met by published material". For this reason, the students who chose to attend the SFP workshops were described by examining the demographics of the target group as well as students' language needs. Information was collected by accessing the UNISA student information system (to gather information about demographics) and by examining samples of student assignments and examinations (to find out more about their language needs). Informal conversations with students also contributed to the collection of information. To effectively describe the target group, a target situation analysis framework was used.

The target situation analysis was originally conceived by Hutchinson and Waters (1987), and consists of the following considerations: why the language is needed; how, where and when the language will be used; what the content areas will be; and who the language will be used with.

This framework, however, seems to disregard several questions thought to be important to form a broader picture of the type of student who attends an ESP course, so as to more adequately adapt such a course to learners' needs. Additional considerations would include what the ages and distribution of males and females in the student population are, whether the students are first or additional language speakers, how proficient they are in the target language, and what their schooling background is.

Therefore, for the purposes of the current study, Hutchinson and Waters' (1987) target situation analysis is expanded to include the following questions:

- What is the average age of the student population?
- What is the distribution of males and females?
- What is the distribution of first and additional language speakers?
- What is students' schooling background?
- How proficient are students in the language of learning/training (i.e. English)?
- What will the content areas be?
- Why is the language needed?
- Who will the learner use the language with?
- Where will the language be used?
- How will the language be used?
- When will the language be used?

A discussion of this framework follows in Sections 3.2.1 and 3.2.2. The framework is divided into two broad categories, namely **the demographics of the target group** and **the language needs of the target group.**

3.2.1 The demographics of the target group

It is important to have a broader picture of the demographics of a group before developing appropriate course material. The average age, distribution of males and females, as well as students' educational background can influence the type of exercises used in course material, as well as the type of texts selected. In a study by Spoon and Schell (1998), for example, the majority of adult ‘basic skills’ students preferred a teacher-centred learning style, as opposed to younger students who tended to be more learner-centred. Although a focus on the demographics of the target group is not included in Hutchinson and Waters’ (1987) target situation analysis, it is included in this section.

The oldest student to attend the workshops on a regular basis was 52 years old, and the youngest student to attend the workshops regularly was 17 years old. The average age of students attending the workshops was 23 years. Although the mean age is somewhat higher than it would be at a residential university, the majority of students are still relatively young, and unlikely to have reached a stage of maturity where they could be optimally successful in a distance learning environment (see, for example, Souder [1993], Buchanan [1999] and Diaz [2002]).

Approximately twice as many males as females attended the workshops. Of the 21 students who attended more than seven workshops (and wrote both pre- and post-tests), 13 (65%) were male and 7 (35%) were female. This does not, however, reflect the total UNISA registrations for the subjects that were targeted in these workshops. In 2009, a total of 49.6% of the students registered for the subjects analysed in this study were female, and 50.4% were male. Therefore, no significant deductions can be made from the spread of male and female students attending the workshops.

The students attending the workshops were, without exception, additional language speakers of English. The majority of learners were South African citizens. Only two students who attended the workshops regularly came from other African countries, and no students came from outside of Africa.

From informal conversations with students, it transpired that the students generally come from an impoverished schooling background, more often than not with teachers who themselves are not fully proficient in English. They are generally used to a more teacher-centred teaching methodology, but as Chapter 2 shows, are likely to enjoy a more collaborative methodology, due to their cultural background and values. The qualitative questionnaire completed by students (discussed further in Chapter 5) confirms their preference for a collaborative learning environment.

Growing up in South Africa (as the majority of them did), they seem to understand conversational English well (often communicating in English in shops, with friends speaking other languages, and hearing it on television), and even speak it quite fluently, but they generally lack critical reading and writing abilities, as could be seen early on in the workshop series after several reading and writing tasks were completed. Almost all of them recently completed their secondary education, and few have completed any degrees or other short courses before this year. Thus, the subject knowledge that the average attendee of these workshops had was that of a school leaver. As they chose to study sciences, one could surmise that all of the participants have at least some interest in subjects that are scientific in nature.

3.2.2 The language needs of the target group

Before developing effective material for an ESP course, students' language needs must be taken into account.

All students who participated in this study are first-year undergraduate Science Foundation Programme students. Their greatest need for having mastered the target language to an adequate level is therefore to use their language ability in order to study successfully in a wide range of science-related fields. During their studies, students will have to write assignments and examinations, read study material, and take notes. Since students do not always realise the extent to which they use language in their studies (or the true level of their language proficiency; see Coetzee-Van Rooy and Verhoef [2000]), they are not likely to be motivated by a generic language course, as its application to their studies might not be clear (this emerged from informal conversations with students, as well as from the questionnaires discussed in Chapter 5). They are, however, more likely to be motivated by acquiring language skills in the context of the sciences, where clear relations can be seen between the language course and their studies after every workshop.

Since learners will make use of the language to communicate to both lecturers and students, they have to be able to function on different levels of formality in terms of language usage. Furthermore, the language is likely to be used both for individual work as well as in group contexts: during workshops, tutorials, at home or at the library, when writing assignments or examinations. Again, depending on the context they find themselves in, students must be able to switch their level of language formality. During workshops and when taking notes, for example, more informal language may be used, whereas very formal language must be used when writing assignments or examinations. In addition, students must be able to express themselves clearly when both writing and speaking. Since the language will be used not only during the ESP course, but also later on in their studies and in their future professions, the abilities that students acquire during the workshop programme must be solidified into their language usage to such an extent that they still remember and build on these abilities in years to come. One method of achieving this is to ensure that acquired abilities are reinforced regularly during the workshop series.

In addition to determining why, where, when and how students use language in their studies, it is important to determine what motivates students to attend language workshops. In this study, the workshops were voluntary. Students attended them either to improve their academic literacy for use in their studies, or specifically to get better marks for an English course many of them have to take in their first year (though the workshops and the English course are unrelated). No students were forced to attend the workshops. Students are often motivated through external reasons (or instrumental motivation) to study a literacy course - the most significant reason is for good marks (or at least a pass, so as not to be required to repeat the course again the next year). Such motivation, however, could be argued to be less desirable than what Hutchinson and Waters (1987:48) term 'integrative motivation', a motivation that "derives from a desire on the part of the learners to be members of a speech community that uses a particular language"[16]. It is an internally generated *want* rather than an externally imposed *need*. Most students attending these workshops did so for both of these reasons. Many merely wanted more help with their English abilities so as to pass their English course. Others (many of whom did not take this English course) were motivated purely by a desire to improve their literacy abilities.

Now that the target group has been described more comprehensively, it is important to understand what literacy abilities students lack. This is discussed in the following section.

[16] See Footnote 11 on page 45 for a discussion of this controversial topic. Again, in the context of this study, the implication is not that students wish to replace their own culture with that of the discourse community they are entering. Rather, the researcher believes that it is a desire to gain access to additional discourse communities that motivates students to acquire an additional language, and that access to additional discourse communities will empower, rather than disempower, students in the academe.

3.3 Analysis of the TALL

To analyse students' academic literacy strengths and weaknesses, an academic literacy test – the Test for Academic Literacy Levels (TALL) – was used. The TALL has been developed collaboratively by the University of Pretoria, the University of Stellenbosch and North-West University. It was developed because other available academic literacy tests were seen as insufficient (Van Dyk, 2004), especially in the South African context. This test was chosen for the current study because of its high reliability (an alpha-measure of 0.92 across several versions) (Weideman, 2006). The TALL of 2007 comprised solely of multiple choice questions.

The blueprint for this test is based on the following definition of academic literacy. In order to study successfully at a tertiary institution, students should be able to:

- understand a range of academic vocabulary in context;
- interpret and use metaphor and idiom, and perceive connotation, word play and ambiguity;
- understand relations between different parts of a text, be aware of the logical development of (an academic) text, via introductions to conclusions, and know how to use language that serves to make the different parts of a text hang together;
- interpret different kinds of text type (genre), and show sensitivity for the meaning that they convey, and the audience that they are aimed at;
- interpret, use and produce information presented in graphic or visual format;
- make distinctions between essential and non-essential information, fact and opinion, propositions and arguments; distinguish between cause and effect, classify, categorise and handle data that make comparisons;
- see sequence and order, do simple numerical estimations and computations that are relevant to academic information, that allow comparisons to be made, and can be applied for the purposes of an argument;
- know what counts as evidence for an argument, extrapolate from information by making inferences, and apply the information or its implications to other cases than the one at hand;
- understand the communicative function of various ways of expression in academic language (such as defining, providing examples, arguing); and
- make meaning (e.g. of an academic text) beyond the level of the sentence.

(Weideman, 2003a: xi).

The designers of the TALL argue that this definition is based on an open and interactive view of language, rather than a restrictive, grammar-based one (Weideman, 2006).

The test was written before the intervention started (pre-test), as well as after the intervention ended (post-test). The results discussed in this section are only those of the pre-test, which served to identify the literacy abilities that students lacked. The post-test results are discussed fully in Chapter 5.

This test was analysed according to certain categories of academic literacy, and the main weaknesses and strengths in students' academic literacy were identified. The results of 46 students were used, since only students who wrote both the pre- and the post-test were considered for this analysis. The sample size exceeds the number of 30 which Cohen *et al* (2007) describe as the minimum for useful statistical analysis. On average, students obtained 26.98% for the test. The highest mark was 70%. Except for this mark, only one student managed to obtain more than 50%, with a mark of 59%. The lowest mark was 2%, with the second and third lowest marks at 14% each. If these students had studied at the University of Pretoria, everyone who scored below 55% would have been classified as at-risk, which means that only two students would have been considered not at risk.

The abilities tested in the TALL were categorised as follows:

Main sections in the test	**Abilities tested**	**Number of questions / 65**	**Number of marks / 100**
Section 1: Scrambled text	Relations between parts of a text, logical sequence of a text	5 questions	5 marks
Section 2: Interpreting graphs and visual information	Understanding basic numeracy (including percentages and fractions), identifying trends	8 questions	8 marks
Section 3: Text types	Understanding the difference in style, register and tone of different texts	5 questions	5 marks
Section 4: Understanding texts	Comprehension, understanding connotations, understanding relationships between ideas, inferencing, distinguishing between essential and non-essential information	22 questions	48 marks
Section 5: Academic vocabulary	Understanding academic vocabulary in context	9 questions	18 marks
Section 6: Text editing	Understanding words in context, understanding sentence structure	16 questions	16 marks

Table 3.1 Academic literacy abilities tested by the TALL

The following table presents students' results broken down into the various test sections:

Test section	**Average percentage**
Section 1: Scrambled text	34.35%
Section 2: Interpreting graphs and visual information	34.78%
Section 3: Text types	33.48%
Section 4: Understanding texts	31.66%
Section 5: Academic vocabulary	18.12%
Section 6: Text editing	15.76%
TOTAL AVERAGE MARK	**27.15%**

Table 3.2 Results of target group's academic literacy abilities

Clearly, students were extremely weak in all of these areas. Even the section on 'Interpreting graphs and visual information', that one would expect the SFP students (who all had mathematics and/or science in secondary school) to do very well in, received very low results (an average of 34.78%) – this is, however, the section in which students fared the best.

The results of the test show that the participants need to significantly improve in all of the academic literacy areas identified by the TALL for them to have less risk of failing at their studies. Chapter 5 discusses the improvement in each of these areas, which was determined by comparing the pre- and the post-tests.

To identify which of these skills are most important for the UNISA SFP students, an analysis of a sample of their assignments was done. This analysis is discussed in the following section.

3.4 Analysis of assignments

In 2006, the UNISA Science Foundation Programme comprised of 17 subjects, namely:

1. Agriculture 1: Production Economics and Management (AME1015)
2. Nature Conservation 1: Animal Studies (ANS101T)
3. Agriculture 1: Animal Nutrition (ASA102M)
4. Biology 1 (BLG111H)
5. Mathematics 1: Precalculus A (MAT110M)
6. Chemistry 1: General Chemistry (CHE101N)
7. Computer Science 1: Introduction to Programming (COS111U)
8. Geography 1 (GGH101Q)
9. Nature Conservation 1: Resource Management (HBB121R)
10. Mathematics 1: Precalculus B (MAT111N)
11. Engineering 1: Mechanical Engineering Drawing (MED161Q)
12. Animal Health 1: Anatomy and Physiology (PAH131S)
13. Physics (PHY104-9)
14. Nature Conservation 1: Plant Studies (PSO141Q)
15. Mathematics 1: Mathematics for Mining (WIM131U)
16. Zoology 1: Animal Diversity: ZOL121Q
17. Botany 1 (BOT121U)

Assignments of 6 of the 17 subjects were examined to determine which skills students needed most to successfully complete these subjects. The subjects that were analysed were:

1. Animal Nutrition: ASA102M
2. Animal Studies 1: ANS101T
3. Botany 1: BOT121U
4. General Chemistry A: CHE101N
5. Production Economics and Management: AME1015
6. Resource Management 1: HBB121R

The sample was chosen based on the appropriateness of assignments. Some subjects were disregarded for reasons such as:

- assignments requiring only calculations or drawings, for example Mathematics (MAT111N) and Mechanical Engineering Drawing (MED161Q);
- assignments comprising solely of multiple choice questions, for example Geography (GGH101Q). These were disregarded because the multiple choice questions tested

only knowledge, and no higher order abilities (as defined in Bloom's taxonomy [see below])[17]; and

- assignments not being available in the tutorial letter, for example Physics (PHY1049) and Biology (BLG111H).

Previous studies (such as Braine, 1995) have categorised science students' assignment types under the following headings: 'Summary', 'Reaction', 'Experimental laboratory report', 'Experimental design report', 'Case study', and 'Research project'. The use of the same categories was, however, not possible for the current study, since first-year students were not required to do any of the more 'extensive' writing tasks that these categories require. The most extensive writing that was ever expected of students was answering short questions. The longest piece of writing required of students was one paragraph. Thus, the abilities that students needed in order to complete assignments successfully had to be categorised differently.

The following eight abilities were identified:

1) Writing definitions
2) Naming / listing points
3) Answering true/false questions
4) Explaining
5) Comparing / contrasting
6) Illustrating / drawing sketches
7) Drawing tables or graphs
8) Categorising / ordering

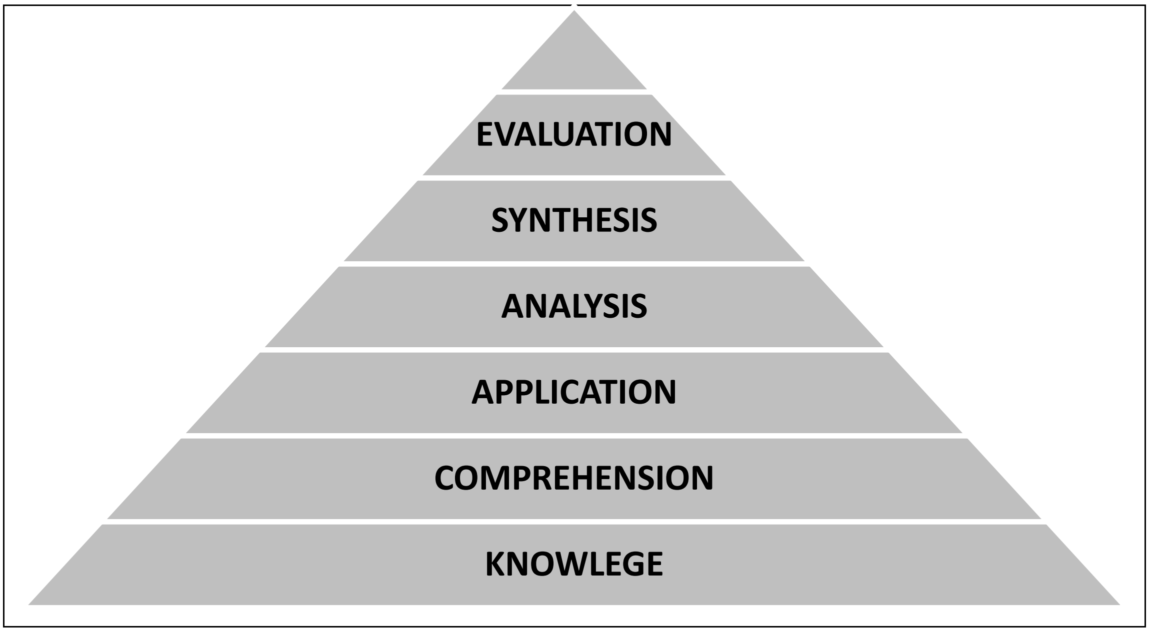
These abilities were chosen based on how frequently they were required in students' assignments.

To further categorise these abilities, Bloom's taxonomy was used. Bloom's taxonomy can be divided into three domains of learning, namely cognitive (knowledge), affective (attitude) and psychomotor (manual and physical skills) (Clark, 2004). In looking at students' assignments, it is useful to examine the cognitive domain more closely, to determine at what

[17]Although it is possible for multiple choice questions to successfully address higher order cognitive abilities, none of the multiple choice questions examined in these assignments did so.

level of Bloom's taxonomy first-year UNISA students are mostly required to function. Determining the level(s) (as described by Bloom's taxonomy) on which students are required to operate aids, firstly, in categorising the types of tasks students are expected to complete in their studies. Once this has been determined, suitable academic literacy material can be developed to address the appropriate levels students need to function at. A second advantage of categorising student task types according to Bloom's taxonomy is that more insight is gained into the cognitive skills expected of UNISA first-year students. Bloom's taxonomy can be represented as follows:

Figure 3.1 Bloom's taxonomy (Adapted from the University of South Australia [UniSA], 2006)



The first level of the cognitive domain is that of 'knowledge'. This is the most elementary level, requiring the lowest level of cognitive skills (May & Palmer, 2004). At this level, students are merely required to recall information (Clark, 2004). This is often possible through rote learning, where little comprehension is necessary. The first three abilities according to which students' assignment questions were categorised (namely 'defining', 'naming / listing', and 'true/false' questions) would fall under this level.

'Comprehension' is the second level of the cognitive domain. At this level, students are required to understand the meaning of information (Clark, 2004). This is usually best displayed when stating the problem in one's own words, thus the abilities of paraphrasing and summarising are very important here. Of the eight categories identified in students' assignments, the categories that best fit under the comprehension level are 'explaining' and 'comparing/contrasting'. It must be noted that the abilities of comparing/contrasting could also be categorised under either of the next two levels, namely 'application' or 'analysis'. However, the level at which students were required to compare and contrast information in these assignments seemed to fit best under the 'comprehension' level.

The third level of the cognitive domain at which students are expected to function is the 'application level'. At this level, students should be able to use a concept in a new situation (Clark, 2004). Abilities that can be categorised under this level are those of illustrating and drawing graphs and tables.

The fourth level of the cognitive domain, namely 'analysis', requires students to separate information into component parts so as to understand its organisational structure (Clark, 2004). The only ability identified in the assignments analysed in this study that falls under this level is that of categorising or ordering.

The fifth level of the cognitive domain is 'synthesis'. At this level, students must put parts together to form a whole. There is an emphasis on creating new meaning, or at least a new structure (Clark, 2004). This level was identified in only one question of one assignment examined in this study.

The final level of the cognitive domain is 'evaluation'. Here, students must make value-judgments about ideas (Clark, 2004). Again, this level was only identified in one question amongst all the assignments analysed in this study.

3.4.1. Science Foundation Programme (SFP) assignments analysed according to Bloom's taxonomy

Mainly the first four levels of Bloom's taxonomy, namely 'knowledge', 'comprehension', 'application' and 'analysis', were evident in the SFP assignments analysed for this study. A discussion of all the levels of Bloom's taxonomy, together with examples from students' study guides, follows.

3.4.1.1 Knowledge

The cognitive level that is drawn on most frequently in the assignments examined in this study is the 'knowledge' level. 'Defining' was the ability that was needed most regularly in a wide variety of subjects. One assignment specified that concise definitions were necessary, and several assignments required a definition and an example to illustrate the definition. According to Bloom's taxonomy, definition is a lower-order skill. Yet, for students to write clear, concise and complete definitions, it is important that they are able to identify the main points of an issue and use correct sentence grammar. For additional language users, these are not always easy abilities to acquire. Another ability drawn on in most of the assignments is that of naming/listing. Five of the six subjects' assignments required students to complete questions that would fall under this category; however, questions requiring this ability were not very frequent in these five assignments. One of the five subjects analysed contained true/false questions[18]. To answer these questions successfully, as is the case with the multiple choice questions that students were often required to do in their first assignment, students need to be able to implement the reading strategies of scanning, skimming and reading in detail.

Examples of questions that would fall in this category are the following:

- Define the following terms. Illustrate your answer with a suitable example in each case.
  (i) valence electron
  (ii) isotope
  (iii) p-orbital
  (CHE101N – Question 2c)

- Briefly list the relevant points that have to be taken into account when simple random test sampling is used, and state its application.
  (HBB121R – Section B, Question 1a).

- Mark the correct block (…) to indicate whether the following statements are **true** or **false**:
  Malarial organisms belong to the phylum Apicomplexa. (…)
  (ANS101T – Assignment 1, Question 1)

[18] Although various reading strategies are necessary to answer true/false questions correctly, the inclusion of these at Higher Education level is problematic, as students have a 50% chance of being correct. Therefore, results based on these questions cannot be taken as a true indication of students' quality of learning.

- What is the meaning of the term “Cephalopoda”?
  (ANS101T – Assignment 3, Question 1a)

- Write the correct term or phrase that corresponds with each of the statements given below. Number your answers carefully and correctly.
  1.1 What is the fourth factor of production that is also called the know-how or managerial skills? (...)
  (AME1015 – Assignment 3, Question 1.1)

- Describe the structure of the two organelles involved in protein synthesis.
  (BOT121U – Assignment 1, Question 1.2)

3.4.1.2 Comprehension

The second cognitive level of Bloom’s taxonomy, namely ‘comprehension’, was also drawn on quite extensively in these assignments, almost to the same degree as the ‘knowledge’ level. All of the subjects examined required students to either explain a concept, discuss it, or compare and contrast information, often with the purpose of explaining the difference between concepts. For all of these questions, students had to be able to state information in their own words so as to show that they understood the work, and usually it was also necessary for students to summarise information. Here, students not only needed to identify main ideas, but also had to manipulate language to transfer information.

Examples of questions that would fall in this category are the following:

- Explain the term ‘binomial nomenclature’ with the aid of an example.
  (ANS101T – Assignment 2, Question 1a)

- What is the difference between intracellular and extracellular digestion? You must refer to Hydra as an example.
  (ANS101T – Assignment 3, Question 3c)

- Explain the goal of agricultural economics and how it is achieved.
  (AME1015 – Assignment 2, Question 2.5)

- What is the relationship between iodine and thyroxin?
  (ASA102M – Assignment 3, Question 1.3)

- What is the difference between a weak acid and a strong acid? Illustrate your answer with suitable examples.
  (CHE101N – Assignment 1, Question 4c)

- Discuss Mendell's results – the theory of inheritance.
  (BOT121U – Assignment 1, Question 3.1)
- Fire is used in nature conservation management for more than one purpose. Briefly discuss this statement.
  (HBB121R – Assignment 1, Question 4b)

- Write notes on the feeding of the earthworm. Explain why the earthworm is an ecologically important organism.
  (ANS101T – Assignment 3, Question 2e)

3.4.1.3 Application

The 'application' level of Bloom's taxonomy was also required in most assignments, though the marks awarded to questions that called for this level of cognition were considerably fewer than for the previous two levels, namely 'knowledge' and 'explanation'. Four subjects required students to draw tables or graphs. Students either had to complete a table, draw one themselves, or plot graphs. All of these require students to take information from one context and represent it in another context, i.e. visually. Three subjects required students to illustrate information, for example, by drawing a concept map, a diagram, a schematic representation, or a sketch. Two subjects required students to apply information by doing calculations.

Examples of questions that would fall in this category are the following:

- Give a detailed diagram of the cell cycle.
  (BOT 121U – Assignment 1, Question 2.1)

- Use a concept map to illustrate the various components of feed.
  (ASA102M – Assignment 2, Question 1.2)

- Complete the table below. Given the data for the Product and Price of the product, calculate Revenue, ATC and MC and plot a graph to show that MC = ATC at its lowest point.
  (AME1015 – Assignment 3, Question 4.4)

- Calculate the population size from the given population density and area. The population density equals 1,5/ha and the total area is 30 km^2.
  Population density = ...
  (HBB121R – Assignment 2, Section A, Question 3)

- Calculate the energy of a photon of blue light which is observed in the emission spectrum of sodium corresponding to a wavelength of 48 nm.
  (CHE101N – Assignment 1, Question 4d)
- Tabulate the differences between male and female roundworm Ascaris lumbricoides. Draw labelled diagrams to substantiate your answer.
  (ANS101T – Assignment 1, Question 6a).

3.4.1.4 Analysis

The fourth level of Bloom's taxonomy, namely 'analysis', was hardly evident in any of the assignments. Only one subject's assignment required students to complete two questions where they had to categorise and order information. Even these questions, however, could be argued to rather belong to the 'comprehension' or 'application' categories, due to their simplicity.

An example of a question that would belong to this category is the following:

- Compare the different phases of respiration with respect to the starting substrate, end product and energy rich products formed, and where it occurs in the cell.
  (BOT121U – Assignment 2, Question 3.1)

3.4.1.5 Synthesis and evaluation

The last two levels of Bloom's taxonomy, namely 'synthesis' and 'evaluation', were identified in only one question, namely the final HBB121 assignment:

- Study chapters 16 to 18 (study guide 2), the prescribed bulletin of Matthee & van Schalkwyk (1984), and work of other authors on soil erosion. Apply the theory contained in these texts to address an example of ditch erosion that occurs in your area.

  (1) From your own area, choose an appropriate example of soil erosion (preferably one of ditch erosion). Study this specific example in terms of the following factors and write a scientific report of your results.
  (....)

(2) Then, plan a restoration method to stop the erosion and reclaim the eroded area. (...). Incorporate any other management steps you deem necessary (because of the related causes) as management proposals in your assignment.
(HBB121R, Assignment 3)

Here, students had to synthesise the work of several authors on the topic of soil erosion (using the theory to explain soil erosion in a specific area), and subsequently plan a method to stop soil erosion in this area. Although the level of 'evaluation' is only applied to a limited extent in this question, students still need to evaluate the type and extent of soil erosion in an area, and based on this, be creative in planning a restoration method for this area.

When the assignments of second year courses are compared, the trend is much the same as above. The level most drawn on in second year assignments is that of 'comprehension', with a clear shift away from 'knowledge'. Application is focused on to approximately the same extent as in the first-year assignments. The last three categories, namely 'analysis', 'synthesis' and 'evaluation' are again neglected in the second-year assignments. Although slightly more questions fall under these categories (5 questions out of all the second-year assignments, as opposed to 3 in the first-year assignments), lecturers do not seem to expect their second-year students to work at these levels yet.

This analysis of students' subjects gives a clear indication of the cognitive levels at which students are required to operate in their assignments. Clearly, the bottom half of Bloom's taxonomy is much more important for students at first-year and second-year level in the UNISA Science Foundation Programme than are the top three levels. It is important to keep this in mind when developing material for students, so as to focus on abilities relevant to their respective fields of study.

3.5 Conclusion

For an ESP course to be relevant, each individual group of students must be analysed according to certain criteria. This chapter has examined the target group, its language weaknesses as well as the language abilities necessary for the students to successfully complete their assignments.

To begin with, the demographics of the target group were examined. Although students in this study were slightly older than the average school-leaving university student, the average age was still quite low at 23 years – probably not what most people would consider a 'mature' age. All students were additional language speakers of English, and most of them were South African. Most students also came from an impoverished schooling background, and very few had completed any tertiary education before enrolling for the science-related degree they were busy with during this study.

Participants needed to improve their literacy abilities so as to have a better chance at succeeding in their studies. The workshops were voluntary, and students attended the workshops for both instrumental (external) as well as integrative (internal) motivational reasons. The literacy abilities acquired in these workshops were used for students' first-year assignments and studies, but were also aimed at equipping them for the rest of their studies, as well as their future careers.

To determine the literacy abilities that students lacked, the TALL was used. The pre-test indicated that students' academic literacy abilities were at an unacceptably low level for all test sections: the average score for the test was 27%, a score that indicates that students are at high risk of failing their studies.

Finally, students' language needs were identified by examining the assignments of a sample of SFP subjects. Traditional categorisations of assignments were impractical for this study, since little (if any) extensive writing seems to be done in students' first year. Instead, eight categories were identified as recurring frequently in students' assignments (see Section 3.4).

The assignment questions falling under these eight categories were subsequently classified according to abilities necessary for the six levels of Bloom's taxonomy. It was found that the first two levels of Bloom's taxonomy, namely 'knowledge' and 'comprehension', were relied upon most heavily in assignments. The 'application' level followed these two levels. The fourth, fifth and sixth levels, namely 'analysis', 'synthesis' and 'evaluation' were rarely required from students in their assignments.

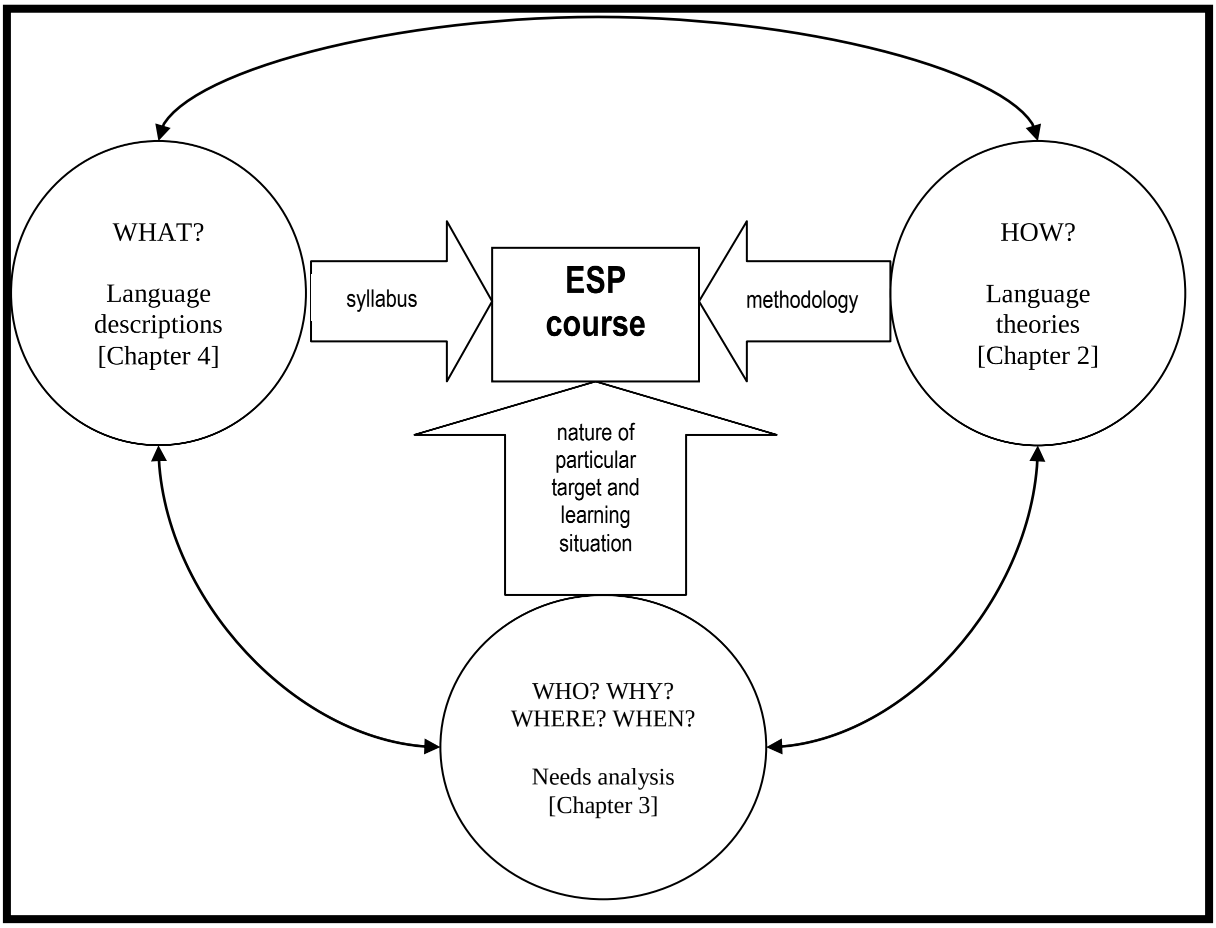
The next chapter examines the workshops in the SFP academic literacy intervention programme, and consequently criticises their design, keeping in mind the needs identified in Chapters 2 and 3.

CHAPTER 4 Description of workshop material

4.1 Introduction

As already mentioned in previous chapters, the effective development of learning materials depends on the developer's understanding of how the course is to be constructed, familiarity with students' needs, and finally a decision on what type of language students will need. Diagram 4.1 illustrates that the most important aspects regarding material development have already been discussed in previous chapters.

Figure 4.1 Factors affecting ESP course design (Hutchinson & Waters, 1987:22)



Chapter 2 deals with a justification of English for Specific Purposes (ESP) courses, and discusses relevant approaches to language learning (the main one being collaborative learning) that are underlying principles of the material used in the current study. The literature study done in this chapter further considers student needs and the requirements of scientific writing. Chapter 3 serves as a needs analysis for this study's specific target group, describing its nature and learning situation. It also examines what type of literacy abilities students in the SFP need to successfully complete their assignments. The current chapter discusses the syllabus of the workshop programme used in this study.

4.2 Description of the workshop programme outline

The intervention took the form of a series of 20 workshops of three hours each. The workshops were designed to show a logical progression from dealing with vocabulary acquisition to the writing of an extensive academic text. The following topics were covered during the workshops:

1. **Improving your vocabulary**
    - Acquire methods of improving vocabulary;
    - Understand and use parts of speech; and
    - Use a range of vocabulary in specific subject fields in sentences.

2. **Writing good[19] sentences**
    - Use words in the appropriate contexts;
    - Identify all of the necessary parts of speech that constitute a proper sentence; and
    - Identify and use the active and passive voice correctly.

3. **Using scientific words and concepts in context**
    - Correctly use words that can be used in more than one context;
    - Convert symbols into formulas written in good sentences and vice versa; and
    - Identify the various connotations of words, and the feelings and emotions that accompany such words.

[19] This word 'good' in this title is problematic, as it is unclear what a 'good' sentence would be. However, this word was chosen as it was thought to be the most accessible to students. The same is the case with the title "Writing good paragraphs" on the following page.

4. Reading in the sciences (1)

- Develop techniques of skimming, scanning and reading closely; and
- Apply these abilities to a variety of scientific texts.

5. Writing good paragraphs (1)

- Develop an awareness of topic sentences, and identify these in paragraphs in your study guides;
- Write good paragraphs that are built on good topic sentences;
- Develop an awareness of discourse markers (conjunctions); and
- Use discourse markers in joining ideas and sentences.

6. Writing good paragraphs (2)

- Use discourse markers to combine more difficult ideas and sentences;
- Analyse logical relations; and
- Write answers (in paragraph form) to questions in study guides.

7. Paraphrasing

- Write information in your own words.

8. Summarising

- Paraphrase and summarise information; and
- Distinguish between essential and non-essential information.

9. Visual literacy (1)

- Read and interpret tables, graphs, charts and other visual information.

10. Visual literacy (2)

- Gather and tabulate data, and do basic calculations to interpret this data;
- Interpret results obtained in your own research; and
- Represent these results visually, in graphs and charts.

11. Distinguishing between essential and non-essential information

- Distinguish between main ideas, supporting ideas and examples;
- Distinguish between facts, opinions and assumptions; and
- Classify, categorise and label information.

12. Note-taking strategies

- Make an outline of information; and
- Represent information visually in the form of a mind-map.

13. Introduction to referencing

- Develop an awareness of the function and location of different parts of a text; and
- Develop an awareness of plagiarism and how to avoid it by means of referencing correctly.

14. Bibliographies

- Use in-text referencing appropriately; and
- Construct a list of references of books, study guides, journals, newspapers and the Internet.

15. Revision – Parts of speech and paragraph writing

- Revise the use of parts of speech and conjunctions; and
- Practise writing effective paragraphs.

16. Reading in the sciences (2)

- Revisit reading strategies, and combine these with effective note-taking skills; and
- Apply these abilities to advanced reading comprehension activities.

17. Writing about facts in the sciences (expository writing)

- Analyse the structure of a text (introduction, body, and conclusion);
- Understand the hierarchy of ideas; and
- Illustrate concepts and ideas with examples, drawings or theorems.

18. Arguing in the sciences (argumentative writing)

- Understand the hierarchy of ideas;
- Judge information critically, and prove the validity of statements; and
- Argue concepts and ideas with examples, theorems or persuasive passages.

19. Synthesising information

- Apply known knowledge to new contexts and the general to the particular;
- Extrapolate – infer by deducing beyond the facts, estimate beyond the known, and make predictions; and
- Write about a topic in a relevant subject in which several sources are synthesised.

20. Writing a laboratory report

- Understand the various sections of a laboratory report;
- Identify inappropriate language use and unnecessary information in existing laboratory reports; and
- Write sections of laboratory reports when given basic information.

As noted previously, the workshops complemented one another in terms of progressing logically from less complex to more complex language learning tasks. For example, a workshop on writing good sentences preceded the workshop on writing good paragraphs. These were then followed by workshops focusing on, for example, reading strategies (during which students had to use abilities such as vocabulary learning and note taking, which were both addressed in earlier workshops) and, subsequently, a focus on the complexities of writing ability.

4.3 Analysis of workshops

It should be noted that although the workshop titles might imply that the issues addressed were fairly narrow in scope, workshops were treated holistically. Workshops were, therefore, flexible enough so that skills introduced in previous workshops were revisited and reinforced as the need arose. This section analyses workshops (found in Addenda A to T) according to the abilities they address. They are then discussed in terms of the extent to which they address the abilities identified in the previous chapters.

4.3.1 Workshop 1: Improving your vocabulary

Workshop 1 was titled 'Improving your vocabulary' (Addendum A). All vocabulary used in this workshop is subtechnical vocabulary typically used in a scientific context. As Section 2.4.3 argues, students generally have more difficulty with subtechnical vocabulary than with purely technical vocabulary. The vocabulary used in the first three workshops either comes from a scientific word list (Gillett, [undated]) or from articles or books that focus on vocabulary that science students generally struggle with (for example Johnstone & Cassels, 1978). All vocabulary was chosen on the grounds of its occurrence in scientific discourse, its difficulty, or how often students confuse its meaning (see Section 2.4.3, as well as Ma [1993] and Miller [2009]).

In this workshop, some grammar is dealt with (parts of speech in Task 1), but only with the purpose of applying that knowledge in manipulating vocabulary so as to make an educated guess about the context in which to use new vocabulary (e.g. as a noun, verb, adjective or adverb) (Task 2), and so as to correctly use the vocabulary in sentences (Task 3). Thus, the approach to grammar teaching in this workshop series is similar to that of Ellis (2006), as discussed in Section 2.5.3 (also see Nunan [1988]). In addition, students are given a 'New word list' in which they can write down new vocabulary, together with parts of speech, dictionary definitions and explanatory sentences where the new words are used in context. Students were supposed to update this word list during the year to improve their vocabulary. However, a weakness in this study was that the facilitator did not check throughout the year whether students did indeed update this list. Finally, students complete a crossword puzzle consisting of academic vocabulary (Task 4).

Students worked in small groups of three to four to write down the functions of the different parts of speech in Task 1. For the second task, they had to manipulate the parts of speech and subsequently write sentences in pairs. In Task 3, students firstly wrote as many sentences as possible individually, and then worked in pairs to teach each other vocabulary that their partners might not have identified. Finally, students worked in groups of three to four to create as many correct sentences as possible. The crossword puzzle in Task 4 was completed in groups of three to four students.

Knowledge of academic vocabulary generally underlies successful reading and writing abilities, which in turn largely predict academic success (see, for example, Phillilps [2004]). The importance of this issue is also acknowledged in the TALL, where an entire section is devoted to academic vocabulary (Section 5 of the TALL). In addition, it tests students' ability to make educated guesses (in terms of making use of the context) about missing words in the section on text editing (Section 6 of the TALL). It is necessary that students acquire the ability to make such educated guesses about new academic vocabulary, as well as broaden their academic vocabulary range, for them to ultimately be successful in their studies. This forms part of being academically literate, according to the definition of academic literacy given by Weideman (2003a) in Section 3.3.

When this workshop is evaluated, it would seem as though most of the guidelines given in the literature regarding the acquisition of vocabulary in the fields of science and technology are adhered to. The focus is on subtechnical vocabulary that students are likely to encounter and have difficulties with (see Section 2.4.3). Grammar is incorporated in this workshop, but only to facilitate meaning (see Section 2.5.3). A weakness in this programme is that vocabulary development is not stressed throughout the workshops series. As vocabulary acquisition is a continuous process, a three-hour workshop is not sufficient to develop this important aspect of academic literacy.

4.3.2 Workshop 2: Writing good sentences

Workshop 2 is titled 'Writing good sentences' (Addendum B). It focuses on various important abilities such as using the passive voice (Task 1), which is often used in scientific writing; using the correct part of speech in context (Task 2 – reinforcing the abilities dealt with in the first workshop); joining simple sentences into more complex sentences with correct punctuation or conjunctions (Task 3 – here punctuation rules are addressed, together with a basic introduction to discourse markers. The necessity for this ability was highlighted in the literature review, Sections 2.5.2 and 2.5.3, as well as by the fact that most of the students' assignments required one sentence answers, as seen in Section 3.4); and making use of nominalisation (Task 4), yet another characteristic of scientific language. In the final task (Task 5), students are required to answer in full sentences questions that could typically be found in their study guides (an example would be question 5a, where students are asked the following: “In a brief sentence, define pollination in flowering plants”).

Tasks 1, 2 and 4 were done in pairs, Task 3 was done in groups of three to four students, and Task 5 was done individually. Alternating the level of collaborative learning kept students interested in a topic that has the potential of becoming monotonous.

The text excerpts and sentences used in this workshop all come either from students’ tutorial letters or from the science sections of a reading course called START (Strategies for Academic Reading and Thinking), so as to make these exercises more authentic for science students. A degree of authenticity is vital for motivation, as argued in Section 2.4.1.

This workshop, although it does not necessarily focus on any of the abilities tested in the TALL, is vital for students’ assignments, since the majority of assignment questions requires answers in full sentences.

This workshop incorporates several guidelines as set out in the literature, for example practising strategies such as nominalisation, the use of the passive voice, and constructing complex sentences (see Sections 2.5 and 2.5.2). It is the first step in introducing students to longer stretches of scientific discourse, and allowing them to gain entrance into this discourse community. The use of authentic texts further aids in this endeavour.

4.3.3 Workshop 3: Using scientific words and concepts in context

Workshop 3, ‘Using scientific words and concepts in context’ (Addendum C), builds on both the previous workshops. In Task 1, students need to use words which can be used in both an everyday context and a scientific context in complete, explanatory sentences. They can choose words that might typically be found in their own fields of study. Here, students need to firstly understand which part of speech to use, secondly they have to use the word in different semantic contexts, and thirdly they need to use the word in a full sentence. The main aim of this task is to reinforce abilities acquired in the previous workshops. In Task 2, students need to complete a crossword puzzle. The clues give two meanings of the same word, either in different scientific fields or in a scientific and an everyday context. This task is done in the form of a competition, where the first small group of students to finish the crossword puzzle wins a prize (something as small as a chocolate suffices). This encourages an enthusiastic atmosphere, whilst improving students' vocabulary. Task 3 builds on vocabulary that might be used in a mathematical context. Here, students need to complete mathematical instructions with the appropriate word. Task 4 challenges students to convert scientific information either from a symbolic form to a written form, or from a written form to a symbolic form. The last two activities aid in showing students the link between the abilities practised in the workshops and subjects such as mathematics or chemistry.

Task 1 is initially done individually, and then marked in small groups. Task 2 is also done in small groups. In both of these tasks, students can teach each other words that certain group members might not know. Tasks three and four are completed in pairs.

Dictionaries are freely available, and students use these extensively to look up words, without being forced to do so. This also encourages dictionary use in a relaxed atmosphere. Words and sentences used in tasks mainly come from the fields of mathematics, physics, chemistry and biology. Thus, at least some of the material in this workshop would be authentic for students.

Although no new abilities are focused on in this workshop, it is valuable in that it builds on previous workshops. It especially focuses on the difficulties that students often have with distinguishing between everyday and specialised meanings of words (see Section 2.4.3), in addition to providing practice in writing single sentences. In an enjoyable manner, this workshop highlights the importance of correct vocabulary usage; that in itself makes the workshop worthwhile.

4.3.4 Workshop 4: Reading in the sciences (1)

Workshop 4 (Addendum D), titled 'Reading in the sciences (1)', is the first workshop that focuses on reading abilities. In this workshop, skimming and scanning are introduced. These reading strategies are first explained to students and subsequently practised in Tasks 1 to 3.

All tasks are first completed individually. After Task 1 has been completed individually, students have small-group discussions about the most important facts they picked up whilst skimming three texts. A whole-class discussion is held on their feedback[20]. Tasks 2 and 3 are again done in the form of a competition, with the first student to have all the answers correct winning a small prize. This is very effective in getting students to engage with the tasks, and encouraging them to find the correct answers. This is followed by a whole-class discussion of what students might use skimming and scanning for.

Two of the texts used are authentic texts taken from tutorial letters (i.e. study guides). Another text is taken from a diagnostic assessment task that most students had to complete at the beginning of the year (though the questions asked do not come from this diagnostic assessment). Thus, they are all texts similar to those that students are likely to come into contact with whilst engaging in their studies.

Reading abilities are tested in the TALL under the reading comprehension section (Section 4). Fine-tuning these skills could be argued to be the most important ability a student can acquire during a literacy course. As illustrated in Section 2.5.3, many researchers believe reading abilities to be even more vital than writing, speaking or listening abilities. This section also emphasises the importance of reading strategies such as skimming and scanning. Although adequate reading abilities are important at all of the levels in Bloom's taxonomy, they are vital at the first two levels of 'knowledge' and 'comprehension', since here, students' own opinions matter little. They merely need to effectively transmit what they read and understand onto paper (see also the importance of skimming and scanning under the discussion of the 'knowledge' level of Bloom's taxonomy under Section 3.4.1.1).

4.3.5 Workshops 5 and 6: Writing good paragraphs

Workshops 5 and 6 (Addenda E and F) both address 'Writing good paragraphs'. In Workshop 5, students have to start by identifying topic sentences in various authentic scientific texts (Task 1). Subsequently, they have to write a variety of paragraphs themselves (i.e. definition,

[20] The instructions regarding group discussions and whole-class feedback are not mentioned on the students' worksheets (added as addenda at the end of this dissertation). These instructions are, however, indicated on the facilitator's handout. Throughout the workshop series, further instructions on activities such as these are often indicated only on the facilitator's notes.

classification, comparison and contrast, sequence, explanation and evaluation paragraphs) (Task 2). On transparencies, students are given typical discourse markers that might be used in each of these paragraphs (building on Workshop 2), and are given topics to choose from when writing the paragraphs. The paragraphs can be classified under the categories in Bloom's taxonomy, ranging from the knowledge level (e.g. the definition paragraphs) to the evaluation level (e.g. the evaluation paragraphs). Many of these paragraphs are typical of short questions of about 5 to 10 marks that students might have to answer in their assignments.

These tasks are all completed individually. The paragraphs are subsequently scored by three other classmates. This phase is 'scaffolded' in the sense that students are provided with specific criteria for assessing one another's work. Such criteria include that there has to be a topic sentence, at least some of the given discourse markers have to be used, grammar and spelling have to be correct, and the content needs to be cohesive and coherent. Students need to indicate what they deduct marks for by underlining problematic areas and writing a short justification next to it. If they do not deduct more than two marks, or if they are not sure about the marks they want to give each other, they need to call the facilitator for a second opinion. Marking each other's work helps to foster a critical awareness of certain common mistakes that occur in student writing. Although it is always more difficult to see mistakes in one's own work, the hope is that this critical awareness would later on filter through to students' own writing.

The paragraphs used in the first task come from a variety of scientific fields (in this case, from mathematics, biology, computer science, chemistry and geology), so as to interest as many students as possible. A variety of topics is also given for each type of paragraph that students have to write, so as to give them the opportunity of writing on a topic related to their field of study.

Workshop 6 is a continuation of 'Writing good paragraphs'. In this workshop, the use of discourse markers (which were introduced in previous workshops) is dealt with in detail, and the relationships between sentences and ideas in paragraphs are examined.

In the first task, students' existing knowledge is exploited, and groups of four to five students need to think of as many discourse markers as they can, in addition to organising these into three broad categories (namely 'additive', 'contrastive' and 'cause and effect' discourse markers). This serves to let students think about the meaning and purpose of these discourse markers. In Task 2, students need to construct sentences with five discourse markers that they find difficult. This again reinforces abilities dealt with in previous workshops, whilst integrating these with new knowledge. In Task 3, students merely need to identify discourse markers, although the words they have to identify are often words that might not seem like discourse markers at first. This again serves the purpose of letting students think carefully about the purpose of certain words in sentences, and how discourse markers connect ideas. The first part of Task 4 is a simple 'fill-in-the-gap' exercise, although students do need to think very carefully about the meaning and purpose of words, together with correct punctuation, to complete this task successfully. In Task 5, students are required to connect two sentences using some of the more difficult discourse markers. Here, students need to again carefully think of the relationship between these two sentences to correctly identify an appropriate discourse marker. At the same time, they need to use the correct word order, as certain discourse markers require the word order of the sentences to change. Students are also sensitized to appropriate punctuation in this exercise. Finally, students are required to write two cohesive paragraphs in Task 6. This builds on the ability of writing specific paragraph types (with appropriate vocabulary) that was practised in Workshop 5, but this time using appropriate discourse markers at a more difficult level than was required in the previous workshop.

Task 1 is a group activity, in which students have to find as many discourse markers as possible. The opportunity exists for students to learn how to use unfamiliar discourse markers from fellow students. Task 2 is an individual activity which is marked in pairs afterwards. Tasks 3, 4 and 5 are done in pairs, with whole-class feedback given. Task 6 is again an individual activity which is scored afterwards by 3 other students. As in the previous workshop, students need to mark and score each other's paragraphs.

The ability to write cohesive paragraphs is vital for first-year students. It is part of learning how to write effectively, an ability that is extensively discussed in Section 2.5.1. It also introduces students to some of the characteristics of scientific writing, for example, the use of semantic relations, as examined in Section 2.5.2. In various assignment questions, students need to answer a question for between 5 and 10 marks. This usually requires of students to write a paragraph. A section in the TALL that tests students' ability to understand the relationship between sentences in a paragraph is the first section, ‘Scrambled text’. Here, students need to identify introductory, concluding and linking sentences, as well as recognize discourse markers and their functions within a paragraph, so as to identify the sequence in which the sentences in a text should follow. Writing good paragraphs is also essential for all the levels of Bloom’s taxonomy, especially the four higher levels of ‘application’, ‘analysis’, ‘synthesis’ and ‘evaluation’, since it is rarely possible to function at any of these levels by writing one-sentence answers.

One criticism against this workshop is that three higher-order levels in Bloom’s taxonomy, namely ‘analysis’, ‘synthesis’ and ‘evaluation’, are practised in some of the paragraphs, even though these levels are rarely required from students in their assignments (see Section 3.4.1). It can be argued that it would be advantageous to challenge students to function slightly above the level they are expected to be proficient in already. This firstly makes the lower-level tasks seem easier, but also challenges students to function at a higher level. This corresponds to Krashen’s (1992) theory of comprehensible input. However, it seems unlikely that specifically the levels of ‘synthesis’ and ‘evaluation’ could be considered as comprehensible input this early in the workshop programme, taking into consideration the very low level of the target group’s academic literacy (see Section 3.3), as well as the fact that students are not required to function at these levels in their second year assignments either (see Section 3.4.1).

A further criticism is that too much attention is paid to discourse markers, especially in the second workshop. It might be more effective to design a separate workshop on cohesion, during which discourse markers and other cohesive devices can be practised extensively. Although these would have to be revised during the two paragraph writing workshops, more time could be spent writing and editing a wide variety of paragraphs.

4.3.6 Workshop 7: Paraphrasing

Workshop 7 is titled ‘Paraphrasing’ (Addendum G). This is an essential ability for science students, as can be seen from the analysis of students’ assignments (Section 3.4) as well as the literature review (Section 2.5.3). To do this successfully though, the previous workshops were necessary, since students cannot paraphrase appropriately if they cannot write correct and complete sentences or paragraphs, and if they do not know how to approach unfamiliar vocabulary. The workshop is structured in three phases. Firstly, students need to paraphrase sentences, then paragraphs, and finally an entire section from their own study guides.

In the first two tasks, students are encouraged to paraphrase in pairs. This enables them to help each other, and not to feel discouraged if they cannot paraphrase effectively by themselves, thus building confidence. In the last task, students need to paraphrase individually. All of these activities are checked in larger groups afterwards, and students give feedback on each others' efforts. Whole-class feedback is given for the first two tasks.

The texts used in this workshop again come from a variety of scientific disciplines, but are not so subject specific as to exclude any students. Where technical terms do occur, these are explained to the students by the facilitator before commencing with a task.

Paraphrasing is very important at the top five levels of Bloom's taxonomy, starting at 'comprehension', since students cannot show that they understand work if they cannot paraphrase concepts. As argued in Section 2.5, science students' inability to paraphrase is often one of the biggest challenges faced in their studies, and one of the reasons why they make themselves guilty of plagiarism.

Students had great difficulties with this workshop. This is understandable, as paraphrasing is a very complex ability to acquire, and it would be unrealistic to expect of students to master it in a three-hour workshop. Although all activities in this workshop worked well, another useful activity would have been to take sample questions (on the knowledge and comprehension levels of Bloom's taxonomy) from a few assignments, and to also provide the text in which the answers could be found. Students would then have to answer authentic questions by paraphrasing the information. This would also have introduced the concept of plagiarism, and made the concept more tangible to students.

4.3.7 Workshops 8: Summarising

Workshop 8, titled 'Summarising' (Addendum H), is dealt with next. Again, all of the abilities practised in previous workshops are necessary to be able to summarise effectively.

This workshop starts off by showing students an example of a text as well as its summarised version on the overhead projector. In pairs, they then need to try to summarise another text on the overhead projector. A sample answer is given, and students need to compare their own answers to this. In Tasks 2 and 3, students summarise sentences and paragraphs with a partner. Whole-class feedback is given. Finally, a longer text is summarised individually. This is checked afterwards in small groups, so that students can debate what points were important enough to include in a summary. The facilitator is available to facilitate this process, but the consensus of the group is heavily depended on.

As in previous workshops, various methods of student interaction are used here, ranging from small-group work (Task 1), pair work (Tasks 2 and 3), individual work (Task 4) to whole-class feedback (Tasks 1 to 4). Thus, a variety of preferred interactional patterns are utilised, which prevents any student from feeling frustrated and left out.

Similar to the previous workshop, text extracts were chosen from scientific texts, but none were so technical as to exclude students from certain scientific disciplines.

Section 2.5.3 indicates that summarising, together with paraphrasing, is a vital ability for science students. This ability becomes specifically important at the four highest levels of Bloom's taxonomy, namely 'application', 'analysis', 'synthesis' and 'evaluation'. All of these require that students take the gist out of a certain section of work, and integrate it with either other work or their own ideas.

A weak point of this workshop is that this ability could have been scaffolded better. Showing students examples on the overhead projector was a good idea, but could have been supplemented by including activities on underlining key words and ideas before summarising texts.

4.3.8 Workshops 9 and 10: Visual literacy

Workshops 9 and 10 (Addenda I and J) both focus on visual literacy. This is an important ability for science students, who often need to either interpret visual information, or represent information visually. Students often find these workshops very relevant to their studies, and thus these are very important for student motivation. In these workshops, students need to interpret graphs and tables, either giving one-word answers or writing paragraphs interpreting the graphs. They also need to convert tables to graphs and vice versa.

All of these tasks are done in pairs, so that students can support and teach each other. Answers are then checked by means of whole-class feedback.

Graphs and tables used in these workshops come from scientific areas such as physics, chemistry, and biology.

These workshops are of particular importance, since the scores on the corresponding sections in the TALL pre-test were very low (Section 2: 'Interpreting graphs and visual information') – something that was surprising for students studying science-related fields. In addition, many of the 'application' questions (as defined in Bloom's taxonomy) in the SFP subjects' assignments require students to either interpret information in graphs or tables, or to represent information in this format (see Section 3.4.1.3).

The literature also shows that reading graphs and tables is an important skill for scientists. See, for example, the discussion in Section 2.5.3 on a study by Berkenkotter and Huckin (1995) examining the reading habits of scientists. According to this study, visual elements of an article were read right after the title and abstract, indicating that scientists use these sections to gain an understanding of the entire article. It would also seem as though undergraduate students internationally have the need to become more proficient in visual literacy. In a study by Ostler (1980) (discussed in Section 2.4.2), for example, this was listed as one of the most needed skills, according to a survey of undergraduate students.

4.3.9 Workshop 11: Distinguishing between essential and non-essential information

In Workshop 11, 'Distinguishing between essential and non-essential information' (Addendum K), students need to identify main ideas. This workshop is done before the one on note-taking, so that students can first get used to identifying important information in a text. Here, students need to identify main ideas (by, for example, identifying topic sentences, practised first in Workshop 5; Tasks 1, 6, 8 and 11) and supporting details (Tasks 1, 3 and

11), paraphrase information (practised first in Workshop 7; Task 4), answer short questions that they might typically have to answer in assignments (Tasks 2, 4, 5 and 10), give headings to paragraphs (Task 7), summarise information (either in tabular form [Task 9] or paragraph form [Task 8]), and respond to a text by illustrating points from the text (Task 11).

Tasks 1 to 7 are done in pairs, with whole-class feedback, and Tasks 8 to 12 are done individually, with feedback in small groups. The material used for this workshop comes from the Horticulture 1 (one of the SFP subjects) study guide.

The abilities practised in this workshop are particularly important for the ‘analysis’, ‘synthesis’ and ‘evaluation’ levels of Bloom’s taxonomy, though they are also important for the first two levels of ‘knowledge’ and ‘comprehension’. The section in the TALL that tests these abilities is the ‘Understanding texts’ section.

Although this workshop requires students to summarise information to some extent, it might fit more logically before Workshop 8 (Summarising), because to summarise a text, it is necessary to first identify the main points of the text. The next workshop builds on the ability of distinguishing between important and unimportant information.

4.3.10 Workshop 12: Note-taking strategies

In Workshop 12, titled ‘Note-taking strategies’ (Addendum L), students need to take notes in a variety of forms from a popular scientific text. First, students highlight important ideas in the text (reinforcing abilities practised in Workshop 11), after which they annotate this text. This is done individually, and then small groups come together and compare their underlining and annotations. Together, they need to decide on the best version, which can be adapted or added to, as the group sees fit. The best version of each group is then distributed to all other groups, who each have to score it. The group with the version where the best notes were made receives a small prize. Subsequently, students need to create a mind map of the text (outlining is also discussed, but was not practised during this workshop, due to lack of time). This is again done individually, after which small groups decide on the best version. This version is then transferred to an A1 sheet of paper (thick coloured pens are provided to students), and one student from the group has to present this mind map to the rest of the class.

The class again awards marks for each mind map, and the group with the best mind map wins a small prize.

Again, a variety of interactional patterns are used in this workshop, including individual work (Tasks 1 and 2), small-group work (Tasks 3 and 4), small-group feedback (Tasks 1 and 2) and whole-class feedback (Tasks 1 to 4). A popular scientific text on 'black holes' is used for this workshop.

This workshop builds on previous workshops, specifically 'Distinguishing between essential and non-essential information' and 'Summarising'. Taking the essence out of a text and representing it through notes should also improve students' comprehension abilities, which in turn should be reflected in their TALL scores. Section 2.5.3 argues that note-taking strategies such as mind mapping could be used to prepare students for the more difficult task of summarising. A weakness in the order of these workshops could therefore be that this workshop on note-taking strategies was held after the paraphrasing and summarising workshops. In addition, it was difficult to complete all the tasks within the time frame of this workshop. Specifically the ability of creating mind maps deserves additional time.

4.3.11 Workshops 13 and 14: Referencing

These workshops, titled 'Introduction to referencing' and 'Bibliographies' (Addenda M and N), deal with plagiarism, in-text referencing and bibliographies. Although none of the analysed assignments directly test referencing, almost all tutorial letters contain a section on the importance of referencing in academic writing. Departments therefore value the presence of referencing from as early as students' first-year level, and retain the right to fail students if any plagiarism occurs.

Workshop 13 starts with a small-group discussion of what plagiarism is (Task 1), followed by a whole-class discussion of the topic. This is very effective in letting students learn from each other, rather than just giving them the information and expecting them to remember it. After that, students discuss the difference between various types of sources, specifically in terms of their credibility (Task 2). In the next task (Task 3), students identify various sources handed out to them (including a journal article, a book and a magazine article), and the specific information contained in these sources that would be necessary when drawing up bibliographies and doing in-text referencing. In this task, students also have to write down direct and indirect quotations, as they would be required to do in an assignment, with appropriate in-text referencing.

Except for the whole-class discussion at the beginning of the workshop, all tasks are done in small groups of four to five students. This forces students to collaborate in collecting the relevant information. The facilitator moves between the groups and gives feedback on correct and incorrect attempts. Whole-class feedback is later provided on problematic areas.

In Workshop 14, students compile the bibliographic references for books, journal articles, study guides, Internet articles, and magazine articles (Tasks 1 and 2). This is done in small groups. After students have practised compiling their own bibliographies, they need to individually identify mistakes in other bibliographies (Task 3). This makes them aware of the importance of the order of information in, as well as the completeness of, bibliographic references. Whole-class feedback is given on all tasks.

All of the handouts used in these two workshops either come from students' own study material (e.g. study guides and books), or popular scientific sources (e.g. the magazine and Internet articles). Again, the choice of material emphasises the principle of relevance to students' fields of study.

As shown in Section 2.5, plagiarism is one of the more serious problems that lecturers deal with when marking science students' assignments. One possible explanation for such plagiarism is that students do not know how to paraphrase. Another possibility is that they simply do not know the conventions used in the academe to prevent plagiarism. Often, students have never heard of plagiarism or referencing by the time they attend these workshops. This is very problematic, considering that these two workshops are only held towards the end of the year. It thus seems as though this is one of few occasions where students are made aware of this phenomenon. Although referencing techniques are not dealt with in the TALL at all, it is a vital skill that students need to acquire, especially when considering that students at tertiary education institutions should be working towards the top three levels of Bloom's taxonomy, namely 'analysis', 'synthesis' and 'evaluation'

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4.3.12 Workshop 15: Revision – Parts of speech and paragraph writing

In the original workshop programme, a revision workshop was scheduled on any topic that students wanted to revise. The majority of students indicated that they wanted to revise parts of speech, conjunctions and paragraph writing. The material developed for this workshop can be found in Addendum O.

Tasks 1 and 2 focus on parts of speech. The use of conjunctions in sentences is addressed in Tasks 4, 5, 6 and 7. Finally, students practise paragraph writing in Task 8.

During this workshop, students either work in groups (Task1), in pairs (Tasks 2, 3, 4, 5 and 6), or individually (Tasks 7 and 8).

This revision workshop builds on previous workshops (specifically Workshops 2, 5 and 6) and strengthens students' abilities so as to prepare them for the essay writing workshops (Workshops 17 and 18).

4.3.13 Workshop 16: Reading in the sciences (2)

In the second workshop entitled 'Reading in the sciences' (Addendum P), students are required to use several abilities practised previously to interact with a text. Text extracts are taken from the fields of chemistry, physiology, physics, geography, and biology. In Task 1, students preview a text and subsequently annotate it (abilities practised in Workshops 5 and 12) with possible questions they might have about the text. In Task 2, students draw a diagram of a text, thus practising their visual literacy abilities (first practised in Workshops 9 and 10). In Task 3, students summarise a text (an ability practised in Workshop 8), and in Task 4, a diagram is drawn and a summary is written. Task 5 requires students to use the acquired abilities to summarise a section of their own study guides at home.

Task 1 is done individually, with whole-class feedback. Task 2 is done in pairs, with feedback first in small groups, followed by whole-class feedback. Tasks 3 and 4 are first done individually, and then discussed in small groups, with a possible model answer given afterwards by the facilitator. Task 5 is given as homework.

In the TALL, students' reading abilities are tested specifically in the 'Understanding texts' section. This workshop aims to develop their reading abilities in processing difficult texts. Practising annotation can be particularly helpful at the 'knowledge' and 'comprehension' levels of Bloom's taxonomy. Drawing a diagram of a text practises students' 'application' abilities, and summarising a text serves as a foundation for the levels of 'analysis', 'synthesis' and 'evaluation'.

This workshop follows Johns' (1981) advice, as discussed in Section 2.4.3, in that the writing in this workshop is a response to reading. In addition, students need to 'translate' (see Montgomery [2004] in Section 2.5.1) what they read into other forms of communication (for example diagrams and summaries). Such 'translation' ensures that students "read with understanding" (UNISA [2006]; see Section 2.5.3 for a more complete discussion), as information can only be converted from one form to another (for example, a full text to a diagram or a summary) if the writer understands its content.

This workshop is well-structured, and leads students to interpreting and 'translating' texts effectively. The only criticism is that, as with the workshops on paraphrasing and summarising, more time needs to be spent on this topic to help students acquire the broad ability of reading. It might also be useful to have students do Task 5 in small groups in class, and to subsequently present their summaries and/or diagrams.

4.3.14 Workshop 17: Writing about facts in the sciences (expository writing)

Workshop 17 is titled 'Writing about facts in the sciences (expository writing)' (Addendum Q). In this workshop, students are firstly introduced to the idea of thesis statements. Students are asked to individually write down a thesis statement; these are then discussed in small groups to determine whether they adhere to the given criteria. In Task 2, students are each given an article on a particular subject, upon which they have to give feedback in small groups. Each student in a small group receives a different article, and they are encouraged to use the note-taking abilities practised in previous workshops to summarise the information in some way that will make it easier for them to give feedback in their small groups later on. In Task 3, students have to plan their essays. They must create either an outline or a mind map (both abilities were addressed in Workshop 12), and are encouraged to use topic sentences at this point already (first practised in Workshop 5). In Task 4, students write a thesis statement for their essay, based on the various articles that were discussed in small groups. In Task 5, students write the essay. There was not enough time to write the essays in class time, and students were required to write these as homework and bring them to class the following week. Unfortunately, only five students did so. Since these workshops are not compulsory, it is impossible to force students to do homework. The workshop succeeded in guiding students to practise the reasoning and planning abilities required to plan an essay and construct a thesis statement, and thus, even if students did not write the actual essay, valuable practice was still achieved. However, composing an essay is a writing experience that is too valuable to dismiss. There was also not time for Task 6 – a check-list to determine whether the essential elements are present in the expository essay.

Student interaction is very important in this workshop. Students first work individually on most tasks (except for Task 3, where they work in pairs), but for each task, feedback is given in small groups. In Task 3, they have to rely on information from other students to present a comprehensive mind map or outline. Here, summarising, listening and speaking abilities are particularly important, so as to ensure that all group members get a holistic view of all the articles, even though each group member reads only one article. Also, the difficult skill of synthesising is practised extensively for the first time in this workshop.

The topic chosen for this workshop was 'nuclear energy', since it is a scientific concept that all students have heard of and know at least something of, and it is something that touches their lives, or has the potential to. This topic is therefore likely to be of interest to students.

The abilities needed to write an expository essay are reflected in all sections of the TALL. In addition, certain characteristics of scientific writing mentioned in the literature (see Section 2.5.2), such as scientific writing being linear and inductive, concise and precise, as well as clear and objective, can only be fully explored in a longer piece of writing. A weakness in this workshop series is that these characteristics were not explicitly discussed during earlier workshops such as paragraph writing, nor were they discussed in this workshop.

Although none of the assignments analysed required students to write expository essays, this type of essay is the culmination of most of the abilities addressed thus far in the workshop series. Also, the sequencing and other reasoning abilities (for example the abilities to compare and contrast, summarise, paraphrase, etc.) required in this task would help students with various other assignments. On Bloom's taxonomy, these abilities would mostly be represented at the levels of 'analysis' and 'synthesis'. Thus, even though these levels are rarely required in students' first year, this workshop would hopefully start to prepare students for essay-type assignments they might be required to do in the remainder of their undergraduate studies.

Students struggled with the concept of thesis statements, and a three-hour workshop specifically on this topic would have been very valuable. Activities could have included identifying thesis statements, criticizing good and bad thesis statements, and finally developing thesis statements of their own. However, the topic was only touched upon, and was not fully exploited. Yet another workshop could have been productively spent on planning an essay. Here, the concept of topic sentences could have been revisited in detail, and concepts such as linear argumentation, objectivity and precision could have been explored more fully. Finally, writing the essay would take students at least another three hours, as redrafting, self-editing as well as peer-editing would have to be incorporated. Thus, this workshop would have been much more effective had it been divided into three separate three-hour workshops.

4.3.15 Workshop 18: Arguing in the sciences (argumentative writing)

Workshop 18, 'Arguing in the sciences (argumentative writing)' (Addendum R), is another workshop that focuses on essay writing. In Task 1, thesis statements are revisited. In Task 2, students again read one article each in small groups, summarise this information and share this information with the rest of the group. In Task 3, a thesis statement on the topic of genetically modified foods is written individually, and then checked in small groups, and in Task 4, an argumentative essay is written. Again, there was not enough time to finish the essay in class, but everyone did at least finish their introductory paragraph, which was then checked in small groups.

As with the previous workshop, students first work individually (except in Task 1, where pair work is made use of), and then get feedback in small groups. Also, students get another opportunity to practise their summarising abilities when reading and summarising their specific article, which then needs to be presented to the rest of the group.

The topic of genetically modified foods was chosen, firstly because of its scientific nature, and secondly because of its interest value. This is not a topic that many of the students know much about, but they are very interested in it, especially if a discussion is held about the state of genetically modified foods in South Africa. Students were again invited to submit their essays the following week. Six students did this.

This workshop presents students with a second opportunity of synthesising information – an ability that most of them found very difficult. As with the previous workshop, cognitive levels on Bloom's taxonomy that are practised most here are 'analysis' and 'synthesis', but in this workshop, students are also required to function at the level of 'evaluation', since they now need to not only represent factual information, but also have to evaluate this information by presenting a convincing argument.

Even though UNISA students do not seem to be required to argue at this level in either their first or second year of study, this workshop is still worthwhile. As Fellows (1993) argues, students often learn through the process of writing, as the act of writing integrates new ideas and previous knowledge (see Section 2.5.3). It is only when writing an essay that students see how all the abilities they have acquired thus far fit together.

This workshop faced the same challenges as the previous one, namely that there was not enough time to explore all activities fully, and as with the previous workshop, additional time spent on these activities might be fruitful.

4.3.16 Workshop 19: Synthesising information

In the 'Synthesising information' workshop (Addendum S), students are given two pairs of short texts (Task 1), as well as a collection of 9 short texts (Task 3) which need to be synthesised, using the appropriate referencing techniques. The texts were taken from the fields of information technology and geography, both fields included in the SFP. These texts offer different perspectives on various issues. In addition to synthesising the texts, students are required to incorporate their own opinions into the synthesis. This workshop builds on previous workshops in that students firstly have to use the referencing techniques practised in Workshop 13, and also apply the abilities practised in Workshop 11, namely 'Distinguishing between essential and non-essential information'. Furthermore, they need to paraphrase information (practised in Workshop 7) to successfully complete this task.

In Task 1, students work in pairs to synthesise information. Subsequently, they use a set of peer review questions to evaluate the synthesis of another group (Task 2). This promotes critical awareness of the features of a well-synthesised text. Finally, students are required to individually write a synthesis (Task 3), with small-group feedback given afterwards.

Although students are not required, in any of the analysed assignments, to function at the 'synthesis' level of Bloom's taxonomy, the same argument as for the previous two workshops is given, namely that this ability incorporates several abilities practised during earlier workshops, allowing students to see the relationship between abilities practised during the year.

Researchers argue that synthesising is a vital ability for students entering tertiary learning institutions (see, for example, Jacoby *et al* [1995] in Section 2.4.3, Snow and Brinton [1988] and Horowitz [1986], in Section 2.1.1). Through synthesis, ideas are formulated, meaning is constructed and one's own opinion is formed (see Kuanda *et al*, 1998, Section 2.1.1). Whether or not the assignments analysed in this study require this ability, it is clearly an ability that is generally required from tertiary level students. Therefore, it can be argued that it is UNISA's responsibility to lead students towards acquiring this ability. Preferably, this should be done in all assignments. The fact that this does not seem to be the case at present should not be an excuse to neglect this important ability in the workshop programme.

4.3.17 Workshop 20: Writing a laboratory report

The final workshop is titled 'Writing a laboratory report' (Addendum T). Here, different sections of laboratory reports are analysed to determine whether they are written well, and include the necessary information. This is done by means of guided discovery questions (Tasks 1 to 3). Analysing sections of laboratory reports in groups helps students to identify which aspects are critical in each of these sections. In Task 4, an example of a badly written laboratory report (i.e. with important information left out, unnecessary information included, and incorrect sentence and paragraph structure) is examined, and again students need to identify strengths and weaknesses, and suggest how these weaknesses could be improved. All activities are initially done in pairs, with whole-class feedback at the end of each activity.

There was no time in this workshop for students to write their own laboratory reports, and since the majority of students do not need to write a laboratory report at first- or second-year level[21], it was decided against having a second workshop on this topic for that purpose. However, it might be worthwhile to create a second workshop in the future, so that students can practise writing their own laboratory reports. One reason for this would be that laboratory reports, like with expository and argumentative essays, incorporate a wide range of abilities such as paraphrasing, summarising, describing, comparing, contrasting, showing cause and effect, interpreting and analysing data, and using graphs and tables (Braine, 1995; Section 2.5.3). Another would be that students in the SFP know that they will have to write laboratory reports at some point in their tertiary studies (as is done internationally – see, for example, Section 2.5.2), and are thus likely to be motivated in engaging in this 'real-life' writing activity.

4.4 Conclusion

Since it was impractical to develop a subject-specific workshop series for each of the SFP subjects, a common-core approach (described in Section 2.4.2) was used. In this approach, material from general interest areas is utilised, instead of focusing on a specific subject (Kennedy & Bolitho, 1984). Semi-technical texts from a broad variety of scientific disciplines (including computer sciences, chemistry, physics, biology and mathematics) were included in the workshops. This prevented the exclusion of students from any scientific discipline. Hutchinson and Waters (1987) argue that there is little justification in including highly specialised texts in ESP courses. Rather, it is preferable to use semi-technical texts from general interest areas that would keep all students interested. As Hutchinson and Waters

[21] When examining the assignments of a sample of fifteen second-year modules, only one module (PSO281Z [Plant Studies 2]) required students to write a laboratory report.

(1987) state, successful learning must be interesting, fun, and include variety to ensure that students develop a positive attitude towards the learning.

A variety of strategies for student interaction are used – at least two different interactional patterns are used in each workshop, although most workshops utilise at least three to four different patterns. These include individual work, pair work, small-group work and whole-class discussions. The variety of interactional patterns keeps the three-hour long workshops student-centred, and prevents monotony. As stated in Section 2.2, although black South African students are likely to prefer collaborative learning, individual learning styles must not be neglected as a result. Firstly, there may be some students who prefer individual tasks, and these students should not be excluded. Secondly, though students might prefer small-group learning tasks, it is beneficial for them to be exposed to a variety of interactional patterns, as this allows them to grow into more holistic learners who are able to function under a variety of learning conditions (also see Felder and Henriques [1995]).

The workshops were designed to build on each other, and as seen throughout this chapter, abilities acquired in previous workshops were revisited and refined in later workshops. Although the abilities required for students' assignments were an important consideration in the workshops, the workshops often challenged students to even higher levels of thinking, so as to prepare them for the remainder of their studies. The workshops also regularly focused on abilities that would be necessary to successfully complete the TALL, but workshops were not structured around the TALL. Rather, the workshops were meant to help students practise abilities that would be vital in their studies.

After completing this workshop series, several recommendations can be made about the order, frequency and content of workshops. These will be discussed in Chapter 6. Although it is always important to keep improving the structure of a workshop series such as this one, and to continually revise material, it would be important to maintain the principles of building on abilities previously acquired (and thus also revising them), as well as ensuring that workshops are interesting and challenging, firstly by developing appropriate material, and secondly by making sure that students get the opportunity to function in different interactional patterns. This should ensure continued motivation on the part of the students, which is vital for the success of a voluntary programme such as the SFP academic literacy workshops.

CHAPTER 5 Data analysis

5.1 Introduction

The previous chapter discussed the content of, and rationale behind, the intervention that was undertaken in the current study. However, for an intervention programme to be improved through a process of action research, it is also vital that the extent of its effectiveness be determined. This chapter analyses its effectiveness in two ways.

Firstly, a comparison between pre- and post-test results is made to determine the improvement (if any) in various sections of the TALL. Subsequently, a T-test is done of students' TALL pre- and post-test results, to determine whether the improvement in various sections of the TALL is statistically significant. Furthermore, an Analysis of Variance (ANOVA) is done to determine which variables influenced improved test marks significantly.

Secondly, a questionnaire that participants completed at the end of the workshop programme is analysed to determine what they felt the strengths and weaknesses of the intervention were, and how they suggested the intervention could be improved.

5.2 Statistical analysis of the TALL

The first step in determining whether the academic literacy intervention discussed in this study had any influence on students' TALL results was to compare pre- and post-test results. An overview is given in Table 5.1.

Test section	Average pre-test percentage	Average post-test percentage	Improvement between pre- and post-tests
Scrambled text	34.35%	30.87%	-3.48%
Interpreting graphs and visual information	34.78%	39.95%	5.16%
Text types	33.48%	43.91%	10.43%
Understanding texts	31.66%	37.64%	5.98%
Academic vocabulary	18.12%	28.99%	10.87%
Text editing	15.76%	27.72%	11.96%
TOTAL AVERAGE MARK	**27.15%**	**34.65%**	**7.5%**

Table 5.1 Average improvement between pre- and post-test results in various sections of the TALL

It would seem as though students improved in all sections of the TALL, except for the section on 'Scrambled text'. In fact, on average, students' performance in this section was worse in the post-test than it was in the pre-test. Although there seems to have been an improvement in the sections of 'Interpreting graphs and visual information' as well as 'Understanding texts', this improvement is not very substantial (at 5.16% and 5.98% respectively). The greatest improvements seem to be in the sections on 'Text types', 'Academic vocabulary' and 'Text editing' (all show improvements higher than 10%).

It is dangerous to make the assumption that the improvement discussed above is necessarily a significant improvement. A paired T-test was done to determine whether there was a statistically significant improvement between students' pre-test and post-test scores. A paired T-Test is used "when there is a natural pairing of observations in the samples, such as when a sample group is tested twice – before and after an experiment" (Microsoft Office Excel, 2007).

When the test as a whole is looked at, there is a significant improvement in students' test scores (P-value = < 0.0001; T-value = 5.54). When one looks at the various sections of the test, however, all sections do not show a statistically significant improvement between pre-test and post-test.

Section	**T-value**	**P-value**
Whole test	5.54	<.0001*
Section 1 – Scrambled text	-0.73	0.4675**
Section 2 – Interpreting graphs and visual information	1.46	0.1506**
Section 3 – Text types	2.04	0.0473*
Section 4 – Understanding texts	2.97	0.0048*
Section 5 – Academic vocabulary	4.01	0.0002*
Section 6 – Text editing	3.40	0.0014*

* Significant at the 0.05 level   ** Not significant

Table 5.2 Statistical significance of average improvement between pre- and post-tests

Sections 1 and 2 (‘Scrambled text’ and ‘Interpreting graphs and visual information’) do not show a significant improvement between pre-and post-test. However, the last four sections do show a significant improvement (at the 0.05 level).

Although there is a clear improvement between pre- and post-test results, it is not a very heartening improvement. It must be kept in mind, however, that the population that was tested includes a range of students who attended anything from one to twenty of the intervention workshops. It might therefore be useful to create two broad categories of students, namely those that attended one to seven workshops, and those that attended eight to twenty workshops, and to subsequently compare these two groups’ results. This is done in Table 5.3. The division between the two categories (1 to 7 workshops and 8 to 20 workshops) was made so as to ensure that the group size was roughly the same in each category.

	Students who attended 1 to 7 workshops (n = 26)	**Students who attended 8 to 20 workshops (n = 20)**
TALL pre-test result	25.19%	29.70%
TALL post-test result	29.69%	41.10%
Average improvement between pre- and post-tests	**4.50%**	**11.40%**

Table 5.3 Results divided into sessions attended (1-7 and 8-20 sessions)

The difference in the improvement would seem to indicate that students attending more workshops were likely to show a greater improvement between pre- and post-tests. The 4.50% improvement of the group of students who attended seven workshops or less could either be attributed to having spent a year in an academic environment, or to the effect of the workshops that the students did attend. In contrast, the marked improvement of students who attended between eight and twenty workshops would seem to imply that workshop attendance influenced the extent of improvement on the TALL.

To statistically verify the assumption that the number of sessions attended influenced students' improvement between pre- and post-tests, an Analysis of Variance (ANOVA) was done to see which variables most influenced the improvement between the pre-test and post-test. An ANOVA is "an analysis of the variation in the outcomes of an experiment to assess the contribution of each variable to the variation" (The American Heritage Dictionary, 2006).

A range of variables can influence an improvement in students' test marks. Three such potential variables were identified for this study, namely 1) the number of sessions attended; 2) the participants' age; and 3) the participants' sex.

Section	**T-value**	**P-value**
Sessions attended	2.73	0.0225 *
Age	-0.31	0.7610 **
Sex	0.46	0.6459**

* Significant at the 0.05 level ** Not significant

Table 5.4 Analysis of Variance (ANOVA) for sessions attended, age and sex

As can be seen in Table 5.3, the only variable that seems to have had a significant influence on the improvement between students' pre- and post-test results is that of number of sessions attended (with a P-value well below the required 0.05). Neither age nor sex seem to have had a significant influence on the improvement between pre- and post-tests. This implies that the more workshops students attended, the bigger the improvement between pre- and post-test results was likely to be.

This discussion has shown that there was a statistically significant improvement between students' pre- and post-test results in most sections of the TALL. Further, it would seem as though the number of intervention workshops that students attended significantly influenced this improvement. Unfortunately, the improvement was not substantial enough to take students out of the 'at-risk' group, and even after the intervention, the majority of students are still considered at-risk of not completing their studies. Possible ways of further improving students' test results are discussed in Chapter 6.

5.3 Qualitative analysis of feedback questionnaire

According to Hutchinson and Waters (1987), in addition to determining what students need and lack, it is important to keep in mind what students want when developing an ESP course (see Section 3.1). Therefore, before Chapter 6 examines how this intervention can be improved further in future, it is important to first ascertain students' opinions of the workshop programme, so as to incorporate their 'wants' effectively.

At the end of the workshop series, students completed a questionnaire (Addendum U) in which they evaluated the workshops. This section discusses the feedback on each question.

5.3.1 Students' perception of important abilities gained

Students were firstly asked which abilities addressed in the workshops were most important to them.

Of the 37 students who completed this question, 38% stated that summarising was the most important ability acquired during the workshop programme. This was closely followed by 32% of students stating that improved reading/understanding abilities were most valuable to them. Thirty per cent of students wrote that writing essays was very useful to them, 27% of students listed paraphrasing as a very important ability, and 24% of students stated that improved note-taking abilities were most important to them. Other important abilities included understanding/creating graphs (14% of students), referencing (14% of students), writing sentences and paragraphs (11% of students), writing laboratory reports (11% of students) and increasing academic vocabulary (11% of students). Although many of the abilities do correspond to a workshop topic with a similar title, most of these abilities were practised in a variety of workshops.

5.3.2 Aspects of workshops most enjoyed by students

In the next question, students were asked what they enjoyed most about the workshops.

The theme that emerged most strongly here was how much students enjoyed collaborative learning. This was commented on by 43% of the students. Comments included that students enjoyed "meeting other students" as well as "discussing tasks in class and being able to answer questions in groups".

In a distance education environment, students rarely get the opportunity to measure themselves against other students, and therefore one advantage of the workshops was "meeting other students to see their ability of writing and reading [*sic*]". Students also seem to have enjoyed the mental stimulation that group work brings: "I enjoyed group discussions and arguing in the class". Another student states that what was most enjoyable was "the teamwork, and new students' inputs, the manner in which we were shown how to handle the study material which looked difficult at home, and became easy hereafter". Biggs (1989), in Section 2.2.1, states that it is through such learner activity and interaction that deep learning takes place.

Section 2.2.3 states that collaborative learning increases self-confidence, and one student agreed, saying that the workshops "boosted my self-confidence [and] language proficiency".

The most important benefit of collaborative learning might be the opportunity "to meet with fellow students and share ideas, as we are part-time students [and] we met in the workshops" – here, students who hardly ever see other students are given the opportunity of becoming part of a larger university community, whilst at the same time entering the discourse community of science.

Another advantage of collaborative learning is that it ensures an informal learning environment. Eleven per cent of the students stated that they enjoyed "the freedom of learning without being afraid of making a mistake or asking". One student stated that "there is no oppression, [you are] free to ask if there is something you don't understand". Of course, collaborative learning allows students a certain degree of freedom that is not always possible in a traditional educational environment, as this student states: "everyone was free to express his/her ideas and points of view. I also enjoyed working in groups to express our ideas and pick the fundamental points [*sic*]". Students are given the chance to experiment, to learn by asking and by trial and error, and through this to construct knowledge (see Section 2.2.1).

Students also seemed to enjoy the challenging environment that the workshops ensured. One student stated that her favourite workshops were "the brainstorming ones", and another enjoyed learning "how one should learn to think critically, out of the box".

5.3.3 Aspects of workshops least enjoyed by students

The third question asked students what they enjoyed least about the workshops.

Five per cent of students stated that they did not enjoy group work. It is important to keep in mind the warnings given in Section 2.2.2 and 2.2.3 that not all students will have the same learning preferences. Thus, even though, as stated in Section 2.2.2, black South African students are likely to enjoy collaborative learning, there will always be exceptions, and thus all learning styles need to be catered for when designing an ESP course.

Eight per cent of students felt that groups did not participate enough or that students were rude. Here, the importance of the facilitator comes to the fore – it is his/her responsibility to ensure that order is maintained whilst ensuring a comfortable environment, and also to make sure that all groups participate in activities. Misselhorn's (1995) conclusion that students prefer having an authority figure present when learning (as discussed in Section 2.1.1) seems to be confirmed by students' feedback in the current study, and should be kept in mind when designing an ESP course. Leaving students to their own devices too much could lead to the failure of an intervention such as the one described in this study.

Five per cent of students stated that they felt there were not enough workshops. This is a theme that came through quite strongly in Question 8, and is discussed in more detail in Section 5.3.8.

Eight per cent of students blamed themselves for not enjoying the workshop series as much as they might have, saying that they did not attend all of the workshops, or were often late. This is a pitfall of voluntary workshops – if there is not a big enough incentive for students to attend all workshops, they are likely to start missing workshops once the pressure of assignments and examinations starts burdening them. This ultimately prevents them from optimally benefiting from the workshops.

5.3.4 Workshop topics to be included in future

The fourth question asked students which workshop topics they would like included in future.

Several students mentioned workshop topics that they were unable to attend, confirming the point made above, that voluntary workshops often lead to students missing out on important information – something that they regret afterwards.

Several new workshop topics were suggested. The only topic that was suggested by two students was one on 'presentation skills'. In a distance education environment, students never get the opportunity to practise class presentations, though they realise that this is an important life-skill. Other topics that were suggested included 'punctuation', 'preparing for exams', 'designing projects' and 'multiple choice questions'. Some workshop topics were suggested that have nothing to do with language acquisition. These include 'computer literacy' and 'vectors and directions'. The fact that students suggest such topics might indicate that they see the workshops as helping them acquire general academic abilities, and not necessarily only language abilities. This is positive in that the workshops do not seem to be stigmatised as only being intended for students with poor language abilities.

5.3.5 Abilities students need to practise more

In Question 5, students were asked what workshop topics they needed additional practice in.

Twenty-eight per cent of students who completed this question felt that they needed more practise in paraphrasing. Interestingly enough, though students did not indicate that laboratory reports were important in Section 5.3.1, it closely follows paraphrasing as an ability that students would like additional practice in (24% of students wanted to practise this ability more). This seems to indicate that one workshop was not enough to familiarise them with this topic, and that they see this as an important topic. Other topics that students would like more practice in are synthesising (17% of students), summarising and referencing (14% of students each), academic vocabulary, argumentative writing and note-taking abilities (10% of students each), writing paragraphs and general reading skills (7% of students each).

Clearly, students feel they need more time to practise almost all topics on the workshop programme. It might therefore be worthwhile to present more workshops per week, taking students' preferences into consideration. The fact that students show the desire to spend even more time on various topics shows a strong desire to learn and to be challenged intellectually. As this participant states, students want more practice in "anything that will make our brains think and work much [*sic*]".

5.3.6 Further improvement of workshops

Question 6 asks students how the workshops could be improved further.

Forty-five per cent of students who answered this question stated that there should be more workshops, or longer workshops. Since the workshops are already three hours long, and challenge students' concentration span, it would probably be advisable to increase the number of workshops. This suggestion is not unproblematic either though, since some of the students are working students, and already have difficulty getting the time off work to attend the workshop programme in its current format.

Twenty per cent of students suggested including tests or questionnaires. Since these workshops were not for credit purposes, no formal evaluation (other than the TALL pre- and post-tests) was done. Yet, students might need some sort of formative assessment for them to assess whether they are making any progress.

One student suggested presenting the workshops via satellite broadcasting for students who live far away from Pretoria. Though this is an interesting suggestion, this method of presentation would have to be researched and designed very carefully, so as not to lose the benefits of collaborative learning that the workshops presently have.

Another student wanted more relevant texts. Although the material is designed to appeal to all students studying in science-related fields, it is impossible in the UNISA context to present specialised workshops for each module. However, it should be investigated whether some of the workshops could be adapted to use students' own study material, instead of generic texts.

Some of these suggestions, for example increasing the number of workshops and including formative assessment, could quite easily be incorporated into the redevelopment of this workshop series. Others would have to be planned carefully, but should seriously be considered for future refinement and improvement of the intervention programme.

5.3.7 Transference of abilities to students' studies

In Question 7, students were asked in what way the workshops have helped them to become more successful in their studies. Almost all students felt that the workshops did help them in their studies. Thirty per cent of students specifically stated that the workshops helped them in their assignments.

One participant commented that s/he used the skills "in my biology books" and another student "received good marks in my last assignment". Eight per cent of students stated that they used the acquired abilities in examinations, and 8% of students mentioned that they used the abilities in the communications module that some of them had to do. One student enthusiastically wrote: “Yes! I did [*sic*] most of them, like paraphrasing, note-taking, summaries, almost every skill that I have learned, I applied it”. Though it is very difficult to establish whether most students did indeed transfer the abilities acquired in the workshops to their other subjects, comments like these do imply that at least some students did.

5.3.8 Students’ rating of workshops’ usefulness

In the final question, students had to rate the usefulness of each workshop on a scale from 1 to 5, 1 being ‘Very useful’, and 5 ‘Not useful at all’. Students rated the workshops as follows:

Workshop topic	**1 Very useful %**	**2 Useful %**	**Total 1 & 2**	**3 Useful to an extent %**	**4 Not very useful %**	**5 Not useful at all %**	**Total 4 & 5**
Workshop 1: Improving your vocabulary	43.2	48.6	91.9	5.4	2.7	0.0	2.7
Workshop 2: Writing good sentences	48.6	37.8	86.5	10.8	2.7	0.0	2.7
Workshop 3: Using words and concepts in context	35.5	51.6	87.1	12.9	0.0	0.0	0.0
Workshop 4: Reading in the sciences (1)	38.7	45.2	83.9	16.1	0.0	0.0	0.0
Workshop 5: Writing good paragraphs (1)	43.8	46.9	90.6	9.4	0.0	0.0	0.0
Workshop 6: Writing good paragraphs (2)	45.5	42.4	87.9	12.1	0.0	0.0	0.0
Workshop 7: Paraphrasing	52.9	29.4	82.4	17.6	0.0	0.0	0.0
Workshop 8: Summarising	51.5	27.3	78.8	18.2	3.0	0.0	3.0
Workshop 9: Visual literacy (1)	43.8	34.4	78.1	9.4	12.5	0.0	12.5
Workshop 10: Visual literacy (2)	38.7	45.2	83.9	9.7	6.5	0.0	6.5
Workshop 11: Distinguishing between essential and non-essential information	31.0	44.8	75.9	17.2	3.4	3.4	6.9

Workshop 12: Note-taking strategies	48.1	25.9	74.1	14.8	11.1	0.0	11.1
Workshop 13: Introduction to referencing	35.5	35.5	71.0	22.6	6.5	0.0	6.5
Workshop 14: Bibliographies	46.9	31.3	78.1	18.8	3.1	0.0	3.1
Workshop 15: Revision – parts of speech and paragraph writing	28.6	28.6	57.1	35.7	7.1	0.0	7.1
Workshop 16: Reading in the sciences (2)	60.7	21.4	82.1	10.7	7.1	0.0	7.1
Workshop 17: Writing about facts in the sciences (expository writing)	41.4	48.3	89.7	10.3	0.0	0.0	0.0
Workshop 18: Arguing in the sciences (argumentative writing)	48.3	27.6	75.9	10.3	10.3	3.4	13.8
Workshop 19: Synthesising information	53.3	33.3	86.7	10.0	0.0	3.3	3.3
Workshop 20: Writing a laboratory report	30.0	40.0	70.0	23.3	3.3	3.3	6.7

Table 5.5 Students' rating of usefulness of workshops

Although some workshop topics were clearly more popular than others, more than half of the students felt that all of the workshops were 'very useful' or 'useful'.

The most useful workshops, according to the responses in this question, were 'Improving your vocabulary' and 'Writing good paragraphs (1)'. However, most workshops received very good ratings, with between 70% and 91.9% of all students finding almost all workshops either 'very useful' or 'useful'. The only exception was the revision workshop on 'Parts of speech and paragraph writing'. Only 57.1% of students indicated that this workshop was either 'very useful' or 'useful'.

The only workshops that received more than 10% in the categories of being 'not very useful', or 'not useful at all', were the workshops on 'Argumentative writing', 'Visual literacy' and 'Note-taking strategies'. It must be remembered that the students who did find these workshops useful or very useful far outweigh the students who did not believe themselves to benefit from these workshops.

Since there were no instances where the majority of students felt that a workshop was 'not very useful', or 'not useful at all', it does not seem advisable to change any of the current workshop topics. At most, workshop material might be adjusted so as to be more relevant to students.

5.4 Conclusion

This chapter examined the effectiveness of the SFP academic literacy intervention in two ways.

Firstly, a statistical analysis was conducted to determine whether the improvement between students' TALL pre- and post-test results was significant, and subsequently what variable had the greatest influence on students' improvement. It was found that the improvement between pre- and post-test results were statistically significant, and that the number of sessions attended significantly influenced the extent of students' improvement between pre- and post-tests.

Secondly, the feedback obtained in the form of a questionnaire, completed by students at the end of the workshop programme, was examined.

Students indicated that they had gained a wide variety of abilities, foremost being summarising, reading, comprehension, writing essays, paraphrasing and note-taking abilities. Students also felt that they needed additional practise in almost all abilities, especially paraphrasing, writing laboratory reports, and synthesising. As all of these abilities are very complex, students probably felt that not enough time was spent to adequately master these abilities. The majority of students indicated that all existing workshop topics were either 'very useful', or 'useful'. The only new topic that was suggested by more than one student was that of presentation skills. This, however, does not justify it being included in future workshop programmes as a distinct topic. Rather, it could be included in other workshops, as an alternative to general discussions as a form of feedback.

A major emerging theme was that students enjoyed small-group, collaborative learning. Such learning, however, must be carefully structured, and led by an authority figure. Several students also indicated that they enjoyed learning that was perceived as being challenging. Suggestions for improving the workshop programme in future included having additional or longer workshops, as well as incorporating formative assessment in addition to the TALL, which could be considered a summative assessment. Almost all students indicated that the workshops helped them in their studies, with approximately a third of the respondents indicating that they used the abilities acquired in the workshops in their assignments. It can thus be surmised that at least some transference occurred.

Now that the effectiveness of the SFP intervention programme has been investigated, Chapter 6 will focus on making recommendations for the refinement and redevelopment of this workshop programme.

CHAPTER 6 Critique of the workshop programme

6.1 Introduction

As discussed in Chapter 4, many of the guidelines suggested in the literature review were followed in the development and implementation of the intervention programme. However, some suggestions were not incorporated – possibly to the detriment of the intervention. Additionally, feedback on the effectiveness of this workshop programme was obtained from the TALL results as well as students' feedback at the end of the workshop series. This feedback can only be of value if it is considered in the redevelopment of future workshop programmes. This section starts off by examining to what extent the principles of collaborative learning and the use of authentic materials were followed in the intervention programme. Thereafter, a summary is given of instances where the guidelines in the literature review and the current workshop programme either coincide or differ. Furthermore, students' feedback and suggestions, as well as the implications of students' TALL results, are incorporated. Finally, a revised workshop programme is suggested which takes into account guidelines from the literature, implications from the TALL results, as well as students' preferences.

6.2 The principles of collaborative learning and the use of authentic materials

Two important principles underlie the workshop programme. The first is collaborative learning. The second is the use of authentic materials.

The importance of collaborative learning is discussed in detail in Section 2.2. The concept of collaborative learning has been shown to be ideal for an African context (see Rosenthal [1996] and Misselhorn [1997]) as well as for language learning (Nunan, 1992).

This workshop series integrates aspects of collaborative learning throughout, and supports the principle that students learn best from each other, while actively engaging with knowledge (see Kohonen [1992]). Throughout the workshop programme, students are encouraged to engage with the learning material, and great care is taken to not create a distance between student and learning material in the form of a formal lecture. At the same time, the principle that an authority figure must be present to regulate group work and to lend authority and legitimacy to the workshops is followed (see Murray [1992] and Misselhorn [1997]).

The design of the workshops acknowledges that students have different learning style strengths (see Willing [1988] and Rosenthal [1996]), and therefore incorporates whole-class work, small-group work, pair work as well as individual work, so as to accommodate as many students as possible.

This defining characteristic of the workshop series was the one that students commented on most favourably in their feedback at the end of the year. Almost all students made positive comments about being able to learn with, as well as from, other students. Comments included that students enjoyed "the teamwork, and new students' input", as well as "to meet with fellow students and share ideas" (see Section 5.3.2). This makes sense in an ODL environment where students do not often get the opportunity of engaging in collaborative learning. In view of students' comments, as well as recommendations made in the literature review, this is one aspect that should continue to be integrated in future intervention programmes.

The second principle that underlies much of this workshop programme is that of using authentic material (discussed in Section 2.4.2). One advantage of this is that students see the intervention as having relevance to their own studies (see Hutchinson and Waters [1987]), and are consequently more motivated to engage in language learning (see Kroll [1979]).

Authentic material in this context refers to texts that are scientific in nature and that are accessible to students from various scientific fields, rather than highly technical and specialised texts (see Hutchinson and Waters [1987]). This is because students attending the SFP workshops come from a variety of scientific fields. Examples of texts used in the intervention programme include samples taken from students' study guides in Workshops 4 (Reading in the sciences [1]) and 12 (Distinguishing between essential and non-essential information), texts found in scientific textbooks and reference books in Workshops 7 (Paraphrasing) and 16 (Reading in the sciences [2]), as well as popular scientific articles in Workshops 17 (Writing about facts in the sciences) and 18 (Arguing in the sciences).

Developing specialised workshops for each module or even scientific field would be impractical in the UNISA context, and therefore, the approach of using topics and material of general scientific interest is the best approach for this type of intervention. Misselhorn's (1997) advice is followed in that a wide variety and large number of texts are used, so that students get a feeling of how the texts are constructed (Section 2.4.3).

In addition to these two principles, various abilities are incorporated into the workshop programme. Although many of these abilities correspond to workshop titles, abilities are generally practised and reinforced throughout the workshop series (see Section 4.2). Section 6.3 examines to what extent the abilities practised in the workshops coincide with findings in the literature, as well as students' TALL results, and their opinions on the workshop programme.

6.3 Critique of elements of the intervention

6.3.1 Grammar

When one thinks about a language course, grammar is often one of the aspects focused on most. In this workshop programme, the advice from language practitioners such as Nunan (1988) and Ellis (2006) is followed, in that grammar was dealt with in context, and only so as to facilitate meaning. Examples of this are where parts of speech are dealt with in the vocabulary learning workshops (Workshops 1 and 3), the use of the active and passive voice in the workshop on writing good sentences (Workshop 2) or tenses in the workshop on writing laboratory reports (Workshop 20). Students are thus made aware of the linguistic structures (as discussed by Coffin and Hewings [2003] in Section 2.5.3) so as to facilitate the production of language (Hudson [2002], Section 2.5.3).

Grammar was not overtly tested as a section in the TALL. In addition, no students commented thereon in the questionnaire. Thus, no further comments can be made regarding the use of grammar in the workshops, except that students seem to feel comfortable with the status quo, and that the approach to grammar should stay the same in subsequent workshop programmes.

6.3.2 Vocabulary

Rosenthal (1996) argues that low vocabulary levels are a particularly great obstacle for science students when it comes to decoding information through the receptive abilities of listening and reading (see Section 2.5.3). In this intervention programme, two workshops are dedicated to vocabulary learning, with some emphasis on vocabulary learning strategies (Phillips [2004]; Section 2.5.3). These workshops address problems found in the literature relating to students having difficulty with distinguishing between the general and scientific meaning that many words have, as well as struggling with sub-technical vocabulary more than with technical vocabulary (see Section 2.4.3).

Students showed an encouraging improvement in the vocabulary section of the TALL (10.87%, $p = 0.0002$; see Section 5.2). Several students also stated that increased academic vocabulary was one of the most important abilities gained throughout the workshop series (Section 5.3.1), rating them at the levels of 'very useful' and 'useful' with combined scores of 91.9% and 87.1% respectively (Section 5.3.8). However, more could still be done to reinforce vocabulary learning throughout the workshop programme.

After focusing on vocabulary acquisition in Workshops 1 and 3, it is not directly focused on again throughout the rest of the workshop series. One way of building on the abilities practised in the two vocabulary workshops would be to have a short exercise on vocabulary acquisition built into all workshops. Potentially problematic words can be identified in each workshop, and these can be addressed either through a separate activity, or by adding them to a vocabulary journal in which the words, their meanings, as well as meaningful sentences are written during each workshop[22].

[22] The intention was to do this in the intervention under discussion, and a framework for such a list was handed out to students at the beginning of the year, but this was not followed up throughout the year.

Furthermore, vocabulary could be tested throughout the year as part of formative assessment, to encourage students to continuously work at acquiring new vocabulary. Although it seems fashionable to steer away from tests in the era of outcomes-based education, students' feedback in the questionnaire (discussed in Section 5.3.6) seem to indicate that they do have a desire to know at what level their abilities are. Informal tests (possibly with a prize for the students who perform best, to make the experience more fun and increase student motivation) would be one way of assisting them in this.

The definition of academic literacy that the TALL is based on includes that students "understand a range of vocabulary in context" (Weideman, 2003a: xi). As understanding and using academic vocabulary is a prerequisite for academic reading and writing, it is important that this ability be practised throughout the workshop programme, so as to expand students' academic vocabulary as much as possible.

6.3.3 Visual literacy

Not much is said about visual literacy for science students in the literature, yet it remains an important ability for them to acquire. The definition of academic literacy on which the TALL is based states that students must be able to "interpret, use and produce information presented in graphic or visual format" (Weideman, 2003a: xi). Furthermore, the UNC-CH Writing Centre [2005] mentions that quantitative descriptions are preferred over qualitative descriptions in a scientific context (Section 2.5.3). One way of representing quantitative descriptions would be through graphs, charts and tables. This is practised in both visual literacy workshops (Workshops 9 and 10), as well as in the second workshop focusing on reading strategies (Workshop 16).

In the feedback questionnaire, 14% of the respondents mentioned understanding and creating graphs as one of the most important abilities acquired. However, as the TALL results show that students did not improve significantly in the visual literacy section (5.16%, $p = 0.1506$), this ability would have to be examined more carefully in subsequent workshops so as to better equip students in future. Even though no students indicated that they felt they needed more practise in visual literacy, the TALL results indicate that there is much room for improvement.

One suggestion would be to include more graphs, tables and charts in the texts used in other workshops, thus assisting students in becoming familiar with the convention of using visual literacy elements in scientific writing. It would also be useful to include at least one additional visual literacy workshop, and to avoid clustering the workshops together in the programme. Rather, workshops should be spread throughout the year, allowing students to revisit abilities acquired previously, and building on these abilities. A further strategy that might be useful in the visual literacy workshops would be to include more small-group work. In the current workshops, all activities are done in pairs. It is possible that students would learn more if the groups were slightly bigger (approximately 4 to 5 students), as this would increase the chances that stronger students could explain difficult concepts to weaker students. It is also possible that workshops were pitched at a lower level than the TALL was. If this is the case, it would be necessary to make certain that all visual literacy workshops build on each other in terms of difficulty level, so as to ensure that students have a thorough foundation in this ability, and are then able to progress to more difficult activities.

6.3.4 Speaking and listening

Although this workshop programme focuses very little on presentational speech, much exploratory speech occurs between students, and between students and facilitator (see Section 2.4.3 for a discussion of these types of speech).

Since the workshops are informal, and allow much time for students to explore topics with fellow students and with the facilitator, they have the opportunity of expressing their ideas in a stress-free environment. Furthermore, exploratory speech helps students to discover and sharpen their ideas by sharing these with other people (Thier & Daviss [2002], Section 2.5.3). Through the process of exploratory speech, opportunities are also created for students to practise their listening abilities. Students need to concentrate on what fellow students say, as they usually have to offer a reaction to other students' thoughts.

None of these activities seem like traditional learning (which usually consists of formal listening and note-taking in a lecture, with very little speaking in between), which probably assists in breaking down affective filters (see Section 2.2.2 for a discussion hereof). This is indicated in the questionnaire by comments such as that students enjoyed "the freedom of learning without being afraid of making a mistake or asking", and that they "enjoyed group discussions and arguing in the class" (Section 5.3.2). This feedback corresponds with the argument made in Section 2.5.3 that specifically black South African students, who often come from on oral background, might prefer expressing themselves verbally before engaging in writing activities.

The fact that two students suggested presentation skills as a new workshop topic in subsequent intervention programmes indicates that, as much as students enjoy and value exploratory speech, there is some need to also practise presentational speech. One way of exposing students to this type of speech would be to vary whole-class discussions as a method of feedback by having students present their feedback in front of the class. This would have the advantage of allowing students to improve the ability of presentational speech in a relatively stress-free environment, whilst increasingly getting used to presenting in front of groups of people – an ability they might need when entering their chosen professions. Some workshops where this could be incorporated would be Workshop 10 (Visual literacy), Workshop 12 (Note-taking strategies), and Workshop 19 (Synthesising information). By the time students would first have to present their work (Workshop 9), they would have participated in the workshop programme for approximately two months, and would, presumably, feel comfortable enough with their fellow students to have the self-confidence to present in front of the rest of the class.

6.3.5 Reading

The definition of academic literacy upon which the TALL is based emphasises a wide variety of reading abilities, for example: understanding metaphor, idiom, connotation, word play and ambiguity; understanding relations between various parts of a text and seeing sequence; interpreting text genres; distinguishing between essential and non-essential information; and understanding what would count as evidence for an argument (Weideman, 2003a: xi). The fact that reading abilities are focused on so strongly in the TALL indicates that they are the cornerstone of academic literacy.

Only two workshops (Workshops 4 and 16) specifically focus on reading abilities, but students are expected to read and process texts in many other workshops, often writing in response to such texts (see Johns [1981]; Section 2.4.3). Phillips (2004) claims that just by reading a wide variety of texts, students will begin to imitate the style and structure of such texts in their own writing (see Section 2.5.3). Examples of workshops in which scientific texts are read include the workshops on ‘Summarising’ (Workshop 8), ‘Distinguishing between essential and non-essential information’ (Workshop 11), ‘Note-taking strategies’ (Workshop 12) and the two workshops on essay writing (Workshops 17 and 18). The fact that a wide variety of text types is used across workshops means that students are exposed to a broad range of writing, which challenges them to adapt their reading strategies.

Many of the texts used in this intervention programme (specifically those used in the two essay writing workshops) encourage students to be critical about information, understanding that “observations of the world are made from a personal perspective built up by prior knowledge, beliefs and theories” (Murcia [undated:10]; Section 2.5.3). This helps them to cultivate the healthy habit of scepticism (Thier, 2005; Section 2.5.3). One student commented that s/he enjoyed learning “how one should learn to think critically, out of the box”. This display of meta-cognitive thought shows that a habit of critical thinking was fostered with at least some participants.

Students are taught reading strategies (as suggested by Berkenkotter and Huckin [1995] in Section 2.5.3) to some extent, specifically in the first reading workshop (Workshop 4) where the abilities of skimming and scanning are practised. However, reading abilities should receive much more attention throughout the workshop series. Berkenkotter and Huckin (1995) suggest that students should be familiarised with the strategies that scientists use to read texts, namely first reading the title, followed by the abstract, the visual elements, the results and finally the content. Although I believe that it would be unrealistic to expect UNISA first-year students to see the value in reading academic articles so early in their studies, Berkenkotter and Huckin’s strategy could be followed with more basic texts as well. Exercises could, for example, be included before all longer texts, where students are asked leading questions about the various sections of texts, or are asked to create a short outline or mind-map of the texts by using visual clues (for example headings, bold keywords and visual elements). If such activities are regularly included in a variety of workshops, reading strategies would probably become automated, and students would be more likely to apply these strategies to their studies.

In addition to paying more attention to reading strategies throughout the workshop programme, at least one extra workshop would have to focus on equipping students with strategies to access very dense, atomistic texts (all characteristics of scientific writing, as discussed in Section 2.5.2). The recommendation of scaffolding material and exercises, made in Section 2.5.3, should be followed by gradually introducing students to increasingly difficult reading texts, which would progressively demand improved reading strategies.

Another recommendation regarding workshops in which aspects of reading strategies are focused on is that the order of various workshops be changed. For example, it is recommended that Workshop 11 (Distinguishing between essential and non-essential information) be moved before Workshop 8 (Summarising), because in order to summarise a text, it is necessary to first identify the main points of that text. Furthermore, Workshop 12 (Note-taking strategies) should be placed between the workshops on ‘Distinguishing between essential and non-essential information’ and ‘Summarising’. To effectively take notes, the abilities introduced in Workshop 11 should already have been addressed. Once students have practised distinguishing between essential and non-essential information and taking effective notes, fewer new abilities would have to be introduced in the summarising workshop. The more complicated note-taking method of mind mapping could be removed from the current note-taking workshop, and be discussed in a separate workshop at a later stage, so as to ensure that enough time is spent on this ability.

Students seem aware of the crucial importance of reading abilities. In the questionnaire completed at the end of the workshop series, 32% of the respondents mentioned reading and understanding as one of the most important abilities gained during the intervention programme. Both reading workshops were rated as ‘very useful’ or ‘useful’ (with combined scores of 83.9% and 82.1% respectively). Interestingly, only two students indicated that they needed more practice in this ability. Students seem to have an unrealistic perception of how much they had improved in this ability, and how much they still needed to improve (also see Coetzee-Van Rooy and Verhoef [2000] for a discussion on students’ inaccurate perceptions of their language proficiency levels, specifically their reading abilities). In the ‘understanding texts’ section in the TALL, there was a mere 5.98% improvement between pre- and post-test. Thus, even though students do not seem to realise it, this ability definitely has to be practised more. This will be possible if the recommendations made in this section are followed.

6.3.6 Writing

Several workshops in this intervention programme focused on writing abilities. Jacoby *et al*. (1995) suggest that important writing abilities include prewriting, planning, organising, synthesis, and content and rhetorical analysis of texts (see Section 2.4.3). All of these were addressed in this intervention programme. Prewriting and planning were practised in both essay writing workshops (Workshops 17 and 18). In these workshops, students had to take notes from articles as the basis for their own essay. In the expository essay workshop, students had to think of topic sentences for the paragraphs in their essays. Organising abilities were also practised in both of these workshops, as well as in sessions such as ‘Note-taking strategies’ (Workshop 12), where information had to be organised logically into a mind map or outline. Synthesis was practised in both essay writing workshops, as well as in a workshop dedicated to synthesising texts (Workshop 19). Content and rhetorical analysis of texts was also practised in both essay writing workshops, as well as the synthesising texts workshop.

These are not the only writing abilities important to students studying science-related courses. Being able to summarise (and included in that, paraphrase) effectively is vital for science students (Braine, 1995; Section 2.5.3), as scientific writing is “tightly knit” in “a style of writing which is concise and precise” (Rosenthal, 1996:105) and atomistic (Becher, 1987:273; see Section 2.5.2). These abilities are addressed in workshops 7 and 8. Using semantic relations (Phillips, 2004) can assist in making highly structured academic writing more comprehensible. This is addressed in the workshops on paragraph writing (Workshops 5 and 6). Another way of preparing students for the complex task of summarising is to train them to underline, colour code, and create mind maps or diagrams (Kirkland & Saunders, 1991; Section 2.5.3). These strategies are addressed in Workshop 12 (note-taking strategies). However, as this workshop takes place long after the workshops on paraphrasing and summarising (Workshops 7 and 8), the workshop is not ideally placed to be a useful tool in preparing students to summarise effectively (as discussed in Section 6.3.5).

The characteristics of objectivity and neutrality (for example Phillips [2004]; Section 2.5.2) are touched upon in the workshop on writing good sentences (Workshop 2), where students have to convert sentences in the active voice to the passive voice (an important ability according to White [1988], Robinson [1980] and the UNC-CH Writing Centre [2005]). These characteristics are further addressed specifically in the workshop on expository writing

(Workshop 17), where students are expected to objectively report on nuclear energy – a topic that students can become very emotional about.

When examining the feedback questionnaire, students indicated that they benefitted from several writing workshops (see Section 5.3.1). Foremost amongst these was summarising, with 38% of the respondents indicating that this ability was one of the most important abilities acquired during the year. Surprisingly, 30% of the respondents mentioned essay writing as an important ability gained, in spite of the fact that little extensive writing is done in students' first year, as indicated in Section 3.4.1. As this constitutes a favourable response from almost a third of the respondents, it would seem prudent to keep the two essay writing topics in the workshop programme, and to possibly even expand on them. Other abilities that students believed they gained were paraphrasing, referencing (specifically important in essay writing, but also in other assignments), writing sentences and paragraphs, as well as writing laboratory reports. Students also indicated that they needed more practise in many writing orientated workshops. Twenty-eight per cent of the respondents indicated that they needed more practise in paraphrasing. Other abilities that were mentioned were writing laboratory reports, synthesising, summarising, referencing, argumentative writing and writing paragraphs. Even though the academic literacy abilities tested in the TALL would most likely have an impact on students' writing abilities, one limitation of this study was that there was no specific writing pre- and post-test. Therefore, students' feedback has to be relied upon to determine the extent to which the writing components in future workshops would have to be adapted.

In spite of a wide array of writing abilities being successfully addressed in a variety of workshops, several recommendations can be made to further enhance students' writing abilities. Firstly, in early workshops such as the two paragraph writing workshops (Workshops 5 and 6), more attention should be given to Bloom's lower-order levels, and fewer exercises should focus on 'synthesis' and 'evaluation'. As students clearly need much development at all levels, it seems worthwhile to start by paying attention to lower-order cognitive levels, and to gradually introduce students to higher-order cognitive levels[23]. In

[23] The intention here is not to encourage the UNISA curriculum away from higher order cognitive abilities. However, the purpose of UNISA learner support is to support learners in their existing academic courses. To neglect lower-order cognitive levels (which are heavily relied upon until at least second year level) in favour of the ideal that students should have reached higher-order levels already would go against the purpose of learner support, and ESP in general. This study therefore proposes that lower-order cognitive levels receive priority until these are adequately mastered.

addition, it is recommended that Workshop 19 (Synthesising information) be placed before the two essay writing workshops (Workshops 17 and 18), as these workshops require students to have already acquired the ability of synthesising information. If it is placed after these workshops, it seems disconnected from the rest of the acquired abilities, and might not seem valuable to students. Again, abilities need to logically build on each other to be of worth.

Furthermore, several workshops seem to be too short to fully address all activities in those workshops. It is recommended that less time be spent on cohesive devices in Workshops 5 and 6, and that an additional workshop be created during which cohesion and coherence could be addressed more fully. A revision workshop on paraphrasing and summarising abilities should be scheduled, so as to provide students with a more solid foundation in these crucial abilities. Another topic that would be well served by an additional workshop would be writing thesis statements. Students had great difficulty with this in the workshops on expository and argumentative writing, and thus much time was spent on explaining and creating thesis statements. More time could be spent on writing essays in these two workshops if thesis statements were discussed in a separate workshop. Even if such a workshop is added, more time should still be spent on planning, writing and evaluating expository and argumentative essays. Therefore, at least one additional workshop on both of these essay-writing topics is recommended. Finally, it might be worthwhile to create a second workshop on writing laboratory reports, so that students can practise writing their own laboratory reports. One reason for this would be that laboratory reports, like with expository and argumentative essays, incorporate a wide range of abilities such as paraphrasing, summarising, describing, comparing, contrasting, showing cause and effect, interpreting and analysing data, and using graphs and tables (Braine 1995; Section 2.5.3). Another would be that students in the SFP know that they will have to write laboratory reports at some point during their tertiary studies (as is done internationally – see, for example, Section 2.5.2), and are thus likely to be motivated by engaging in this 'real-life' writing activity.

Although it can be argued that less focus should be given to writing abilities, as little extensive writing is done in science students' undergraduate studies (see Chapter 3), I agree with Fellows (1993) in that, by writing, students are able to integrate previous knowledge and new ideas (see Section 2.5.3). Possibly even more importantly, students are given the opportunity of integrating previously acquired abilities with new abilities, and at the same time of becoming more proficient in previously acquired abilities. An example of a workshop where this is the case is the workshop on writing laboratory reports (Workshop 20). Here, students need to integrate a "complex mixture of writing skills such as summary, paraphrase, seriation, description, comparison and contrast, cause and effect, interpretation of data, analysis, and the integration of mathematical and scientific data into a text" (Braine, 1989:9-10; Section 2.5.3). Therefore, writing is not necessarily seen as the ultimate goal, but as a vehicle that aids students in fully acquiring a wide range of abilities.

6.4 Number of workshops

In addition to commenting on various workshops and acquired abilities, students made some recommendations for the improvement of the academic literacy intervention discussed in this study.

The most notable issue that emerged was that students (45% of the respondents) felt that more or longer workshops were required. As discussed in Section 5.3.6, increasing the number of workshops might be more useful than increasing the length of the workshops. Students' recommendation that more workshops should be included corresponds with suggestions made throughout this chapter, that more workshops are needed in order to adequately address various abilities. It would seem as though a 60-hour (twenty 3-hour workshops) workshop programme is not sufficient to optimally improve students' academic literacy in the UNISA context.

One problem with an increased number of workshops is that this would make it more difficult for employed students to attend. As all abilities might not require additional workshops, it is probably sufficient to increase the contact time by 30 hours (thus adding ten workshops for reinforcing abilities dealt with during the intervention programme). This would already be a significant improvement on the current timeframe.

The next section makes final recommendations regarding the redevelopment of the SFP academic literacy intervention.

6.5 Recommendations for the redevelopment of the intervention

Previous sections have shown that much of the workshop content of the SFP academic literacy intervention corresponds with what the literature recommends. However, some suggestions were made that could potentially help students increase their level of academic literacy even more significantly in future intervention programmes. These recommendations are made in this section.

The principle of making use of collaborative learning in workshops should be retained. The role of the facilitator should be clearly defined to students at the beginning of the intervention programme, so that students know what to expect in terms of guidance from the facilitator. Certain rules also need to be laid down at the beginning of the year to ensure that discipline will be maintained in spite of the collaborative, informal atmosphere of workshops. This should address objections raised in Section 5.3.3, that students sometimes did not participate, or were occasionally unruly.

The use of authentic materials should continue. One recommendation here would be that texts at various degrees of difficulty are chosen. The difficulty of texts should increase as the year progresses, so that students are constantly challenged just above their current competency level.

Although workshops already build upon previously acquired abilities, this should happen to an even greater extent. In Section 6.3, it was argued that several abilities, for example reading and vocabulary strategies, should be continuously emphasised in as many workshops as possible. In addition, abilities not focused on in the present workshop programme could be included as activities in various workshops. Examples include presentation skills and the organisation of texts. The integration of abilities into various workshops should be formalised by adding exercises to all workshops (where applicable) that would draw students' attention to, for example, difficult vocabulary, text structure or presentation skills.

In addition to integrating the reinforcement of various abilities into subsequent workshops, it is recommended that extra workshops be added to the existing workshop programme. This would enable students to gain additional practise in newly acquired abilities, which in turn should assist them in coping better with new, complex abilities. A 90-hour workshop programme is recommended. This will provide students with an additional 30 hours contact time.

It is further recommended that some form of formative assessment, as well as additional pre-assessment and summative assessment activities, be included in the intervention programme. Formative assessment need not be formal, as this is a non-credit bearing programme[24]. It would, however, assist students by giving them a standard by which they can measure their improvement throughout the year. Formative assessment can take the form of occasional short tests (as recommended for vocabulary acquisition in Section 6.3.2) or essays that are assessed by the facilitator (as discussed in Sections 4.2.13 and 4.2.14 – this would be dependent on the two essay writing workshops being increased to four workshops, so that students are able to complete at least a draft of an essay during the workshops). In addition to this, it is recommended that three academic literacy tests be scheduled after three, six and nine months of the intervention. The existing pre- and post-tests should be supplemented with a writing activity, so that the improvement in students' writing abilities can be measured.

Based on recommendations made in this chapter, a revised workshop schedule (including revised workshop outcomes) is suggested. Note that the sequence of some workshops has changed from the original workshop programme discussed in Section 4.2. Additional alterations to the current workshop programme are indicated by means of italics. An additional workshop to the recommended 30 workshops is added after the final assessment. This is a feedback workshop on the summative assessment. It reflects on what has been learnt throughout the year, and allows students to think about how they will continue to build on the abilities acquired throughout the year.

[24] The academic literacies workshop fall under UNISA learner support. Learner support at UNISA does not take the form of credit-bearing courses, as the underlying belief is that student support must happen on a voluntary basis, and that programmes must be available to all UNISA students.

Formative assessment: Pre-test

1. **Improving your vocabulary**
   - Acquire strategies for improving vocabulary;
   - Understand and use parts of speech; and
   - Use a range of subject-specific vocabulary in sentences.

2. **Writing *academic* sentences**
   - Use words in the appropriate context;
   - Identify all of the necessary parts of speech that constitute a proper sentence;
   - Identify and use the active and passive voice correctly; and
   - *Add difficult words to a personal vocabulary list.*

3. **Using scientific words and concepts in context**
   - Correctly use words that can be used in more than one context;
   - Convert symbols into formulas written in complete sentences and vice versa;
   - Identify the various connotations of words, as well as the feelings and emotions that accompany such words; and
   - *Add difficult words to a personal vocabulary list.*

4. **Reading in the sciences (1)**
   - *Add difficult words to a personal vocabulary list;*
   - Develop techniques of skimming, scanning and reading closely; and
   - Apply these abilities to a variety of scientific texts.

5. **Writing *academic* paragraphs (1)**
   - *Add unfamiliar words to a personal vocabulary list, and write complete sentences with these words;*
   - Develop an awareness of topic sentences, and identify these in paragraphs in your study guides;
   - Write academic paragraphs that are built around effective topic sentences;

- Develop an awareness of basic discourse markers, and use them in joining ideas and sentences; and
- *Develop an awareness of the characteristics of scientific writing (i.e., scientific writing being linear and inductive, concise, precise and clear).*

6. Visual literacy (1)

- Read and interpret tables, graphs, charts and other visual information; and
- *Acquire vocabulary and phrases used to represent and interpret visual information in a written form.*

7. Cohesion and coherence

- *Add unfamiliar words to a personal vocabulary list, and write complete sentences with these words;*
- *Highlight certain aspects of text structure, focusing on cohesive devices;*
- *Analyse logical relations;*
- *Develop an awareness of discourse markers, and use them in joining ideas and sentences;*
- *Use advanced discourse markers to combine ideas and sentences; and*
- *Develop an awareness of text coherence.*

8. Writing *academic* paragraphs (2)

- *Supplement personal vocabulary list with a variety of conjunctions;*
- *Develop an awareness of the characteristics of scientific writing (i.e., scientific writing being linear and inductive, concise, precise and clear);*
- *Write academic paragraphs that are built around effective topic sentences;*
- *Use advanced discourse markers to show relationships between ideas in paragraphs; and*
- Write answers (in paragraph form) to questions in study guides.

Formative assessment 1: Vocabulary, sentences, paragraphs, visual literacy

9. Reading in the sciences (2)

- Revisit reading strategies of skimming and scanning;
- *Create an outline or mind map of text structure, focusing on headings, topic sentences, key words and visual information;*
- *Develop strategies for reading comprehension; and*
- Apply these abilities to advanced reading comprehension activities.

10. Revision – parts of speech and paragraph writing

- *Add unfamiliar words to a personal vocabulary list, and write complete sentences with these words;*
- *Use discourse markers in joining ideas and sentences;*
- *Develop an awareness of topic sentences, and identify these in paragraphs in your study guides;*
- *Develop an awareness of the characteristics of scientific writing (i.e., scientific writing being linear and inductive, concise, precise and clear);*
- *Write academic paragraphs that are built on effective topic sentences;*
- *Develop an awareness of discourse markers (conjunctions);*
- Revise the use of parts of speech and conjunctions; and
- Practise writing effective paragraphs.

11. Distinguishing between essential and non-essential information

- *Add unfamiliar words to a personal vocabulary list, and write complete sentences with these words;*
- *Show comprehension of the text through answering comprehension questions;*
- Distinguish between main ideas, supporting ideas and examples;
- Distinguish between facts, opinions and assumptions; and
- Classify, categorise and label information.

12. Note-taking strategies (1)

- *Add unfamiliar words to a personal vocabulary list, and write complete sentences with these words;*
- *Show comprehension of the text through answering comprehension questions;*

- *Distinguish between essential and non-essential information, through underlining and annotating;*
- *Highlight certain aspects of text structure, focusing on headings, topic sentences, key words and visual information;*
- Create an outline of information; and
- *Present completed outlines in front of an audience.*

13. Paraphrasing

- *Add unfamiliar words to a personal vocabulary list, and write complete sentences with these words;*
- *Collect synonyms for unfamiliar and difficult words;*
- Write information in your own words;
- *Show comprehension of the text through answering comprehension questions; and*
- *Develop an awareness of plagiarism by answering assignment questions from study guides.*

14. Summarising

- *Add unfamiliar words to a personal vocabulary list, and write complete sentences with these words;*
- *Show comprehension of the text through answering comprehension questions;*
- *Develop an awareness of the characteristics of scientific writing (i.e., scientific writing being linear and inductive, concise, precise and clear);*
- Distinguish between essential and non-essential information;
- *Underline key words and ideas; and*
- Paraphrase and summarise information.

15. Visual literacy (2)

- Gather and tabulate data, and make basic calculations to interpret this data;
- Interpret results obtained in your own research;
- Represent these results visually, in graphs and charts; and
- *Present completed graphs and charts in front of an audience.*

16. Revision – paraphrasing and summarising

- *Supplement personal vocabulary list by adding unfamiliar words, and write complete sentences with these words;*
- *Show comprehension of the text through answering comprehension questions;*
- Distinguish between essential and non-essential information;
- *Underline key words and ideas;*
- *Create an outline of text structure, focusing on headings, topic sentences, key words and visual information;*
- Paraphrase and summarise information;
- *Develop an awareness of the characteristics of scientific writing; and*
- *Develop an awareness of plagiarism by answering assignment questions from study guides.*

17. Note-taking strategies (2)

- *Add unfamiliar words to a personal vocabulary list, and write complete sentences with these words;*
- *Show comprehension of the text through answering comprehension questions;*
- *Identify essential information by underlining it;*
- *Highlight certain aspects of text structure, focusing on headings, topic sentences, key words and visual information;*
- *Develop an awareness of mind mapping techniques;*
- Represent information visually in the form of a mind map; and
- *Present completed mind maps in front of an audience.*

Formative assessment 2: Vocabulary, sentences, paragraphs, visual literacy, note-taking, paraphrasing, summarising, comprehension

18. Introduction to referencing

- *Add unfamiliar words related to referencing to a personal vocabulary list, and write complete sentences with these words;*
- Develop an awareness of the function and location of different parts of a text; and

- Develop an awareness of plagiarism and how to avoid it by means of referencing correctly.

19. Bibliographies

- *Add unfamiliar words related to referencing to a personal vocabulary list, and write complete sentences with these words;*
- Use in-text referencing appropriately; and
- Construct a list of references from books, study guides, journals, newspapers and the Internet.

20. Visual literacy (3)

- *Acquire vocabulary and phrases used to interpret visual information;*
- Represent written information in a variety of visual formats;
- Read and interpret tables, graphs, charts and other visual information;
- *Present completed graphs and charts in front of an audience; and*
- *Synthesise visual information represented in a variety of texts, using appropriate referencing techniques.*

21. Reading in the sciences (3)

- *Add unfamiliar words to a personal vocabulary list, and write complete sentences with these words;*
- *Practise accessing dense, atomistic texts;*
- *Create an outline or mind map of text structure, focusing on headings, topic sentences, key words and visual information; and*
- *Practise to read for comprehension by creating your own comprehension test.*

22. Writing thesis statements

- *Add unfamiliar words to a personal vocabulary list, and write complete sentences with these words;*
- *Identify thesis statements in texts;*
- *Distinguish between effective and ineffective thesis statements; and*
- *Create thesis statements, written in complete sentences.*

Formative assessment 3: Vocabulary, sentences, paragraphs, visual literacy, note-taking, paraphrasing, summarising, referencing, comprehension, thesis statements

23. Synthesising information

- *Add unfamiliar words to a personal vocabulary list, and write complete sentences with these words;*
- *Show comprehension of the text through answering comprehension questions;*
- *Highlight certain aspects of text structure, focusing on headings, topic sentences, key words and visual information;*
- Apply knowledge to new contexts and the general to the particular;
- Extrapolate – infer by deducing beyond the facts, estimate beyond the known, and make predictions;
- *Develop an awareness of the characteristics of scientific writing;*
- *Use referencing abilities to synthesise a variety of sources;*
- Write about a topic in a relevant subject in which several sources are synthesised; and
- *Present completed syntheses in front of an audience.*

24. Writing about facts in the sciences (expository writing) (1)

- *Add unfamiliar words to a personal vocabulary list, and write complete sentences with these words;*
- *Show comprehension of the text through answering comprehension questions;*
- Analyse the structure of a text (introduction, body, and conclusion);
- *Highlight certain aspects of text structure, focusing on headings, topic sentences, key words and visual information;*
- *Develop an awareness of the characteristics of scientific writing;*
- Understand the hierarchy of ideas;
- Illustrate concepts and ideas with examples, drawings or theorems; and
- *Develop an awareness of the importance of objectivity and neutrality in expository writing.*

25. Writing about facts in the sciences (expository writing) (2)

- *Highlight certain aspects of text structure, focusing on headings, topic sentences, key words and visual information;*
- *Develop the outline for an essay, including key words for each paragraph;*
- *Develop an awareness of the characteristics of scientific writing;*
- *Synthesise a variety of sources by means of an outline or mind map;*
- *Use referencing abilities effectively;*
- *Create topic sentences for each paragraph;*
- *Write the first draft of an expository essay; and*
- *Develop peer editing abilities by giving feedback on another student's essay.*

26. Writing about facts in the sciences (expository writing) (3)

- *Revise the first draft of an expository essay; and*
- *Develop peer editing abilities by giving feedback on another student's essay.*

27. Arguing in the sciences (argumentative writing) (1)

- *Add unfamiliar words to a personal vocabulary list, and write complete sentences with these words;*
- *Show comprehension of the text through answering comprehension questions;*
- *Highlight certain aspects of text structure, focusing on headings, topic sentences, key words and visual information;*
- *Develop an awareness of the characteristics of scientific writing;*
- Understand the hierarchy of ideas;
- Judge information critically, and prove the validity of statements; and
- Argue concepts and ideas with examples, theorems or persuasive passages.

28. Arguing in the sciences (argumentative writing) (2)

- *Develop the outline for an essay, including key words for each paragraph;*
- *Create topic sentences for each paragraph;*
- *Write an argumentative essay;*
- *Use referencing abilities effectively; and*
- *Develop peer editing abilities by giving feedback on another student's essay.*

29. Writing a laboratory report (1)

- *Add unfamiliar words to a personal vocabulary list, and write complete sentences with these words;*
- Understand the various sections of a laboratory report; and
- Identify inappropriate language use and unnecessary information in existing laboratory reports.

30. Writing a laboratory report (2)

- *Add unfamiliar words to a personal vocabulary list, and write complete sentences with these words;*
- *Highlight certain aspects of text structure, focusing on headings, topic sentences, key words and visual information;*
- *Understand the various sections of a laboratory report; and*
- *Write sections of laboratory reports when given basic information.*

Summative assessment: Post-test

31. Feedback on summative assessment

- *Determine what your strengths and weaknesses in the post-test were;*
- *Develop a strategy to continue building on strengths, and to work on weaknesses;*
- *Create a mind-map or outline in which you show how you will use various abilities in your studies; and*
- *Present the mind-map or outline to an audience.*

6.6 Conclusion

Based on results from the TALL, feedback from students, as well as recommendations made in the literature, this chapter has critiqued the academic literacy workshop programme used in the current study. Subsequently, it made recommendations as to how this programme can be improved in future.

The next chapter summarises the findings of this study, highlights its limitations, and makes recommendations for future research.

CHAPTER 7 Conclusion

7.1 Introduction

This study commenced with a description of the poor pass rate at South African secondary school level, especially in the fields of science and mathematics (Collings, 2000; Pandor, 2007). It was argued that one of the main reasons for this poor pass rate is students' low academic literacy levels (McCallum, 2000; Phillilps, 2004). The fact that so many first-year tertiary level students are not prepared for the demands of tertiary studies has the direct effect that few students complete their degrees, specifically in the fields of science and technology (Collings, 2000; Phillips, 2004). This is very problematic in a country that has a growing need for graduates in these fields (Phillips, 2004).

This study has addressed the Ministry of Education's (2001) call to universities to improve the throughput rate at South African universities by suggesting one way of improving the academic literacy levels of students at a tertiary, open and distance learning (ODL) institution. One of UNISA's greatest challenges is that the demographics of the average enrolled student have changed over the past decades. Whereas many people used to see distance learners as mature, older students, the average UNISA students today are young school leavers who often enrol at UNISA because they cannot gain entrance into residential universities (due to poor Grade 12 marks or financial difficulties). This means that these students possibly have an even greater need for contact with the institution and fellow students than do many students at residential universities. Therefore, the intervention discussed in this study took the format of twenty weekly face-to-face workshops (see Section 1.1.4 for a justification of presenting contact classes at an ODL institution). This allowed employed students to attend the workshops, as they only had to take off three hours from work per week. It also allowed the majority of full-time students to have much-needed interaction with peers and a language facilitator.

The current workshop programme was an attempt at holistically giving students exposure to as many elements of academic literacy as possible. Abilities were, for the most part, practised in context, and were revisited throughout the workshop programme. As shown in Chapter 4, the intervention took into consideration the fields of study of its target population (namely science and technology) in the choice of material used. Furthermore, the needs of the target population were taken into account in the varied interactional patterns used in each workshop, building on the assumption that most students would enjoy a collaborative learning methodology, yet keeping in mind that some individual work would also be necessary. Also, guidelines given in the literature were taken into account in the development of this intervention programme, as discussed in Chapter 4. This chapter considers the outcomes of the current study by returning to the three research questions posed in the first chapter of this dissertation. Subsequently, the implications and the limitations of this study are examined, and potential topics for future research are examined.

7.2 Research questions

This study originally posed three research questions. These were as follows:

1. Can an English for Specific Purposes (ESP) intervention improve the academic literacy levels of first-year open and distance learning students studying science-related courses?
2. What areas of academic literacy have been improved most after the ESP intervention?
3. How can the ESP intervention be adapted to further develop students' academic literacy abilities?

The findings of these questions are summarised in Sections 7.2.1 to 7.2.3.

7.2.1 Research question 1

The first question asked whether an ESP intervention could improve the academic literacy levels of first-year ODL students studying science-related courses. As shown in Chapter 5, this is indeed possible.

Students participating in the intervention improved their academic literacy levels, as measured by the TALL, by an average of 7.5%. Students who attended eight or more workshops improved their academic literacy by an average of 11.40%. Unfortunately, the average percentage that this group of students obtained for the post-test was only 41.10% - a result which still classifies them as at-risk of not completing their studies. Therefore, the possibility of improving the intervention should be examined, so as to potentially raise students' academic literacy levels even further, thereby giving them a greater chance of succeeding in their tertiary studies.

7.2.2 Research question 2

The second research question asked what areas of academic literacy had improved most after the ESP intervention. This question was examined in Chapter 5.

The section in the TALL that showed the greatest improvement was the section on 'Text editing', with an improvement of 11.96% (p = 0.0014). This section is a good indicator of students' general academic literacy levels. Reasons why students performed better in this section could include that students' reading and comprehension speed increased, thus enabling more students to complete the entire test. The improvement could also be due to students' increased academic literacy levels.

'Academic vocabulary' was the section in the TALL that showed the second greatest improvement (10.87%; p = 0.0002). It is heartening to see that students' academic vocabulary results increased with over 10%. As indicated in Chapter 4, and again suggested in Section 6.3.2, it should be possible to continually focus on vocabulary to an even greater extent than has been done in this study. Ways in which this could be done are discussed in Section 6.3.2.

The section on 'Text types' also showed a marked improvement, with 10.43% (p = 0.0473). However, as this section only counted five marks, it does not have a great impact on the total result.

The section on 'Understanding texts' showed an improvement of 5.98% (p = 0.0048). This is somewhat disappointing, as this section was not only the biggest section in the TALL, but is arguably also the most important ability ODL students need to acquire. Reading with comprehension is an ability that ODL students need, possibly more so than their residential university counterparts, as most of their learning occurs through reading. If reading comprehension levels are poor, it seems logical that learning will not be optimal. Recommendations for creating additional opportunities for focusing on reading abilities are discussed in Section 6.3.5.

The section on 'Interpreting graphs and visual information' showed a moderate improvement (5.16%; p= 0.1506). However, statistically, this improvement does not seem to be significant. This is problematic, as visual literacy is an integral component of almost all science students' syllabi. Suggestions for further improving students' visual literacy are discussed in Section 6.3.3.

In the section on 'Scrambled text', students' post-test marks were, surprisingly, lower than their pre-test marks (results dropped by 3.48%, although this result was shown to be statistically insignificant [p = 0.4675]). This section counted only five marks, and therefore it is difficult to make any meaningful conclusions based on this result. However, as discussed in Section 6.5, it might be advisable to spend more time during the workshop series on the organisation of texts (focusing on discourse markers, introductions and conclusions).

Examining the extent of the improvement between the TALL pre- and post-test results is important in deciding on the number of workshops on each topic in subsequent intervention programmes, as well as the outcomes and type of activities that should be included in various workshop topics in future. Recommendations in this regard were made in Chapter 6, and are summarised in Section 7.2.3.

7.2.3 Research question 3

The third research question asked how an ESP intervention could be adapted to further develop students' academic literacy. Chapter 6 outlines comprehensive recommendations regarding the possible improvement of the intervention programme, with the goal of ultimately further improving students' academic literacy levels.

The recommendation with the broadest implications is that the number of workshops be increased from 20 to 30, thus increasing the total contact time from 60 hours to 90 hours.

Additional workshops are recommended for the following topics: 'Cohesion and coherence'; 'Revision – paraphrasing and summarising'; 'Note-taking strategies (2)'; 'Visual literacy (3)'; 'Reading in the sciences (3)'; 'Writing thesis statements'; 'Writing about facts in the sciences' (2 and 3); 'Arguing in the sciences (2)'; and 'Writing a laboratory report (2)'. Moreover, three formative assessment opportunities (in addition to the current pre- and post-tests) are recommended.

In addition to increasing the number of workshops, numerous outcomes were added to existing workshops so as to address various abilities more fully across a range of workshops. Additional activities based on these outcomes were also suggested for various workshops.

A final recommendation was to spread out workshops that are currently clustered together (thus, the same topic in consecutive weeks), so as to ensure that students are exposed to and practise abilities throughout the year.

If these recommendations were followed in the redevelopment of the current academic literacy intervention, the possibility exists of increasing the improvement of students' academic literacy levels between pre- and post-tests more considerably than was the case in this study.

7.3 Implications of the current research

This research study has several implications.

Firstly, it would seem as though attending academic literacy workshops does have an influence on improving students' academic literacy levels. If academic literacy levels play a role in student throughput, then it would be vital for universities to invest in such courses, so as to empower students with the abilities they need to succeed at higher education.

A further implication is that contact sessions, based on collaborative learning, would seem to be highly beneficial, especially to black students studying language-related subjects.

Therefore, even ODL institutions like UNISA should consider allowing students the flexibility of attending such courses, so as to be optimally engaged in their own learning.

One troubling observation made in this study is that UNISA science subjects seem to require very few higher-order cognitive skills from students in their first and second years. This is problematic, since students might not be sufficiently prepared for entering the work market after their studies, and even less for pursuing postgraduate studies. The possibility exists that UNISA students might become known as students with a sub-standard level of education, because they were not expected to function on certain cognitive levels – a fact which would ultimately carry grave consequences for the University's reputation.

7.4 Limitations

For this study to be of any worth, it must be seen as the first step in a cycle of action research. Without determining the effects of the recommendations made in this study, it will be impossible to determine its ultimate worth.

The first limitation of this study is therefore that the effects of the proposed revised workshop curriculum remain unknown. Research on this project will have to be ongoing, so as to determine whether increased tuition time and revised workshop outcomes (and thus revised activities) do indeed further improve the academic literacy levels of students in UNISA's Science Foundation Programme. The effects of the implementation of these recommendations will be reported on in scholarly articles in future.

A weakness in the pre- and post-tests was that no writing component was included. It would be useful to include such a component in future pre- and post-assessments, so as to more objectively ascertain the impact of the intervention programme on students' writing abilities.

Another limitation is that the research group was relatively small. Although many more than the 46 students who wrote the TALL pre- and post-tests took part in the workshops at some point throughout the year, the "quasi-permanent absence of the learning group" (Keegan 1986:44) meant that the learning group was never very stable, and that students regularly disappeared, whilst others appeared at various points during the year. Because of the voluntary nature of the workshops, it is very difficult to motivate students to attend an intervention programme like this from beginning to end. Future studies could consider offering some sort of incentive for students who remain part of the intervention for the entire year. This could be in the form of a certificate, a book prize or even a letter of reference.

An obstacle for interventions such as this is convincing lecturers to support such initiatives. An important step would be to inform relevant lecturers of the results of this study, and to keep them informed of future research that measures the effectiveness of the intervention programme. Once lecturers are convinced that this intervention could help their students succeed in science-related modules, lecturers would be more likely to refer their students to UNISA's Academic Literacies Centres. This might ultimately secure a more stable learning group.

A final challenge is to accommodate working students as well as students who do not live close to a regional centre. Several working students did attend the workshops, but many were unable to take off the necessary time each week. In addition to that, many full-time UNISA students stay far away from UNISA regional centres, and cannot attend weekly workshops.

7.5 Recommendations for future research

The current research study raises various issues that should be addressed in future research.

One limitation that was mentioned in the previous section is that working students and students living far away from UNISA regional centres did not have the opportunity of attending this intervention programme. One possibility would be to adapt the workshops to a web-based environment. However, many UNISA students are not computer literate, and would therefore not be able to make use of such a course. One student suggested that satellite broadcasting be used to communicate with students who are spread across the country. Though this is an interesting suggestion, this method of presentation would have to be researched and designed very carefully, so as not to lose the benefits of collaborative learning that the workshops presently have. This challenge would have to be researched further, as no simple answer seems forthcoming.

Another suggestion for future research is taken from a student who commented that s/he would like to see more relevant texts used in the workshops. Although the workshop material is designed to appeal to all students studying in science-related fields, it is impossible in the UNISA context to present specialised workshops for each module. However, it should be investigated whether some of the workshops could be adapted to use students' own study material instead of generic texts.

An additional aspect that deserves further research is to determine how realistic students are about their own literacy levels. As discussed elsewhere in this study, it is possible that many students do not take advantage of opportunities such as the SFP academic literacy workshops because they believe their own literacy levels to be much higher than is the case. Should this be found to be true, an alternative strategy would have to be followed to convince a broader range of students to attend such an intervention.

The revised workshop programme which is proposed in Chapter 6 suggests ten additional workshop topics. The suggested programme is based on academic literacy weaknesses identified in the TALL, an overview of what students are required to do in a variety of assignments, as well as the needs identified by students themselves. Only one of these workshop topics are solely dedicated to improved reading abilities. Although many of the additional workshops also contain reading components, it might be worthwhile to investigate the possibility of developing a separate reading development intervention. Such an intervention could potentially make use of reading laboratories, and could supplement the current proposed workshop programme.

The final, yet most important, suggestion for future research is that a process of action research be followed with the academic literacies programme discussed in this study. There is much that can be done to refine the workshop programme so as to increase the likelihood of improving students' academic literacy levels more markedly in future. Some of these suggestions were made in Chapter 6. Only through a process of action research would the possible effects of such refinement be measurable, and would the current research benefit students.

7.6 Conclusion

Even though EAL "students enrolled in science classes are ostensibly learning science, we forget that they are also simultaneously both learning and acquiring proficiency in English" (Rosenthal, 1996:44). The intervention examined and evaluated in this study was an attempt at assisting students who not only have to learn science whilst acquiring academic literacy, but who also have to do this in an ODL environment.

The recommendations made in this study are based on an EST academic literacy intervention. However, it is hoped the recommendations would also be of value to other ESP academic literacy programmes at first-year level, specifically in an ODL context where such interventions are sorely needed.

Although Pretorius and Bohlmann's (2003) word of caution is heeded, that one cannot have unrealistic expectations about the impact of a reading (or, in this case, an academic literacy) intervention in a short time, this study has shown that such an intervention can have a positive impact on students' academic literacy levels. With further refinement and research, this impact can hopefully be improved further in future. If this intervention was able to create a foundation that would enable students to become aware of their own academic literacy levels, and subsequently encourage them to become lifelong learners, then it has achieved a great deal in setting a process in motion where students may continuously develop the abilities addressed in the intervention.

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Addenda

Addendum A

WORKSHOP 1: IMPROVING YOUR VOCABULARY

In the sciences, words usually have very specific meanings which can often be confusing. Science is also a very dense language. That means that a scientific text is often packed with difficult words. Ignoring these words might make it difficult to understand the rest of the text. It is therefore important for you to increase your scientific vocabulary as soon as possible.

For you to understand why a word is used in a specific way, you have to understand what its job is. Words can be used differently in various contexts. The word “accelerate”, for example, also has different forms such as “accelerated”, “accelerator”, “accelerating” and “acceleration”. To understand when to use which word, you have to understand parts of speech.

Task 1
Look at the two sentences in Section A. The parts of speech are written on top of most words in capital letters. In groups of three to four, try to work out the job/description of each of these parts of speech, and write this down in Section B. Then look at the sentences in Section C, and categorise the words in **bold** into each part of speech category in Section B.

SECTION A

SENTENCE 1

VERB	ART	NOUN		ADJ	NOUN
Name	a	goal	of	agricultural	economics

SENTENCE 2

ADJ		ADJ	NOUN	VERB	ADJ		ART	ADJ	NOUN
Ruminant	and	avian	fermenters	differ	significantly	from	the	monogastric	system

SECTION B

Articles
Job / description:____
Examples:____

Noun
Job / description:____
Examples:____

Adjective
Job / description:____
Examples:____

Verb
Job / description:____
Examples:____

Adverb
Job / description:____
Examples:____

SECTION C

- Some **poisonous** gases can enter **the** body by **absorption** through the **skin**.
- The microphone **converts acoustic** waves to electrical signals for **transmission**.
- Forensic scientists have so far been unable to **ascertain** the cause of the **explosion**.
- **Sound** and pictures can be stored **digitally**, as on **a** CD.
- Steam is water in its **gaseous** form.
- A **mathematical formula** must always be followed **exactly**.
- The doctor told him to go to the hospital if there was a **recurrence** of his symptoms.
- New technology has **rendered** my old computer obsolete.
- Computers operate using **binary** numbers.
- Advanced mathematics consists almost entirely of **theorems** and proofs.

Task 2

Now that you understand how parts of speech work, work with a friend to complete this table by filling in the missing parts of speech. You may only use the dictionary if neither you nor your friend have any idea what the answer is. Then make your own sentences with the 5 most difficult words on this list.

Noun	Adjective	Verb	Adverb
analysis	analytical	analyse	analytically
		accelerate	
			acoustically
	alternating		
conduction			
	decoded		
digit			
efficiency			
			electronically
	illuminated		
oscillation			
		rectify	
	rotating		
		scan	

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

5. ______________________________

Task 3

Look at the words in the following list. Individually, categorise at least 15 of them in the three categories provided (try to have at least five words in each category), and try to write sentences where you can. When this has been completed, compare your sentences with those of a friend, and try to acquire new vocabulary. Afterwards, compare words and sentences in groups of three to four.

marginal; inefficiency; scarcity; tangible; concise; distinguish; tabulate; substance; synthesis; illustrate; disproportional; conductivity; regarding; rectify; indicates; compile; metrication; assume; formulate; interdependent; hierarchical; variation; distribution; variable; analyse; parameter; convert; correlation; application; conducted; bounded; plot (verb); comprising; constituents; auxiliary; irrelevant; inevitable

I DEFINITELY KNOW WHAT THIS WORD MEANS (WRITE A DEFINITION AND A GOOD EXPLANATORY SENTENCE)
I THINK I KNOW WHAT THIS WORD MEANS, BUT I'M NOT SURE (WRITE DOWN WHAT YOU THINK THIS WORD MEANS, AND TRY TO WRITE A SENTENCE WITH IT)
I HAVE NO IDEA WHAT THIS WORD MEANS

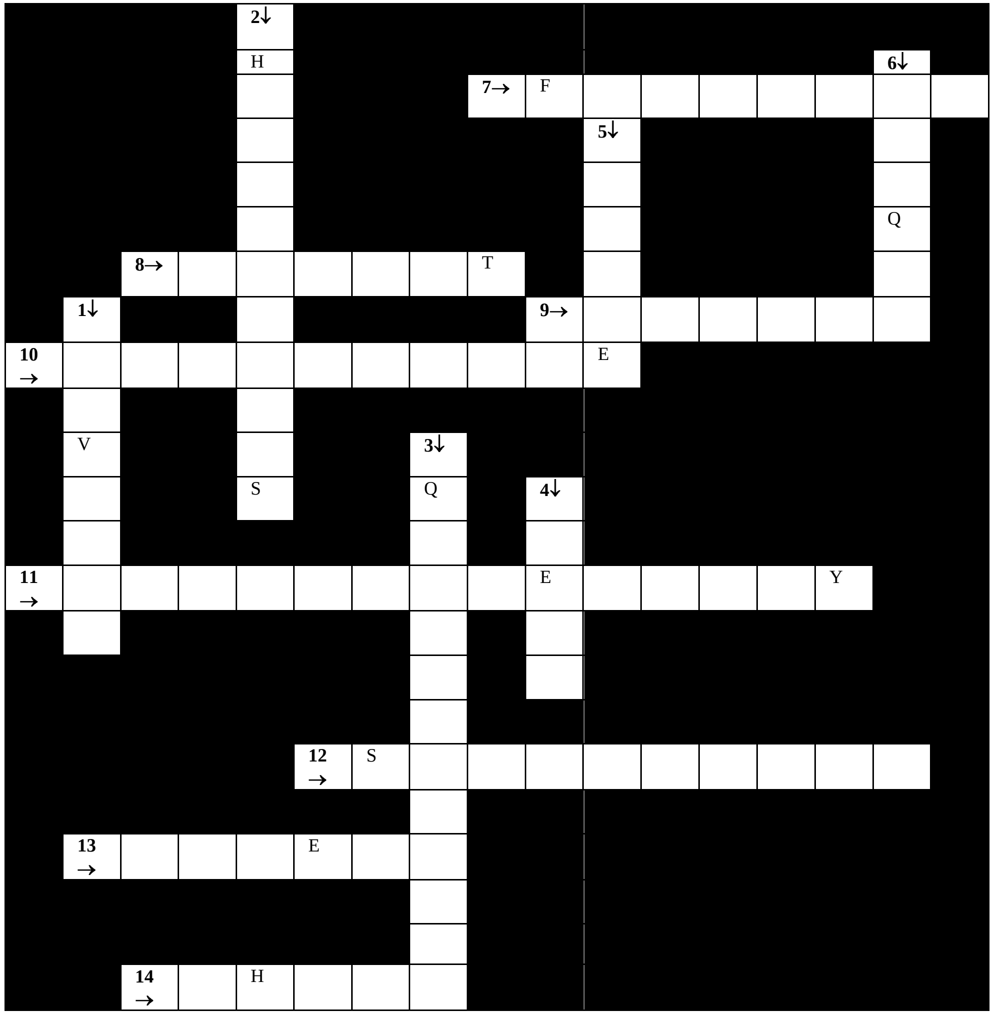
New word list

An increased vocabulary will help you to succeed in your science course. Use this list to write down all of the difficult or unknown words in your study guides and textbooks.

Word	Part of speech	Dictionary definition	Your own sentence
oscillate	verb	▪ to keep changing between two extreme amounts or limits ▪ if an electric current oscillates, it changes direction very regularly and very frequently	The major problem with this experiment was that the current oscillated drastically without any clear reason.

Task 4

Complete the following crossword puzzle in groups of three to four.



Clues:

1. **Part of speech**: adjective
   Definition: having a negative or harmful effect on something
   Sentence: So far the drug is thought not to have any ______________ effects.
2. **Part of speech**: adjective
   Definition: consisting of parts or people which are similar to each other or are of the same type
   Sentence: It is important to choose a ____________________ sample for this experiment, otherwise the results will not be reliable.
3. **Part of speech**: adjective
   Definition: relating to numbers and amounts
   Sentence: He decided to conduct __________________ research instead of qualitative research.
4. **Part of speech**: noun
   Definition: a hole or crack in a pipe or container which allows liquid or gas to escape
   Sentence: The experiment failed due to a gas _____________.
5. **Part of speech**: noun
   Definition: a unit of measurement equal to 100 centimetres
   Sentence: The bomb shelter has concrete walls that are three ______________ thick.
6. **Part of speech**: adjective
   Definition: preventing light from travelling through, and therefore not transparent
   Sentence: He knew that the experiment was successful, since the clear water turned _________.
7. **Part of speech**: noun
   Definition: the force which makes it difficult for one object to slide along the surface of another or to move through a liquid or gas
   Sentence: When you rub your hands together the _______________ produces heat.
8. **Part of speech**: verb
   Definition: to happen, or to do something, more than once
   Sentence: To ensure that your results are accurate, ____________ the experiment several times.
9. **Part of speech**: verb
   Definition: to (cause to) turn in a circle, especially around a fixed point
   Sentence: _____________ the handle by 180° to open the door.
10. **Part of speech**: verb
    Definition: to happen or make something happen sooner or faster
    Sentence: They use special chemicals to __________________ the growth of crops.
11. **Part of speech**: adverb
    Definition: happening or being done at exactly the same time
    Sentence: The two tubes exploded _________________________.
12. **Part of speech**: adjective
    Definition: not moving, or not changing
    Sentence: The traffic got slower and slower until it was _____________________.
13. **Part of speech**: verb
    Definition: to choose a small number of things, or to choose by making careful decisions
    Sentence: A mouse is a device which makes it easier to _________________ different options from computer menus.
14. **Part of speech**: noun
    Definition: any stage in a series of events or in a process of development
    Sentence: The experiment is in a very delicate _________________; please be careful!

Addendum B

WORKSHOP 2: WRITING GOOD SENTENCES

1) Active and Passive Voice:

In pairs, change the following sentences from the active voice into the passive voice:

a. They observed the reactions carefully.
b. People always wear protective clothes in a nuclear active environment.
c. One of the students recorded the results.
d. They repeated the experiment to investigate reliability.
e. One finds algae on many kinds of rocks.

2) Using words in sentences correctly:

In pairs, choose the correct form of the word in each sentence.

a. It is a factor that frequency/ frequently recurs.
b. Make sure that both outputs are correct: 84 and 138 respectfully/ respectively/ respective.
c. A logic/ logical error is another kind of error.
d. It is evident/ evidence from the data that the species is in decline.
e. The colours reflected are brilliance/ brilliant/ brilliantly.
f. The frequency/ frequently of the waves was measured.
g. The SABS 0111 ensures uniformly/ uniformity of drawings and interpretations.

3) Creating more complex sentences:

Below are groups of sentences. In groups of three to four students, join these sentences together, using whichever conjunctions and punctuation that you think are most appropriate. You can make changes to the word order of the sentences, as long as the meaning remains the same.

a. He went back to his notes on birds. He noted that birds have strong chest muscles. Birds use these chest muscles to flap their wings.
b. He studied his drawings. He studied his drawings some more. He made wings of several shapes. He used paper and wood.
c. Cayley made a glider with two wings. Each wing was about 1, 5 m long. The glider had a tail plane. The tail plane stopped his glider from tipping forward.
d. He made the flying machine. He used silk material. He used wood. They are light materials.
e. Everyone else was surprised to see the glider flying. Cayley was not surprised. He based his machine on sound principles. He drew these principles from nature.

[Sentences based on START Reading Sheet: Science- Unit 1]

4) Nominalization

In pairs, change the following sentences by changing the verb into a noun to let the sentence sound more objective.

a. It is unacceptable to draw horizontal lines with the lower edge of the T-square.
b. It is a scientific fact that some substances exist in states that do not comply with the normal definitions of a gas, a liquid, or a solid.
c. Recreating such a plasma on Earth would hopefully produce a controlled thermonuclear fusion reaction as a source of power.
d. If the sun was compressed into a ball 3 km in diameter, then it would form a black hole.
e. Einstein's theory of relativity more accurately described the behaviour of matter than Newton's laws do.

5) Using sentences to answer questions:

Individually, answer the questions below in complete and well-constructed sentences. This is an opportunity to put all you have learned in this workshop into practice.

Pollination and Compatibility:
In flowering plants, pollination is defined as the transfer of pollen from an anther to a stigma. The previous chapter explained the ways in which pollen can be transferred. Not all the pollen that lands on a stigma is suitable or desirable, although in theory, any pollen could land on an exposed stigma. Even pollen of the same type can, in certain cases, be unacceptable. When the pollen is acceptable, it is referred to as compatibility. When a stigma is not receptive for certain pollen, the pollen will either not germinate at all, or commence germination, but the pollen tube will not grow any further. In such as case the pollen and stigma are incompatible, fertilisation cannot take place and therefore seed cannot be produced.

Source: Study Guide 1 of 2: Plant Studies 1

a. In a brief sentence, define pollination in flowering plants.
b. Explain what "compatibility" means, in this context.
c. Identify the effects on germination, of a stigma not being receptive for certain pollen.
d. Identify the consequences of incompatibility of the pollen and the stigma.

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Addendum C

WORKSHOP 3: USING SCIENTIFIC WORDS AND CONCEPTS IN CONTEXT

1. **Write two full sentences with at least 5 of the following words (words which you use in your field of study). One sentence should use the word as it is used in everyday language, and one sentence should use the word as it is used in chemistry, biology or physics. This is an individual task.**

a) aromatic
- ______________________________
- ______________________________

b) base / basic
- ______________________________
- ______________________________

c) bond
- ______________________________
- ______________________________

d) cell
- ______________________________
- ______________________________

e) charge
- ______________________________
- ______________________________

f) culture
- ______________________________
- ______________________________

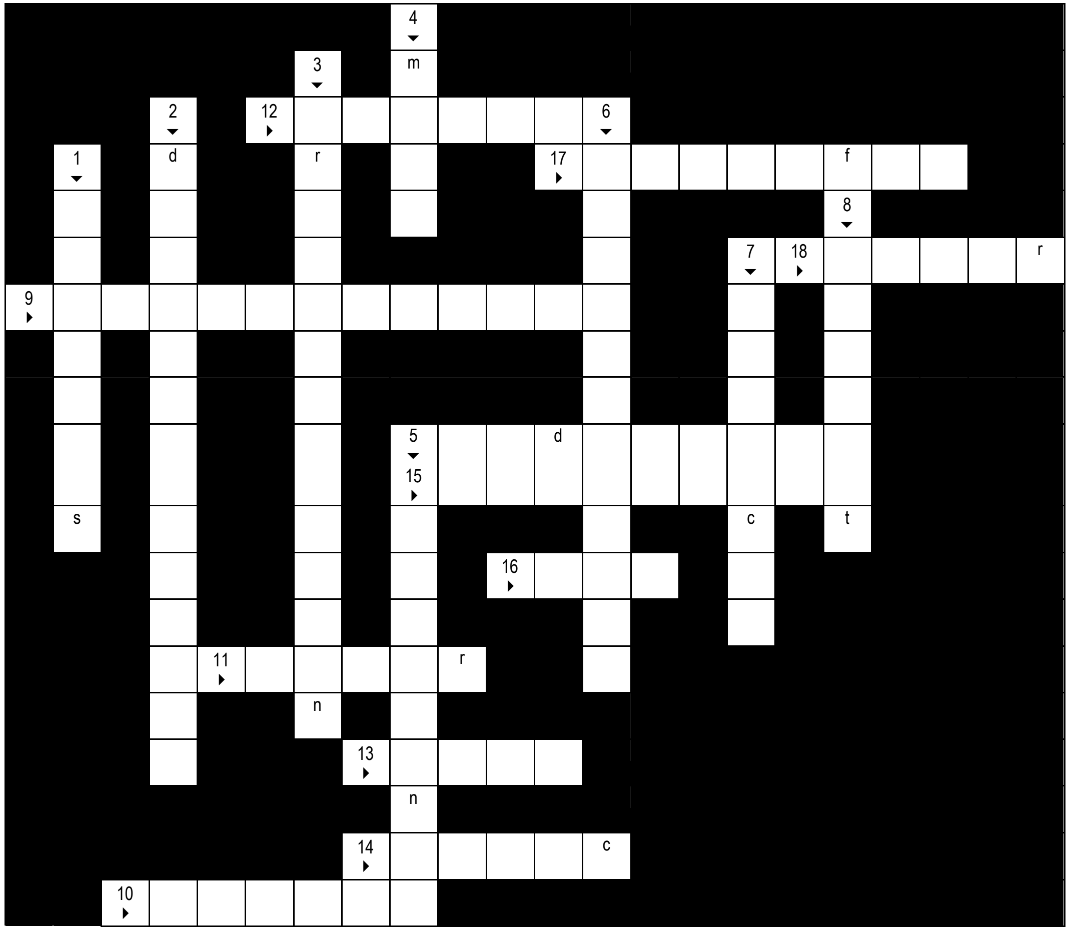
g) matter
- ______________________________
- ______________________________

h) mechanics
- ______________________________
- ______________________________

i) mole
- ______________________________
- ______________________________

j) solution
- ______________________________
- ______________________________

2. **Complete the following crossword puzzle in groups of four to five students.**



Clues :

1. [NOUN] The general meaning is centre, source, or cluster. In biology, it means the central part of a cell; in physics and chemistry, the centre of the atom; and in anatomy, a cluster of nerves.
2. [NOUN] This refers to one type of chemical reaction in chemistry and to rotting in biology.
3. [NOUN] This occurs when you mix two liquids in the chemistry lab and solid particles from that settle to the bottom of the tube. In non-scientific language, it can also refer to making something happen suddenly or sooner than expected.
4. [NOUN] The amount of matter in a sample. In non-scientific language, it can refer to a crowd of people or a religious service.
5. [NOUN] In physics, this refers to vibrations, especially regarding sound. In chemistry it describes chemicals which have a certain molecular structure.
6. [ADJECTIVE] "____________" figures refers to numbers which were measured. They may or may not be important. In non-scientific language, this word always means "important".
7. [ADJECTIVE or NOUN] In chemistry, this means a group of atoms that make up a part of a molecule; a free __________________ is very reactive. In math, the square root sign $\sqrt{}$ is called a _______________. In non-scientific language, ______________________ means "extreme", "fundamental" or "major".
8. [NOUN] In physics, this refers to the tendency of something to twist or turn about a point. Unlike non-scientific language, it does NOT refer to time in physics.
9. [NOUN] In chemistry, this word refers to a particular type of bond or force holding atoms together. In non-scientific language, it can refer to the ability to walk without tripping over your own feet.
10. [NOUN] This can mean a shape, an area (______ feet), or multiplying a number by itself (five ________ [verb] is 5 x 5 = 25).
11. [NOUN] This describes certain nerves that permit or control movement. In non-scientific language, it can also refer to a car.
12. [NOUN] In biology, this refers to a certain portion of the blood. In physics, it describes certain superheated gases.
13. [NOUN] A certain class of chemicals that includes vinegar. In non-scientific language, this often refers to psychedelic drugs.
14. [ADJECTIVE] This can mean a shape (like a block) or volume (_______ feet). Its noun means multiplying a number by itself three times (the _______ of 5 is 5 x 5 x 5 = 125).
15. [NOUN] This term may refer to either energy transferred in the form of waves (light is a form of electromagnetic _________) or to the energy and particles released by a radioactive substance. In the physical sciences _______ does not necessarily refer to something dangerous.
16. [NOUN] A ________ in science is not a rule passed by people which can be broken (the way it is used in non-scientific language), but is a description or summary of things that happen, with no exceptions.
17. [ADJECTIVE] Referring to a species of plant or animal in biology. In physics, it indicates a number measuring a property of a substance compared to that of water (_______ gravity, ________ heat).
18. [ADJECTIVE or NOUN] In chemistry, this measures how concentrated a solution is. In biology, it means one particular type of tooth.

3. Work with a partner to choose one word from the following list for each of these sentences. You many use each word only once.

therefore (for this reason); **it follows that** (implies); **prove / verify** (show the validity of a given statement); **determine** (calculate the answer that satisfies the particular requirements); **solve** (find the value(s) for which a given statement is true); **state** (write down fully, explain clearly); **denote** (indicate by means of a symbol); **simplify** (express the answer in its simplest terms); **define** (give in exact mathematical terms the meaning of a concept); **convention** (a specifically agreed rule or standard); **respective** (relating to a given order/sequence); **unique** (the only one of a kind); **assign** (allocate); **ambiguous** (having more than one meaning).

a) ___________________ for x: $2 - 3x = 8$.
b) ___________________ that $\sqrt{2}$ is an irrational number.
c) ___________________ the expression in brackets.

d) ___________________ the Theorem of Pythagoras.
e) ___________________ the x-intercepts of the graph.
f) In the expression $x^2 + 2xy + y^2$ we ___________________ the value of 2 to x, and 3 to y. (This means that we replace each x with the number 2, and each y with the number 3.)
g) It is ___________________ to write "The solution of the equation is x = 2, x = 3." We must state this by writing either "x = 2 and x = 3" or "x = 2 or x = 3".
h) Since x = 2, ___________________ 3x = 6.
i) The ___________________ solution of $(x – 3)^3 = 0$ (if x is real) is x = 3.
j) The ___________________ values of a, b and c are 2, 1 and 7 (this means that a = 2, b = 1 and c = 7).
k) We ___________________ a rational number as any number that can be expressed as an exact fraction.
l) We ___________________ the operation of addition by means of +.
m) We use the BODMAS ___________________ for the order of arithmetic operations.
n) x = 1. ___________________ x + 3 = 4.

4. In pairs, convert at least one of the following – either from its written form to its symbolic form, or from its symbolic form to its written form.

a) The difference of the third powers of any two numbers x and y is equal to the product of the difference of these two – numbers and the sum of three terms, the first of which is the square of the first number, the second the product of the two numbers, and the third the square of the second number.
b) Twice the product of any two consecutive numbers is equal to the sum of their squares less one.
c) $a \in R$
d) Lead nitrate reacts with sodium chloride in cold solution to give a precipitate of lead chloride and a solution of sodium nitrate.

Addendum D

WORKSHOP 4: READING IN THE SCIENCES (1)

Steps to go through when skimming a text:

1) Read the heading carefully. Ask yourself, "What do I expect to read about? What do I already know about this topic?"
2) Read the sub-headings (if any.) What is each section going to be about? Is this what you were expecting?
3) For longer texts, read the topic sentence (first sentence) of each paragraph. For shorter texts, read the first few words of each paragraph. It can also be useful to read the last sentence (or last few words) of each paragraph.
4) For longer texts, make a skeleton plan of the sub-headings and topic sentences. This will help you to keep track while you read, and to help you to refocus if you lose concentration or become confused.

Task 1:
Skim the following texts:
a. Letter from "Introduction to Programming" Tutorial letter
b. Letter from "Know your world: Introduction to Geography" Tutorial letter
c. "Measurements and Units": in a variety of tutorial letters as part of the Diagnostic Skills Task.

How to scan:

Make sure that you know what information you are looking for. Think of different words that might be used to refer to this information. Then scan the page, looking for the relevant words or phrases.

Practise scanning:

Task 2:
Look at page 5 of the Introduction to Geography tutorial letter, and answer the following questions individually:
a. What topic can be found on page 135 of the Study Guide? And on page 129? Page 136?
b. What is Study Unit 5 about?
c. In the 2003 edition of Bergman & Renwick, which pages correspond to page 124 of the Study Guide?
d. In the 1999 edition of Bergman & Renwick, which pages correspond to page 133 of the Study Guide?
e. In the 2004 edition of Bergman & Renwick, which pages correspond to page 122 of the Study Guide?

Task 3:
Look at the text on lasers and holograms, and answer the following questions individually:
a. What does the word "laser" stand for?
b. According to the text, what is a photon?
c. What was the first type of laser used?
d. What are the three main components of a laser?
e. What two types of mirrors are generally used in a laser?

Lasers and Holograms

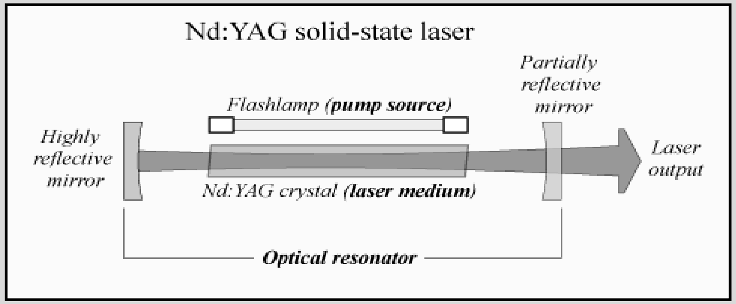
The finest, sharpest, surgical scalpel is not a knife – it is a ray of light, called a laser beam. It can be used in surgery in the same way as a scalpel, but it does not transfer any germs to the patient. It also seals up the smaller blood vessels as it cuts, and thus reduces bleeding. This remarkable beam of light can be used to 'weld' a detached retina back into place in the eye and thus cure a common form of partial blindness.

Beams of laser light are also used to cut through metals and glass, to mark straight lines accurately, and to produce three-dimensional photographs called holograms.

What exactly is a laser?

'Laser' stands for 'Light Amplification by Stimulated Emission of Radiation'. Stimulated emission can be understood by thinking of light as a stream of radiated particles (These particles are also called *photons.*)

Photons are emitted from atoms when the electrons in the atoms are excited (given more energy than they had before). All the photons in a laser beam have the same amount of energy, and as a result, the light has a single frequency. In addition, the photons are all emitted from the atoms at the same instant. This light is then said to be 'in phase' (the photons all move in step with each other), and the light is called 'coherent' light. This is the property that makes a laser so powerful.



The ruby laser

The first type of laser invented was a laser which used a ruby crystal as the medium from which the light was emitted. The man-made ruby crystal was in the shape of a cylinder, and it had the sides and one end silvered to act as mirrors. The other end was partly silvered so that the laser light could emerge. A light tube surrounded the ruby crystal.

When light flashed in this tube, some of the electrons in the ruby were excited to a higher energy level. This is called 'pumping'. These electrons then moved back to a lower energy state, (but still above the original energy level) and emitted photons of light. When these photons hit other atoms in this raised energy condition, the atoms simultaneously emitted other photons (a process called 'lasing'), and the atoms returned to the lowest energy level. These photons hit other atoms, and so on. The whole process of stimulated emission takes place in milliseconds.

The cascade of photons of light was reflected backwards and forwards by the silvered mirrors, which caused the light to be amplified (increased) as it colleted other photons of light. These photons travelled together, and resulted in short pulses of red light which were emitted from the semi-silvered end of the crystal in a narrow beam.

Gas lasers

Most lasers in use today are gas lasers. They produce a continuous beam of light. Instead of a ruby crystal, they consist of a tube of carbon dioxide or a mixture of helium and neon gas. Radio waves are used to 'pump' the gas, and the laser which is emitted may be in the infra-red spectrum as well as in the spectrum of visible light. The main advantage of using gas is that there are no minor imperfections to cause a slight divergence in the light as there may be in the crystal.

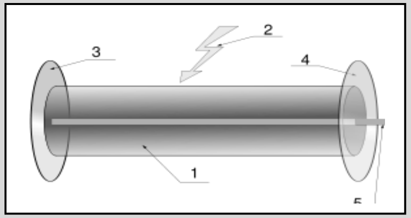
The use of lasers to make holograms

A hologram is a type of three-dimensional photograph. It is produced on a photographic plate using a laser beam. By changing the view-point, the viewer can see round the objects in the foreground and also see objects from the side.

A hologram is made by using semi-silvered mirrors which split the laser beam and one or more object beams. The object beams shine onto the object being photographed, and are then reflected to the photographic place. The reference beam shines straight onto the place. When the beams of light meet on the plate, they interfere with each other, and make a pattern on the plate.

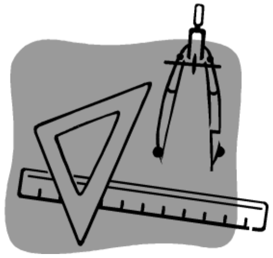
Application of holograms

Holograms, like lasers, have many useful applications. Since holograms require special equipment to produce they are difficult to copy. For example, some credit cards now carry a hologram to show that they are genuine. If a hologram is removed from one credit card and transferred to another, the picture produced by the hologram is distorted. Another use for holograms is the storage of three dimensional pictures of defective components. For example, engineers can easily monitor, in three dimensions, the development of a crack in a working part.



Principal components:
1. Active laser medium
2. Laser pumping energy
3. Mirror
4. Partial mirror
5. Laser beam

Reproduced from the START materials, level 4, Science Unit 4 – in turn adapted from "*Physics Today*, World Book Encyclopaedia of Science. 1986. World Book, Inc. By permission of the publisher.



Measurements and units

The following article emphasises the importance of understanding measurements and its units, and how this understanding can be useful when it comes to entrepreneurship. Read the article and answer the questions that follow [Adapted from Hill, J. W. & Kolb, D. K (1995); Zumdahl & Zumdahl (2003); Halliday, et al (2001)].

1. Making observations is fundamental to all science. Scientific experiments involve observations such as mass, length, time, temperature, electric current and the amount of a chemical compound. A quantitative observation, or measurement, always consists of two parts: a number and a scale, also called a unit.

2. Scientists recognised that standard systems of units had to be adopted if measurements were to be useful. Unfortunately, different standards were adopted in different parts of the world. The two major systems are the English system used in the United States of America and the metric system used by most of the rest of the industrialised world. This duality causes a good deal of trouble.

3. The metric system of weights and measures was first established in 1792 in France. Its cornerstone was the meter, defined to be one ten-millionth of the distance from the North Pole to the Equator. For practical reasons, the Earth standard was abandoned and the meter came to be defined as the distance between two fine lines engraved near the ends of a platinum – iridium bar, the standard meter bar, which was kept at the International Bureau of Weights and Measures near Paris.

4. Accurate copies of the bar were sent to standardising laboratories throughout the world. These secondary standards were used to produce other, still more accessible standards so that ultimately every measuring device derived its authority from the standard meter bar through a complicated chain of comparisons.

5. In 1960, a new standard for the meter, based on the wavelength of light, was adopted. Specifically, the standard for the meter was redefined to be 1 650 763.73 wavelengths of a particular orange-red light emitted by atoms of krypton-86 (a particular isotope, or type of krypton) in a gas discharge tube. This awkward number of wavelengths was chosen so that the new standard would be close to the old meter-bar standard.

6. By 1983, the Krypton-86 standard could not meet the demands for higher precision. The meter was redefined as the distance travelled by light in a time interval of x = 2997924581 of a second. The speed of light was chosen as 299 792 458 m/s.

7. Knowledge of units of measurement can be useful for anyone who would like to be an entrepreneur in the painting industry. For example, a customer may commission you to paint her house. For you to know how much and what kind of paint to use, you need to know the size of the surface to be painted and whether it is interior or exterior.

8. Paint is a broad term that covers a wide variety of products - lacquers, enamels, varnishes, oil base coatings and different water-base finishes. Paint contains three basic ingredients: a pigment, a binder, and a solvent. Paint is originally white due to Titanium dioxide. To make it coloured, small amounts of coloured pigments or dyes are added to the white-base mixture.

9. The binder, or film former, is a substance that binds the pigment particles together and holds them on the painted surface. In oil based paints the binder is usually tung oil or linseed oil. In water based paints it is a polymer such as polyvinyl acetate for interior paints and acrylic resins for exterior paints.

10. The solvent is added in order to keep the paint fluid until it is applied to the surface to be painted. The solvent might be an alcohol, a hydrocarbon, an ester (or a mixture of these) or water.

Addendum E

WORKSHOP 5: WRITING GOOD PARAGRAPHS (1)

Task 1: Underline the topic sentence in each of the following paragraphs. Divide number 5 into 3 paragraphs, and find the topic sentence of each of those paragraphs. This is an individual task.

1. As far as we are concerned in this module, there are two main kinds of numbers. There are integers; we use them when we do not need to talk about fractions. often, though, we need to talk about fractions as well, and then we use floating point numbers. For example, 2.3 metres or R6.99. We use a decimal point to show this.

2. Scientists have learned to supplement the sense of sight in numerous ways. In front of the tiny pupil of the eye they put, on Mount Palomar, a great monocle 200 inches in diameter, and with it see 2000 times farther into the depths of space. One can also look through a small pair of lenses arranged as a microscope into a drop of water or blood, and magnify by as much as 2000 diameters the living creatures there, many of which are among man's most dangerous enemies. To see distant happenings on earth, they use some of the previously wasted electromagnetic waves to carry television images which they re-create as light by whipping tiny crystals on a screen with electrons in a vacuum. They can also bring happenings of long ago and far away as colored motion pictures, by arranging silver atoms and color-absorbing molecules to force light waves into the patterns of original reality. If we want to see into the center of a steel casting or the chest of an injured child, they send the information on a beam of penetrating short-wave X rays, and then convert it back into images we can see on a screen or photograph. Thus almost every type of electromagnetic radiation yet discovered has been used to extend our sense of sight in some way. George Harrison, "Faith and the Scientist"

3. The Internet is a network of thousands of computers across the world. Researchers, students, government agencies, schools, businesses and individuals have left multigigabytes of free information on these computers, available to anyone with a computer and an Internet connection. There are thousands of "web sites", as they are called, with text, pictures, sounds, and movie clips. You can see this material by simply sending out the appropriate Internet address, and after a few moments, it appears on your screen. You can type in the address directly, or you can automatically invoke an address by tapping on an icon or an underlined "link" on the home page of a web site that you already have on your screen. Often the information can be printed or downloaded (copied) directly to your local computer and saved on your own diskette. Clearly, the Internet is an incalculable tool for research.

4. Distillation is a most widely used separation process and ranges from the age-old rectification of alcohol to the fractionation of crude oil. The basic construction feature and design methods also apply to the processes of stripping, absorption and extraction. The separation of liquid mixtures by distillation depends on differences in volatility between the components. The greater the relative volatilities, the easier the separation.

5. Diamond is one of the two best known forms (or allotropes) of carbon, whose hardness and high dispersion of light make it useful for industrial applications and jewelry. (The other equally well known allotrope is graphite.) Diamonds are specifically renowned as a mineral with superlative physical qualities — they make excellent abrasives because they can be scratched only by other diamonds, Borazon, ultrahard fullerite, or aggregated diamond nanorods, which also means they hold a polish extremely well and retain luster. About 130 million carats (26,000 kg) are mined annually, with a total value of nearly USD $9 billion. The name "diamond" derives from the ancient Greek adamas (αδάμας; "invincible"). They have been treasured as gemstones since their use as religious icons in India at least 2,500 years ago—and usage in drill bits and engraving tools also dates to early human history. Popularity of diamonds has risen since the 19th century because of increased supply, improved cutting and polishing techniques, growth in the world economy, and innovative and successful advertising campaigns. They are commonly judged by the "four Cs": carat, clarity, color, and cut. Roughly 49% of diamonds originate from central and southern Africa, although significant sources of the mineral have been discovered in Canada, India, Russia, Brazil, and Australia. They are generally mined from volcanic pipes, which are deep in the Earth where the high pressure and temperature enables the formation of the crystals. The mining and distribution of natural diamonds are subjects of frequent controversy—such as with concerns over the sale of conflict diamonds by African paramilitary groups. There are also allegations that the De Beers Group misuses its dominance in the industry to control supply and manipulate price via monopolistic practices, although in recent years the company's market share has dropped to below 50%.

Task 2: Choose one topic for each of the following paragraph types, and individually write a paragraph thereon.

Definition paragraph

Notes____

____

____

Topics:

1. Define trigonometry.
2. Give the definition of a bar graph.
3. Define the term 'species'.
4. What are genetically modified foods?

Paragraph

____

____

____

____

____

____

____

____

Classification paragraph

Notes____

____

____

Topics:

1. Write a paragraph discussing two kinds of energy resources.
2. In a short paragraph, discuss how you would classify an elephant, a shark, a whale and an eagle.
3. Discuss the numbers 1 and 0 in programming language.

Paragraph

____

____

____

____

____

____

Compare and contrast paragraph

Notes____

____

____

Topics:

1. Compare and contrast mammals and amphibians.
2. What are the similarities of and differences between an acid and a base.
3. Critically compare and contrast desktops and laptops.

Paragraph

____

____

____

____

____

____

Sequence paragraph

Notes____

____

____

Topics:

1. Write a paragraph in which you describe how you would go about testing whether a chemical is an acid.
2. How would conduct an experiment in which you wanted to determine the velocity of a 1 kg brick falling from a building that is 2 km tall.
3. Describe the steps necessary to open a new folder on a Word document.

Paragraph

____

____

____

____

____

____

Explanation paragraph

Notes____

____

____

Topics:

1. In a short paragraph, discuss whether a feather or a rock would fall to the earth at a greater velocity from a 2 km tall building, and explain why.
2. Explain why a pie chart is sometimes more appropriate than a bar graph when representing figures.
3. Why do things on earth not float around, as they would on the moon?
4. Why do various rocks have different colours?

Paragraph

____

____

____

____

____

____

____

____

Evaluation paragraph

Notes____

____

____

Topics:

1. Do you think that genetically modified foods should be labelled in shops?
2. Should a mechanical engineer be sued if the car she worked on causes an accident due to a mechanical error?
3. Is it necessary for pupils to have mathematics as a subject until Grade 12?

Paragraph

____

____

____

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Addendum F

WORKSHOP 6: WRITING GOOD PARAGRAPHS (2)

Conjunctions are examples of logical connectors. They are words that join two or more sentences or ideas together. The main types of conjunctions are additive conjunctions, contrastive conjunctions, and cause and effect conjunctions.

Task 1

The easiest additive conjunction is "and", the easiest contrastive conjunction is "but", and the easiest cause and effect conjunction is "because". Now, in groups of three, think of as many other conjunctions as you can under these three categories.

Additive conjunctions:

____
____
____
____

Contrastive conjuctions:

____
____
____
____

Cause and effect conjuctions:

____
____
____
____

Task 2

Choose five difficult conjunctions from the overhead projector, and make sentences with them. This is an individual activity.

1. ____
   ____
2. ____
   ____
3. ____
   ____
4. ____
   ____
5. ____
   ____

Task 3

Work with a partner to underline the conjunctions in the following sentences.

- Gears are used in many applications in machines, but are of utmost importance in motor vehicles.
- When a multicellular, diploid organism produces gametes, the gametes can be a product of only meiosis.
- After fertilisation, any organism produced by successive mitotic divisions is diploid.
- The brick possesses potential energy because it can do work.
- A fast moving motorcar can do more harm in an accident than a slower moving motor car of the same mass, since it has more kinetic energy that must be transferred to another body or form of energy in the case of an accident.
- If a person starts to pull the chain up, then the part which still has to be pulled up gets shorter and shorter and therefore the chain will become lighter.
- As the sun gradually brightened over hundreds of millions of years, the greenhouse heating from all that carbon dioxide could eventually have brought the oceans to boil.

Task 4

Working with a partner, complete the following text by inserting the best logical connector / conjunction from those provided below.

firstly; fourth; because; besides; but; secondly; however; in other words; and; still; in conclusion

The electric car

There is no doubt among transport researchers and environmentalists that alternatives to today's cars must be found. The reasons for this are simple: _____________ being inefficient consumers of fuel, cars contribute considerably to the global warming phenomenon.

_____________, scientists are finding it hard to develop acceptable alternatives, with only the electric car likely to present any serious opposition to the combustion engine. This discussion will focus on just some of the advantages and disadvantages of the electric car over the conventional fuel-burning engine.
The electric cars already in operation, in countries like Britain, the USA and Sweden, are used mainly as delivery vans or commuter buses; ____________, in applications which do not demand high speeds or long ranges _______________ which allow the battery to be recharged overnight.

The advantages of the electric car are _____________ that it is quiet. Secondly, it emits no polluting exhaust fumes. In the third place, it accelerates rapidly from the start. This feature, of course, makes it ideal for city driving. A ____________ advantage is that is does not depend on oil or other fossil fuels, because batteries can be recharged by electricity, generated by, say, nuclear power.

___________ the electric car does also pose important problems, most of them related to the battery. First of all, the lead-acid batteries are so bulky and heavy that the car cannot carry enough batteries to cover long distances. Naturally, this severely limits the range of the car. __________, the batteries are expensive. Even in countries where the electricity for recharging them is cheap, the electric car is ____________ more expensive to run than the petrol-driven car. And thirdly, the electric car cannot attain a top speed of much more than 80 km/h, which is unacceptably low to most car owners.

_______________, if the disadvantages mentioned above could be addressed productively, electric cars could replace fuel burning cars as the vehicles for a cleaner, pollution-free future.
(Kotecha in Butler, H.G. 2005. *Academic Writing in English EOT 162*. Unpublished workbook: University of Pretoria.

Task 5

Make use of the text that you have already used for the previous task to create a meaningful context. Join the pairs of sentences with a conjunction. Do not use and, but or because. Rewrite the whole sentence. You may work with a friend on this activity.

a) Alternatives to today's cars must be found.
Cars contribute considerably to the global warming phenomenon.

____

____

b) The electric car is quiet.
It emits no polluting exhaust fumes.

____

____

c) The electric car accelerates rapidly from the start.
It is ideal for city driving.

____

____

d) The lead acid batteries are bulky and heavy.
The car cannot carry enough batteries to cover long distances.

____

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e) The batteries are expensive.
The electric car is still more expensive to run than the petrol-driven car.

f) The car cannot carry enough heavy batteries over long distances.
It severely limits the range of the car.

g) Many car owners would not be interested in an electric car.
It can only reach a top speed of approximately 80 km/h.

(Adapted from Du Toit, Heese & Orr in Butler, H.G. 2005. *Academic Writing in English EOT 162*. Unpublished workbook: University of Pretoria.)

Task 6

Choose two topics from the options below. Write a paragraph on each of these topics. Use as many appropriate logical connectors as possible. This is an individual activity.

- Compare electric cars to petrol-driven cars (compare and contrast paragraph)
- Compare and contrast kinetic energy to potential energy (compare and contrast paragraph)
- Explain what the function of the spleen is (explanation paragraph)
- How does a magnet work (explanation paragraph)
- Explain how a diamond is formed (sequence paragraph)
- Give all of the steps of saving a Microsoft Word document on the Desktop (start from switching on the computer) (sequence paragraph).
- What is the definition of energy? (definition paragraph)
- What is a vector? (definition paragraph)
- Is it viable to use electric cars in South Africa? (evaluation paragraph)
- Should medical experiments first be done on animals? (evaluation paragraph)

Paragraph 1

Paragraph 2

Addendum G

WORKSHOP 7: PARAPHRASING

- A paraphrase is a restatement in your own words of some written material. The paraphrased text should be approximately as long as the original.
- Your goal is to state the author's ideas accurately but in your own words, so a paraphrase calls for careful study of the original.
- A paraphrase should not contain any words that add your opinion about the writer's ideas.
- Primary purpose: to clarify difficult material.

Guidelines for paraphrasing

- Read the passage through carefully before staring to paraphrase (often one sentence that is not clear by itself becomes clear as you read on).
- Look in the dictionary for meanings of unfamiliar words. The dictionary may give you simpler language for the idea.
- Do not try to change specialized vocabulary
- Paraphrase by idea, whether the idea is stated in a phrase or in several sentences. Do NOT try to paraphrase word by word.
  - First write down all of the main ideas (in single words and phrases)
  - Rewrite the main ideas into your own sentences.
  - Now combine all of these ideas into a piece of continuous writing.
- As you write each sentence of your paraphrase, do not look at the original passage. HINT: Do not use more than *three* words in a row from the original.
- You may find that changing the order of the ideas will help you use your own wording.
- After you have finished your paraphrase, compare it to the original to see if you are satisfied with the accuracy and completeness of your notes.

TASK 1

Paraphrase the following sentences. Work in pairs.

a) Many invertebrates, on the other hand, such as snails and worms and crustacea, have a spiral pattern of cleavage.

____

____

b) Similarly, the muscles will not grow in length unless they are attached to tendons and bones so that as the bones lengthen, they are stretched.

____

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c) Given the extent to which deforestation increased markedly in the four southern states during 1987 and 1988, it is heartening news that during the early part of the 1989 dry season the burning seemed to have been curtailed somewhat, due to a combination of policy changes, better controls on burning, and most important of all an exceptionally wet "dry" season.

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TASK 2

Paraphrase the following paragraphs. Work in pairs.

a) In general, the knowledge that enables us to build intelligent tutors is not yet fully understood. Further research into each domain and tutoring knowledge is required to make further advances in this area.
Self, J. (ed) 1988. *Artificial Intelligence and Human Learning.* Chapman and Hall, p. 27.

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YUNIBESITHI YA PRETORIA

b) Freezing

Although freezing was being used as a food preservation technique by the end of the 19th century, the freezing itself took a day or more and food tended to be damaged in the process. The modern methods that take only a few minutes or a few hours, started in the 1930s. Today, with the deep-freeze a common item of household equipment in developed countries, frozen foods are an extremely popular convenience food. Additives are rarely needed, most of the nutritional value of food is maintained, and a wide variety of precooked frozen foods is available.

The living planet. SA. *Food Processing*. Date unknown: 196-197.

c) We now have the power to take an adult sheep and replicate it endlessly. It is a truly awesome capability to contemplate. And since – biologically speaking – sheep aren't that different from humans, it probably wouldn't take much more research before we could create clones of humans too.

Anderson, A.M. 1997. Facing science fact – not fiction. *Washington Post*, 12 March 1997.

d) Acids can be classified into two groups. Acids which always contain the element carbon are called organic acids and they often come from growing things, like fruit. Citric acid, which is found in lemons and oranges and other citrus fruits, and acetic acid, which is found in vinegar, are organic acids. Acids which do not contain the element carbon are known as inorganic acids. They are usually prepared from non-living matter. Inorganic acids consist only of hydrogen and an acid radical. Hydrochloric acid consists of hydrogen and the chloride radical, and sulphuric acid consist of hydrogen and the sulphate radical. They are inorganic acids.

Allen, J.B. & Widdowson, H.G. 1979. *English in Physical Science*. Oxford: Oxford University Press, p.11.

e) To operate the bell, the key, or screw, is connected to the positive terminal of the battery, and the copper wire coming from the electromagnet is connected to the negative terminal. When the current is switched on, it flows through the key into the spring, passing from there round the coils of the electromagnet and then back to the battery. As the current passes through the coils of copper wire, the soft iron cylinders around which it is wound become magnetised. Consequently, they attract the armature, causing the head of the striker rod to hit the gong. As the striker hits the gong, the spring to which it is fixed loses contact with the screw, breaking the circuit. The current ceases to flow, the electromagnet loses its magnetism and the armature, being no longer attracted, is pulled back by the spring. When this happens, the spring makes contact with the screw once more, allowing the electric current to pass, again magnetising the cylinders. These then attract the armature, once more pulling the spring away from the screw and breaking the circuit. The whole process is repeated over and over again, causing the head of the striker to vibrate rapidly against the gong, thus producing the familiar sound of an electric bell.

Allen, J.B. & Widdowson, H.G. 1974. *English in Physical Science*. Oxford: Oxford University Press, p.84.

TASK 3

Take a long text from one of your study guides (preferably about one page long), and paraphrase it. This is an individual activity.

Sources:

Gillett, A. 2006. *Using English for Academic Purposes: A Guide for Students in Higher Education*. School of Combined Studies, University of Hertfordshire. From: http://www.uefap.com/writing/report/rep_para.htm (accessed 18 July 2006).

Orr, M.H. & Schutte, C.J.H. 1992. The language of science. Durban: Butterworths.

Addendum H

WORKSHOP 8: SUMMARISING

A] WHAT IS A SUMMARY?

- A summary is a shortened version of a text. It deals with the main ideas (argument) of the text, but doesn't necessarily follow the same order as the original text. It is clear and concise, reflecting the main ideas of the original text, leaving out the details of the original text. If a summary is as long as the original text then it is not a summary. A summary can be a short paragraph, one sentence or several paragraphs.
- We omit examples and explanations when doing a summary.
- Summaries are objective. The writer does not give his or her opinion, but the ideas are stated in the writer's own words.
- A good example of a summary is your CV. It is concise, easy to read and only contains the necessary information. It does not contain unnecessary details nor is it written like an essay.
- Many students get confused between a summary and an analysis of a text. Analysis involves the discussion of ideas or meaning in a text while a summary does not involve the critique of the text or its ideas.

B] WHY SUMMARISE?

If your purpose is one of the following, you may wish to summarize a whole text or a portion of a text:

- To discuss someone's argument or text directly
- To supply context for a specific point in another's text that you are discussing
- To use as expert evidence for a point you are making in your own argumentative text
- To present an opposing point of view that you wish to refute
- To write a one or two page summary of an article
- To take notes
- To condense large amounts of information when doing research

http://www.bridgewater.edu/WritingCenter/Workshops/summariztips.htm

C] HINTS FOR SUMMARISING

- Read and re-read the text thoroughly to get the overall meaning.
- Use a dictionary if need be.
- Underline/highlight the main points of the text or circle key sentences, phrases and words.
- Annotate: make notes in the margin as you read.
- Find the topic sentence in each paragraph. The topic sentence will capture the meaning of the paragraph.
- Link key points using sentences or paragraphs.
- You can also use headings and sub-headings.
- Revise and edit your summary.
- Be aware of plagiarism.

D] TWO TECHNIQUES FOR WRITING SUMMARIES

Summarising Shorter Texts (ten pages or fewer)

1. Write a one-sentence summary of each paragraph.
2. Formulate a single sentence that summarizes the whole text.
3. Write a paragraph (or more): begin with the overall summary sentence and follow it with the paragraph summary sentences.
4. Rearrange and rewrite the paragraph to make it clear and concise, to eliminate repetition and relatively minor points, and to provide transitions. The final version should be a complete, unified, and coherent whole.

Summarising Longer Texts (eleven pages or more)

1. Outline the text. Break it down into its major sections--groups of paragraphs focused on a common topic--and list the main supporting points for each section.
2. Write a one or two sentence summary of each section.
3. Formulate a single sentence to summarize the whole text, looking at the author's thesis or topic sentences as a guide.
4. Write a paragraph (or more): begin with the overall summary sentence and follow it with the section summary sentences.
5. Rewrite and rearrange your paragraph(s) as needed to make your writing clear and concise, to eliminate relatively minor or repetitious points, and to provide transitions. Make sure your summary includes all the major supporting points of each idea. The final version should be a unified, complete, and coherent whole.

http://rwc.hunter.cuny.edu/reading-writing/on-line/summary.pdf

E]

Task 1: Look at the sample texts on the overhead projector. Try to summarise these texts in small groups.

F]

Task 2: Find a partner and summarise the following sentences using your own words.

1. The amphibia, which is the animal class to which our frogs and toads belong, were the first animals to crawl from sea and inhabit the earth.

   ____

   ____

2. Failure to assimilate an adequate quantity of food over an extended period of time is absolutely certain to lead, in due course, to a fatal conclusion.

   ____

   ____

3. The climatic conditions prevailing in the British isles show a pattern of alternating and unpredcitable periods of dry and wet weather, accompanied by a similarly irregular cycle of temperature changes.

   ____

   ____

4. Tea, whether of a Chinese or an Indian variety, is well known to be high on the list of those beverages which are most frequently drunk by the inhabitants of the British Isles.

   ____

   ____

5. One of the most noticeable phenomena in any big city, such as Cape Town or Johannesburg, is the steadily increasing number of petrol-driven vehicles, some in private ownership, others belonging to the public transport system, which congest the roads and render rapid movement more difficult year by year.

   ____

   ____

Task 3: Working with your partner, summarise the following text.

Volcanic islands

Islands have always fascinated the human mind. Perhaps it is the instinctive response of man, the land animal, welcoming a brief intrusion of earth in the vast, overwhelming expanse of sea. When sailing in a great ocean basin, a thousand miles from the nearest continent, with miles of water beneath the ship, one may come upon an island which has been formed by a volcanic eruption under the sea. One's imagination can follow its slopes down through darkening waters to its base on the sea flow. One wonders why and how it arose there in the midst of the ocean.

The birth of a volcanic island is an event marked by prolonged and violent travail : the forces of the earth striving to create, and all the forces of the sea opposing. At the place where the formation of such islands begins, the sea floor is probably nowhere more than about fifty miles thick. In it are deep cracks and fissures, the results of unequal cooling and shrinkage in the past ages. Along such lines of weakness the molten lava from the earth's interior presses up and finally bursts forth into the sea.

But a submarine volcano is different from terrestrial eruption, where the lava, molten rocks, and gases are hurled into the air from an open crater. Here on the bottom of the ocean the volcano has resisting it all the weight of the ocean water, the new volcanic cone builds upwards towards the surface, in flow after flow of lava. Once within reach of the waves, its soft ash is violently attacked by the motion of the water which continually washes away its upper surface, so that for a long period the potential island may remain submerged. But eventually, in new eruptions, the cone is pushed up in the air, where the lava hardens and forms a rampart against the attack of the waves.

G]

Task 4: Now summarise this longer text individually.

FOOD PROCESSING

For thousands of years people have processed natural foods to improve their keeping qualities, nutritional value or flavour. Natural processes have been harnessed to create totally new foods and drinks, or to change the characteristics of a raw material completely. Biotechnology and genetic engineering are now used to enhance what can be done with the world's harvest, and will undoubtedly shape some of the foods and drinks of the future.

The oldest processing techniques improve the digestibility and enhance the keeping qualities of foodstuffs. Examples include grain-milling, the cooking of meat, and the fermentation of grapes to make wine.

Fermentation and enzymes
The most widely used biological technique is *fermentation* – the changing of food components such as carbohydrates into natural preservatives, or more easily digestible nutrients, by the action of yeasts, fungi or bacteria. Bread making, the brewing of beers, and the manufacture of yoghurts and cheeses are typical examples. Fermentation is also used for the preservation of proteins, as for example in meats such as pastrami and salamis. In Japan, fermentation has been used for centuries both for food conservation and in order to produce new flavours, such as rice saks, soya bean sauce, and whole fermented soya beans (natto).

Enzymes – proteins that are produced by living organisms – are used as catalysts in biochemical reactions in a number of food-processing techniques. For example, *rennet*, derived from rennin (an enzyme found in the stomachs of cud-chewing animals such as cows), is used ot curdle milk in the manufacture of cheese.

Dairy foods
Milk, butter, cheese and yoghurt are *staples* – basic components of many diets all over the world. Milk is mainly water, with some protein, fat, lactose (milk sugar) and salts. It sours easily, and can also be a vehicle for human diseases. Louis Pasteur (1822-95), the great French microbiologist, devised a method of heating liquids to temperatures that destroy harmful microorganisms. His work in the 1860s concentrated on wines and beers, where spoilage caused great economic losses. He found that heating to temperatures as low as 57°C (135 °F) for a few minutes extended the safe shelf-life without spoiling the taste. *Pasteurisation* of milk is undoubtedly one of the most significant advances in public health of the last hundred years.

In 1907, Ilya Mechnikov (1845-1916) of the Pasteur Institute in Paris published the results of his research into the long life-spans of Bulgarian farming families. He was convinced that their diet of natural yoghurt was the cause. Since then yoghurts have shown a greater worldwide market growth than any other dairy product. In the manufacture of yoghurt, certain bacteria are responsible for turning the lactose in milk into lactic acid, so enhancing the milk's nutritional value and preventing other organisms from causing rancid sourness.

Bread and alcohol
Grains are another staple of the human diet. Modern milling of cereals such as wheat and maize separates fibrous, floury and proteinaceous components. The fibre is known as *bran* and the protein as *germ*, which often has a high oil content. The flour is either used for baking or processed further, by means of biochemical enzymes, into fructose or glucose syrups. These are then used in all kinds of snacks, processed foods, cake and confectionery. The germ and bran are often sold separately as health foods. Bakeries are now often recombining the separate ingredients in 'multi-grain', bran-enriched and 'natural' breads, to take advantage of a consumer trend for foods with a healthier image. Enzyme-based whole-grain processes are now being developed to retain protein and fibre in the end-product and avoid separation techniques.

Other types of grain are used to make drinks. Barley is *malted* – the grains are sprouted in warm, wet conditions that encourage natural enzymes to turn the starchy component into maltose, another sugar. After drying, the malted barley as used as one of the sugar ingredients making beer and lager; special yeasts on these sugars to turn them into carbon-dioxide and alcohol.
(…)

Freezing
Although freezing was being used as a food preservation technique by the end of the 19th century, the freezing itself took a day or more and food tended to be damaged in the

process. The modern methods that take only a few minutes or a few hours, started in the 1930s. Today, with the deep-freeze a common item of household equipment in developed countries, frozen foods are an extremely popular convenience food. Additives are rarely needed, most of the nutritional value of food is maintained, and a wide variety of precooked frozen foods is available.

Food presentation

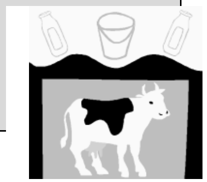
Many of the older food-processing techniques alter the flavour, appearance or texture of foodstuffs. Even freezing – despite its advantages – can alter texture and taste on thawing, because of the disruptive effect of ice crystals.

The 20th century has seen an increasing emphasis on freshness, visual appeal and freedom from additives. The retailer's aim is to make food items look and taste as if they have just been harvested or freshly prepared. Chilling, vacuum-packing, controlled-atmosphere packing and irradiation are all possible ways of achieving this aim. Of these, *irradiation* – the controlled use of gamma or beta rays – is the most effective anti-microbial technique and preserver of quality, but it is not widely used in Europe and America because of fears about its safety. *Chilling* is particularly useful for foods that are sold and eaten within a few days of preparation. Chilling approximates to household-refrigerator conditions, and slows down spoilage considerably. However, the bacterium Listeria, which can cause food poisoning, can persist at chilling temperatures. Controlled-atmosphere packing involves the use of unreactive gases such as nitrogen, which slow down the rate of spoilage.

Biotechnology in food processing

The possibility of altering the genes of a food source to change the characteristics of a food product is now real. Raw materials may be manipulated to give new effects, or effects currently achieved only by using additives. Currently under research are animals with a better lean-to-fat ratio, and soya-bean proteins with better 'foaming' properties to help make certain desserts more attractive to eat. New sweeteners such as aspartame and thaumatin are produced using genetic engineering techniques or mass-culture of plant cells. Tomatoes have been created that contain genes preventing the softening of skin associated with ripening, thus prolonging shelf life. Diagnostic tests, based on monoclonal antibodies and gene probes, have been developed to detect food-poisoning bacteria in raw and processed foods, and toxins in fish that come from algae they eat.
(…)

Source: The living planet. SA. *Food Processing*. Date unknown: 196-197.



Addendum I

WORKSHOP 9: VISUAL LITERACY (1)

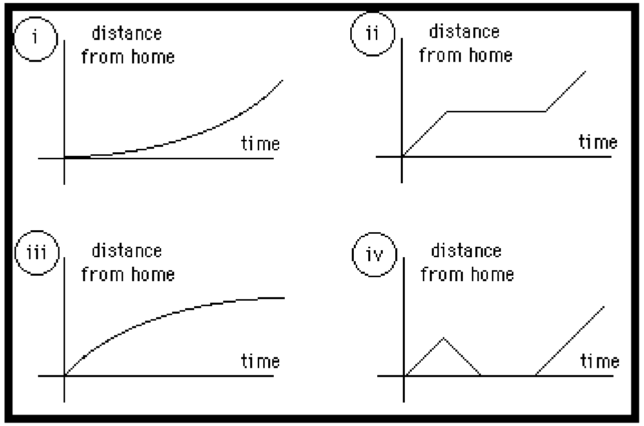
A graph is a pictorial representation of ordered pairs of numbers. The reader can quickly determine relationships between the quantities that the ordered pairs represent.

In a graph, the DEPENDENT VARIABLE (y-axis on graph / right on the data table) is the variable that changes each time that the INDEPENDENT VARIABLE (x-axis on the graph / left on the data table) goes up or down. For example, in a circle, the radius would be the independent variable, and the area would be the dependent variable (the area becomes bigger / smaller each time that the radius becomes bigger / smaller).

Graphs are a useful tool in science. The visual characteristics of a graph make trends in data easy to see. One of the most valuable uses for graphs is to "predict" data that is not measured on the graph.

- Extrapolate: extending the graph, along the same slope, above or below measured data.
- Interpolate: predicting data between two measured points on the graph.

Task 1: Find a partner with whom you will work for the duration of this workshop. Make up a short story (2 to 4 sentences) for each of these 4 graphs



i____

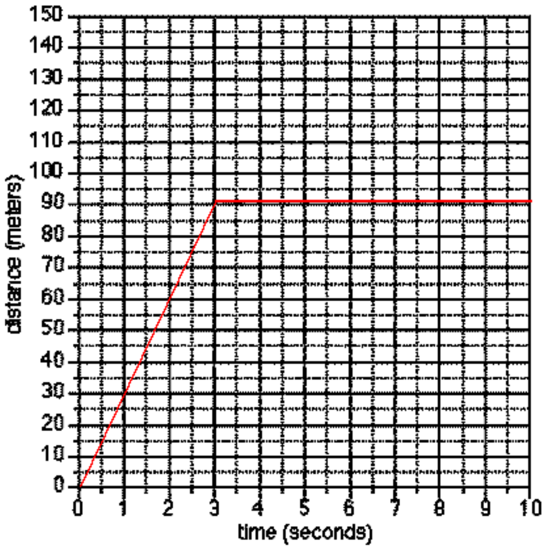
ii____

iii____

iv____

Task 2:

A. Describe what happens during the time represented by this graph.
B. Convert the data in this graph into a table.



Task 3:

Oxygen can be generated by the reaction of Hydrogen Peroxide with Manganese Dioxide.

$$2H_2O_2 + MnO_2 \rightarrow 2H_2O + Mn + 2O_2$$

A chemistry class sets up nine test tubes and places different masses of MnO_2 in each test tube. An equal amount of H_2O_2 is added to each test tube and the volume of gas produced is measured each minute for five minutes. The data from the experiment is:

Tube #	MnO_2 (g)	1 min (ml O_2)	2 min (ml O_2)	3 min (ml O_2)	4 min (ml O_2)	5 min (ml O_2)
1	0.1	1.4	2.6	3.5	4.2	5.1
2	0.2	2.8	4.6	5.8	7.1	7.6
3	0.3	4.9	7.2	8.8	10.2	11.3
4	0.5	5.9	8.5	10.4	11.8	13.3
5	1.0	8.5	12.4	14.4	16.1	17.1
6	1.5	11.0	14.8	17.5	19.8	21.8
7	2.0	12.0	17.0	20.2	22.7	24.8
8	2.5	13.6	19.0	22.1	24.7	27.3
9	3.0	16.2	21.8	25.1	28.2	30.4

A. What volume of O_2 did tube #3 produce between the second and fourth minutes?
B. How much O_2 is produced in tube #5 during the first two minutes?
C. How much oxygen did tubes 7 and 8 produce together during the third minute?
D. What volume of oxygen gas, in liters, was produced during this procedure (thus the total for all of the test tubes)?
E. Make a graph of the amount of oxygen produced each minute in test tubes # 2, 4, and 6.
F. Make a graph using the mass of manganese dioxide and the volume of oxygen for all tubes at five minutes.
G. Interpret the above two graphs in a short paragraph. Remember to use conjunctions to show the relationship between ideas.

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Task 4:

The energy needed to remove the most loosely held electron in an atom is called the First Ionization Energy. This energy for the first 18 elements is shown in the table below.

Atomic Number	1st I.E. (volts)
1	13.53
2	24.46
3	5.64
4	9.28
5	8.26
6	11.22
7	14.48
8	13.55
9	17.34
10	21.47
11	5.12
12	7.61
13	5.96
14	8.12
15	10.9
16	10.3
17	12.95
18	15.68

A. Plot the data points and then draw a line graph in "connect-the-dot" fashion.

How to draw a graph

How To Construct a Line Graph On Paper		
Step	What To Do	How To Do It
1	Identify the variables	a. Independent Variable - (controlled by the experimenter) • Goes on the X axis (horizontal). • Should be on the left side of a data table. b. Dependent Variable - (changes with the independent variable) • Goes on the Y axis (vertical). • Should be on the right side of a data table.
2	Determine the variable range	a. Subtract the lowest data value from the highest data value. b. Do each variable separately.
3	Determine the scale of the graph	a. Determine a scale (the numerical value for each square) that best fits the range of each variable. b. Spread the graph to use MOST of the available space.
4	Number and label each axis	• This tells what data the lines on your graph represent.
5	Plot the data points	a. Plot each data value on the graph with a dot. b. You can put the data number by the dot, if it does not clutter your graph.
6	Draw the graph	a. Draw a curve or a line that best fits the data points.
7	Title the graph	a. Your title should clearly tell what the graph is about. b. If your graph has more than one set of data, provide a "key" to identify the different lines.

Sources

- http://staff.tuhsd.k12.az.us/gfoster/standard/bgraph2.htm
- http://honolulu.hawaii.edu/distance/sci122/SciLab/L3/L3.html

Addendum J

WORKSHOP 10: VISUAL LITERACY (2)

A graph is a pictorial representation of ordered pairs of numbers. The reader can quickly determine relationships between the quantities that the ordered pairs represent.

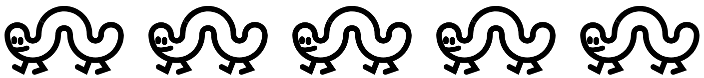
In a graph, the DEPENDENT VARIABLE (y-axis on graph / right on the data table) is the variable that changes each time that the INDEPENDENT VARIABLE (x-axis on the graph / left on the data table) goes up or down. For example, in a circle, the radius would be the independent variable, and the area would be the dependent variable (the area becomes bigger / smaller each time that the radius becomes bigger / smaller).

Graphs are a useful tool in science. The visual characteristics of a graph make trends in data easy to see. One of the most valuable uses for graphs is to "predict" data that is not measured on the graph.

- Extrapolate: extending the graph, along the same slope, above or below measured data.
- Interpolate: predicting data between two measured points on the graph.

All activities in this workshop will be completed with the help of a partner.

Task 1



Number of hookworms in the intestine	Amount of blood lost per day in cm^3
24	12
45	
80	40
88	44
63	
	25
	6

Hookworms live in the human intestine drinking the blood it sucks from the intestine wall. It is estimated that a single hookworm can drink 1/2 cm^3 of blood per day. The chart above contains data on the number of hookworms and the amount of blood loss caused by that number of worms.

A. In some cases the data table is blank. Determine the number of worms or the amount of blood lost and complete the table.
B. What is the dependent variable?
C. What is the independent variable?
D. Make a line graph of the data.
E. How many cm^3 of blood will be lost by a person containing 88 hookworms in a week?

Task 2

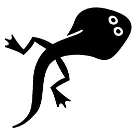
Age of the tree in years	Average thickness of the annual rings in cm. Forest A	Average thickness of the annual rings in cm. Forest B
10	2.0	2.2
20	2.2	2.5
30	3.5	3.6
35	3.0	3.8
50	4.5	4.0
60	4.3	4.5

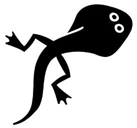
The thickness of the annual rings indicates what type of environmental situation was occurring at the time of the tree's development. A thin ring usually indicates a rough period of development: lack of water, forest fires, or a major insect infestation. On the other hand, a thick ring indicates just the opposite.

A. What is the dependent variable?
B. What is the independent variable?
C. Make a line graph of the data.
D. Based on this data, what can you conclude about Forest A and Forest B? Write a short paragraph in which you interpret the data.

Task 3

pH of water	Number of tadpoles
8.0	45
7.5	69
7.0	78
6.5	88
6.0	43
5.5	23



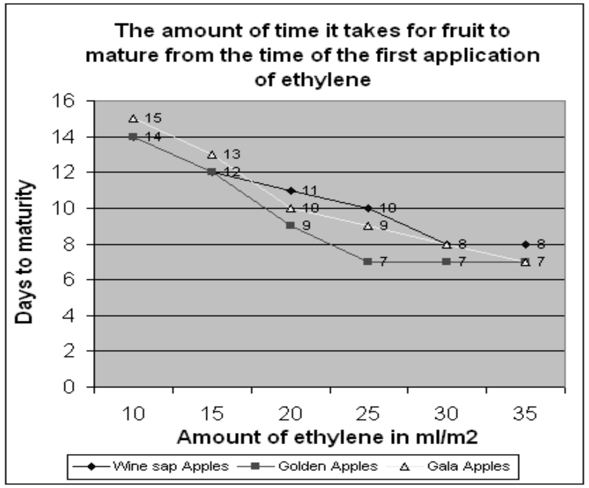


A. What is the dependent variable?
B. What is the independent variable?
C. Make a bar graph of the data.
D. What is the average pH in this experiment?
E. What is the optimum water pH for tadpole development?
F. Between what two pH readings is there the greatest change in tadpole numbers?
G. Approximately how many tadpoles would we expect to find in water with a pH of 5.0?

Task 4

Ethylene is a plant hormone that causes fruit to mature. The data on the right concerns the amount of time it takes for fruit to mature from the time of the first application of ethylene by spraying a field of trees.

A. What is the dependent variable?
B. What is the independent variable?
C. Convert this line graph into a table.



Task 5:

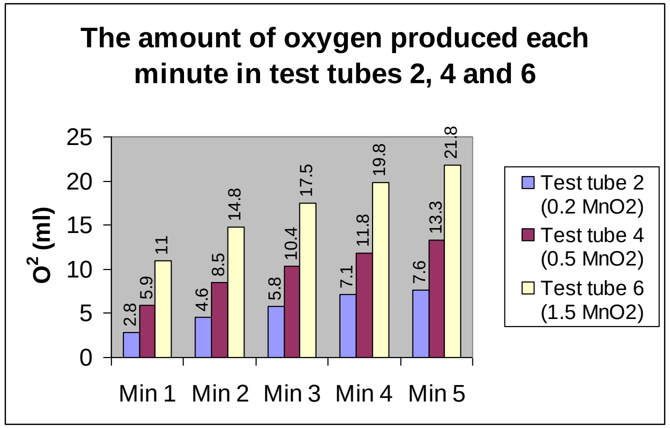
Oxygen can be generated by the reaction of Hydrogen Peroxide with Manganese Dioxide.

$$2H_2O_2 + MnO_2 \longrightarrow 2H_2O + Mn + 2O_2$$

A chemistry class sets up nine test tubes and places different masses of MnO_2 in each test tube. An equal amount of H_2O_2 is added to each test tube and the volume of gas produced is measured each minute for five minutes. The data from the experiment is:

Tube #	MnO_2 (g)	1 min (ml O_2)	2 min (ml O_2)	3 min (ml O_2)	4 min (ml O_2)	5 min (ml O_2)
1	0.1	1.4	2.6	3.5	4.2	5.1
2	0.2	2.8	4.6	5.8	7.1	7.6
3	0.3	4.9	7.2	8.8	10.2	11.3
4	0.5	5.9	8.5	10.4	11.8	13.3
5	1.0	8.5	12.4	14.4	16.1	17.1
6	1.5	11.0	14.8	17.5	19.8	21.8
7	2.0	12.0	17.0	20.2	22.7	24.8
8	2.5	13.6	19.0	22.1	24.7	27.3
9	3.0	16.2	21.8	25.1	28.2	30.4

H. Make a graph of the amount of oxygen produced each minute in test tubes # 2, 4, and 6.



I. Make a graph using the mass of manganese dioxide and the volume of oxygen for all tubes at five minutes.

J. Interpret the above two graphs in a short paragraph. Remember to use conjunctions to show the relationship between ideas.

Sources

- http://staff.tuhsd.k12.az.us/gfoster/standard/bgraph2.htm
- http://honolulu.hawaii.edu/distance/sci122/SciLab/L3/L3.html

Addendum K

WORKSHOP 11: DISTINGUISING BETWEEN ESSENTIAL AND NON-ESSETIAL INFORMATION

Outcomes

- Distinguish between main ideas, supporting ideas and examples.
- Distinguish between facts, opinions and assumptions.
- Classify, categorise and label information.

Activities

Tasks 1 to 7 should be completed with a partner.
Tasks 8 to 12 should be completed individually.

Environmental factors affecting grafting and budding

To obtain proper growth of callus tissue, certain environmental conditions are required.

Temperature

Temperature has a significant effect on callus growth. In apples (malus) no callus will form below 0 degrees Celsius, or 40 degrees Celsius. The rate of callus formation is directly in relation to temperature – the warmer the temperature, the more rapid the tissue growth. Where high temperatures may be detrimental to graft healing the stem could be white-washed where the graft has been done. Alternatively the side where the graft has been done could be turned to face south.

1. *The paragraph above is constructed out of various sentences that have different functions. These are the topic sentence, the main idea, supporting details, and an example. Identify which sentence or sentences represent these functions. One of them has been done for you.*

Topic sentence: Temperature has a significant effect on callus growth.
Main idea:

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Supporting details:

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Example:

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Humidity

If graftwood or buds are exposed to dry air the parenchyma cells will be killed and no callus formation will take place. The humidity should be kept as close as possible to saturation point (100%) – better still is a condition where a continuous layer of water covers the graft. For successful grafts, humidity is therefore of the utmost importance and the use of sealing wax can prevent problems in this regard.

2. *Based on the fact that callus and callus tissue have been mentioned in both paragraphs above, deduce the meaning of the word from the context.*

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3. *Highlight the less important ideas in the above paragraphs by underlining them.*

Oxygen

Rapid cell division goes hand in hand with a higher respiration rate and is accompanied with higher levels of oxygen. As the process is expedited the oxygen uptake must not be hampered. The use of sealing wax does hamper gaseous exchange to a great extent. In difficult cases therefore sealing wax should not be used. These difficult cases are normally also those that require the higher humidity.

4. *'As the process is expedited the oxygen uptake must not be hampered'*

   a) *What process is being referred to here?*

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b) *Paraphrase the quoted sentence.*

Light

Attempts to determine the effect of light intensity on the recovery of graft tissue has not yet yielded conclusive results although better callus growth was obtained in Prunus Serotina (Black cherry) in darkness.

5. *Describe whether light intensity promotes better callus growth or not?*

Season

It is important to note the season when grafting is undertaken. To do successful budding it must be possible to lift the bark easily from the rootstock. This is only possible if the plant has shown sufficient water uptake. The cell activity is at its highest during late winter to autumn (Fall) – this is therefore the best season to do budding and grafting.

In varieties where excessive **bleeding** (Sap flow) occurs, one should wait for the bleeding to stop or the plant should be subjected to lower temperatures and lower levels of moisture. No union of rootstock and graft is possible during excessive bleeding. (Acer palmatum, Juglans regia).

It may even become necessary to make oblique cuts on the stem below the graft so that the bleeding will occur there and not at the graft site.

6. *Identify two main ideas from the paragraphs above.*

To obtain a permanent, successful graft, it is essential that the top of the graft must point upwards. (This is also the case with the bud). It is however possible that a graft will form a union if turned upside down, but the passage of water and nutrients would be restricted in the contorted underlying tissue.

7. *Give a subheading for the paragraph above.*
8. *a) In which sentence can one find the main idea in the paragraph above? Underline this sentence.*

   b)The two paragraphs above have over 160 words - summarise the information so that it captures the essential ideas in the paragraph in not more than 80 words.

Food presentation

Many of the older food-processing techniques alter the flavour, appearance or texture of foodstuffs. Even freezing – despite its advantages – can alter texture and taste on thawing, because of the disruptive effect of ice crystals.

The 20th century has seen an increasing emphasis on freshness, visual appeal and freedom from additives. The retailer's aim is to make food items look and taste as if they have just been harvested or freshly prepared. Chilling, vacuum-packing, controlled-atmosphere packing and irradiation are all possible ways of achieving this aim. Of these, *irradiation* – the controlled use of gamma or beta rays – is the most effective anti-microbial technique and preserver of quality, but it is not widely used in Europe and America because of fears about its safety. *Chilling* is particularly useful for foods that are sold and eaten within a few days of preparation. Chilling approximates to house-hold-refrigerator conditions, and slows down spoilage considerably. However, the bacterium *Listeria*, which can cause food poisoning, can persist at chilling temperature. *Controlled-atmosphere packing* involves the use of unreactive gases such as nitrogen, which slow down the rate of spoilage.

9. *The passage 'Food Processing' is a history of how, for thousands of years, people have manipulated natural food to improve their keeping qualities, nutritional value and flavour. Draw a table and illustrate the evolution of this industry up to the twenty-first century. Where the facts are not given, make assumptions based on the evidence from the text.*

Dates	**Food processing types**	**Contribution**
Before the nineteenth century		
	Pasteurization	
1907		
		Frozen foods
20th century		
21st century		

10. *In five lines, write your opinion of what you think is a natural process and a biotechnological process of food processing. Use examples from the passage to illustrate your answer.*

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11. *Take your study guide or textbook and highlight all the main ideas and the supporting ideas in a section or unit (you can use different colours to differentiate between these). If you do not have a suitable study guide, use the text provided for this activity.*

Source: Adapted from Horticulture 1, HOR141ZE, TSA, 2004, compiled by GJ Engelbrecht

Addendum L

WORKSHOP 12: NOTE-TAKING STRATEGIES

Objectives

- Knowing how to highlight/underline when reading
- Knowing how to annotate when reading
- Knowing how to outline when reading
- Knowing how to draw mind maps

HIGHLIGHTING/UNDERLINING

- You highlight by using coloured pens to mark over important words or lines of a text. The colour calls attention to the marked material.
- Underlining serves the same purpose, because words are underscored.
- Reasons to use highlighting:
    - It helps you **concentrate** as you read. If you are going to mark the text, you will be paying more attention than if you have no pen in hand.
    - Highlighting requires readers to **decide what is important** – because that is what will be marked.

Guidelines for highlighting/underlining

- First read the paragraph or section so that you can see what the main ideas are.
- Do not mark too much. Remember that you want to focus on main ideas and major details that you need to learn.
- Use your prereading as a guide. Read to answer the questions you have raised from titles and section headings. Mark the answers as you find them.

TASK 1

Individually, highlight or underline all of the important information in the text "Black holes in space".

ANNOTATING

- Annotating means adding your marks to the text, whatever marks will help you comprehend as you read and revise for tests.
- You may make short summaries, ask questions, or note reasons for agreeing/disagreeing.
- Annotating is both a main idea strategy and a personal response strategy.

Guidelines for annotating

- After reading a paragraph or section, underline the parts of sentences that contain main ideas.
- Remember that you highlight by contrast; do not underline too much.
- When you look up a word's definition, write the definition in the margin next to the word.
- Note lists of points by numbering each one in the margin, and give the list a name.
- Circle key terms and the names of important figures.
- Draw arrows to connect examples to ideas.
- Devise your own symbols and abbreviations.
- Add your reactions and questions. Both keep you engaged in your reading and prepare you for class discussions and tests.

Example of annotating

Since when?	For thousands of years people have processed natural foods to improve their keeping qualities, nutritional value or flavour.
Two methods of food processing	*1* Natural processes have been harnessed to create totally new foods and drinks, or to change the characteristics of a raw material completely. *2* Biotechnology and genetic engineering are now used to enhance what can be done with
Very controversial!!!	the world's harvest, and will undoubtedly shape some of the foods and drinks of the future.
Natural processes	The oldest processing techniques improve the digestibility and enhance the keeping qualities of foodstuffs. Examples include grain-milling, the cooking of meat, and the fermentation of grapes to make wine.

TASK 2

Annotate the text "Black holes in space". This is an individual activity.

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OUTLINING

- Outlining is a main idea strategy
- Effective outlining depends on your recognition of the relationships between main ideas and details.
- It shows relationships among ideas and details and uses major headings and subheadings.

Guidelines for outlining

- Items of the same level (e.g. A and B) are lined up evenly.
- Include a thesis statement or a statement of the topic at the top of the page.
- If you seem to be just making a list rather than an outline, look at what you have written and see how you can reorganize the material or if you need some headings under which to group points.
- Add notes in the margin of your study outline when helpful.

Example of outlining

Food processing

I. Natural processes
   A. Fermentation and enzymes → *Most widely used technique*
      1. Fermentation – changing food components into natural preservatives
      2. Enzymes – catalysts in biochemical reactions
   B. Dairy foods (esp. pasteurisation)
   C. Bread and alcohol
   D. Freezing → *Used since end of 19th century, but only now effective*
   E. Food presentation
      1. Chilling
      2. Vacuum packing
      3. Irradiation – anti-microbial technique – preserves quality
II. Biotechnology and genetic engineering = altering the genes of a food source to change the characteristics of a food product. → *Might be dangerous. Not widely used in Europe and USA.*

TASK 3

In groups of 4 to 5 students, make an outline of the text "Black holes in space".

MIND MAPS

- Mind maps are almost like outlining, but use a visual pattern rather than numbers, letters, and indenting.
- Use mapping when you might consider outlining, but you prefer a visual pattern.

Guidelines for using mind maps

- Decide on the topic and write it, in a word or phrase, within a circle or box, either in the centre of your paper or at the top.
- Place each main idea on a line radiating out from the centre circle (or in boxes attached to lines coming down from the top box).
- Use as many levels of lines or boxes as needed to include the information you want to learn.
- You may want to turn the paper to the side so that you have more space for your map.
- Experiment with different patterns to find what works for you – or what best represents the pattern used in the material.

TASK 4

In groups of 4 to 5 students, create a mind map of the text "Black holes in space".

Sources:

The living planet. SA. *Food Processing*. Publisher unknown: 196-197.
Seyler, D.U. 2000. *The reading context: developing college reading skills*, 2nd ed. Boston: Allyn and Bacon.
START materials - adapted from: World Book Encyclopedia of Science. 1986. *Physics Today*. World Book, Inc.

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Black holes in space

Living stars and galaxies

When we look up into the sky on a dark night, we see thousands of points of light. They never seem to change, except to twinkle from time to time. The points of light may be single stars or huge clusters of stars called galaxies. For example, a massive spiral galaxy, called M81, is made up of over 200 thousand million suns. Astronomers have identified several different types of stars and galaxies. They have found that some stars and galaxies are growing in size, while others are decreasing. Physicists and astronomers talk of stars being born and dying.

Dying stars

Physicists are trying to explain how stars are born and how they die. A dying star has special interest for scientists because strange effects occur. Some of these effects support modern theories of physics, while others cannot be explained yet by our theories. When a star dies, the matter making up the star collapses towards the centre of the star. In some cases, the contraction can never be halted and the dead star forms a black hole in space. Before the first black hole was discovered, a famous scientist by the name of Einstein predicted that black holes could exist.

Black holes

A black hole is a region of space into which a star or galaxy has collapsed. The matter is compressed into a very small volume. If the sun was compressed into a ball 3 km in diameter, then it would form a black hole. Why is this phenomenon called a black hole?

Matter exerts a gravitational force on all the other matter around about, just as the earth pulls an object in the air back to earth. Gravitational force even affects light. For example, the gravitational field of a star can bend the rays of light passing by from another star.

As a star collapses, the matter at the center becomes denser and denser. This makes the gravitational field near the star extremely strong. All mater near the star is pulled in to the center, making the star even denser. As light passes close to the center of the collapsed star, it is attracted into the centre just as matter is.

No escape

So anything such as a particle of matter, a ray of light or even another star, which comes too close to the collapsed star, is pulled in. Nothing can escape the strong field of gravity. To an observer it appears as a hole in space. To physicists and mathematicians a black hole is a remarkably simple phenomenon: a very large mass in a very small volume.

Escape from the laws of physics

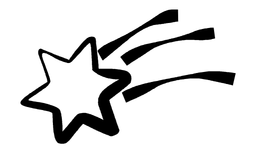
Einstein's theory of relativity provided a more accurate description of the behaviour of matter than Newton's laws do. However, the one is merely a simplification of the other. That is to say, simplifying Einstein's theory will produce Newton's laws. One of the characteristics of a black hole is that, at its centre, all the known laws of physics break down. While Einstein's theory will predicts that black holes exists, his theory breaks down as well, at the centre of a black hole. This situation provides an exciting challenge to scientists today, and new theories predict that matter can be crushed out of existence in a black hole.

Do we have evidence for black holes?

Scientists give a tentative 'yes' to this question. Bodies have been observed in space which behave almost exactly as Einstein's theory says they should. Astronomers have identified a 'supergiant' star called HDE 226868. This star gives off blue light and appears to be orbiting around an invisible companion. Scientists have calculated the mass of this invisible object. The mass is enormous, just as that of a black hole. The gas and material from HDE 226868 are being sucked into the invisible black hole as it revolves around the hole. Also, we know that light should reach Earth from certain galaxies, but it never does. The theory is that the light is absorbed into a black hole between the stars emitting such light and the earth.

The importance of investigating black holes

Many people question the wisdom of spending time, money, and effort investigating phenomena far removed from us in space. But human beings have always felt challenged to investigate things that they cannot explain. As scientists attempt to construct new theories to explain different phenomena, they develop new 'tools' to enable the theories to be tested. The theories benefit humanity because they open scientists' eyes to new possibilities. For example, a new material which enables us to save energy may be developed from theoretical predictions. New mathematical tools are also developed to support and test new theories. Nuclear energy is an example of theory providing man with new sources of energy. The study of black holes will help scientist understand how gravity works and how matter and energy are related. Indeed, to most of us, black holes may prove to be of great benefit to us in developing our understanding and improving our lives, just as space flight has given us new, strong materials and many other beneficial spin-offs.



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Addendum M

WORKSHOP 13: INTRODUCTION TO REFERENCING

TASK 1: In groups, discuss what you understand under the term "plagiarism".

How to avoid plagiarism

1. **Acknowledge your sources**: If you use information from a source, identify the source or person according to the conventions for referencing. These references enable a reader to track down the words and ideas you are borrowing to check whether you are using them accurately and fairly. You need to reference every source you use in two places:
   - In-text referencing – after your quotation (be it direct or paraphrased), you have to add the surnames of the authors and the year in which the source was published (Nkosi, 2000).
   - List of references / bibliography – at the end of each assignment, study guide or book, there should be a list of references, acknowledging all of the sources used in that assignment, study guide or book.

2. **Use proper in-text referencing**: Use phrases such as, "according to Jones (2004)…", "Smith (2005) argues that…" etc.

   - **Use indirect quotations**: With an indirect quotation, you paraphrase information – that means, putting it in your own words. Even if you use your own words, the idea still belongs to someone else, so even though you do not use quotation marks, you still have to add the in-text reference (Author, Year).
     OR
   - **Use direct quotations**: With a direct quotation, you repeat the author's words directly, word for word. You have to put quotation marks ("…") around the quotation, and add the in-text reference (Author, Year: Page).

How to reference information correctly in the text (in-text referencing) – HARVARD METHOD

Original:
We are releasing uncontrollable forces into our environment and food supply. Recently in Mexico, birthplace of corn and storehouse of its genetic diversity, researchers reported that local varieties had been contaminated by modified genes – even though Mexico has banned the planting of engineered corn.
(Author's surname: Ackerman. Published: 2002. Page: 32)

In-text reference: Indirect quotation
Genetically modified (GM) foods are unsafe and the risks associated with them have hazardous effects. Ackerman (2002:32) argues that forces outside of our control are being let loose on our environment.

In-text reference: Direct quotation

Genetically modified foods have a negative impact on our surroundings. They are risky. "We are releasing uncontrollable forces into our environment and food supply" (Ackerman, 2002:32). These "forces" include new plant genes that spread to related plants, causing them to become mutated and difficult to control.

In-text reference: Direct quotation of more than 3 lines.
Genetically modified (GM) foods are unsafe and the risks associated with them are dangerous to our surroundings. Ackerman argues:

> We are releasing uncontrollable forces into our environment and food supply. Recently in Mexico, birthplace of corn and storehouse of its genetic diversity, researchers reported that local varieties had been contaminated by modified genes – even though Mexico has banned the planting of engineered corn (Ackerman, 2002:32)

Although these findings are questionable, this new research may suggest that plant species could become affected with new "mutated" genes, even when not planted next to GM crops.

For you to reference properly, you have to be aware of where to find certain information in books, study guides, journal articles, newspaper articles and magazine articles.

TASK 2: In groups, discuss the differences between the following (look at their definitions, what kind of information you can get from each of them, how reliable they are, etc.):

- A book
- A study guide
- A magazine article
- A journal article
- A newspaper report

TASK 3: In groups, examine the three appendices that your tutor will hand out to you.

Appendix A

1. What kind of text is this (a book, a study guide, a magazine article, a journal article, or a newspaper article)?
2. What is the title?
3. What is the author's initial and surname?
4. How many editions are there?
5. What is the copyright year (thus, what year should be put in the in-text reference, and in the bibliography)?
6. Who is the publisher?
7. Who is the printer?

Appendix B

8. What kind of text is this (a book, a study guide, a magazine article, a journal article, or a newspaper article)?
9. What is the title of the article?
10. What is the name of the source?
11. What are the initials and surnames of the authors?
12. What is the copyright year?
13.

Feldmann, Morris and Hoisington (2000:7) state that "these include, but are not necessarily limited to, health issues".

"These include, but are not necessarily limited to, health issues" (Feldmann, Morris & Hoisington 2000:7).

Why are the surnames in the first quotation outside of the brackets, but inside of the brackets in the second quotation?

14. Look at first sentence of the third paragraph on p. 53 of Appendix B (starting with "Alternatively"). Now, act as though you are quoting this in an assignment. First, write it down as a direct quotation (remember quotation marks and in-text reference). Then, write it as an indirect quotation (i.e. a paraphrased quotation).

Direct quotation:

Indirect quotation:

15. Choose a long quotation (3 lines or more). Quote this in the correct manner, embedded in your own argument.

Appendix C

16. What kind of text is this (a book, a study guide, a magazine article, a journal article, or a newspaper article)?

17. What is the title of the article?

18. What is the name of the source?

19. What is the initial and surname of the author?

20. What is the volume and number?

21. What is the copyright year?

22. This article uses footnotes for referencing (which is a different method of referencing). Reference the two quotations in the article as they would have been referenced when using the Harvard method.

Reference: Killen, P. O. & Walker, C. (eds.). 1979. *Handbook for teaching assistants at Stanford*, 2nd ed. Stanford: Stanford University.

Addendum N

WORKSHOP 14: BIBLIOGRAPHIES

Books

- **Author (surname and initials)**
- **Year of publication**
- **Title (in italics or underlined)**
- **Edition (except for the 1st edition)**
- **Place of publication**
- **Publisher**

(One author)
Askeland, D.R. 2006. *The science and engineering of materials*. Southbank: Thomson.

(Two or more authors)
Petocz, P., Petocz, D. & Wood, L.N. 1992. *Introductory Mathematics*. Sydney: Thomas Nelson.

(A later edition)
Zumdahl, S.S. & Zumdahl, S.A. 2000. *Chemistry, 5th ed.* Boston: Houghton Mifflin Co.

(A book with an editor(s))
Heldman, D.R. & Lund, D.B. (eds). 2007. *Handbook of food engineering*. Boca Raton: Taylor & Francis.

(A chapter in a book, edited by another person)
Doe, J. 2007. Engineering the apple. In *Handbook of food engineering*. (eds.) Heldman, D.R. & Lind, D.B. Boca Raton: Taylor & Francis.

Journal and magazine articles

- **Author (surname and initials)**
- **Year of publication**
- **Title of article**
- **Name of journal (*italics* / underlined if written by hand – may be abbreviated if the abbreviation is a standardised abbreviation used by the journal itself)**
- **Month, season, year**
- **Volume**
- **Number**
- **Pages of the article (from beginning to end, not just what you quoted)**

(An article by one author)
Insoo, H. 2006. Magic eggs and the frontier of stem cell science. *Hastings Center Report*, July 2006, 36(2): 16-19.

(An article by more than one author)
Gentry, T.J., Rensing, C. & Pepper, I.L. 2004. New Approaches for Bioaugmentation as a Remediation Technology. *Critical Reviews in Environmental Science and Technology*, 34(5): 447-494.

Internet

National Institute of Health (NIH). 2005. *Stem Cell Basics*. From: http://stemcells.nih.gov /info/basics/ (accessed 13 September 2006).

Anon. [s.a]. *New Hope for Stem Cell Research*. From: http://science.slashdot.org/ article.pl?sid=06/08/23/1838213&from=rss (accessed 13 September 2006).

Study guide & tutorial letter

Dangor, M., Erasmus, T., Finlayson, K., Malan, G., Reynecke, A., Van der Watt, J.J. & Willemse, R.J. 1993. *Housing Management I: Study guide 1 for HOM121RE*. Florida: Technikon SA.

Technikon SA. 2003. Management of Training II: Tutorial letter 1 (1st registration 2003) for MOT201UE. Florida: Technikon SA.

TASK 1: In groups of 3 to 4 students, complete the following activities.

1. Write down a reference for two books.

2. Write down a reference for two journal articles.

3. Write down a reference for two study guides / tutorial letters.

4. Write down a reference for two Internet articles.

5. Write down a reference for two magazine articles.

6. Now write down the whole bibliography for all of these.

TASK 2: In groups, write down the correct references (as you would in a bibliography) of the following sources. Also put them in alphabetical order, as you would a real bibliography!

1. In 2006 I found a book, called Science for Engineers, that I used in an assignment. The book was written by Peter A. Steward. It had 313 pages, and the information I used was on page 299. It was printed by Pretoria Printers, and published by Protea. The book was written in 1999. It was published in Pretoria.

2. In my search, I also found a great journal called "Science South Africa". The journal had 222 pages. I used one quote on page 177 of an article called "Engineering the Nelson Mandela bridge". The author of this article was John Doe. The article was from page 170 to page 179, and was published in the Spring of 2003. The volume of the journal was volume 8, and it was number 2.

3. On 8 August 2006 I found an article called "Benefits of Stem Cells to Human Patients" on the Internet. It was written in 2005. The Internet address is www.stemcellresearch.org/facts/treatments.htm.

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TASK 3: Identify the mistakes in the following bibliography. There are at least two mistakes in each reference. Rewrite the whole reference, and circle the two mistakes which you corrected. This is an individual activity.

Kittel, C. 2005. Introduction to solid state physics, 8th edition. J. Wiley: New York.

Perin, H., Dohmann D. and Borojevic K. 2005. *Transendocardial autologous bone marrow cell transplantation for severe, chronic ischemic heart failure*, Circulation **107**

McCarthy. 2005. Frequently asked questions about nuclear energy. From: http://www-formal.stanford.edu/jmc/progress/nuclear-faq.html

Guttman, B.S. January 2005. *Evolution: a beginner's guide*. Oxford: Oneworld, p.155.

Douglas M. Gingrich. *Practical quantum electrodynamics*. Boca Raton: Taylor & Francis.

C.M. Verfailie, Adult stem cells assessing the case for pluripotency, *Trends Cells Biol* **12**, p. 502

Moran, S. 2006. New York Times. *Biofuels come of age as the demand rises*, 12 September 2006.

Biofuel. http://en.wikipedia.org/wiki/Biofuel (accessed 14 September 2006).

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Addendum O

WORKSHOP 15: REVISION - PARTS OF SPEECH AND PARAGRAPH WRITING

- Parts of speech
- Conjunctions
- Writing good paragraphs

Parts of speech

Task 1: In groups, discuss what the job of each of these parts of speech is. Write this down, and give a few examples of each part of speech:

Article (art)

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Noun (n)

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Adjective (adj)

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Verb (v)

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Adverb (adv)

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Preposition (prep)

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Conjunction (conj)

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Task 2: Work with a partner to identify which part of speech each of these words belong to, by writing the abbreviation above each word.

- **Science** in **the broadest** sense **refers** to **any knowledge** or **trained skill**, **especially** (but not **exclusively**) when **this** is **attained** by **verifiable means**.
- **In a** more **restricted sense**, **science refers to** a **system** of **acquiring knowledge based** on empiricism, experimentation, and **methodological naturalism**, as well as to **the organized body** of knowledge **humans have gained** by such research.

Task 3: In pairs, complete the following table by filling in the missing part of speech:

Noun	Adjective	Verb	Adverb
analysis	analytical	analyse	analytically
synchronisation			
		accelerate	
		quantitate	
encryption			
			densely
	tabulated		
virus			
	emitted		
significance			
	deflecting		

Writing good paragraphs and conjunctions

Task 4: Working with a partner, create a flow-chart showing the sequence of milk processing.

- They separate the milk into cream and milk.
- The cow produces the milk.
- A dairy will pasteurise the milk (heat it until 72ºC), cool it, bottle it, pack it in crates, and deliver it to the consumer.
- The factory weighs and tests the milk.
- The farmer delivers the milk to a factory.

Task 5: Organise the text in the correct sequence. Use logical connectors (e.g. after this, finally, next, then, and then, subsequently, at the next stage in the process, the final stage occurs when, after being...) to write a coherent paragraph, explaining the order in which the above process takes place. Remember to write it in a scientific style (i.e. in the passive form). You may work with a partner on this activity.

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Task 6: In pairs, combine the following sentences by using each of the given conjunctions

- The zinc is resistant to corrosion.
- It is used for coating sheet steel.

a) (Because)

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b) (Therefore)

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- The piston is lowered.
- The pressure increases.

a) (As a result)

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b) (If)

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c) (Thereby)

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d) (Consequently)

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e) (Results in)

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f) (As a result of)

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Task 7: Fill in the conjunctions / logical connectors in the following paragraph. This is an individual activity.

although; and; firstly; hence; lastly; secondly; since; such as; thirdly; whereby

Parasitism

The relationship between host and associate has been hinted at already and can be defined as the association between organisms ____________________ only one, the parasite, benefits, the partner suffering some definite harm. There is often some loss of free life on the part of the parasite, __________________ the association between host and parasite is frequently of long duration when judged against the life span of the organisms involved.

Parasites exhibit four features that collectively identify them as such. ___________, they live in or on a host, and do it harm. The depth to which they penetrate the host varies, as indeed does the damage. _______________, parasites show some simplification of body structures when compared with free-living relatives. ______________, ___________________ all organisms show adaptations to their way of life, in the case of parasites they are often associated with a complex psychological response, e.g. the ability to survive in regions almost devoid of available oxygen, _______________ adult liver flukes, or the hooks and suckers of adult tapeworm. ________________, parasites exhibit a complex and efficient reproduction, usually associated in some way with the physiology of the host, eg rabbit fleas are stimulated by the level of sex hormone in their host.

Many authorities consider that the most damaging and traumatic parasitic associations are probably relatively recent relationships, _______________ the participants have not yet had time to 'settle down' to the parasitic way of life. Obviously it is of no value to the parasite to seriously damage, or even kill, its source of food and life.

Parasites have a long history of association with man, and such finds as Egyptian mummies have shown evidence of parasitic infections that were obviously present in people many thousands of years ago. It should be remembered that often the mummies were the remains of wealthy people who presumably lived a full and healthy life by the standards of that time, and ____________ one can imagine the state of people living in dirty and impoverished conditions.

Task 8: Individually, write one definition, classification, compare and contrast, sequence, explanation and evaluation paragraph

Types of paragraphs

Definition paragraph

Notes____

Topics:
1. Define science.
2. Give the definition of a triangle.
3. Define the term 'omnivore'.
4. What is a black hole?

Paragraph

Classification paragraph

Notes____

Topics:
1. Write a paragraph discussing two kinds of energy resources.
2. In a short paragraph, classify sunlight, germs, trees, plastic, and animals under biotic and abiotic factors, and explain why.

Paragraph

Compare and contrast paragraph

Notes____

Topics:
1. Compare and contrast series and parallel electrical circuits.
2. What are the similarities of and differences between solar power and fossil fuels.
3. Critically compare and contrast desktop and laptop computers.

Paragraph

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Sequence paragraph

Notes____
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Topics:

1. Write a paragraph in which you describe how you would go about testing whether a substance is indeed carbon dioxide.
2. How would you conduct an experiment in which you wanted to determine the velocity of a car falling down a cliff.
3. Describe the steps necessary to save an Excel document on your desktop.

Paragraph

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Explanation paragraph

Notes____
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Topics:

1. Explain why a pie chart is sometimes more appropriate than a bar graph when representing figures.
2. Why do various chemicals smell differently?
3. How does a computer convert what you type on a keyboard to the screen?

Paragraph

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Evaluation paragraph

Notes____
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Topics:

1. What type of energy is better – solar or fossil? Why?
2. Should chemistry and physics be taught as separate subjects at school level?
3. What are the advantages and disadvantages of studying at a distance learning institution?

Paragraph

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Addendum P

WORKSHOP 16: READING IN THE SCIENCES (2)

Before you start reading, first preview the text.

Steps to go through when previewing a text:

1) Read the heading carefully. Ask yourself, "What do I expect to read about? What do I already know about this topic?"
2) Read the sub-headings (if any.) What is each section going to be about? Is this what you were expecting?
3) For longer texts, read the topic sentence (first sentence) of each paragraph. For shorter texts, read the first few words of each paragraph. It can also be useful to read the last sentence (or last few words) of each paragraph.
4) For longer texts, make a skeleton plan of the sub-headings and topic sentences. This will help you to keep track while you read, and to help you to refocus if you lose concentration or become confused.
5) Look at the problems at the end of the chapter and the chapter summary.

You should adopt a scientific mindset. Ask questions such as:

- Why?
- How do we know this?
- How does this happen?
- What does this show?
- Are alternative explanations plausible?
- What laws govern or affect this?

Task 1: Look at the following annotated example. Do the same with the second text (i.e., ask as many questions as you can about the text). This is an individual activity.

EXAMPLE
Some biochemical processes

How do we know?

How?

Only a certain number of each element's atoms exist on earth. For plants and animals to reproduce and grow, atoms must be recycled and used over and over again. The atoms that make up our bodies now are only temporarily ours. These atoms probably belonged at one time to prehistoric plants and animals, and they will belong to other organisms in the future. Figure 19.10 shows roughly how carbon and nitrogen are recycled in nature.

Why?

Where?

Plants make glucose by photosynthesis, and they use the energy from it to make amino acids out of inorganic nitrogen – ammonia and nitrates– in the soil. Then the plants make proteins for their own use. Herbivorous (plant-eating) animals eat the plants, taking amino acids from the plants' proteins and re-forming them into their protein structures. Carnivorous (meat-eating) animals eat the herbivorous animals to obtain proteins for their own structure and to store fat for their complex organic structure back into simple inorganic compounds that can be used again by plants.

Why not?

What are the consequences?

Animals can't make amino acids, so they depend on plants for them. Plants can't use organic compounds, so they depend on the bacteria in the soil to break them down. If decay didn't occur, the elements would reach a literal dead end as organic compounds, and the cycle would be incomplete. Our production of certain plastics and other substances that do not decay is beginning to interrupt this cycle.

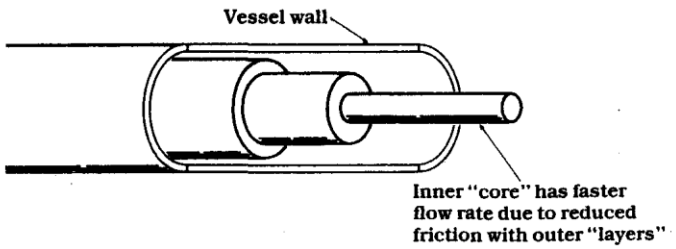
Newell, *Chemistry: An Introduction*, pp. 476-478.

Peripheral Resistance and Vessel Surface

As just demonstrated, it is possible to increase the heart rate to an extent that blood is pumped into an artery faster than it can drain out. This increased volume of blood raises the pressure in the vessel. Recall that the volume and pressure of blood in a vessel depend upon two factors, the amount pumped in and the amount allowed to drain out. The "draining" of blood from arteries is controlled by regulating the resistance to blood flow through branches of the arterial tree – this resistance to flow in the peripheral circulation is termed peripheral resistance.

Blood, like any other fluid flowing through a system of vessels, is subjected to friction as it "rubs" against the vessel walls. Consequently, blood does not flow uniformly through any given vessel. The outer portion of blood in contact with the vessel wall is subjected to greater friction and flows more slowly. Blood toward the centre of the vessel moves under less friction and flows more rapidly. These different flow rates within the same vessel result in a layered flow pattern, or laminar flow (figure 18.8). Any feature of the circulatory system that changes the amount of blood exposed to vessel surface changes the amount of friction and the peripheral resistance. An increase in friction increases resistance and slows the flow of blood while a decrease in friction decreases resistance and speeds the flow of blood.

Laminar flow of blood results from greater friction at the vessel periphery due to contact with the vessel wall. (Figure 18–8)



—Davis, Holtz, and Davis, *Conceptual Human Physiology*, pp. 358–359

Davis, Holtz, and Davis, *Conceptual Human Physiology*, pp. 358-359

<u>Study and draw diagrams and drawings</u>

- Diagrams and drawings often clarify a principle or concept.
- They are used to show forces, conditions, shapes, directions, processes, or positions.
- They provide a visual representations of an object or occurrence, and increase your ability to both understand and retain information.
- Study the drawings or diagrams in your text. Then use them to recall key concepts and processes. Finally, you can try to draw the diagram from memory. Then compare it to the original to see what you forgot.
- Drawing diagrams can also be useful in laboratory situations. Draw brief sketches of your equipment setup, techniques, and observations. These will help you when you have to write your lab report.

Task 2: With a partner, draw two diagrams of the following text, one of the convention current at the seashore during daytime, and the other at night.

Convection

Convection is a means of heat transmission in all fluids, whether liquids or gases. Whether we heat in a pan or warm air in a room, the process is the same. If the fluid is heated from below, its molecules increase in speed and rise, permitting cooler fluid to come to the bottom. In this way, convection currents keep the fluid stirred up as it heats.

Convection currents stirring the atmosphere result in winds. Some parts of the Earth's surface absorb heat from the sun more readily than others, and as a result the air near the surface is heated unevenly and convection currents form. This is most evident at the seashore. In the daytime the shore warms more easily than the water; air over the shore rises and cooler air from above the water takes its place. The result is a sea breeze. At night the process reverses because the shore cools off more quickly than the water, and then the warmer air is over the sea. Build a fire on the beach and you'll notice that the smoke sweeps inward during the day and seaward at night.

Hewitt, *Conceptual Physics*, p. 237

DAY	NIGHT

Summarise the text in the margin

- First, read through the entire text to get an overview.
- Then read it one more time to understand the steps and the connections between them. Try to look for cause-and-effect relationships – thus, what is the process involved, what step happens first, second, etc.
- Finally, write a step-by-step summary of the process in your own words.

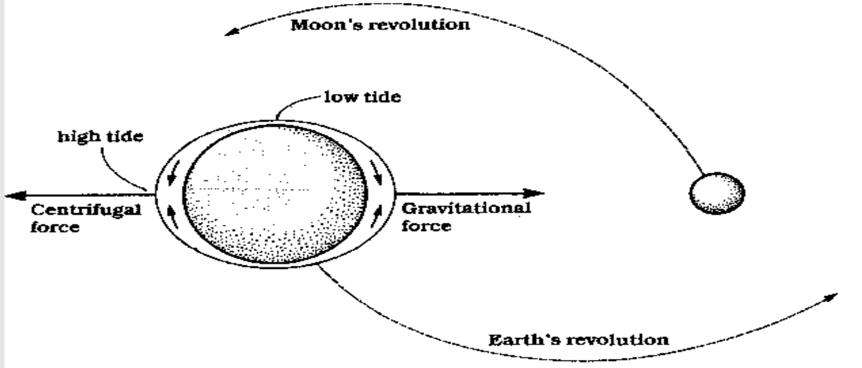
Task 3: Write a step-by-step summary of the following text in the margin. The summary should be approximately 70 – 100 words long. This is an individual activity.

TIDES

Several forces impart energy to Earth's waters to produce high and low tides. To understand how these forces operate to change the level of water, you must construct a model of Earth completely covered by water and without continental land masses. The interaction of Earth and moon causes two tidal bulges on opposite sides of the planet (in our model without land). The bulge on the side of the Earth closest to the moon occurs as a consequence of the mutual attraction between moon and Earth. The moon's gravitational attraction pulls and moves the water (because water is more responsive than solid crustal material only water moves perceptibly in real life). The bulge on the opposite side results from the centrifugal force created as Earth and moon revolve around a common point, or barycentre, located 4670 km (2900mi) from the Earth's centre (Figure 1.15). Centrifugal force is illustrated by water spinning off a moving bicycle tire. Remember, the moon does not revolve around Earth; rather, the moon and Earth revolve around each other. Consequently, the point on Earth farthest from the moon travels farther as the moon and Earth swing together through space. The centrifugal force generated by their revolution is sufficient to overcome the gravitational forces of Earth and moon; thus, the second tidal bulge is formed. If our model is accurate, high and low tides would occur exactly 6 hours apart during Earth's 24-hour day. However, they do not.

Tides occur at different times each day partly because of the motions of Earth and moon. The moon completes one apparent revolution around Earth in 24 hours and 50 minutes, the lunar day. The moon's apparent motion is an illusion caused by the rapid rotation of Earth; in reality, we are observing Earth's rotation, which we see as the moon travelling across the sky. In addition, as Earth completes one rotation (24 hours), the moon changes its heavenly position as it revolves around Earth, causing the moon to rise 50 min later each day; the tides also occur 50 minutes later each day. The frequency between successive high tides, therefore, is 12 hours and 25 minutes. Due to the friction between Earth and the moving tidal bulges, high tide in a given location occurs approximately 50 minutes after the moon is over that point on Earth. These tides are known as lunar semidiurnal tides. . .

Along most coastlines, the difference between the vertical height of the high and low tide–the tidal range–varies from day-to-day. The changing tidal range for a particular location results from the gravitational attractions of sun and moon. Solar tides are about one-half the size of lunar tides. Although the mass of the sun is 27 million times greater than that of the moon, the sun is 400 times farther away from Earth and thus has only a slight effect on Earth's tides compared to the moon. According to Newton's Law of gravity, the gravitational force (attraction) between two bodies is directly proportional to their masses and inversely proportional to the square of the distance between them.



The revolution of Earth and moon around a common barycenter located 4670 km from Earth's center. The tidal bulge farthest from the moon is caused by centrifugal force as Earth and moon revolve around each other. The point on Earth farthest from the barycenter travels farther and faster, generating sufficient centrifugal force to overcome gravity. The tidal bulge closest to the moon is created by the gravitational pull of the moon and the sun. Each tidal bulge represents the crest of the wave at high tide. (Figure 1–15)

Lerman, *Marine Biology: Environment, Diversity, and Ecology*, pp. 19, 20

Task 4: Now, write a step-by-step summary of the following text, and draw a diagram. This is an individual activity.

The movement of water and minerals

Transpiration

A plant needs far more water than an animal of comparable weight. In animals most of its water remains in its body and recirculates. By contrast, in plants more than 90 % of the water that enters the roots is given off into the air as water vapour. Thus, for example, a single corn plant needs 160 to 200 liters of water from seed to harvest, and 1 acre of corn requires almost 2 million liters of water a season. British ecologist John L. Harper describes the terrestrial plant as "a wick connecting the water reservoir of the soil with the atmosphere". The loss of water vapour from the plant body is known as transpiration.

The uptake of water

As we noted earlier, water enters the body of most plants almost entirely through the roots. During periods of rapid transpiration, water may be removed from around the roots so quickly that the water in the soil in the vicinity of the roots becomes depleted. Water will then move slowly by diffusion and capillary action through the soil toward the depleted region near the roots. The roots also obtain additional water by growing beyond the depleted region; the main roots of corn plants, for example, grow an average of 52 to 63 millimeters a day.

Roots cells, like other living parts of the plant, contain a higher concentration of solutes (both organic and inorganic) than does soil water. As a result, water from the soil enters the roots by osmosis. The osmotic potential is sufficient to move water a short distance up the stem, a phenomenon known as root pressure. Guttation is a visible consequence of root pressure. But how can water reach 20 meters high to the top of an oak tree, travel three stories up the stem of a vine, or move 125 meters up in a tall redwood?

One important clue is the observation the during times when the most rapid transpiration is taking place–which is, of course, when the flow of water up the stem must be the greatest–xylem pressures are characteristically negative (less than atmospheric pressure). The existence of negative pressure can be demonstrated readily. If you peel a piece of bark from a transpiring tree and make a cut in the xylem, no sap runs out. In fact, if you place a drop of water on the cut, the drop will be drawn in. What is the pulling force? It is not simple suction, as the negative pressure might indicate. Suction simply removes air from a system so that the water (or other liquid) is pushed up by atmospheric pressure. But atmospheric pressure is only enough to raise water (against no resistance) about 11 meters at sea level, and many trees are much taller than 11 meters.

The Cohesion-Tension Theory

According to the now generally accepted theory, the explanation is to be found not only in the properties of the plant but also in the properties of water, to which the plant has become exquisitely adapted. As we pointed out in chapter 2, in every water molecule, two hydrogen atoms are covalently bonded to a single oxygen atom. Each hydrogen atom is also held to the oxygen atom of a neighbouring water molecule by a hydrogen bond. The cohesion resulting from this secondary attraction is so great that the tensile strength in a thin column of water can be as much as 140 kilograms per square centimeter (2,000 pounds per square inch). This means that it requires a negative pressure of more than 140 kilograms per square centimeter to pull the column of water apart. In the leaf, water evaporates, molecule by molecule, from the cells into the intercellular spaces within the leaves. The water potential of the leaf cell falls, and the water from the vessels or tracheids moves, molecule by molecule, into the leaf cell. But each molecule in the xylem vessel is linked of the molecules in the vessel. They, in turn, are linked to others, forming one ling, narrow, continuous thread of water reaching right down to a root tip. As the molecule of water moves through the stem and the leaf, it tugs the next molecule along behind it.

Because the diameter of the vessels is very small and because the water molecules adhere to the walls, even as they are cohering to one another, gas bubbles, which could rupture the column, do not usually, form. The pulling action, molecule by molecule, causes the negative pressure observed in the xylem. The technical term for a negative pressure is tension, and this theory of water movement is known as the *cohesion-tension theory*.

Curtis and Barnes, *Biology*, pp. 614-616

Diagram

Source:
Adapted from: McWhorter, K.T. 1990. *Academic Reading*. Glenview: Scott, Foresman & Co.

Read section by section

Chapters in science texts are usually long. Due to the complex nature of the material, try not to read an entire chapter in one sitting. Instead, divide the chapter into sections and read one at a time. It is sometimes possible to mark problems or questions at the end of the chapter that correspond to particular sections. Then, after you have read a section, do the questions or problems in that chapter.

Task 5: At home, take one of your textbooks, and try to study a chapter by following the above advice.

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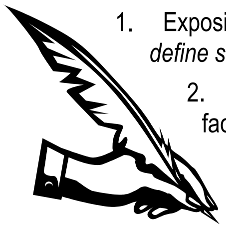
Addendum Q

WORKSHOP 17: WRITING ABOUT FACTS IN THE SCIENCES (EXPOSITORY WRITING)



1. Expository essays require that the writer *give information*, *explain the topic* or *define something*.
2. To accomplish that, expository essays are best developed by the use of facts and statistical information, cause and effect relationships, or examples.
3. Since they are factual, they are written without emotion and usually written in the third person. That means that the use of the pronoun "I" is not usually found within the essay.
4. Expository essays also have a distinct format.
   - The thesis statement (see the next section) must be defined and narrow enough to be supported within the essay.
   - Each supporting paragraph must have a distinct controlling topic and all other sentences must factually relate directly to it. The transition words or phrases are important as they help the reader follow along and reinforce the logic.
   - Finally, the concluding paragraph should originally restate the thesis and the main supporting ideas. Finish with a statement that reinforces your position in a meaningful and memorable way.
   - Never introduce new material in the conclusion.
5. When you are asked (now as a student or perhaps later as a managerial or professional worker) to produce a piece of expository writing or to give a presentation aimed at explaining some subject matter to an audience, basically you are being asked to function as a teacher. A doctor teaches his or her patients about their medical conditions. A lawyer teaches his or her clients about the law. A sales representative teaches his or her customers about a product. Approach expository essays assignments as if you were preparing in each case to teach others about the particular topic you have selected as your subject matter. The main question that should guide you in writing a expository essay should be, "*How would I teach this idea or doctrine to someone else* (a friend, a fellow student, a family member, a co-worker)?"

THESIS STATEMENTS IN EXPOSITORY WRITING

In an expository paper, you are explaining something to your audience. An expository thesis statement will tell your audience:

- what you are going to explain to them;
- the categories you are using to organize your explanation; and
- the order in which you will be presenting your categories.

Example:
The lifestyles of barn owls include hunting for insects and animals, building nests, and raising their young.

A reader who encountered the thesis above would expect the text to explain how barn owls hunt for insects, build nests, and raise their young.

Questions to ask yourself when writing an expository thesis statement:

- What am I trying to explain?
- How can I categorize my explanation into different parts?
- In what order should I present the different parts of my explanation?

Task 1: Individually, write down the thesis statement of any expository paragraph / essay / assignment that you might be asked to do in one of your subjects. Once finished, swap your thesis statement with 2/3 other people, and comment on each other's statements.

Task 2: In groups of 3 to 5, read the articles on Nuclear Energy. Each person in the group should read at least one article, and then give a summary of the most important points to the rest of the group.

Task 3: In pairs, plan your essay in an outline or mind map form. Use the essay format provided on page 3 as guideline.

Task 4: Individually, write a thesis statement for your essay on Nuclear Energy.

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Task 5: Now write an expository essay on the details on **nuclear energy**. Use the provided essay format.

THE FIVE PARAGRAPHS OF A BASIC EXPOSITORY ESSAY

Paragraph 1

- This is your introduction. Begin with a good "grabber."
- Restate the topic and define it.
- State three explanations or examples.
- Conclude with a transition sentence that leads into the next paragraph.

Paragraph 2, Paragraph 3, and Paragraph 4

- These paragraphs are the body of your essay.
- Use a transition at the beginning of each paragraph. Try to be different.
- In each paragraph you develop one of your arguments, points, or explanations as fully as you can, restating the explanation and then expanding on it with examples or evidence that supports it.
- Each of these paragraphs needs an introductory sentence and a concluding sentence.
- These are the paragraphs where it is important to use advanced vocabulary to show a good knowledge of words.
- A little well placed humour and creativity definitely add to the quality of the paper.

Paragraph 5

- This is your conclusion.
- Restate your topic in words that are different from those in paragraph 1.
- Summarize paragraphs 2, 3 and 4.
- Draw a one sentence conclusion.
- End with a thought that makes the reader think or smile.

Expository Tips

- Keep to the topic. Do not stray or go off on a tangent.
- Use advanced academic vocabulary. You want to show that you have a good command of words that is above and beyond what the average student your age knows.
- Organize yourself well. Never make a statement that you do not back up or support. Develop that support well.
- Use transitions such as first, second, third, next, before or after, and finally.

Task 5: Once completed use the Performance Task Assessment List to check your essay.

Performance Task Assessment List: Expository Writing

Element	Mark ?/10	Mark ?/10
	Your mark	Friend's mark
Prewriting		
1. Graphic organisers and outlines show work which has been / has to be explored, researched, collected, selected information, and focused ideas.		
The Writing		
2. The writing demonstrates an ability to interpret ideas meaningfully in context.		
3. The "big idea" of the paper is interesting and clear.		
4. All the main ideas are clearly related to the "big idea."		
5. The main ideas are organized into a logical sequence.		
6. The transitions from one main idea to the next are smooth.		
7. There are enough appropriate and accurate details to support each main idea.		
8. The choice of words is appropriate, varied, and creates a natural voice.		
9. The mechanics and grammar are integral to the meaning and effect of the writing.		
10. The paper is neat and presentable.		
Total:		

Task 6: Now switch essays with another group, once again using the Performance Task Assessment List to edit their work.

Sources:

- http://www.geocities.com/SoHo/Atrium/1437/expo.html?20064
- http://www.msu.org/writing_guides/writ2.html
- http://owl.english.purdue.edu/handouts/general/gl_thesis.html
- *"Blowing Away the State Writing Assessment Test" by Jane Bell Kiester available through Maupin House Publishing.* http://www.sbac.edu/~idylwild/writingtips.html
- http://www.bcpl.net/~sullivan/modules/tips/rubrics_sec/expository.html

Addendum R

WORKSHOP 18: ARGUING IN THE SCIENCES (ARGUMENTATIVE WRITING)

Before you start:

- When arguing and discussing, you should present two or more points of view and discuss the positive and negative aspects of each case.
- On the basis of your discussion, you can then choose one point of view and persuade your readers that you are correct, based on sufficient evidence.
- You need to evaluate arguments, weigh evidence and develop a set of standards on which to base your conclusion.
- All your opinions must be supported - you should produce your evidence and explain why this evidence supports your point of view.
- Remember that in scientific writing, you should try to be as objective as possible. That means that you should try to avoid pronouns such as "I" and "you". Rather use the *passive voice* (thus, instead of saying "people do not understand the advantages of using nuclear power", rather say "the advantages of using nuclear power are often not understood"). If the passive voice is not appropriate, then try to use the pronoun "*one*".

The thesis statement:

Thesis statement rules: A thesis statement…

- takes on a subject upon which people could agree or disagree;
- takes on a subject that can be discussed comprehensively in the assignment (i.e., it should not be so broad that it cannot be discussed completely in the assignment);
- expresses one main idea;
- makes a stand about a topic;
- is a complete sentence, not a 'heading-like' topic; and
- is specific, not vague and general.

Your thesis statement will usually:

- appear at the end of the first paragraph of your assignment.
- be revised as you write your assignment, so as to fit the assignment perfectly.

TASK 1: In pairs, look at the following thesis statements. Decide whether each one is weak or strong, and substantiate your answer. Try to revise the weak thesis statements into strong ones.

1. There are some negative and positive aspects to the Banana Herb Tea Supplement.

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2. World hunger has many causes and effects.

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3. Because the Internet is filled with tremendous marketing potential, companies should exploit this potential by using web pages that offer both advertising and customer support.

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4. People use many lawn chemicals.

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Hint: Good thesis statements often include conjunctions such as "because", "since", "although", "however", "therefore" and "unless".

A sample argumentative essay format: The balanced view

Present both sides of an argument, without necessarily committing yourself to any opinions, which should always be based on evidence, until the final paragraph.

Introduce the argument to the reader. e.g. why it is a particularly relevant topic nowadays / what comments have been made on this topic recently?
⇩
Reasons in favour of your argument. State your point of view, your evidence and your reasons.
⇩
Reasons against your argument. State your point of view, your evidence and your reasons.
⇩
After objectively summarising the two sides, make clear which argument you think is stronger, and explain why you think as you do. For an assignment in the sciences, do not use subjective arguments such as religion.

Language that can be used for argumentative essays:

Presenting another point of view

Some people X In a study of Y, X	maintain(s); say(s); argue(s); assert(s); believe(s); claim(s); point(s) out; is/are of the opinion; seem(s) to believe	that	…
It is the view of X; The opinion of X is; It can be argued; It has been suggested; It might be said		that	…
According to X			…

Commenting on another point of view

Negatively

They; He/she; X; This		is/are / may be / seem(s) to be / would seem to be	somewhat rather -	mistaken. / wrong. / rigid. / inadequate.
X's	approach / position / methods / beliefs	is/are / may be / seem(s) to be / would seem to be	somewhat rather -	mistaken. / wrong. / rigid. / inadequate.

This These views	is/are	open to doubt. / not always the case. / not necessarily true. / unlikely to be true. / highly debatable. / incorrect. / highly speculative.
This These views	cannot be upheld.	

Serious	doubts / reservations	can / may	be raised against this.
However, it is clear that	…		

One of the main arguments	against	X is that	…

One disadvantage of / Another point against / A further argument against / One other disadvantage of	X	is	…
One objection to this argument		is	…

Plus negative words: wrong, mistaken, false, erroneous, misplaced, inaccurate, incorrect, debateable, untrue, not the case.

Positively

X is certainly correct X may be correct	when he	says	that …
	in saying		that …

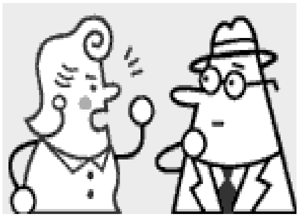
One advantage of / Another point in favour of / A further argument supporting One other advantage of / One of the main arguments in favour of	X	is	…

Plus positive words: correct, right, accurate.

Presenting your own point of view

It is	important / true / necessary / essential	to	remember / bear in mind / point out	that	…

The first thing to be considered is	...	
It is a fact / There is no doubt	that	…



Other transitions

The first reason why … is … / First of all, …
The second reason why … is … / Secondly, …
The most important …
In addition, … / Furthermore, … / What is more, … Another reason is … / A further point is …

Keywords: Discuss (with own opinion), compare, contrast, prove, justify, evaluate, respond, argue.

TASK 2:
In small groups, read the articles on Genetically Modified Foods (GM Foods) handed out by your tutor. Each group member should read at least one article, summarise it, and share the content of that article with the rest of the group.

Summary of your article:

TASK 3:
Write a preliminary thesis statement for your argumentative essay on GM Foods. This is an individual task.

TASK 4:
Write an argumentative essay, using the balanced view format, to discuss the topic of GM Foods. Try to use as many of the above phrases as possible in your essay. This is an individual task.

Sources:

- Gillet, A. 2006. *Organising the answer*. Using English for Academic Purposes. Available from: http://www.uefap.com/writing/ (accessed 28 September 2006).
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Addendum S

WORKSHOP 19: SYNTHESISING INFORMATION

SYNTHESISING INFORMATION MEANS COMBINING DIFFERENT IDEAS TO MAKE A WHOLE WHICH IS DIFFERENT OR NEW

- You synthesise information every day without knowing it. You might report on a conversation that some of your fellow students had in a discussion class to another friend, for example.
- Also, when you do assignments, you have to read through various chapters, and often various textbooks, and only select the most relevant information for a specific assignment.

How to synthesise information:

1. Synthesizing information can be difficult because it calls for you to combine two or more summaries in a meaningful way.
2. Begin by reading the texts carefully. Make sure that you are able to identify the writer's main point as well as the key ideas the writer uses to support the main point in your own words.
3. When finding relevant ideas, highlight / underline or write them down.
4. Now you must decide what details to include based on your purpose and audience.
5. Once you have marked the relevant information, organise the information you have. You could group similar ideas from both texts using the same number, letter or colour.
6. Transfer all the relevant information onto a piece of paper. Write down all similar information together.
7. Now paraphrase and summarise as necessary. Go back to the original texts to make sure that you do not misrepresent the author.
8. Combine your notes into one continuous text.
9. Remember to acknowledge your sources.
10. Remember that when you are writing a synthesis, you use sources to make a point of your own. In your synthesis, you state the broad relationship that you see between the sources. You cannot just put two sources together; you must have some connection in mind when synthesizing the sources.

To sum up: In synthesizing information, you must bring together all your opinions and research in support of your thesis. You integrate the relevant facts, statistics and expert opinions directly with your own opinion and conclusions to persuade your audience that your thesis is correct.

An example synthesis of two texts:

Thesis	Anti-thesis
This study has therefore revealed that children who play computer games on a regular basis experience a number of medical problems. The evidence suggests that the most serious problem is crooked posture, which is caused by their being hunched over their computers for considerable periods of time. Another common problem associated with playing computer games over long periods (when the same moves are constantly repeated) is that of pain in the hands. (extracted from p. 141) Source: Brown, M.J. 2000. The impact of computer games on children's physical health. *Journal of Physical Health*, *23*(1):129-142.	It is claimed that computer games have negative physical effects on eyesight, hands and posture. However, all of these are caused by the computer hardware and equipment, not by the software. The same physical effects occur from prolonged usage of computers for any reason, such as word-processing. In fact, carpal tunnel syndrome was identified as a workplace ailment caused by office programs, not games. These physical effects can all be reduced or eliminated by better hardware and more attention to ergonomics, such as higher-resolution and higher-contrast screens, and supportive furniture. Source: Smith, A.J. 2003. *Synthesis*. The Hong Kong Polytechnic University, The English Language Centre Web site. From: http://elc.polyu.edu.hk/CILL/ eap/synthesis.htm (accessed 26 July 2006).

Synthesis

Example 1.
Although Brown (2000:141) states that computer games can cause physical problems such as bad posture and pain in the hands, Smith (2003) argues that these problems are caused by the hardware, not the games. In my opinion the games cause physical health problems because they encourage long periods of computer use on harmful hardware.

Example 2.
Brown (2000:141) suggests that computer games can cause physical problems such as bad posture and pain in the hands. However, Smith (2003) points out that these problems are caused by the hardware, not the games. I believe that the physical health problems are caused by games as they encourage long periods of computer use on harmful hardware.

Example 3.
According to Brown (2000:141), computer games can cause physical problems such as bad posture and pain in the hands. Smith (2003) disagrees, and argues that these problems are caused by the hardware, not the games. I contend that the physical health problems are due to the long periods of computer use on harmful hardware which occur when children are playing computer games.

TASK 1: IN PAIRS, WORK THROUGH THE FOLLOWING EXERCISES. READ TEXT A AND TEXT B AND THEN WRITE YOUR OWN SYNTHESIS.

Task 1.1.

TEXT A	TEXT B
One problem that Internet users have to deal with is the huge quantity and variety of sources of possible interest to them. This creates problems of how to select relevant information. The problems are aggravated by a lack of effective search tools. Many search facilities are limited in their capabilities and are consequently not able to deal with the volume of available resources. Some search engines often return a huge number of results to users' queries, and the details provided in the search output often lack enough detail to enable users to assess the relevance of the sites which are listed. However, other search engines source a limited number and kind of sites. This makes the list of sites they provide both restrictive and possibly biased. It is hard for the untrained eye to detect these restrictions. Source: Cuisinier, B. 2000. *A guide to studying on the Internet*. London: Lockstone Publishing.	Although, for a novice user, the results returned by Internet search engines may appear confusing and any bias may not be obvious, these problems are becoming less serious. Firstly, although some search engines have problems, there is a wide range of engines available. Users can choose a search engine which suits them and gives informative and relevant results. Secondly, modern search engines often identify sponsored links. If users find that their search engine refers them to sites that give irrelevant commercial links, they can use a different search engine. Finally, as the Internet becomes more mature, users become more experienced. Therefore they can increasingly use search terms or advanced search functions which give better results. Source: Smith, A.J. 2003. *Synthesis*. The Hong Kong Polytechnic University, The English Language Centre Web site. From: http://elc.polyu.edu.hk/CILL/ eap/synthesis.htm (accessed 26 July 2006).

Synthesised paragraph:

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____
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Task 1.2

TEXT A	TEXT B
It is a fact that many individuals use the Net to share their opinions with a potentially huge audience via their own Web pages. Some of these individuals are fully qualified to write with authority on their particular field of expertise. Others, unfortunately, are not qualified and their views are really little more than personal opinions and beliefs rather than fully supported, credible arguments. Clearly, a set of criteria is needed to help students distinguish between reliable information and that which must be viewed more critically. One criterion is that of authorship, a second the status of the website, while a third is the credibility of a document itself. There are various checks that a student can perform to determine these, and it is crucial that they do so. Source: Chan, W.K. 2001. Using information found on the Web. *IT Journal* 6(2).	Although Chan's (2001) criteria are theoretically appealing, they are so time consuming that they are impractical. To check whether an author is an expert involves searching the Internet for references to that author's work, and analysing whether those references are just from people with similar opinions, or from other experts. While it is relatively easy to determine whether a website is a high-status educational or government domain, it is much more difficult to discover the reliability of a commercial site. The credibility of the document may also be difficult to determine, as it may have all the components of a reputable page, such as links to supporting evidence, but the content may still not be credible. Finally there are many genuine academic debates with many valuable points of view. There is no clear distinction between beliefs and different interpretations of evidence in many areas. Therefore Chan's criteria may be too simple. Source: Smith, A.J. 2003. *Synthesis*. The Hong Kong Polytechnic University, The English Language Centre Web site. From: http://elc.polyu.edu.hk/CILL/ eap/synthesis.htm (accessed 26 July 2006).

Synthesised paragraph:

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TASK 2: ONCE YOU HAVE WRITTEN YOUR OWN SYNTHESES, USE THESE PEER-REVIEW QUESTIONS TO CHECK THE ANSWER OF ANOTHER GROUP.

1. What do you like best about your peer's synthesis? Why?

   ____

   ____

2. Is it clear what is being synthesized – i.e. are the topic and argument of the synthesis clear?

   ____

3. Were the sources listed and cited correctly?

   ____

4. Are the ideas from the original texts reflected in the synthesis?

   ____

5. If you read the same sources,
   a. did you identify the same points as your peer? If not, how do they differ?

      ____

      ____

   b. did your peer miss any key points from his/her thesis? If so, what are they?

      ____

      ____

   c. did your peer include any of his/her own opinions in the thesis? If so, what are they?

      ____

      ____

6. Were there any points in the thesis where you were lost because a transition was missing or materials seem to have been omitted?

   ____

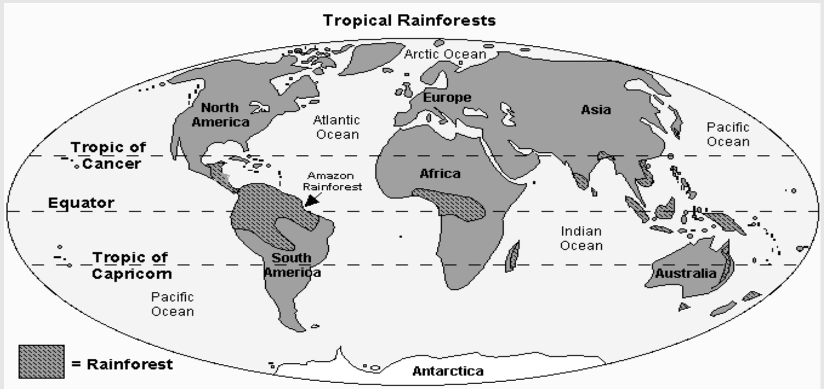
7. What other advice do you have for your peer?

   ____

TASK 3: INDIVIDUALLY, WRITE A PARAGRAPH (APPROXIMATELY 200 - 300 WORDS, FOR 30 MARKS) ON THE REASONS FOR PROTECTING THE EARTH'S TROPICAL RAINFORESTS. USE THE FOLLOWING INFORMATION FROM DIFFERENT SOURCES:

1 A rainforest is a thick forest of tall trees which is found in tropical areas where there is a lot of rain (Govender, 1999:10).

2



(Doe, 1985:5)

3

- An area of tropical forest the size of Britain is deforested every year. This is one million acres a week or 100 acres a minute.
- In 1950, 30% of the earth was covered by tropical forest. By 1975, only 12% was left and in 2002, they now cover only about 6% of the earth's land.
- Today more than 40% of the world's original forests have gone. Latin America has lost 37% of its original tropical forests, Asia 42% and Africa 52%.
- The world is now losing its tropical forest at the rate of 7% a year and the end of the tropical rainforests is in sight. (Andrews, 2005:115)

4 Forests are one of the most valuable ecosystems in the world, containing over 60% of the world's biodiversity. This biodiversity has multiple social and economic values, … varying from the important ecological functions of forests in terms of soil and watershed

	protection to the economic value of the numerous products which can be extracted from the forest. For many indigenous and other forest-dependent people, forests are their livelihood. They provide them with edible and medicinal plants, bush meat, fruits, honey, shelter, firewood and many other goods, as well as with cultural and spiritual values. On a global scale, all forests play a crucial role in climate regulation and constitute one of the major carbon sinks on earth, their survival thus preventing an increase in the greenhouse effect. (January, 2000:200).

5	The United States Cancer Institute has identified more than 2,000 tropical rainforest plants with the potential to fight cancer. And yet, as the forests come down, such plants - and the hopes they embody - are destroyed. Already about 40% of all drugs prescribed in the United States owe all, or much, of their potency to chemicals from wildlife - largely from the rainforest. Quinine, which acts against malaria, comes from the bark of a South American tree. The armadillo is helping us find a cure for leprosy. Sufferers from … high blood pressure gain relief from the snakeroot plant from Indian forests. And the yam has given us the contraceptive pill. (Smith, 2004:5).

6	Until now … there has been enough remote and underdeveloped land for small groups of people to follow their traditional ways of life without interference; and since such people rarely make any drastic change in their environment, their life is often life in the rain forests. The forest provides their food (wild vegetables, fruits and hunted animals) and their material culture (houses or shelters, boats, hunting equipment, twine, rope, poisons and medicines). There are reckoned to be over 4,000 plant species used by forest dwellers as food and medicine alone, many of which are local or endemic, known only to small groups whose knowledge of the forest is passed on orally, from generation to generation. Adapted to life in the forest, self-sufficient in it, using its products but never destroying their source, hunting forest animals but only according to need, such people both protect the forest and are protected by it. (Gazu, 1998:20).

7	Rainforests influence the carbon cycle (green plants take up carbon dioxide, which they convert to sugars by means of photosynthesis, a process during which oxygen is released into the air) and also have a profound effect on rainfall. The uneven surface of treetops causes air turbulence that increases the amount of water evaporating from the forest. This forms clouds that fall as rain. If forests disappear, less rain will fall, it will drain more quickly, and soil temperature will rise. (Anon, 1990).

8	Most striking … is the obvious lack of trees. With the population growth in the region, the amount of land under cultivation increases. The forests are then cut down to make way for more agricultural terraces. This lack of trees has led to many problems. The soil is now exposed during the dry season and this land is very vulnerable to water erosion during monsoon rains. Lack of tree cover has led to a more exposed soil, highly susceptible to wind erosion. The consequent depletion of the topsoil reduces soil fertility, causing great concern to the food producing farmers. Kanda is located on very steep slopes. The soil substrate is soap stone, a particularly porous stone mined commercially. The area is thus made more vulnerable to landslides. Tree roots help retain soil stability when waterlogged by heavy downpours. In hilly areas, tree roots help in the maintenance of a healthy watershed system. Nowadays, with forests gone, many springs stop running in the dry season. Without the drawing action of deep tree roots, the underground water table has dropped beyond reach. Floods down stream from valleys such as Kanda are said to result from the lack of tree cover in the Himalayan Hills. With Monsoon patterns changing, and torrential unseasonal downpours increasingly common, this problem worsens to often catastrophic consequences. (Quinn, [s.a]).

9	Most of Bangladesh lies less than 10 metres above sea level. Over 90 million people live within this area. Floods in 1987 covered 40% of Bangladesh and in 1988 they covered 62%. In Bangladesh the 'normal floods' resulting from the 'usual' monsoon rainfall are considered a resource by farmers. Monsoon flooding is necessary for the maintenance of agriculture with floodwaters covering 30% of the land in a normal year. Yet in certain years they can experience disastrous flood events. Abnormal flooding occurs once every few years and is regarded as an undesirable and damaging phenomenon. All floods are not caused by the same factors. One possible cause is that forest clearance in the Himalayas is responsible. They say it removes large areas of trees, which takes an important water store away, so more water goes as surface runoff. When trees are present they act as a natural buffer against erosion and floods. Surface flow is slowed; rainwater infiltrates the soil by way of root channels; the leaf canopy protects the surface of the soil from the impact of large raindrops; and the root systems bind the soil particles. Forest clearance may be the cause of widespread soil erosion in areas like Nepal. Downstream from the Himalayas, uncontrolled runoff caused by deforestation in the catchment areas of the major rivers, and the increased silting of river channels as a result of soil erosion may have contributed to disastrous flooding in Bangladesh. (Smith, 1980).

Sources:

- Centre for Independent Language Learning. 2003. *Synthesis*. From: http://elc.polyu.edu.hk/CiLL/eap/synthesis.htm (accessed 4 October 2006).
- Gillett, A. 2006. Reporting: synthesis. Using English for Academic Purposes (UEfAP). From: http://www.uefap.com/writing/report/rep_syn.htm (accessed 4 October 2006).
- Jamieson, S. 1999. Synthesis writing. Drew University. From: http://www.users.drew.edu/sjamieso/Synthesis.pdf (accessed 4 October 2006).
- University of Maryland University College. 2005. *Thinking strategies and writing patterns: Synthesis*. From: http://www.umuc.edu/prog/ugp/ewp_writingcenter/writinggde/chapter3/chapter3-05.shtml (accessed 4 October 2006).

Addendum T

WORKSHOP 20: WRITING A LABORATORY REPORT

What is a lab report?

- A lab report gives details about the procedures, data and outcome of an experiment. Future researchers can use this information to build on.
- The goal of lab reports is to document your findings and communicate their significance.

Format

The typical lab report includes the following headings. Depending on the course you do, these headings might change a bit in reports you will be expected to write, but this format should give you a good idea of how to structure your lab report.

Title:

- Reflect the factual content (in less than ten words) in a straightforward manner.
- Use keywords that researchers and search engines on the Internet will recognize.

Abstract:

- Summarise in a concise paragraph the purpose of the report, data presented, and major conclusions. For shorter reports, approximately 50 words are long enough. For longer reports, your abstract can be up to 200 words.

Sample Abstract

This experiment examined the effect of line orientation and arrowhead angle on a subject's ability to perceive line length, thereby testing the Müller-Lyer illusion. The Müller-Lyer illusion is the classic visual illustration of the effect of the surrounding on the perceived length of a line. The test was to determine the point of subjective equality by having subjects adjust line segments to equal the length of a standard line. Twenty-three subjects were tested in a repeated measures design with four different arrowhead angles and four line orientations. Each condition was tested in six randomized trials. The lines to be adjusted were tipped with outward pointing arrows of varying degrees of pointedness, whereas the standard lines had inward pointing arrows of the same degree. Results showed that line lengths were overestimated in all cases. The size of error increased with decreasing arrowhead angles. For line orientation, overestimation was greatest when the lines were horizontal. This last is contrary to expectations. Further, the two factors functioned independently in their effects on subjects' point of subjective equality. These results have important implications for human factors design applications such as graphical display interfaces.

TASK 1: Working with a partner, carefully read through the above sample abstract, and answer the following questions about the experiment that was conducted.

1.1 What was the purpose of this experiment?

1.2 What were the key results?

1.3 What is the most significant point of discussion?

1.4 What is the major conclusion?

1.5 Is a brief method included? If yes, underline this method in the abstract.

1.6 Is a brief theory included?

Quick Abstract Reference

Must have:
1. Purpose
2. Key result(s)
3. Most significant point of discussion
4. Major conclusion

May include:
1. Brief method
2. Brief theory

Introduction:

- Defines the subject of the report: "Why was this study performed?"
- Provides background information and relevant studies: "What knowledge already exists about this subject?"
- Outlines scientific purpose(s) and/or objective(s): "What are the specific hypotheses and the experimental design for investigation?"

Quick Intro Reference

Must Have:
1. Purpose of the experiment
2. Important background and/or theory

May include:
1. Justification of experiment's importance

Example: The purpose of this experiment was to identify the specific element in a metal powder sample by determining its crystal structure and atomic radius. These were determined using the Debye-Sherrer (powder camera) method of X-ray diffraction.

TASK 2: Carefully read through the above example of an introduction with a partner, and answer the following questions about the experiment that was conducted.

2.1 What was the purpose of this experiment?

____

2.2 Is there any important background and/or theory in this introduction?

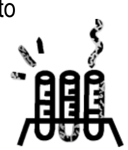
____

2.3 Is there a justification of the experiment's importance?

____

Materials and methods:

- List materials used, how they were used, and where and when the work was done (especially important in field studies).
- Describe special pieces of equipment and the general theory of the analyses or test used.
- Can usually be a simple list, but make sure it is accurate and complete.
- Provide enough detail for the reader to understand the experiment without overwhelming him/her.
- Describe the process in chronological order. Using clear paragraph structure, explain all steps in the order they actually happened, not as they were supposed to happen.



Results:

- Concentrate on general trends and differences and not on trivial details.
- Summarise the data from the experiments **without discussing their implications.**
- Organise data into tables, figures, graphs, photographs, etc. Data in a table should not be duplicated in a graph or figure.
- Title all figures and tables; include a legend explaining symbols, abbreviations, or special methods.
- Number figures and tables separately and refer to them in the text by their number, i.e.
  1. Figure 1 shows that the activity....
  2. The activity decreases after five minutes (fig. 1).

Quick Results Reference

1. Number and title tables and graphs
2. Use a sentence or two to draw attention to key points in tables or graphs
3. Provide sample calculation only
4. State key result in sentence form

Discussion:

- Interpret the data; do not restate the results.
- Relate results to existing theory and knowledge.
- Explain the logic that allows you to accept or reject your original hypotheses.
- You can speculate if you feel it necessary, but clearly state that that is what it is – a speculation.
- Include suggestions for improving your techniques or design, or clarify areas of doubt for further research.
- This is the most important part of your report, because here you show that you understand the experiment beyond the simple level of completing it.

Here are some more specific guidelines:

- ***Analyse*** your findings: What do these results indicate clearly? What have you found? Explain what you know with certainty based on your results and draw conclusions.
- ***Interpret*** your findings: What is the significance of the results? What ambiguities exist? What questions might we raise? Find logical explanations for problems in the data.
- ***Compare*** expected results with those obtained.
  If there were differences, how can you account for them? Saying "human error" implies you're incompetent. Be specific; for example, the instruments could not measure precisely, the sample was not pure or was contaminated, or calculated values did not take account of friction.
- ***Explain*** your results in terms of theoretical issues. Often undergraduate labs are intended to illustrate important physical laws, such as Kirchhoff's voltage law, or the Müller-Lyer illusion. Usually you will have discussed these in the introduction. In this section move from the results to the theory. How well has the theory been illustrated?
- ***Identify*** the strengths and limitations of your experimental design.
  This is particularly useful if you designed the thing you're testing (e.g. a circuit).

TASK 3: Working in pairs, look at the following extract of a discussion, and identify which of the above guidelines were followed in the discussion. Identify the guideline and the example from the text.

Since none of the samples reacted to the Silver foil test, therefore sulphide, if present at all, does not exceed a concentration of approximately 0.025 g/l. It is therefore unlikely that the water main pipe break was the result of sulphide-induced corrosion.
Although the water samples were received on 14 August 2000, testing could not be started until 10 September 2000. It is normally desirably to test as quickly as possible after sampling in order to avoid potential sample contamination. The effect of the delay is unknown.

Conclusion:

- The conclusion can be very short in most undergraduate lab reports. Simply state what you know now for sure, as a result of the lab.

Example:
The Debye-Sherrer method identified the sample material as nickel due to the measured crystal structure (fcc) and atomic radius (approximately 0.124nm).

- Notice that, after the material is identified in the example above, the writer provides a justification. We know it is nickel because of its structure and size. This makes a sound and sufficient conclusion. Generally, this is enough; however, the conclusion might also be a place to discuss weaknesses of experimental design, what future work needs to be done to extend your conclusions, or what the implications of your conclusion are.

Quick Conclusion Reference

Must do:
1. State what's known
2. Justify statement

Might do:
3. State significance
4. Suggest further research

References and literature cited:

- Cite only references in your paper and not a general bibliography on the topic.
- Alphabetise by last name of the author.
- Follow the recommended format for citations.

General style:

- Strive for logic and precision and avoid ambiguity, especially with pronouns and sequences.
- Keep your writing impersonal; avoid the use of the first person (i.e. I or we).
- Tenses:
- The experiment is already finished. Use the ***past tense*** when talking about the experiment, e.g. "The objective of the experiment was...".
- The report, the theory and permanent equipment still exist; therefore, these get the ***present tense***, e.g. "The purpose of this report is..."; "Bragg's Law for diffraction is ..."; "The scanning electron microscope produces micrographs ... ".
- Note: "data" is plural and "datum" is singular; "species" is singular and plural.
- Italicize all scientific names (genus and species).
- Use the metric system of measurement and abbreviate measurements without periods (i.e. cm kg); spell out all numbers less than 10 (i.e. "two explanations of six factors").
- Write numbers as numerals when greater than ten (i.e. 156) or associated with measurements (i.e. 6 mm or 2 g).
- Have a neutral person review and critique your report before submission .

TASK 4: In pairs, look at example of a lab report written by an engineering student. Pay specific attention to the style of language and the information included. Rewrite the badly written parts of this lab report with a partner. Once you have finished, compare your suggestions with those of another pair of students.

LAB REPORT – ELECTRICAL FILTERS
by: Joe Schmoe
Lab partners: Sally Smith and John Doe

OBJECTIVE
The goals of this lab are to teach the students how to use a scope and a function generator and some resistors and capacitors to build electrical filters. Sinusoidal inputs and outputs measured and compared to theoretical values.

BACKGROUND
Electrical engineers sometimes use filters. Electrical filters also occur in mechanical engineering instrumentation applications. I guess mechanical engineers we need to know something about them, but I could not find anything when I spent 30 seconds looking on Yahoo.

The circuit shown in Figure 1 gives a simple low-pass filtcr. Such a circuit exhibits a theoretical frequency response given by
??

E0 is the output voltage. E is the input voltage. w is the frequency of both the input and output sine wave. From this it can be seen that the filter break frequency is equal to RC (ME 360 manual, p.28). The units of RC are time.

*

Figure I. Low-pass Filter

EXPERIMENT
The purpose of the experiment was to use both a scope and a function generator to measure electrical signals. Construct a low-pass filter on a breadboard (see Figure 1). Apply sinusoidal signals

to the input side of the filter. Measure the output signals (with smaller amplitude) on the output side of the scope. Plot the ratio of output and input amplitudes as a function of frequency.

The actual values of capacitance and resistance were then measured with some instruments and the uncertainty of these measurements recorded. The resulting uncertainty in the break frequency computed with these measured values was determined with the Taylor Series method.

RESULTS

A drawing of typical waveforms produced during the second experiment are shown in Figure 2. The input signal is bigger than the output.

???

The measurements of the resistance R was 20.456 kilo-ohms and the capacitance C was 0.00000 1234 farads. This gives a theoretical break frequency of 4567.890123 ± 0.1. The uncertainty was computed with the Taylor Series method. This is pretty close to the experimental break frequency shown in Figure 3 in the Appendix.

Hundreds of potential sources of error exist. Temperature effects are one. Human error is another. The measurement of output amplitude from the oscilloscope may have introduced more error than was reflected in the uncertainty because the total voltage transition was measured before the measuring time required for 63% of the transition to occur and the error introduced by this determination was not reflected in the uncertainty of the measured time constant.
Figure 3 (in the Appendix) shows some other results that we don't understand.

CONCLUSIONS

I learned alot during this experiment. We had like, you know, fun with it. During this experiment a circuit schematic was used to construct and test an actual RC filter circuit. The break frequency of this circuit was determined both through measurements of the response to sinusoidal inputs and through analytic calculation. We shown that these two measurements agree to within the uncertainties of the measurements.

RECOMMENDATIONS

This lab took too much time, so the lab instructor needs to do more of the work for us. The lab instructions were not clear. We did not read the lab in advance and forgot to create and bring a data sheet, so you should have given us one. The analog oscilloscope is hard to read, so we should use the digital scope for everything. My lab partners don't trust me and would not let me use the equipment, so I need new lab partners.

Sources:

- Engineering Communication Centre. The University of Toronto. 2002. *Laboratory reports*. From: http://www.ecf.toronto.edu/~writing/handbook-lab.html (accessed 10/10/2006).
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- Study Guides and Strategies. 2006. *Writing lab reports and scientific papers*. From: http://www.studygs.net/labreports.htm (accessed 4 October 2006).
- Wheeler, A.J. and A.R. Ganji, 1996. Introduction to Engineering Experimentation, Prentice-Hall, Upper Saddle River, NJ.

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Addendum U

FEEDBACK FORM: SCIENCE FOUNDATION PROGRAMME WORKSHOPS

Dear student

We would like to improve the Reading and Writing in the Sciences workshops. To do that, we need your feedback. Please take 10 minutes to fill in the following feedback form.

Question 1

What are the most important abilities that you gained during these workshops?

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Question 2

What did you enjoy most about these workshops?

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Question 3

What did you enjoy least about these workshops?

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Question 4

What workshop topics would you like included in future?

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Question 5

What workshop topics do you need more practice in?

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Question 6

In general, how could the workshops be improved even further?

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Question 7

In what way have these workshops helped you to become more successful in your studies? For example, have you applied any of the skills learned in the workshops in your other subjects?

____

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Question 8

How useful were these workshops to you? Rate them on a scale from 1 to 6. Tick the appropriate block.

1 = Very useful

2 = Useful

3 = Useful to an extent

4 = Not very useful

5 = Not useful at all

6 = I did not attend this workshop

	1	2	3	4	5	6
Improving your vocabulary						
Writing good sentences						
Reading in the sciences (1)						
Writing good paragraphs (1)						
Writing good paragraphs (2)						
Paraphrasing						
Summarising						
Revision – paragraphing and summarising						
Visual literacy (1)						
Visual literacy (2)						
Understanding and using words and concepts in context						
Distinguishing between the essential and the non-essential						
Note-taking strategies						
Understanding text form and introduction to referencing						
Referencing						
Reading in the sciences (2)						
Writing about facts in the sciences (expository writing)						
Arguing in the sciences (argumentative writing)						
Synthesising information						
Writing a laboratory report						

Thank you for your participation in this academic literacy programme ☺

Addendum V

INFORMED CONSENT

Universiteit van Pretoria
University of Pretoria

University of Pretoria

Unit for Academic Literacy

Human Sciences Building, Floor 17

Researcher: Ilse Fouche

Tel: (012) 484 1028/9

E-mail: fouchi@unisa.ac.za

Huis Meyer, Building 14, Sunnyside Campus

Title of the study:
Improving the academic literacy levels of first-year Natural Sciences students by means of an academic literacy intervention

Purpose:
The purpose of this study is to determine whether the academic literacy workshops (designed specifically for first-year Natural Sciences students) will assist you in improving your academic literacy levels.

Procedure:
During this study, you will be asked to:
- attend one three-hour reading and writing workshop per week until October (to help you to optimally improve your language skills in the sciences);
- occasionally fill in questionnaires (to help us know more about your background and current needs); and
- complete feedback forms (so that we can adapt the workshop content to suit your needs).

Benefits and risks:
- You will benefit from science-specific language instruction, which will probably help you to complete assignments and study more effectively.
- Your participation in this study will be voluntary. Any information that you share with me will be confidential, and if I refer to it in my research, it will be done anonymously. Therefore you will not be disadvantaged by attending / not attending any of the workshops.
- You will not receive any extra credits for attending these workshops.
- These workshops are, however, presented completely free of charge to you.

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University of Pretoria

Your rights:

- As mentioned above, your participation in this study is voluntary. You can withdraw from participating in the study at any time, without any negative consequences to you.
- All information that you share with the researcher will be treated as confidential – your anonymity is, therefore, guaranteed. If you withdraw from this study, all research data related to you will be destroyed.
- You may contact me at any time during office hours. My contact details are provided above.

By signing this form, you give me permission to use the following in my research:

- any written work completed during the workshops
- data from any questionnaires filled in during the workshops
- your marks for tests and assignments in your other registered courses
- samples of writing from your other registered courses.

Thank you for participating in this study. If you have any other questions, please do not hesitate to contact me.

Ilse Fouche

____

Your name

Signed in Pretoria on the ______ (day) of ____________ (month), 2007.

____

Your signature

____

Researcher's signature (Ilse Fouche)