

**EXPLORING ENGLISH SECOND LANGUAGE SPEAKERS' SCIENTIFIC  
WRITING SKILLS STRATEGIES OF FIRST YEAR LIFE SCIENCES  
STUDENTS**

by

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## ABSTRACT

In South African universities where the medium of instruction is English, writing and conceptualisation in English Second Language in Life Sciences are problematic for first year learners. This study focused on the extent to which Afrikaans – and Xhosa mother tongue speakers employ strategies in order to cope with the demands of scientific writing and how it affects their academic performance. The Basic Interpersonal Communication Skills (BICS) and the Cognitive and Academic Language Proficiency (CALP) theories of Cummins as well as the model of Collier provided a theoretical framework for this study. Tests and tutorials were analysed by means of content analysis. Writing strategies such as coherence has an impact on academic performance but there is no set pattern or degree in which different mother tongue speakers employ them. A collaborative approach that sensitises learners to the meaningful use of strategies to enhance their competency in scientific writing is recommended.

**KEYWORDS:** English second language, mother tongue, writing strategies, BICS, CALP, academic performance, scientific writing, content analysis, collaborative approach

## **DECLARATION**

I declare that EXPLORING ENGLISH SECOND LANGUAGE SPEAKERS' SCIENTIFIC WRITING SKILLS: STRATEGIES OF FIRST YEAR LIFE SCIENCES STUDENTS is my own work and that all sources that I have used or quoted have been indicated and acknowledged by means of complete references.

.....  
**SIGNATURE**  
(Ms. V. A. E. van Staden)

.....  
**DATE**

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“I can do all things through Christ that strengthens me”

(Phillipians 4:13)

## **DEDICATION**

This study is dedicated to my late parents, Jacob and Susanna Lottering whose sacrifices and belief in education were the driving force behind this and all previous achievements.

Also for Sherry, my late sister who was my bosom friend and closest ally in all walks of life.

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## LIST OF ACRONYMS

The acronyms used in this study are listed here in order for them not to be reported now and again in the text of this dissertation. The acronyms are:

**BICS** Basic Interpersonal Communication Skills

**CALP** Cognitive and Academic Language Proficiency

**DOE** Department of Education

**ESL** English Second Language

**NCS** National Curriculum Statement

**SFP** Science Foundation Program

## **CHAPTER 1**

### **BACKGROUND AND RESEARCH PROBLEM**

#### **1.1 RATIONALE**

First year students in Life Sciences in the university where the researcher works come from different language backgrounds namely Afrikaans, Xhosa and English. The majority of these students are English Second Language speakers. No language proficiency or entry test in English is written by prospective students on or prior to admission. In spite of the growing awareness that mother tongue instruction seems to be more effective than second language medium of instruction (Uys, van der Walt, van der Berg, & Botha, 2007) the medium of instruction is English at the institution. All lectures, notes, assessment tasks and practical activities are therefore in English. In most cases the feedback is of a written nature and this is where English Second Language students experience diverse problems because of the language barrier. In no specific order of preference, students perform poorly when they have to answer questions of a comprehensive nature, summarisation, essay writing and report writing. At the tertiary institution first year students are expected to engage in academic writing which differs from the kind of writing that they were exposed to in high school days.

It is when they have to write scientifically as in formulating the answers of questions in tests and tutorials or report their findings based on observations in practical activities, that they struggle the most. They seem to have a disadvantage compared to their fellow

English mother tongue students in that they know what it is they want to say but they do not know how to say it. In most instances there seems to be an absence of logical connectors and specialised vocabulary (Kessler, Quinn, & Fathman, 1992) that indicate that they need to develop their linguistic repertoire and subsequently their higher order cognitive skills tested in a particular activity.

## **1.2 THEORETICAL FRAMEWORK**

Scientific writing is a means to explore, to learn and to comprehend what students are learning about in a subject like Life Sciences. Therefore if English Second Language speakers lack the required writing skills then content is compromised, because knowledge of content is demonstrated by means of effective communication, writing in this particular case (Kokkala & Gessell, 2002). The correlation between knowledge of content and the evidence of scientific writing needs to be demonstrated to the English Second Language (ESL) student. This is critical because these students are judged on what they write with respect to the science subjects they learn. If what they write is not logical then it has the potential to be unscientific in one way or the other. For example, when tasks of a scientific nature such as reports or data collection are written in an illogical manner then the entire scientific meaning may be lost altogether. There however is confusion as to what good scientific English is with reference to non-English speakers (Albert, 2001). He refers to the preference of the use of certain words to what authors on scientific writing prescribe and that the use of detail like punctuation and prepositions should not distract from the serious matter at heart, which is the message of



the author. Hence, he argues that perhaps it is important that the culture of scientific writing must change especially those aspects that are important for English Second Language students (Albert, 2001). The underlying problems that English Second Language students experience when writing scientifically, are of a varied nature with language as the main operator. It has been argued for instance that the effect of language in science operates on a subtle level and that there is a relationship between language and scientific thought (Logan & Hazel, 1999). The level of conceptualisation demonstrated by English Second Language students in first year Life Sciences reflected this relationship as observed by the researcher.

Academic programmes normally designed in English are a challenge to second language speakers especially in instances where higher order thinking skills are required (Downs, 2006). In general, students who are English mother tongue speakers display different discourse patterns in language usage compared to their second language contemporaries. The language of science can only exacerbate second language students' problems since it may be significantly different from everyday language at discourse level (Parkinson, 2000). Krashen (1981) cited in Uzawa (1996) in his theories of second language learning and second language acquisition makes a case for the fact that conscious learning does not promote language acquisition. However Bialystok (1987) on the other hand differs from Krashen and proposes that conscious learning of a second language does serve as a vehicle in the learning or acquisition of a second language. Cummins (2000) as cited by Shoebottom (2007) meanwhile is of the opinion that "conceptual knowledge developed in one language helps to make input in the other language

comprehensible” (p.2) or as Lee (Lee & Fradd, 1998: 14) states it that “students’ academic participation is influenced by their literacy development in home languages and in English”. The implication then is that if an ESL student who has a good conceptual understanding of a biological process in his mother tongue will find it relatively easy to describe that same process in English compared to the other extreme where poor conceptual understanding in the mother tongue will lead to difficulty in conceptualising and translating into the second language such as English. This research study explored ESL students’ scientific writing skills and on that basis, the theories of Bialystok (1990) and Cummins (1996) were central to this investigation. An extension of these theories is the knowledge-transformation model of Bereiter and Scardamalia (1987). These authors are of the view that an expert writer in a second language can whilst undergoing the writing process change or transform ideas by rethinking and restating to eventually produce fully developed thoughts. Such writing tends to be different when compared to a novice writer who will regurgitate factual knowledge without proper planning or setting of goals before writing (Bereiter & Scardamalia, 1987). It might also be the case that the novice writers use discourse patterns of their mother tongue and say too little or too much giving the impression that they do not understand when in fact they lack the particular communication strategy in the second language to express themselves accurately (Lee & Fradd, 1998).

ESL students cope by means of their own learning- and writing strategies. Tarone (1993) as cited in Chimbanga (2000) refers to these communication strategies as “conscious plans that students implement when they are unable to implement their

original plan when they have to communicate in a second language” (p.308). Communication strategies have been defined as systematic attempts to express meaning in a different language in spite of the deficiency of knowledge of the appropriate rules followed in the language (Tarone, Fraunfelder, & Selinker 1976; Tarone, Cohen, & Dumas, 1976) as cited by Lin (2007). In a similar vein, the strategies have been described as conscious attempts to communicate thoughts while in fact inter-language structures are inadequate to convey that thought (Váradi 1973; Tarone 1978; Galván & Campbell, 1979) as cited by Tarone (1981). These definitions however are not clear with respect to the role of consciousness when executing a strategy and therefore were not appropriate as a theoretical basis for this study. Instead the definitions of what communication strategies entail as proffered by Bialystok (1990: 3) were adopted by the researcher and are indicated below:

a systematic technique employed by a speaker to express his ideas when faced with some difficulty (Corder, 1977); a mutual attempt of two interlocutors to agree on a meeting in situations where requisite meaning structures are not shared (Tarone, 1980); potentially conscious plans for solving what to an individual presents itself as a problem in reaching a particular communicative goal (Faerch & Kasper, 1983a) and techniques of coping with difficulties in communicating in an imperfectly known second language (Stern, 1983)”.

A common feature of these definitions is that they refer to a technique as part of a strategy in order to solve the problem of communicating in a second language. This is an aspect that was identified as useful and critical for the purpose of this study. However the researcher did not concentrate on one specific definition but rather drew from all. This combination was seen to be important in identifying (a) the extent to which

communication strategies were employed by ESL students in writing scientifically; (b) how such writing affected their performance in first year Life Sciences.

According to the model designed by Cummins (1996) the writing activities of ESL students can be classified along the cognitive continuum ranging from cognitively undemanding to cognitively demanding that intersects with the contextual continuum ranging from context-embedded to context- reduced tasks. The cognitive demands of the task at hand relate to the mental ability of the students to process information in a given writing activity. Context-embedded tasks are those in which the student can make use of visual and oral assistance such as consulting books or asking questions.

**Figure 1.1:** Relationship between cognitive demands and contextual nature of writing activities\*

Context	Embedded
A	C
Cognitively undemanding	Cognitively demanding
B	D
Context	Reduced

\* Adapted from Cummins (1996)

Particularly, in this study context-embedded tasks were elicited through a tutorial activity. Context-reduced tasks e.g. tests are those where no outside help but the

language itself is available. The relationship between the cognitive demands and the contextual nature of the writing activities of ESL students is illustrated in Figure 1. The Cummins-model was found to be relevant with respect to data collection among ESL students in first year Life Sciences in this research study. This is because for instance data were gathered through, (a) tests – which are cognitively demanding and context-reduced (quadrant D); (b) tutorials - which are context-embedded but depending on the proficiency of the ESL student can be regarded either as cognitively demanding (quadrant C) or cognitively undemanding (quadrant A). Even though text- or content analysis of writing activities provide a limited explanation of how people learn in a second language its value lies in the fact that it points towards tendencies rather than expected outcomes and as such can serve as a guide to inform the instructional programme of ESL students in first year Life Sciences (Cumming, 2001). For this reason content analysis was regarded as a suitable research method to investigate the writing strategies used by the ESL students in this particular study.

Writing in a second language takes place in different contexts such as in a university which requires of the students to enter and acculturate to a particular discourse community such as the scientific community. Culture also informs the ways in which performance is assessed in second language writing (Cumming, 2001). Lee and Fradd (1998:12) have coined the phrase “instructional congruence” as fundamental to “the process of mediating the nature of academic content with students’ language and cultural experiences to make such content (e.g. science) accessible, meaningful, and relevant for diverse students”. This challenge is often overlooked by lecturers of

multilingual and multicultural classrooms who wrongly attribute difficulty in conceptualisation which often results in poor performance to learning disabilities. Such difficulty in conceptualisations is generally as a result of a lack of understanding of the language of instruction, English in the case of this research study. One disadvantage of the Cummins model is that it overlooks the social and cultural experiences of the ESL student which according to the conceptual model of language acquisition of Collier as cited by Katz, Low, Stack and Tsang (2004) which places the socio-cultural aspect at the centre of the interrelationships of “the four components – socio-cultural, linguistic, academic and cognitive development” (p.18).

The theoretical framework presented here is meant to provide a context in which this study is based. It should be acknowledged that a number of factors other than those identified here, may be responsible for the problems experienced by ESL students. In fact, it has been reported that interactions between the variables involved in the teaching and learning of a second language are quite complex (Cumming & Riazi, 1999). In a similar manner it has been noted that other factors like motivation may also play a role in students’ performance (Song & August, 2002). On the basis of the complexities it has been suggested that research on variables that contribute to writing strategies and performance of ESL students should be carried out (Song & August, 2002). Carrying out this particular study could not have come at the right time therefore. This is because in this qualitative and descriptive study, several antecedent variables such as the personal characteristics and background of the students prior to the beginning of the educational programme were considered.

## **1.3 ESL PROBLEMS IN CONTEXT**

### **1.3.1 Types of problems**

English Second Language students have been shown to draw on their own experience, use their own notes, replace words, spell words incorrectly, have no system in place to organize facts and ideas while what they write may lack detailed coherent structure (Kaunda, Allie, Buffler, Campbell, & Lubben, 1998). In concurrence it has been argued that ESL students may end up writing poor essays, using incomplete phrases, limiting the use of connectors to the word “AND” as well as omitting certain words (Fahmy & Bilton, 1990). Such lack of proper writing and omissions may lead to inaccuracies, labelling diagrams incorrectly, avoiding the use of abbreviations and be prone to providing an overload of information (Fahmy & Bilton, 1990). Students’ world of experience is far removed from the explanations of the content by the lecturer and this may lead to difficulty in comprehension and consequently in the definition of terms. Mistranslation will ultimately result in what is termed incorrect reformulation (Fahmy & Bilton, 1990). In Life Sciences this contention is supported by reports that students reveal an inability to summarise, discuss and write good quality essays (Downs, 2006). This inability invariably results in inappropriate understanding of fundamental concepts in the subject.

### **1.3.2 ESL problem trends**

English Second Language students repeatedly make the same mistakes if the logic and the rhetoric are improved, but not the grammar. Research has reported that English

Second Language students perform poorly in theoretical exams where higher order cognitive skills such as application and analysis were tested (Downs, 2006). In fact students find it difficult to advance from the abstract to the concrete. To cope, it is argued, they rely on rote learning and memorization instead of striving to understand the content (Logan & Hazel, 1999). While English Second Language students may be highly motivated to achieve, they however, failed to comprehend scientific written text when delivered as spoken text by the lecturer (Miller, 2002).

For any given activity, English mother tongue speakers have to focus only on the cognitive aspects. English Second Language students on the other hand have an added burden in the sense that they not only focus on the cognitive aspects but also the linguistic aspects of the same activity. This added burden has the potential to result in some of the mistakes and problems that the ESL students experience in scientific learning activities. There is no strong evidence to prove that a relationship exists between entry qualification and degree success (Downs, 2006). However, researchers refer to the dropping out or failure of English Second Language students to be as a result of the anxiety that they experience in order to cope with their linguistic inabilities (Logan & Hazel, 1999).

### **1.3.3 Possible causes of problems**

The problems experienced by ESL students are possibly as a result of a variety of factors. Examples of these include the fact that ESL students taking Life Sciences as a first year subject may not be positively inclined because they are forced to do it as a



non-major (Steglich, 2000). This means that students are therefore unable to proceed and study the subject further. Another reality in South Africa is the fact that students come from environments in which resources are not equally distributed. It has been pointed out for instance that a major contributing factor “... the haves and the have-nots” and the unequal distribution of resources is critical for the successful implementation of any education program (Page, 2001: 37). Another issue is the fact that students and lecturers operate from different cultural backgrounds. Such a situation may in turn lead to problems of disjunction. That is, a change in attitude between ESL students and their lecturer based on misguided perceptions. On the other hand, lecturers may in turn be apprehensive towards ESL students because they lack training to work with such students. There are a number of other related issues that impact on how students taking Life Sciences relate and react to. To this effect, it has been indicated that students’ experience and success at tertiary level must be seen in relation to their learning-approach profiles (Rollnick, Davidowitz, Keane, Bapoo, Magadla, 2008). Also, insufficient guidance, assistance and feedback to prepare students how to approach written tasks such as exam essays are further contributing factors on the part of the content lecturer (Kaunda et al., 1998). The language used in notes and textbooks may also vary and result in communication problems. Finally, another bugbear in the South African context, are large class sizes. One major problem with large class sizes is that the lecture mode tends to be favoured more than any other teaching (McKeachie cited by Marbach-Ad & Sokolove, 2002) which allows for little integration of theory into practice. Like with other methods of instruction, the transfer of knowledge in the

multilingual classroom by means of the lecture mode is embedded in the way in which the theory of research informs, supports and organises the instruction of the content of the curriculum (Randi & Corno, 2007). To this end Anthony (2008) expresses the need for intentional input or classroom-based teaching strategies to target a certain output, i.e. expressive language such as writing in a second language that serves as the “gateway” or “portal” through which transfer of knowledge must take place (Barwell, 2005:143). In large classes at most institutions of Higher Education, the situation does not really allow for practical assessments to take place. Assessment is therefore mainly of a written nature. The writing process as part of collaborative learning in large classes such as first year Life Sciences can also serve as a valuable tool for different reasons: firstly to reflect on how the students write in a second language, secondly to become aware of the writing strategies that students employ and thirdly for feedback to address any grammatical and factual misconceptions and mistakes that were made (Anthony, 2008).

#### **1.3.4 Possible solutions to problems**

English Second Language students must develop confidence in scientific writing such as the use of syntax and grammar to write logically. The limited vocabulary of these students can be extended by providing them with a list of standard abbreviations and symbols and suggestions of how they should be used (Fahmy & Bilton, 1990). Prepared notes will guide students to organize their own notes logically and systematically. Included in this can be tips on how to use and interpret or understand diagrams, flowcharts and arrows. Researchers have advised on a reduction in the use of articles such as modal verbs and instruction-carrying words (Fahmy & Bilton, 1990). Strategies

to be employed must be based on the three R's – revise, rethink, rewrite- such as analysis of reading material and text by numbering, highlighting and underlining of facts, then a short assigned test and finally the written exam. The heterogeneous nature of the student population must also be taken into account. Working in groups to share knowledge is a non - threatening environment for English Second Language students that will ultimately bring about better understanding and comprehension (Kaufman, 2000). For English Second Language students it is important that the lecturer who acts as a model of spoken English must assume the same role for written English (Larsen-Freeman, 2000). Repetitive exercises that are not necessarily stressing on terms by lecturers will inherently afford English Second Language students to take more note of their correct use. Regarding this issue it is advanced that lecturers should also refrain from using negatives and non-technical terms such as “hence” and “apparently” (Logan & Hazel, 1999: 54). Diverse assessment strategies without lowering or compromising the standards are recommended with appropriate assessment tools. These tools could include the use of a set of questions instead of a rubric to assess the efforts of English Second Language students. Ongoing academic support in the form of mentoring should be provided to students.

The principle of reflective practice in teaching should bring about change in instruction and subsequently change in the language of teaching and assessment by the lecturer. This implies that there is a need for conceptual change by applying the principles of constructivist learning theories (Downs, 2006). Such learning theories should allow more time for linguistic and cognitive development. Learning in a constructivist

environment should hopefully change the attitudes of students. The change in attitudes may be encouraged by giving them assignments that (a) connect students' interest and prior experiences to course content and (b) will show that scientists were real people like them by for example allowing them to read and write about biographies of biologists of their choice (Steglich, 2000). Activities such as these have the added potential of ensuring that the human face of science does not get lost. Further and importantly, such activities may inherently enhance students' understanding of science and their writing skills. It is of course easy to expect lecturers and teachers to carry out most of the activities identified here. However, in most instances this is not that obvious so there is always a need to train new crops of educators to prepare them for such activities. In this regard it has been argued that efforts such as contribution to the curriculum can add value to the development of trainee teachers (Kaufman, 2000). Findings of a research study investigating the success rate at South African universities indicated that for students from diverse backgrounds there is a need for "a more flexible curriculum that allows for the production of an educational experience that will allow students to build on what they've got" (Smetherham, 2009: 9). The implication is that English Second Language students must be assigned with tasks that give recognition to the wealth of socio-ethnic and linguistic resources that these students bring to the Life Sciences classroom where they have to explore phenomena and construct meaning (Lee, 2005). It is important that instructional programs meant for such students should however not be of poor quality so as not to create an impression of their need for mediocrity. This is important because poor quality programs will as such reinforce a

stereotypical notion that ESL speakers are inferior to English First Language speakers (Jacobs & Simpson, 1999). Instead the programs should be empowering enough to expand rather than limit the teaching and learning experiences of the Life Science students. Furthermore it has been recommended that a balanced approach should be between teacher-directed and student-initiated activities that provide equitable academic opportunities for both English Second Language - and English mother tongue speakers (Lee, 2005). Team teaching between the English Language lecturer and content lecturer in Life Sciences is also seen as a critical component. This is because it minimizes comprehension failure – based on needs analysis to identify and address problem areas (Miller, 2002).

#### **1.4 STATEMENT OF THE PROBLEM**

English Second Language students have the same amount of time as English mother tongue speakers to master the content of the course. Unfortunately however, the former's linguistic incompetence affects their higher order levels of learning like application, comparison, analysis and synthesis needed in writing tasks of a scientific nature. To identify the characteristics of this incompetence, research that focuses on this is critical. The main objective of such research should be to provide answers in respect of how certain writing strategies used in scientific writing of English Second Language students affect their performance in first year Life Sciences.

In order to achieve the objective stated here three questions were investigated:

1. What is the extent to which certain writing strategies are used by English Second Language students in first year Life Sciences when they write scientifically?
2. Are there any differences in the extent to which the identified writing strategies are used between Afrikaans - and Xhosa speaking students when they write scientifically?
3. In what way do the identified writing strategies affect the performance of the English Second Language students in first year Life Sciences?

### **1.5 SPECIFIC GOALS OF THE STUDY**

The researcher as a lecturer of the ESL students observed that a number of them were not performing as well as was expected. This is an issue that the researcher felt was critical especially for students taking science courses in South Africa. The issue is critical because science lecture rooms in most universities in this country are probably populated by multilingual students. It could be then that their knowledge of the subjects they take is affected by their writing skills hence poor performance. This observation left the researcher wondering how the problem could be addressed and what solutions could be useful to remedy the situation. The researcher decided to draw on the theories and models advanced in literature that have made important contributions to scientific writing relating to English Second Language students in institutions of higher education. In drawing on literature the researcher felt that the knowledge base provided by authors will enable and empower her to find valuable solutions that were research based. Through a structured investigation, the researcher felt that the way in which ESL

students employ certain writing strategies will possibly reveal their level of linguistic competence. Further, how in turn their performance in first year Life Sciences might be affected by such strategies.

The specific goals of this qualitative research study were:

- to identify the writing strategies of ESL students especially in a scientific context
- to explore the possible relationship between the identified writing strategies and performance
- based on the findings of this study, to make recommendations relating to how the curriculum and content in Life Sciences should be structured to cater for English Second Language students.

Specifically, this study therefore was intended to address students' writing skills in order to empower them to write scientifically.

### **1.5 IMPORTANCE OF THE STUDY**

The findings of this research study are of importance first of all to the students who should benefit from the insights gained. An important benefit for the students is that the study will delineate their problem which should lead to a better understanding of how their scientific writing skills may be improved. Such improvement should specifically be observable and beneficial not only in the Life Sciences but in students' general scientific writing skills. An important aspect of this study therefore is the fact that it will provide students with information relating to their language problems. Such knowledge should be useful in enabling them to seek help that would lead to a better understanding

of the language used in their studies. Such understanding will hopefully lead to mastering the content and facilitating the attainment of higher order learning skills. These skills are critical in building confidence and students' self-efficacy beliefs of their ability to perform. The study is also extremely important for the lecturers because if they are aware of problems experienced by the students then it is easier to modify their teaching to cater for the students. For instance lecturers may use examples that typically illustrate how scientific reports are presented for example. Information gained may also be useful for lecturers of support programmes such as Language studies and Communication in English with respect to assisting in the writing skills specific to Life Sciences.

#### **1.6 SCOPE AND DELIMITATION**

The study is limited to one institution of Higher Education in the Western Cape. The sample was selected from a total population of 120 first year Life Sciences students. In particular, six students who performed poorly in first year Life Sciences were selected. Four students were Xhosa speaking and two were Afrikaans speaking.

#### **1.7 DEFINITION OF KEY TERMS**

The following is a list of key terms that are referred to in the study. The list consists of operational definitions of the terms within the context of this study. That is, the terms will be used and should be understood to reflect the meaning that is explained here. For the sake of clarification the definitions were taken from different sources that are



acknowledged in the list of references. These were in certain instances adapted to fit the purpose of this study.

- medium of instruction:**
- According to Longman Exams Dictionary (LED) this is the language that is used for teaching
  - In this study it is defined as the language that is used for teaching and learning
- mother tongue:**
- synonymous to native language - the first and main language that you learned as a child (LED)
  - In this study it is defined as the dominant language of a community that a speaker uses
- second language:**
- the language that you speak in addition to the language that you learnt as a child (mother tongue) (LED)
  - the language that you speak in addition to the mother tongue
- vocabulary:**
- all the words that someone knows or uses/ all the words in a particular language/the words that are typically used when talking about a particular subject (LED)
  - all the words that are used in a particular language and a particular subject
- linguistic repertoire:**
- the total number of things something or someone is able to do (LED)
  - kinds and degrees of skill and experience in a language an individual displays
- higher cognitive skills:**
- synonymous with higher order thinking skills or higher according to Bloom's taxonomy consist of synthesis, analysis and evaluation
- scientific writing:
- writing about scientific subject matter, often in a non-technical manner for an audience of non-scientists; writing that reports scientific observations and results governed by specific conventions (a form of technical writing)
- Nordquist, R. About.com Guide – retrieved on 14/03/2011 from [http://grammar.about.com/od/rs/g/Science-Writing-term.htm]
- a form of technical writing in science that is governed by specific conventions or rules
- communication strategies:**
- exchange of meaning between people occurring either through language or non-verbally, and varying with different degrees of knowledge, motivation and attitudes
  - exchange of meaning between people occurring either

through language or non-verbally, and varying with different degrees of knowledge, motivation and attitudes (LDE)

**multi-cultural:**

- involving or including people from different ethnic groups
- involving or including people or ideas from many different countries, races or religions (LED)

**writing strategies:**

- deliberate and focused attempts or techniques that are employed by the writer to communicate in a meaningful way
- planned series of actions for achieving something; are deliberate, focused ways of thinking about writing.

retrieved on 14/03/2011 from

[[http://gse.buffalo.edu/org/writing strategies/](http://gse.buffalo.edu/org/writing%20strategies/)]

**assessment strategy:**

- in education, the process by which one attempts to measure the quantity and quality of learning and teaching using various assessment techniques, e.g. assignments, projects, continuous assessment, objective-type tests, final examinations and standardised tests
- the process in which you make a judgment about a person or situation (LED)

**bilingual:**

- the ability to speak two languages as mother tongues when the two languages are learned more or less at the same time or when one of the languages is learned later than the other one

**linguistic competence:**

- possession of ability in language skills, either in mother tongue or second languages
- synonymous with linguistic ability for purpose of this study – possession of ability in language skills, either in first or second languages (IED)

**writing skills:**

- systematic and coordinated patterns of mental and/or physical activity to execute the act of writing
- a skill – a systematic and coordinated pattern of mental and/or physical activity, usually involving both receptor processes (senses which receive stimuli) and effector processes (muscles and/or glands which provide responses) (IDE)

**scientific discourse:**

- typical language used in science
- typical language used in an activity, e.g. scientific discourse (IDE)

**scientific community:**

- concept of the faculty staff and students of a university forming a community with a shared interest in the pursuit of teaching and learning science

- lexical density:**

  - concept of the faculty staff and students of a college or university forming a community with a shared interest in the pursuit of learning (IDE)
  - a writing strategy where the proportion of content (lexical) words in a sentence or text over the number of clauses is measured. Texts with a lower density are easy to read.

retrieved on 14/03/2011 from  
[<http://www.usingenglish.com/glossary/lexical-density-test.html>]
- semantic discontinuity:**

  - a writing strategy based on the expectation by the writer of the reader to supply a logical relation between separate chunks of information so as to arrive at the intended message that was communicated
- coherence:**

  - a writing strategy that results in a piece of writing that is easy to understand because its parts are connected in a clear and meaningful way
  - when something such as a piece of writing is easy to understand because its parts are connected in a clear and reasonable way (LED)
- semantic simplification:**

  - a writing strategy which displays grammatical errors that leads to contraction, i.e. incomplete answers based on the meaning of language rather than formal structure and grammar.
- risk avoidance:**

  - a writing strategy whereby due to uncertainty or risk there is a possibility that the intended message is not communicated at all or is reduced in meaning
- cognitive domain:**

  - synonymous with cognition which is the umbrella term for the processes of perception, discovery, recognition, imagining, judging, memorising, learning and thinking through which the individual obtains knowledge and conceptual understanding or explanation. Does not include emotional processes.
  - synonymous with cognition which is the umbrella term for the processes of perception, discovery, recognition, imagining, judging, memorising, learning and thinking through which the individual obtains knowledge and conceptual understanding or explanation. Does not include emotional processes.
  - related to the process of knowing, understanding and learning something (LED)
- proficiency:**

  - a high or low standard of ability and skill
  - a good standard of ability and skill (LED)
- register:**

  - the words, style and grammar used by speakers and

writers in a particular situation or in a particular type of writing

- the words, style and grammar used by speakers and writers in a particular situation or in a particular type of writing (LED)

## **1.8 STRUCTURE OF THE STUDY**

The research study consists of five chapters. Chapter 1 initially provides a theoretical framework that sheds light on the problems that English Second Language speakers experience. This is followed by a problem statement that outlined the questions that this study set out to investigate. The specific goals of the study were detailed including its importance.

Chapter 2 is an overview of the literature used to contextualise the present study in respect of what other researchers have reported. Also, the literature reviewed was specifically selected to locate and position this study within the body of knowledge that has focused on some of the writing strategies used in scientific writing and their effect on the performance of second language speakers in Life Sciences.

Chapter 3 describes the research methods employed in this study. Specifically it provides information relating to qualitative approaches that were used here to collect data. A description of how the study subjects were selected is also provided. Following this is an explanation of the analysis and interpretation of the data. Finally the researcher's roles as well as ethical considerations are articulated.

Chapter 4 presents a comprehensive insight into the findings of this study after the capturing, analysis and interpretation of the collected data. This chapter is divided into three sections. The first section deals with the presentation of the results that were yielded from analysis of the data. The second section discusses the main trends and patterns of the scientific writing abilities displayed by the students. The third section which is the conclusion highlights the positive and negative aspects of the interpretation of the analysis of the data and attempts to establish a relationship between writing strategies, performance and mother tongue of ESL students.

Chapter 5 deals with the summary of the research findings and overall recommendations based on these findings and identification of areas for future research in the multilingual classroom.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 INTRODUCTION**

Good writing still matters today because it is the principal medium of communication in a quest to understand what is happening in the world around us. This is an issue that is supported in literature. For example researchers have made the link between comprehension and therefore conceptualisation and writing by stating that “[I]f the reader is to grasp what the writer means, the writer must understand what the reader needs” (Gopen & Swan, 1990: 1). Interaction with the environment is expressed by means of symbols such as verbal language. Keys (1999, 116) refers to the relationship between thinking, speaking and writing as “inner speech.” This author further makes a case for its development by proposing communicative or transactional writing as a mode of learning in the science classroom (Keys, 1999).

The role of writing has switched from a means of assessment to a means of conceptualisation (Glasson & Lalik, 1993 cited by Halliday & Martin, 1993). When writing, students reveal how they reason and think as their understanding emerges, thereby allowing the instructor to make a judgment call as to the level of the student’s knowledge and the ability to apply that knowledge. Students in turn also discover and distinguish patterns in language that they can use in order to make their understanding and comprehension of the work easier. They display their ability to transfer knowledge

from one situation to the next and the application of this knowledge in a new context. On the contrary the written word is not a true reflection of a student's level of knowledge and understanding of scientific concepts (Vygotsky, 1962). This is complicated more by the correct use of grammar, spelling and punctuation. The diverse linguistic repertoires of ESL first year students depend on factors such as their cross-curriculum experiences in writing at high school level, the communities that they come from, the quality of training that their teachers have undergone and the support provided by the state for bilingual students. Recognition must be given for the need for research in determining and comparing literacy levels of ESL students as they transit from high school to university (Matsuda et al., 2003).

## **2.2 THE NEED FOR SCIENTIFIC WRITING**

Communication lecturers at university teach basic and generic writing skills but not necessarily scientific writing skills. This practice that started at high school level created a backlog that resulted in a perpetual cycle of deficiency in writing skills that is acutely experienced at university level with its higher demands of scientific discourse community (Inglis et al., 2007). Enabling students to write scientifically is imperative to the enhancement of teaching and learning in science. Halliday & Martin (1993) support this fact by stating that in order to learn and understand science the language of science also has to be learned and understood. This language of science has a special grammar that was developed to meet the requirements of scientific knowledge. The relationship between content and how it is organised is the principle on which Pelaez (2002) based

her study in problem-based writing in physiology. She quotes Ausubel (1980) who argues that both the substance and the organisation of the content are principal factors that influence meaningful and lasting learning. The message that the content conveys to the reader and not how the content is presented is the fundamental purpose of scientific discourse (Gopen & Swan, 1990). First year ESL students in Life Sciences should thus be trained to write scientifically but not according to a prescriptive format in their early stages of writing in a new language so that the message is not distracted from the audience which in this case is the lecturer.

When first year ESL science students enter the university they become part of a new culture that encompasses a new discourse community (Inglis et al., 2007) of which behaviour and values form an integral part. The challenge lies not only in the acquisition of English as medium of communication – the spoken and written word – but also as a member of the scientific community in the acquisition of the language of science and subsequently scientific writing skills. The ESL student must therefore be empowered by suitable assessment- and instruction programs to gain access to scientific discourse (Hamps-Lyons, 2002). The complexity of the writing process for the ESL student can be ascribed not only to the what, how and why of writing but will also have as a generated outcome, the acquisition of a new language and becoming proficient in that particular language. Chimbanga (2000) further contended that ESL students “do not have the discourse patterns for argumentation and they lack the vocabulary and terminology for academic discourse” which are essential skills for scientific writing in Higher Education.



Inglis et al. (2007) and Chimbganda (2000) found that ESL students who have completed a Science Foundation Programme (SFP) that focused on the acquisition of communication and study skills, for example report writing, were gradually introduced to scientific discourse. The SFP seems to be a vital role player in assisting ESL students to make the link between written communication skills that were taught in isolation at high school level and the challenges of scientific writing in Life Sciences that is posed at first year university level. When comparing ESL teaching in Botswana (Chimbganda, 2000) at high school level with that in South Africa (Inglis et al., 2007) it seems that in both countries grammar in school is taught in isolation and not as a means of communication. This trend that is continued at university level, explains why students lack basic communication skills or basic interpersonal communication skills (BICS) as denoted by Cummins (1980). BICS which is an aspect of language proficiency for everyday communication such as oral fluency is cognitively undemanding and requires little active cognitive involvement for appropriate performance – BICS reaches its peak in primary school (Fukushima, n.d.). Even though the subject Communication in English is compulsory for all first year students at university, they still cannot make a meaningful link and apply their acquired literacy and communication skills to other content subjects like Life Sciences. Cognitive academic language proficiency (CALP) on the other hand is regarded as necessary to meet the academic demands such as reading and writing in the school context and reaches its peak in the mid-adolescent years i.e. the general age of most university students “following their overall cognitive development” (Fukushima, n.d.).

### **2.3 STRATEGIES IN SCIENTIFIC WRITING**

According to Buffler, Allie, Kaunda & Inglis (1997) writing activities are important in the development and understanding of scientific concepts and process skills and likewise the written word is also useful to measure the “learning objectives in academic settings” (p. 85). The ways in which ESL students express themselves when writing or writing strategies as I prefer to call them, has been analysed from different angles and defined by various researchers (see chapter 1). The following definition as cited by Aliakbari & Allvar (2009), “the ways in which an individual speaker attempts to compensate for (the) gap between what he intends to communicate and his immediate available linguistic resources are known as communication strategies (Faucette, 2001)” very aptly expresses the role of these strategies. These researchers also stated that even though there are just as many communication strategies in the oral medium as are found in the written medium, most of the previous research focused on communication strategies in the oral medium and not so much on the written medium. One example of this research in written communication was done in Botswana by Chimbanga (2000) who sought to understand the communication strategies used in writing by ESL students in an attempt to negotiate meaning.

Halliday (2006: 138) identified the following seven areas that are characteristic of scientific discourse and are “endemic to scientific writing.” These are:

- (i) interlocking definitions
- (ii) technical taxonomies

- (iii) special expressions
- (iv) lexical density
- (v) syntactic ambiguity
- (vi) grammatical metaphor
- (vii) semantic discontinuity

These areas are based on the grammar of the scientific clause that makes meaning in scientific writing but at the same time pose to become problematic for the ESL student in their quest to acquire and communicate their scientific knowledge. The functions of grammar have been depicted as firstly “an expression of the theory of the human experience”, secondly “as an enactment of interpersonal relationships” which thirdly “together with the textual” in the fourth place “creates discourse” (Randaccio, 2004: 2). The functional unit of grammar in scientific English is the clause which according to Halliday (1998) as cited in Randaccio (2004) can be characterised on the “semantic level as a sequence of two figures linked by a logical semantic relation and on the grammatical level as a nexus of two clauses, with the relator/conjunction in the secondary clause” (p. 5). For the purpose of this study lexical density and semantic discontinuity as writing strategies were borrowed from (Halliday, 2006).

Lexical density as defined by Halliday (1989) is a surface feature and indicator of the readability of the text (Harrison & Bakker, 1998). High lexical density makes a passage difficult to read for the ESL student because it contains technical terms that is expected to form part of the background knowledge of the student. However if the ESL student is

not familiar with scientific English this could pose as a problem. On the other hand lowering of the lexical density by chopping up a complex sentence into shorter sentences can result in the loss of the flow of information rendering the intended communication meaningless (Literacy and Science Education, n.d.). Parkinson (2003) contends with the Hallidayan notion of lexical density as “a measure of how written or spoken a text is” (p.256). Written text is viewed as being lexically more dense but grammatically much simpler than spoken text because of the bigger proportion of content words compared to the smaller number of clauses. University textbooks have a lexical density that ranges from 8 to 11 whereas an article read by the researcher had a lexical density of 8. Halliday & Martin (1993) regards the lexical density of speech as low ranging from 4 to 6 compared to the lexical density of scientific writing to be as high as 13. Lexical density is calculated by dividing the number of lexical items by the number of clauses in a sentence. It is also worth mentioning that lexical density of the ESL writer does not necessarily increase with time (Parkinson, 2003) and as such is not a reliable indicator of the performance of a student.

Semantics has to do with the way in which individual words and groups of words together make meaning (Richgels, 2004). Semantic discontinuity (Halliday & Martin, 1993) is the expectation by the writer that the reader will be able to make “a conceptual jump” (Traugott, 2004) or semantic leaps in order to reach a desired conclusion. The onus rests on the reader to supply the logical relation to arrive at the intended meaning – a situation which has the potential to create problems for the ESL student (Lê & Lê,

2007) who communicates knowledge in his/her culture by means of a particular genre such as a narrative, an explanation or an argument.

The role of logical connectors or coherence (Katznelson et. al, 2001; Inglis, et.al, 2007) as a limiting factor in determining the quality of pupils' scientific writing is another writing strategy adopted by my research study. Buffler et al. (1997) regard coherence as an important characteristic of scientific writing and its assessment because coherence: firstly clarifies the relationship between sections, secondly is achieved when there is a close relationship between the content and how it is expressed and thirdly reduces interference when information is conveyed or transferred in written form. Logical connectors are used to join shorter sentences or ideas to form a complex sentence. For the ESL student the use of logical connectors add to the complexity of scientific writing in that complex sentences might have an implicit meaning because certain functions, aspects and characteristics are assumed (Literacy and Science Education, n.d.). The absence or presence of logical connectors need not create difficulty for the audience or reader as long as there is a clear flow of information and "certain other conditions obtain" (p. 139). The responsibility of the novice ESL writer is to write in such a way so as to adhere to the social – and linguistic conventions of the scientific discourse community and to meet the expectations of the reader or the audience (Siepmann, 2006). This aspect was dealt with by Patterson (2001) in his in-depth analysis in which he used context maps as a scaffold to analyse the effects of factors such as coherence in the development of scientific concepts in school pupils. Those pupils who were competent in using context maps when writing were able to produce a remarkable number of

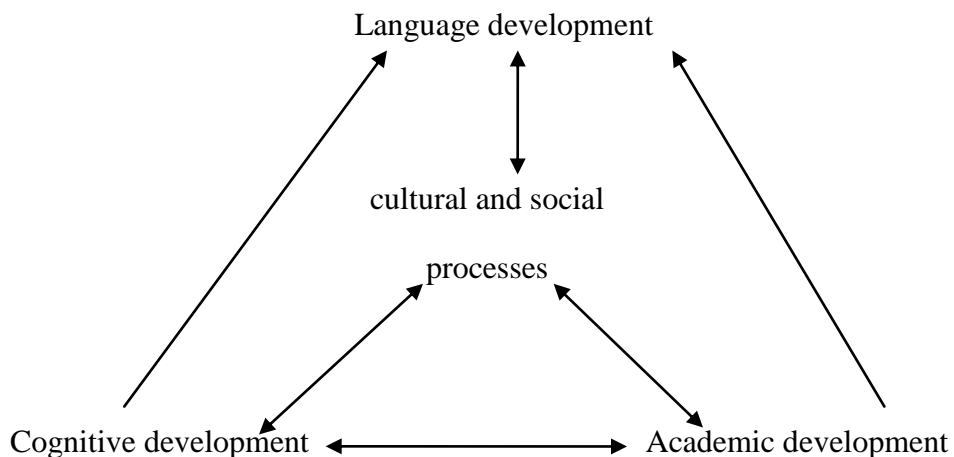
explanations because they were provided with logical sentence connectors. Pupils who were not competent in language could not express themselves well in writing but rather gave factual statements and descriptions because of their poor capability to employ logical connectors when constructing sentences. Inglis et al. (2007) affirms the importance of logical connectors to link subsections of information by the student who is the author so as to write sense for the lecturer who is the audience. Failing this, the result is poor coherence or incoherence, i.e. ideas that are not articulated clearly due to improper use of words.

The scope of Chimbganda's (2000) study was limited to four macro-strategies: risk taking, risk avoidance, L2 based strategies and semantic simplifications, but these are not the only communication strategies used by students. Of these macro-strategies I have found semantic simplification and risk avoidance suitable for my research purposes in order to identify and establish problems and trends in scientific writing so as to become familiar with the scientific writing skills of ESL students in first year Life Sciences. Semantic simplification is blamed on communication problems when the student knew the answer but did not know how to answer the question leading to reduced or incomplete answers. To this end Inglis et al. (2007) also agreed that "grammatical errors lead to contraction" (p. 87) in a way similar as to what Chimbganda (2000) refers to as semantic simplification as explained previously, the outcome of which is incomplete answers. Risk avoidance because of uncertainty or risk is one such measure by which cultural divergence is evident and it exposes itself in the way in which academic or scientific writing takes place (Siepmann, 2006).

## 2.4 MOTHER TONGUE AND SCIENTIFIC WRITING

The theoretical framework of this research study is underpinned by the relationship between second language acquisition and learning in a second language as illustrated by the Cummins model (Cummins, 1996) in chapter 1 and figure 2.1 that represents the conceptual model of Collier (1994) as cited by Katz et al. (2004) of language acquisition which places the socio-cultural aspect at the centre of the interrelationships of “the four components – socio-cultural, linguistic, academic and cognitive development” (p.18).

**Figure 2.1:** Relationship between language, culture and performance



Black African students come from a culture where even though the spoken word is the principal medium of communication, English is hardly spoken in the community (Chimbganda, 2000; Inglis et al., 2007). At university level these ESL students must participate in a culture of scientific writing when their experience of writing was limited to copying notes from the chalkboard. ESL speakers from several mother tongue backgrounds tend to use features more typical of speech than of writing when they have

to write in English. This phenomenon is regarded by some researchers as a confusion of spoken and written register (Gilquin & Paquot, 2007). On the other hand Siepmann (2006) has cited the notions that were proposed by two groups of researchers. The first group contends that academic discourse is universal (Widdowson, 1979; Schwanger, 1981) which is contrary to the viewpoint of a second and later group of researchers. This group recognised that cognitive- and textual structures are culture- specific (Kaplan, 1966, 1980; Clyne, 1981, 1987; Kachru, 1983; Galtung, 1985; House, 1997). Students bring with them the general knowledge and basic features of communication to any task – such as writing in this case. However these features constrain the construction of text in a second language such as English (Yates & Kenkel, 2002). A link can therefore be made between the background knowledge or culture and the linguistic- and text knowledge in order to form a coherent picture of the text. If texts in university are generally viewed as being dense and compressed and all the more so in a second language then it is understood that conceptualisation for the ESL student is difficult (Pretorius, 2006) and consequently writing becomes an arduous task.

The acquisition of a second language places the ESL student in a situation where he has to cope with a variety of factors such as learning styles, emotions, personality and background that has to be catered for when writing is assessed (Hamp-Lyons, 2002). ESL students lack the ability to apply their general writing skills to writing in a foreign language. They prefer to answer questions in their mother tongue because their reading proficiency in English is better than their writing competency (Katznelson et al., 2001). Acquisition of academic English proficiency takes place faster for learners with a strong



academic or primary language background (Wisconsin Department of Public Instruction).

Chimbganda (2000) and Inglis et al. (2007) have found that gender and/or age did not skew the results of their studies since in both cases all the students have completed twelve years of schooling and were at a critical age in terms of needs, attitudes and emotions. This is contrary to the findings of Patterson (2001) who in his analysis of the written work of primary school pupils found that gender seemed to have played a role in the preference of the type of planning prior to written assignments such as writing stories: girls preferred a structured format for planning compared to the less prescriptive style of planning like the context map that was preferred by the boys. What becomes apparent is that age from a certain level does matter when it comes to preferences like planning prior to writing and displaying the understanding of concepts better in an oral form such as interviews than in written form. It seems however that his observation was not conclusive or convincing enough as the sample was too small and therefore more research is needed on this aspect.

Finally, the role of the affective domain should not be disregarded as it is essential for successful scientific writing. It provides students with the opportunity to make that vital link between real life experiences and the Life Sciences classroom thereby allowing first year ESL students to gain entry to scientific discourse community (Inglis et al., 2007). As the ESL student in Life Sciences becomes more adept at scientific writing, the behaviour and attitude or the “by-products or non-writing outcomes” (p.159) of the

students are also perceived to have changed. These changes outside of the writing itself that are effected by the student himself, have an impact on the transformation of the student, making him more capable and mature (Katznelson et al., 2001).

## **2.5 WRITING STRATEGIES AND PERFORMANCE**

For the ESL student who is a novice academic or scientific writer, effective communication remains an essential skill that must be assessed. Academic writing needs to demonstrate a clear understanding of a subject like Life Sciences and can vary based on the instruction given and the nature of the writing task – describe, explain, argue, justify etc. in tests, essays, summaries and reports. The usefulness of writing strategies is recognised and acknowledged by Irimiea (2009) who proposed that aspects like accuracy of content, coherence, lexical density and logical organisation of the text can form part of the assessment criteria for academic writing activities.

There seems to be an overall strong correlation between strategies used and performance. According to Richgels (2004), performance on the written (as well as the spoken) aspect of language “operate at an unconscious level” (p. 470). Aliakbari & Allvar (2009) concluded that high proficiency ESL learners who have a more established linguistic repertoire use a reduced number of communication strategies that are psychologically more demanding. Consequently it results in a decrease in the gap that has to be filled by the communication strategies. The opposite holds true for ESL learners with low proficiency levels for whom the main focus is to produce the oral or written language instead of communicating the intended message. Chimbanga (2000)

in his study found that the competency level of ESL students is determined by the strategies and answering techniques they employ which in turn is linked to their knowledge base.

The scoring of good marks against grammatical errors such as incorrect sentence construction and disobeying of the rules of grammatical concord is the result of being taught to look for the required information instead of how the answer is constructed. The following claim of Bialystok and Frolich (1980) cited by Chimbganda (2000) confirms this: “advanced learners use more achievement strategies such as risk taking and second language based strategies, while less proficient learners prefer to use risk avoidance and semantic simplification strategies” (p. 318).

Based on her findings Pretorius (2006) makes the statement that learners with low English proficiency levels cannot see the relationships between pieces of information and as such miss out on vital clues that will assist in gaining an overall comprehension of text and subsequently how to process this information when writing. The resultant outcome is poorer academic performance because the learner cannot accurately construct the representation of the text he/she is dealing with. This points to a general difficulty for ESL students to deal with academic discourse on the whole. Further research in the use of logical connectors by ESL students in their mother tongue and English Second Language is needed; the findings of such a study will have implications for the multilingual classroom where the language of instruction is not the mother tongue of the student (Pretorius, 2006).

## 2.6 THE COGNITIVE ASPECT OF SCIENTIFIC WRITING

An aspect that is often disregarded by teachers and assessors is that the purpose of writing scientifically should not only be for communication and testing of knowledge but also for learning (Klein, 2004). Being able to converse in a second language such as English is not necessarily the academic language and also not the language of the cognitive domain of the ESL student (e.g. to evaluate, infer, hypothesise). This second language might also be the language of learning and of cognitive development not only in Life Sciences but in all areas of the curriculum. Proficiency in the language of instruction impacts on the performance of students. Low proficiency in the second language which is also the medium of instruction can thus result in poor performance. On the other hand home language affects linguistic – and cognitive outcomes. Bilingualism must be seen as a positive force that can be used advantageously for cognitive and linguistic development in children and so improve access to literacy. When writing systems such as French and English or as in the case of this study Afrikaans and English correspond then “intelligent” (p.3) thinking such as problem solving is enhanced (Bialystok, 2006) – at the other end of the scale if languages do not share a writing system then achievement in the second language is hampered. As stated in chapter 1 according to the Cummins model, writing activities can be classified according to their cognitive demands as demanding and undemanding that intersects with the contextual continuum ranging from context-reduced to context-embedded tasks. Language can therefore be contextualised and decontextualised according to BICS (basic interpersonal communication skills) and CALP (cognitive/academic language

proficiency). CALP refers to those aspects of language proficiency which are closely related to the development of literacy skills in the mother tongue e.g. Afrikaans or Xhosa and in the second language e.g. English. This cognitive academic aspect is not only linked to intellectual development but also underlies the development of proficiency in both the mother tongue and the second language. An implication of this “common underlying proficiency at the level of cognitive academic performance (is that) development in the primary language of a student can promote development in the second language. Therefore the degree of literacy in the first language should predict the degree to which second language literacy skills will be developed in the second language” (Katz et al., 2004).

Language proficiency in the mother tongue like Afrikaans or Xhosa and a second language like English is viewed differently by different researchers in the field of language acquisition. Previously reference was made to CALP which according to Cummins (1980) is closely related to the acquisition of literacy skills in both the mother tongue and the second language pointing towards the interdependence of these two languages on each other. The model of Oller (1978) as cited in Cummins (1980) proposes that “global language proficiency allow for unique variances based on specific competencies of language skills” (p.176). This kind of proficiency is closely linked to the intellect and can be equally measured by all kinds of communication like reading, writing and speaking. Cummins (1980) furthermore acknowledges the model of Hernandez-Chavez et al. (1978) that states that “ language proficiency involves multiple

factors along three parameters, namely linguistic components (syntax, semantics, lexicon), modality (comprehension and production by means of speaking and writing) and sociolinguistic performance (dimensions of style, variety and domain)” (p.176). In order to answer the stated research questions (see Chapter 1) the model of CALP as proposed by Cummins (1980) and described previously (see Section 2.2) is adopted by this research study because of its suitability to the multilingual and multicultural classroom from which data for this study was mined.

Learning to write scientifically in a foreign language brings about changes in the cognitive, affective and social aspects of learning and a range of changes in skills and in being (Katznelson et al., 2001). These changes occur in the cognitive structures of learners that are caused by the cognitive field itself as well as the needs and motivations (Lewin, 1964 cited by Katznelson et al., 2001) that drive the learner who is doing the writing course. Cognitive processes depend heavily on the linguistic ability of the ESL student (Bialystok & Craik, 2010) and as such the ESL student with “a smaller vocabulary generates fewer lexical items and the semantic fluency of the task” (p.10) is compromised. Cognitive processes such as the making of comparisons, explanation and the formulation of hypotheses have a direct bearing on the scientific writing of an individual. When ideas are generated during the application of scientific processes, the knowledge gathered in this way is understood, transferred and applied by means of reasoning and inference (Patterson, 2001). According to the knowledge transforming model of Bereiter & Scardamalia (1987) cognitive functions are utilised to purposefully

reorganise, restructure, process and develop the gathered knowledge when writing occurs.

Using context maps when planning prior to a practical activity proved to be valuable in predicting some kind of result for science investigation activities, be indicative of the capability of the degree of cognitive processes used and also the capability of using cognitive functions when writing. However, because of the small size of the sample no conclusive relationship could be established between the use of cognitive processes such as reasoning demonstrated by the frequency of ideas recorded when the structured context map was used and the ability to use cognitive functions such as planning and predicting in a practical situation (Patterson 2001:12).

## **2.7 TEACHING AND LEARNING OF SCIENTIFIC WRITING**

There is a need for research to address the corroboration of the teacher or lecturer and the ESL student in Biology that is transformed by the scientific writing course (Katznelson et al., 2001) in order to develop and harness their writing and learning capacity. When second language speakers write in English a lot of emphasis is placed on grammar and gradually their awareness of the correct use of grammar is heightened as well as the acquisition of a “metalanguage with which to express grammatical concepts” (p. 150). Yates & Kenkel (2002) is of the opinion that ESL students do not intentionally write incoherently because the focus of teaching of content in the second language classroom should be more on writing and less on language. As such training in

expressing ideas coherently in English is useful in adopting a logical line of thinking when writing in other languages and disciplines.

The frustrations of Biology lecturers teaching ESL first year students are summarised in the following quotation of Chimbganda (2000): “students lack essay writing skills; they lack brevity in answering questions; they do not summarise points and lack logicity; have problems with selection and organisation of points, and merely lift points without recasting them”(p. 310). These frustrations are not unique to the situation in Botswana, but are experienced universally in those higher education institutions where students are not instructed in their mother tongue but in a second language such as English. Patterson (2001) states that when considering the teaching of writing in science there are certain aspects that have to be clarified such as the purpose for writing, ownership of content, type of genres to be taught and the editing of text for a particular audience which as Inglis et al. (2007) states could be the lecturer who must read the scientific report of the student or on a wider scale the research community who must read the research article. The process of academic writing is not spontaneous but a conscious process that can be transferred to other writing contexts. Chimbganda (2000) like Parkinson (2000) claim that acquisition of genre structure and writing conventions implicitly aids ESL students in becoming proficient in scientific writing. The genre-based approach as proposed by Parkinson (2000) seems to be highly recommended in teaching writing in science.

Inglis et al. (2007) used the writing of the scientific report to address two important aspects of scientific writing namely the characteristics and the language used when



writing scientifically. She argues for the fact that the focus should not be on content only but also on writing tasks that affords students the opportunity to bring their own identity to the learning situation. Scientific writing is a challenge for the novice ESL writer and writing across the curriculum advocates disciplinary enculturation (Wang & Bakken, 2004). This kind of writing also assists with bridging the gap between high school and university and between prior knowledge and the knowledge gained as first year ESL students emanate as members of the scientific discourse community. Chimbanga (2000) advocates the revisiting and re-evaluation of high school syllabi that will prepare competent ESL students who will be able to communicate effectively as a member of a scientific discourse community (Chimbanga, 2000). In this way confidence is generated as the knowledge base of the student becomes more comprehensive. Young (2003) proposes the use of poetry “as an important tool for writing against the curriculum of academic (and therefore scientific) discourse” (p.472).

Chimbanga (2000) draws the conclusion that the main focus of teaching must be to improve communication and therefore meaningful writing by exposing ESL students to tasks and activities where they can spontaneously use their own linguistic abilities. Content must be taught at the level where the student is and not where the lecturer wish the student was (Yates & Kenkel, 2002). Communication in ESL can be improved by means of cooperative learning by means of writing groups and group discussions, socializing in the academic community and academic learning in context (Wang & Bakken, 2004). Heightened awareness of the difference between the spoken and the written register should extend beyond the classroom into pedagogic materials such as

the 2<sup>nd</sup> Edition of MacMillan's Dictionary for Advanced Learners that addresses problems with register (Gilquin & Paquot, 2007). Editing of written text as part of feedback after the initial attempt proved to be valuable in the teaching of scientific writing in order to point out technical mistakes that can be eradicated (Inglis et al., 2007).

Even though the emphasis for writing should be placed on communication rather than assessment it deems important that the author, who in this case is the student, should be familiar with the criteria used for assessment of the different outcomes such as teamwork and critical thinking (Katznelson et al., 2001). This will reveal the ability of the student to write factually using relevant information from other sources. How students use other sources to construct knowledge by interpreting it in their own words or copying the information word for word is another important aspect of scientific writing that was addressed in the analysis of the scientific report by Inglis et al. (2007). Incorrect use of sources can be ascribed to the conceptual difficulty that the second language speaker experiences when using text and thus accept information as is and not so much as ignorance to the practice of plagiarism. On the whole ESL students should make at least some effort to integrate their own voice with those of the experts which is imperative in academic writing. However two extremes exist namely, where that either no or poor reading was done or where the student simply used the text of the experts and joined it with his own writing, a practice which is totally unacceptable in scientific writing. To this extent it becomes difficult for the novel scientist such as the first year ESL student in Biology to avoid plagiarism in an effort to disguise their poor skills in

gathering information from someone else's writing (Inglis et al., 2007). If there is limited time to write then content knowledge is valued over writing skills (Wang & Bakken, 2004). It is then advised that instruction of the content in English should be of such a nature that the English used is contextualised to make the content more accessible by avoiding complex syntax and vocabulary but still maintaining the crucial academic content and concepts (Wisconsin Department of Public Instruction).

Even though it was indicated that explanatory writing assignments benefits the learning and understanding of science concepts, this aspect still needs research. To this effect Patterson (2001) cited Rivard (1994) who stated that, "a fruitful area for research would be how the conceptual frameworks of students are transformed by various kinds of tasks such as writing summaries, explanations or analyses" (p.975 and 977). This challenge seemed to have been taken up by the findings of the research of Inglis et al. (2007) that pointed out that writing provides a satisfactory means of expression for what the student experiences in theory or the classroom and how it connects to the real world – the basis for authentic learning and assessment. In this way students become aware of their own voice for instance with reference to environmental issues by "comparing an ecosystem and its elements to a choir consisting of members" (p. 90) in an effort to show their understanding and appreciation. Level of competency in specialization areas should be raised by focusing on "cognitive language proficiency and discipline –specific language competency" (p.90).

Another factor that should also be considered is the role of language as the medium of instruction whereby teaching and learning and then also assessment takes place. What becomes more apparent is the intention to increase the role of mother tongue as a medium of instruction (Cummins, 2005; Zuma & Dempster, 2008). The findings of a controlled experiment done by Mgqwashu (2004) as cited by Zuma & Dempster (2008) with high school Physics learners in Tanzania has shown that the same assessment that was done in mother tongue (which is KiSwahili) or in English which is the second language did not show a significant difference in learner performance. The expected outcome was not better performance because of the fact that non-technical terms in the mother tongue hampered the acquisition of technical terms and vocabulary and thus resulted in affecting the Physics discourse of the learners negatively. The previously mentioned situation can possibly be remedied by creating effective learning spaces that allow for bilingual instructional practice. This kind of practice will not ignore, but rather facilitate the rich wealth of prior knowledge that students bring into the classroom and consequently result in faster and more effective engagement with literacy. A critical consideration here should be to promote cross-lingual transfer and language awareness (Cummins, 2005:585 -592).

## **2.8 SUMMARY**

It can then be concluded that in the analysis of the various theories and models of language acquisition and language proficiency as described in this chapter it became clear that there is a link between mother tongue and second language instruction in that

they both underwrite the writing strategies employed by ESL students. All of this in turn impacts on their performance in content subjects like first year Life Sciences.

## CHAPTER 3

### RESEARCH METHODS

#### 3.1 INTRODUCTION

This chapter describes the research methodology and design employed in this study. It includes the population, data collection as well as analysis method used. The aim of the study was to identify the writing strategies that English Second Language (ESL) students in first year Life Sciences use in scientific writing. The objectives of the study were to:

- identify some of the writing strategies that students use in scientific writing
- establish the extent to which these writing strategies are used by Afrikaans- and Xhosa speaking students when they write scientifically
- establish a possible relationship between the use of the identified writing strategies and the performance of the ESL students
- identify the reasons underlying the observed patterns or trends
- provide recommendations to lecturers how to improve instructional practice and to heighten the awareness of students of the effective use of the identified writing strategies in order to improve their performance in Life Sciences and other content subjects

### **3.2 RESEARCH QUESTIONS**

The research questions that were asked in order to achieve the objectives of this study were:

1. What is the extent to which certain writing strategies are used by English Second Language students in first year Life Sciences when they write scientifically?
2. Are there any differences in the extent in which the identified writing strategies are used between Afrikaans - and Xhosa speaking students when they write scientifically?
3. How did the extent to which the identified writing strategies are used affect the performance of the English Second Language students in first year Life Sciences?

### **3.3 RESEARCH SETTING**

The study was conducted in a natural setting since no changes were made to the environment to fit the purpose of the study which was conducted amongst first year Life Sciences students of the Education Department in one of the universities in the Western Cape. The total number of students taking first year Life Sciences was 120. The medium of instruction is English as dictated by the language policy of this particular university which indicates that “English is the default language of teaching, however, where determined by department, site and market context, isiXhosa and Afrikaans should be used as the language of teaching provided that such usage does not limit access or

promote marginalisation of any language community” (University Policy document, 2008).

The data was collected during normal class time and consist of the unstructured interviews as well as the written assignments in the form of tests and tutorials. The participants in the study were first year students in Life Sciences who were English Second Language (ESL) speakers because their mother tongue was either Afrikaans or Xhosa.

### **3.4 RESEARCH DESIGN**

Research according to Mouly (1978) as cited in Cohen and Manion (1989) “... is best conceived as the process of arriving at dependable solutions to problems through the planned and systematic collection, analysis and interpretation of data. It is a most important tool for advancing knowledge, for promoting progress, and for enabling man to relate more effectively to his environment, to accomplish his purposes and to resolve his conflict” (p. 43). Research design according to Creswell (2009: 233) can be defined as “... plans and the procedures that span the decisions from broad assumptions to detailed methods of data collection and analysis. It involves the intersection of philosophical assumptions, strategies of inquiry and specific methods.”

#### **3.4.1 Qualitative research design**

Qualitative research is regarded as an unstructured approach to inquiry that is flexible with regards to the objectives, design, sample and questions asked in order to explore

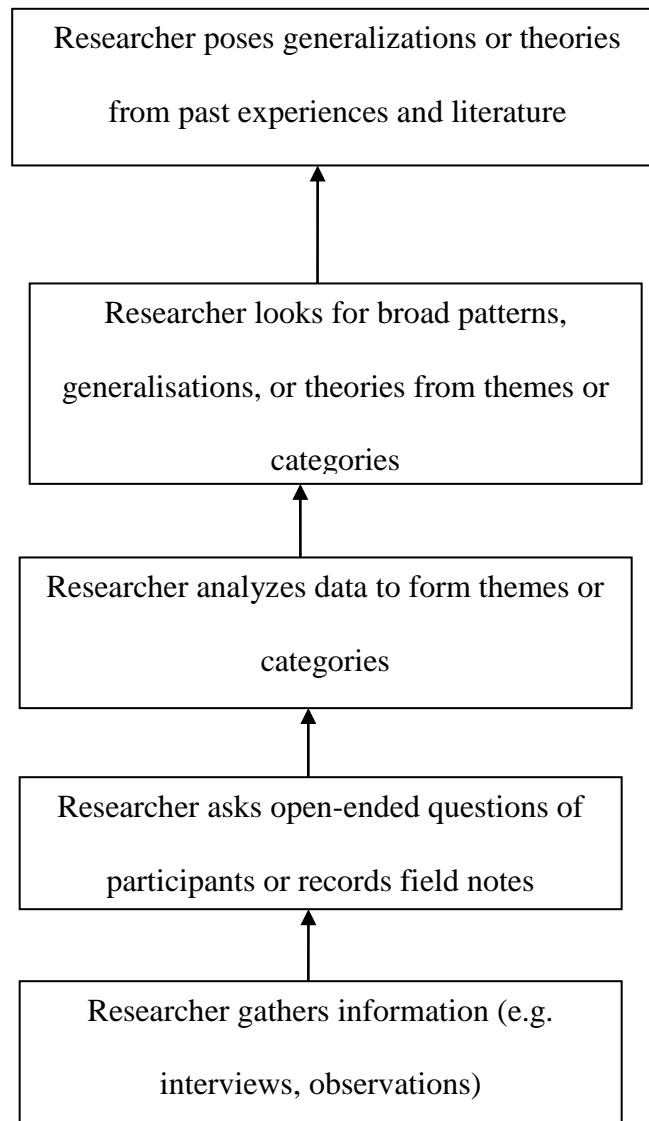


the nature of a problem, issue or phenomenon (Kumar, 2002). The qualitative researcher uses a variety of research methods and empirical materials such as interviews and written texts of individuals in an effort to get a better understanding of the situation or the problem at hand (Denzin & Lincoln, 2000).

This particular research study is first of all descriptive because it accounts for what has already happened. Secondly it is developmental because it “describes what the present relationships are among variables in a given situation and to account for changes occurring in those relationships as a function of time” (Cohen & Manion, 1989: 68). Thirdly it is interpretative as its purpose or objective was to understand how individuals perceived and made sense of the world around them. This situation was looked at on the basis that the actions of individuals are executed with a certain intention in mind and are directed to the future (Cohen & Manion, 1989). This study is also inductive in nature in that information that is derived from particular and similar situations eventually leads to the formation of generalisations or theories (Gibbs, 2009). Fourthly it is also a trend study in which certain factors of a particular population are selected and then studied continuously over a period of time (Babbie, 2007). In particular, selected written activities that students had to attempt over a year were analysed. This was done in order to identify trends or patterns that prevail in scientific writing by ESL students. Finally data used was collected from personal experiences and written texts that provided evidence and corroborated what was observed in a particular research setting (Cohen & Manion, 1989; Denzin & Lincoln, 2000). The rationale for choosing a qualitative

approach was based on the richness in meaning that generates rich descriptions (Babbie, 2007).

**Figure 3.1:** An illustration of the main steps in the qualitative study\*



\* adapted from Creswell (2009, p. 63)

In particular, the phenomenological approach in qualitative research design was utilised by this study. This approach entails a type of inquiry where the experiences of the participants provide a description for a phenomenon that is investigated by the researcher. The world as the participants experience it is described by them in a manner that makes sense to them (Babbie, 2007). The phenomenological approach is also suitable for the fact that it favours a small sample as was the case in this study. This approach allows for a researcher to intensively focus on a phenomenon over a period of time in order to make meaning of developed trends and established relationships. The logical steps undertaken in this qualitative study are summarised in Figure 3.1.

### **3.5 RESEARCH PROCESS AND METHODS**

Research methods refer to the ways in which data is collected so that it can be interpreted, explained and predicted by the researcher. Research methodology on the other hand seeks a comprehensive understanding of the process of research enquiry rather than its products (Cohen & Manion, 1989).

#### **3.5.1 The sample and sampling methods**

A sample is a representative group of a population from which the data is collected. Normally the population size first has to be determined and from there the size of the sample (Cohen & Manion, 1989). In the case of this study the population size was 120, i.e. all the Life Sciences first year students. The size of the sample was six students. These six, participated in activities in which five writing strategies used in ESL writing were investigated. The small size of the sample can be defended on the basis that it

provides for a more intensive study that should satisfy the measurement of variables such as relationship and trends (Cohen & Manion, 1989). According to Patton (2002) it is also a common strategy in qualitative research to study “a relatively small number of cases that are successful at something and therefore a good source of lessons learned” (p.7). Since the purpose of this particular qualitative study was to describe a particular phenomenon the size of the sample may be deemed less important once the collection of data has reached saturation point, i.e. no new information can be retrieved from the existing data (Kumar, 2002).

Non probability sampling which is not random (Troskie-de Bruin, 2008) was used here because the researcher used her knowledge of the participants to select them. All the first year Life Sciences students have come through twelve years of schooling in which they were supposed to have accumulated the same body of scientific knowledge as prescribed by the Natural Sciences – and Life Sciences National Curriculum Statement (DoE, 2003). If scientific knowledge can be regarded as a constant, then in addition to language, the other main operational variables in this study would be scientific writing skills and achievement measure or performance. In this study the participants were selected on the basis of being English Second Language speakers with poor performance in first year Life Sciences. The sampling in a sense was also purposive (Babbie, 2007). This is because the researcher’s judgment was used to handpick a sample that was representative enough to satisfy the specific needs of the study (Cohen & Manion, 1989) and that will ultimately achieve the stated research objectives (Kumar, 2002). Poor performers were selected because these students were the ones that

according to the observations of the researcher needed to improve their academic status which was not the case with their more competent counterparts. The written texts of poor performers in first year Life Sciences were selected to identify the extent to which some writing strategies are used by ESL students when they write scientifically.

### **3.5.2 Content analysis**

Content or textual analysis refers to a “... multi-purpose social research method used to investigate a broad spectrum of problems where the content is used to communicate inference” (Cohen & Manion, 1989: 61). This analysis can range from a simple word count to identification of categories in the main areas of content and units of analysis such as a single word or paragraph that will assist with understanding the type of document and how it can be used for research. In this study the units of analysis involved grammar such as words, sentences and paragraphs extracted from texts of the students (see appendix 2). Text can be defined as a “... heuristic devise to identify data consisting of words and images that have become recorded without the intervention of the researcher” (Denzin & Lincoln, 2000: 825). The rationale behind using content analysis as a data collecting method is based on the fact that it may be used (a) to describe trends in communication content (b) to analyse style (c) to describe patterns of communication (Holsti, 1968; Patton, 2002). Content analysis even though limited to investigation of written communication on the other hand allows for the fact that the researcher does not have any effect on the individual that takes part in the study. Because communication processes per se are not studied, the validity of the study is therefore strengthened. The concrete nature of the written texts makes content analysis a

reliable method of research (Babbie, 2007). These views strengthened the need to utilise content analysis in this study.

### **3.5.3 Coding**

Coding is a method that assists the qualitative researcher to organise and describe the raw data that was collected according to a conceptual framework (Patton, 2002). When coding, the mandatory task of the researcher is to assess the meaning of adjacent chunks of text by making use of numerical values (Denzin & Lincoln, 2000; Kumar, 2002). Content analysis essentially is an operation that involves coding. The researcher has the choice of coding the concrete terms used in the written text referred to as manifest content or the latent content which is the intended meaning of communication. The dilemma that is then faced by the researcher is the compromise that has to be made in terms of depth or validity that is favoured by manifest content and reliability or specific understanding that is favoured by latent content (Babbie, 2007). The traditional approach is used where codes will be developed as the information emerges during the data analysis (Cresswell, 2009). Data collected for the purposes of this study was manifest content in which case validity was favoured. Coding of the written assignments in this study was completed and then analysed manually.

Validity of the coding process was established by means of what Gibbs (2009) refers to as “constant comparisons (p.54)” – a cyclic or repetitive process. The selected text of each written assignment was coded (see appendix 2); similarly coded texts were then compared to lift out the degree of difference for the different cases/writing strategies. A

record was kept of how the codes occurred in the data - see appendix 3 - in the form of a coding frame (Barbour, 2008) and this was checked against the original text and the whole process which if necessary was revised. Variations and differences were singled out to illustrate how social phenomena like culture and mother tongue affect the phenomenon, in this case the writing strategies that were coded.

Code-cross checking as proposed by Gibbs (2009) is one way of verifying the reliability of using codes in content analysis. What I as the researcher have done was to check the coding that was done by one expert e.g. Halliday (1993) against what was done by another expert e.g. Chimbganda (2000) in order to minimise researcher bias and to make the coding more reliable. It must be added though that there might be a small difference in what it is the researchers decide to code but essentially what lies at the heart of the matter is “ the concept or idea behind the code” (p.100) which forms the focus of the research Gibbs, 2009).

#### **3.5.4 Documents**

This was the primary source from which the most important information was extracted. Documents looked at were assessment activities such as tests and tutorials that formed part of continuous assessment. Using the information acquired from student records six students who achieved either an E symbol (40%-49%) or a D symbol (50 - 59%) in Grade 12 Life Sciences were selected. Of these students four were Xhosa speaking and two were Afrikaans speaking. All six students were doing first year Life Sciences at the university.

The writing activities used for the purposes of the study were collected during the first and second semester. The first test written in March 2009 and the first tutorial in June comprised the first semester writing assignments. The writing activities of the second semester consisted of the final test written in October and the fourth tutorial that was done in the third term. When the content analysis was carried out the work of the first and the second semester was compared to trace changes in the writing skills of the students.

Stability as a measure of reliability was established over time as a “test-retest approach” (Boeije, 2010: 169). In this study the research instrument was distributed to the subjects on several occasions, but the phenomenon i.e. the writing strategies that were investigated did not change over time. This was further established by doing content analysis of written assignments that were done in the second half of the second semester to once again get a sense of if and/or how effective their writing strategies and subsequently their performance have improved, i.e. a post - test analysis.

Table 3.1 provides a record of the thirty writing samples that were included in the analysis. For the sake of confidentiality the students preferred to remain anonymous and this was guaranteed. The students were in recognition of their wish given pseudonyms. The researcher decided on names which were: Student A = Zoleka, Student B = Vincent, Student C = Bongani, Student D = Fourie, Student E = Nokuzola and Student F = Funeka.



**Table 3.1** Distribution of writing samples of students

Students	Writing samples		
	First semester	Second semester	
	Pre-test (2 per student)	Pre-test (2 per student)	Post-test (1 per student)
Zoleka	X	X	X
Vincent	X	X	X
Bongani	X	X	X
Fourie	X	X	X
Nokuzola	X	X	X
Funeka	X	X	X

X = writing samples submitted

### 3.5.5 Unstructured interviews

Interviews allow the researcher to get the perspective of the individual who participates in a study with the assumption that this perspective is “... meaningful, knowable, and able to be made explicit” (Patton, 2002: 341). Unstructured interviews were utilised in this study where the purpose was to augment data that was collected from written texts by the students. In the interviews, the questions were open-ended allowing the students to do most of the talking in an effort to elicit their opinions and ideas (Cresswell, 2009). An additional purpose of using unstructured interviews was to minimize the disjunction

(see chapter 2) between the students and the lecturer who is also the researcher. The focus of the conversational nature of the interview was to probe the depth of the problems that students experienced when writing (Babbie, 2007). In a sense the interviews ensured the reliability of conclusions reached because they allowed for a comparison and verification of aspects of the collected data. The interviews were conducted in English (which as mentioned before is the second language for all the research subjects) in an informal, non-threatening but supportive atmosphere away from the lecture halls. In fact all the interviews were conducted over a cup of coffee in a students' cafeteria. In all the cases, the researcher noticed that initially the spontaneity of the interviews were marred by the fact that (a) the students were uncomfortable in answering questions in English and (b) the switching of roles from lecturer to researcher. With the researcher explaining the process and its ultimate goal however, all the students became more relaxed and comfortable.

Validity of the data generated from the interviews as well as the documents (writing assignments) was established by providing evidence in the form of quotations. Quotations supply the reader with a closer look at the subjects used in the study as well as the data that was generated from the writing assignments and “enables to show how the ideas or theories that were discussed are expressed by those you have studied” (Gibbs, 2007: 97).

### **3.6 DATA ANALYSIS**

To ensure that consistency was maintained in the research study the researcher used a taxonomy recommended for characterising difficulties in scientific English. For the purpose of clarification, taxonomy refers to a strict classification of items where the relationships between the subsets of the items are of equal significance (Gibbs, 2007). This taxonomy as in classifying writing strategies deals with issues relating to (a) lexical density and semantic discontinuity (Halliday, 1989); (b) semantic simplification and risk avoidance strategies (Chimbganda, 2000) as well as (c) coherence (Inglis et al., 2007). Lexical density refers to the average number of lexical words in a clause (Halliday, 1989). In fact it has been described as “... a measure of the proportion of lexical items (i.e. nouns, verbs, adjectives and some adverbs) in the text” (Johansson, 2008: 61). In this research study lexical density as defined by Halliday (1989) will be used. A lexical word is a word that ‘carries meaning’ compared to a functional word like ‘the’. The lexical density is calculated by dividing the number of lexical words in an extract by the number of clauses in the same extract. Semantic discontinuity is where the message of the written text is not clear to the reader. The reader is expected to supply logical connectors between chunks of information in order to arrive at a conclusion of sorts (Halliday, 1989). Semantic simplification is a strategy used by ESL learners where for the purpose of communication the message is simplified by either ‘expressing something else’ or by means of ‘ungrammatical uses’ (Chimbganda, 2000, p. 313). Risk avoidance strategies refer to the phenomenon where ESL learners either minimise or miss the intended communication goal or simply abandon it by avoiding the topic

(Chimbganda, 2000). Coherence of text can be explained as efforts such as the use of linking strategies used by ESL writers to construct meaning in order to make the text coherent to the readers (Inglis et al., 2007).

### **3.7 THE RESEARCHER'S ROLE**

The researcher is supposed to be an unbiased person who is bound by a code of conduct in a certain academic discipline that collects information for a particular purpose (Kumar, 2002). The role of this study's researcher as a teacher on the one hand and the researcher on the other overlapped at times. An important aspect here was that personal opinions and beliefs had to be separated from students' responses. In a sense objectivity was the main operational purpose for the collection of data (Kumar, 2002). This objectivity was critical in order not to compromise the reliability and the validity of the results of the research study. It is worth pointing out that the role of the researcher as a teacher who was also concerned about the performance and competence of the students in first year Life Sciences was to find ways to correct this. In fact the researcher noticed that certain students after repeated attempts to improve their performance admitted that they found it difficult to express information in English. This is what encouraged the researcher to investigate the language barriers that students experience when they had to write in English. In a way the researcher wanted to determine how the students made sense of the world as they saw it. The role of researcher brought an awareness of the problems students experienced and therefore a need to be more critical of the way in which content was explained, class notes were designed, as well as practical work

sheets, tutorials and tests were developed. This allowed the researcher to, on a daily basis, take stock of the language used in the learning material and to adapt this appropriately where necessary. All these efforts were carried out in an attempt to improve ESL students' performance in Life Sciences 1. It was therefore critical that a research study of this kind be carried out to find solutions to students' problems. With a great amount of confidence it can be said that the researcher, "has explained or described what [the researcher] has set out to describe and explain"(p.170) and by doing so has established the internal validity of the research process that was undertaken (Boeije, 2010). Possible relationships between medium of instruction, mother tongue, writing strategies and performance as proposed in the theoretical framework were established and in this way internal validity of this study was established.

### **3.8 ETHICAL CONSIDERATIONS**

One of the characteristics of qualitative research is that it "... incorporates informed consent decisions and is responsive to ethical concerns" (Denzin & Lincoln, 2000: 386). All the processes to be followed in the research study were explained to the students. When they indicated that they understood what was to be done and they were willing to participate the researcher introduced the according to consent forms. The consent form is regarded as a formal agreement on paper between the researcher and the respondents that their involvement in the research is voluntary and will do them no harm (Babbie, 2007). The respondents were also informed of the extent to which the information provided by them in the unstructured interviews will be utilised by the researcher to

achieve the purpose of the study (Kumar, 2002). The consent forms (see Appendix 1) were used to verify students' consent as well as their granting permission to use their writing assignments for the purposes of this study. The students' identities were also protected by using pseudonyms. This is a guarantee that the researcher who can trace a particular response to a particular respondent will not make such knowledge known to the public (Babbie, 2007). All these processes were carried out to ensure that the ethical aspects concerned with the appropriate use of information and correct reporting were taken care of (Kumar, 2002).

### **3.9 SUMMARY**

The focus of this chapter was to explain in detail the research design of the empirical study that was carried out. The research problem statement was investigated from which the research questions were stated. The qualitative approach was useful for the purpose of this study, i.e. to identify some of the writing strategies used by ESL students and how these writing strategies affect the performance of these students. The findings and interpretation of the results from the data-generating methods described will be discussed in detail in the next chapter to determine whether the research questions were answered or not.

## **CHAPTER 4**

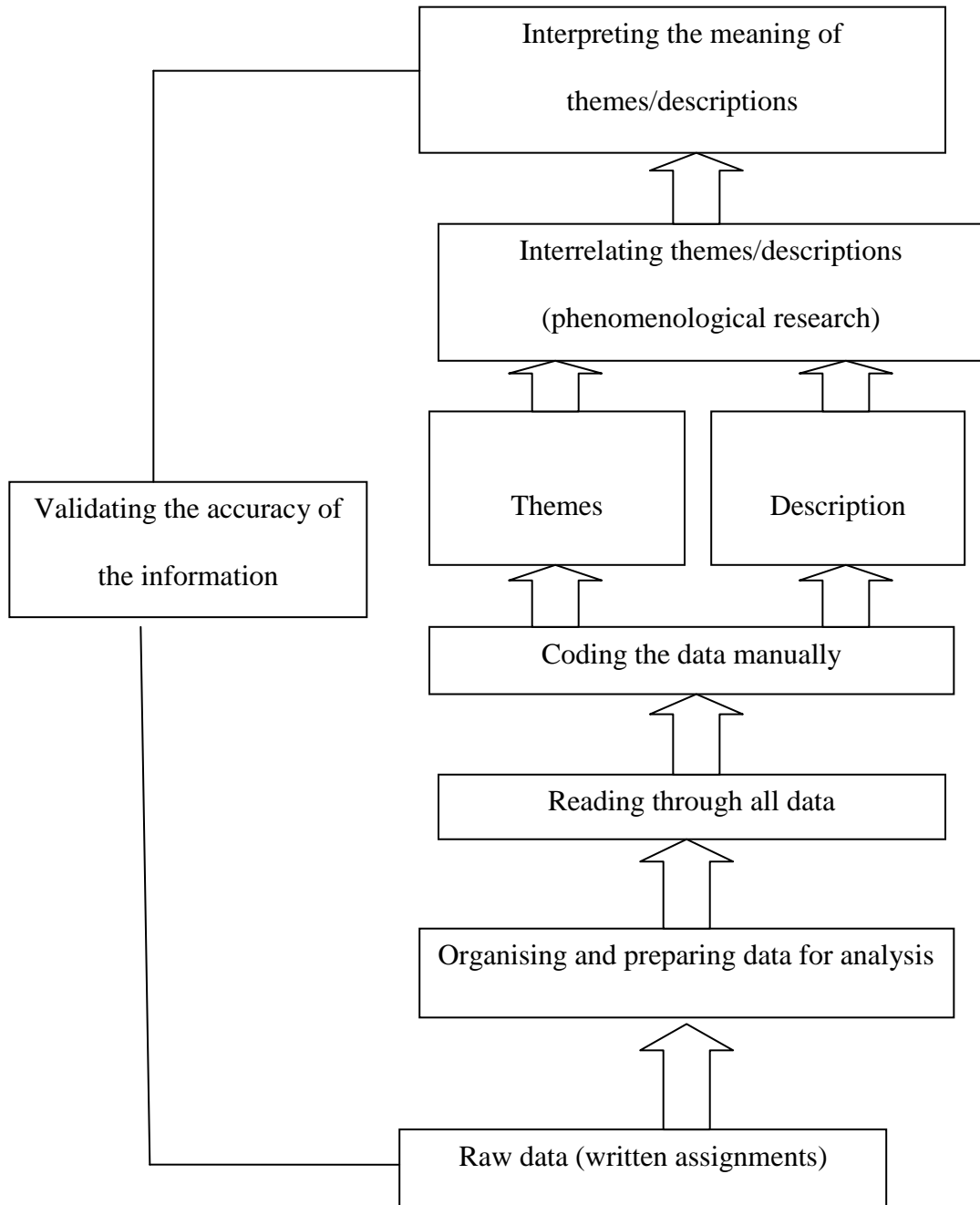
### **DATA ANALYSIS**

#### **4.1 INTRODUCTION**

In the previous chapter the research methods to be followed to collect data and further analyse it, were described. It was indicated that qualitative data was collected with the primary aim of identifying the problems that ESL students in first year Life Sciences experience when writing scientifically. In qualitative research which is based on events and persons that are observed the collection and the analysis of data run concurrently (Cresswell, 2009). An advantage of this method is the fact that as data is analysed patterns or trends unfold which can then be categorised to clarify the phenomenon under investigation (Babbie, 2007).

This chapter is divided into three sections. The first section describes and summarises the main results that were obtained (presentation of results). The second section deals with the discussion of the results in which the main trends and patterns with reference to the data are discussed. The third section consists of the conclusion of the interpretations in which the positive and negative aspects of the results are highlighted (Mouton, 2001). The procedure for the data analysis of this study is based more or less on the steps as illustrated in Figure 4.1 adapted from Cresswell (2009).

Figure 4.1 An illustration of the steps followed in the analysis of data (p. 185)





## **4.2 RESULTS**

### **4.2.1 Student information**

Information about the students was gathered from the unstructured interviews and the student records. This information assisted greatly in understanding where the students come from and ultimately this was reflected in their writing activities. Initially a description of the different students is detailed in order to provide a contextual basis of who they are and in a sense why the findings about them are as they are. The students are given pseudonyms in this study, for example student A = Zoleka, B = Vincent, C = Bongani D = Fourie, E = Nokuzola and F = Funeka. This is because they were promised that information they provided would strictly be utilised for research purposes in which case their names would not be revealed. The student details are followed by a description of different activities that they participated in.

#### ***4.2.1.1 Student A***

Zoleka a 19 year old female comes from a rural area in the Eastern Cape. She obtained a D- symbol (50% - 59%) in Life Sciences in matric. The medium of instruction in high school was English although she admits that very often the teaching was done in Xhosa which is her mother tongue. Her formal experience of writing in English as a second language at school was limited to essays, letters, prescribed literature books and comprehension exercises as dictated by the syllabus. No cross-curricular integration of English Second Language with other content subjects occurred. She was also comfortable with the idea that all the lectures in first year Life Sciences and other

subjects will be taught in English. Since English is not her mother tongue she indicated that she will improve on it by going for extra lessons.

#### ***4.2.1.2 Student B***

Vincent an 18 -year old male hails from a semi-urban area along the West Coast of the Western Cape. In matric he obtained a D- symbol (50% - 59%) for Life Sciences. His mother tongue is Afrikaans which was also the medium of instruction of his whole school career. Writing experiences in English Second Language at school level were limited to essays, letters, comprehension exercises, summaries of prescribed books and model answers to question based on the prescribed books. There was no linkage ever made between English Additional Language and the other school subjects. In spite of his limited exposure to English he was quite comfortable to be taught in English in first year Life Sciences. In this regard he indicated he wanted to “... educate learners around the world”. His idea of improving his English was to put in extra time and to work hard.

#### ***4.2.1.3 Student C***

Bongani is a 19 -year old male from Khayelitsha, a township on the Cape Flats in Cape Town. He obtained an E-symbol (40% - 49%) for Life Sciences in matric. His mother tongue is Xhosa and his medium of instruction at school level was English. At times the content was explained in Xhosa by some of the subject teachers. Like students A and B his writing experiences in English were dictated by what was prescribed by the language syllabus. Communication in English was limited to the transfer of the content in the form of copying notes from the board. In spite of these limitations, he admitted to being

comfortable with English as medium of instruction in first year Life Sciences at university. According to him he would improve his communication in English by “listening to the lecturer”.

#### ***4.2.1.4 Student D***

Fourie is a 20-year old Afrikaans-speaking male from a rural town in the Western Cape. In matric he obtained an E-symbol (40 -49%) in Life Sciences. His school - and home environment were dominated by Afrikaans. He was quite comfortable with the medium of instruction being English in first year Life Sciences even though his writing experiences in English at school level were limited to essays, letters, comprehension exercises and prescribed literature books. Reading of the prescribed literature books was the only English reading that was done outside of the classroom. His idea of improving his command of the English language was to speaking it every day as often as he can.

#### ***4.2.1.5 Student E***

Nokuzola, is a 20-year old Xhosa-speaking female from Langa, a township in Cape Town. She obtained a D-symbol (50 – 59%) in matric Life Sciences and was taught in English for her entire school career. This was also the reason why she was comfortable with English as medium of instruction in first year Life sciences but added that even though she was comfortable, it was of a forced nature. Her command of English though was poor and she ascribed it to the fact that they were allowed in school to answer in Xhosa even if the teacher spoke English. Similar to the other students she only exercised writing in English in school when it came to meeting the expectations of the subject,

English Second Language. She planned to improve her English by reading books and newspapers and by communicating as much as she can in English.

#### ***4.2.1.6 Student F***

Funeka is a 19-year old Xhosa-speaking female from the rural areas in the Eastern Cape. She passed matric Life Sciences with an E-symbol (40% -49%). The reason she gave for being comfortable to be taught in English in first year Life Sciences is that she understands English better than Afrikaans and because she was taught in English in all her school subjects. Writing in English at school level was also limited to essays, letters, comprehension exercises and answering questions based on the prescribed literature books. Her idea of improving her command of the English language is to check the meaning of as she put it “ununderstandable words” in the dictionary.

### **4.2.2 Nature of the writing activities**

#### ***4.2.2.1 Tests***

Tests form part of the continuous assessment activities in first year Life Sciences. Students write the tests in a formal environment under examination conditions. They have to rely only on their recall, memory, comprehension and retention skills in order to answer the questions. No assistance from outside sources like textbooks and class notes are allowed. In both tests used in this study only one question per test was singled out. The questions were selected on the basis of their suitability to answer the research questions.

#### 4.2.2.2 Activity 1: March test

This was the first test that the students wrote at the end of the first term in March 2008. Using the answers to all the questions that the students wrote as part of the methodology and the analysis would have been a very cumbersome task. Therefore the answer to one question was singled out to be used for research purposes. The question was:

***Why do you think the light intensity has little effect on the yield of grapes at 10°C? (2)***

The correct answer to this question would typically be:

**Slow rate of photosynthesis at low temperatures/No carbohydrates or sugars formed at low temperatures**

Table 4.1 shows the answers the different students gave. The table reveals that the students did not have an idea of the correct answer to the question.

**Table 4.1** Answers provided by the six students on the question on light intensity

Student	Answer	Score
Zoleka	Number of growing grapes at both low and high light intensity is concetant [sic] it's the same	0
Vincent	The light intensity don't have an effect on the grapes at 10°C	0
Bongani	it give it chlorophyll from the sun	0
Fourie	both high and low are the same	0
Nokuzola	Because higher temperature encourage grapes to become sweeter	0
Funeka	Because both grape producer produce the same amount of grapes	0

#### ***4.2.2.3 Activity 4: October test***

This test was written in the fourth term and was the last assessment activity for the year. The question chosen was of the same weight as the one in the March test in order to compare the rate at which the students have developed in terms of their writing abilities. The expectation is also there that students will do better since they have been subjected to a teaching programme for the last ten months. This time the students were asked:

***Write your own view or opinion on the use of DDT to prevent further (5) spreading of malaria.***

A correct answer to this question would typically be as shown below and any 5 facts would be acceptable:

- DDT not biodegradable and lands in soil water
- absorbed by roots of plants
- green plants are the first trophic level in food chain
- thus DDT will accumulate in tissues of animals/herbivores that feed on plants
- and the carnivores that feed on those herbivores
- at each higher level of the food chain the DDT level is more concentrated
- and level of contamination with DDT is increased
- mosquitoes can also build up resistance to DDT
- and those that survive might render offspring which is totally resistant to DDT

Table 4.2 shows the answers students gave on the use of DDT to prevent the spreading of malaria. It may be observed from the table that only Student B did give a substantial and coherent correct answer to the question.

**Table 4.2** Answers provided by the six students on the question on the use of DDT

Student	Answer	Score
Zoleka	cover his body	0
Vincent	I think that DDT should not be used because this drug kills other organism as well in the food chain. When spreading this drug some of the parasite can survives and build up resistans against this drug and the other drugs as well and the cycle go's on.	3
Bongani	You must wear the safely clothes in order to prevent malaria You must eat health food to get healthy body You have to avoid to mix your blood with somebody who already infected	0
Fourie	Every South African should be injected with DDT. Just to prevent this disease to increase. This is a harmful and deadly virus. The government should take responsibility to provide DDT to the people. There are a lot of foreigners coming to South Africa.	0
Nokuzola	clean the dam cutting down of trees keey(sic) your place clean	0
Funeka	The DDT is used to kill the Anopheles malaria in South Africa. If the DDT doesn't work the government will provide more of it to kill the anopheles. If we could not use DDT the environment will be damage. More use of DDT will make the leftover anopheles to be dead.	0

### 4.2.3 Tutorials

Tutorials like tests, form part of the continuous assessment activities in first year Life Sciences. The tutorials were done in a relaxed atmosphere where students had access to textbooks, class notes and assistance from the lecturer and the student assistants. Only one question that fits the purpose of this research study was selected from each tutorial.

#### 4.2.3.1 Activity 2: Tutorial 1

This tutorial was done in the second term. Here the question the students had to answer was: *The diagram below is a simplified representation of the oxygen cycle in nature. Describe this cyclic maintenance process by starting with “oxygen in the air...” (15)*

In allocating the 15 marks, students were to get a maximum of 12 marks for a comprehensive answer full of facts. The rest of the 3 marks depended on the synthesis of the answer. For instance, the marks varied in the order of, logical and complete = 3 marks; logical but incomplete = 2 marks; no logic with few correct facts = 1 mark. Here the expected answer was:

- oxygen in the air constitutes/makes up  $\pm$  21% of the atmosphere
- used for combustion/burning of fossil fuels like wood, coal, petroleum and oil
- also used for the oxidation of glucose in plant cells during respiration
- and also for the oxidation of glucose in animal cells during respiration
- during combustion and respiration in both plant and animal cells carbon dioxide is released
- carbon dioxide makes up 0.03% of the gases in the atmosphere



- during photosynthesis carbon dioxide is used /taken up /absorbed for the synthesis of carbohydrates in green plants
- oxygen is formed as a by-product during photosynthesis and is released into the atmosphere

Table 4.3 shows the answers students gave on the description of the cyclic maintenance process. In this case Student B provided a comprehensive and substantial answer to the question. In terms of the synthesis, no student provided a logical and complete answer worth a maximum of 3 marks.

**Table 4.3** Answers provided by the six students on the question on the description of the cyclic maintenance process

Student	Answer	Score
Zoleka	<p>Oxygen in the air (<math>\pm 21\%</math>)</p> <p>The burning combustion of wood , coal, petrol and oil leads to the release of O</p> <p>Oxidation of glucose in plant cells during respiration 0.03% of carbon dioxide is given off</p> <p>Carbon dioxide is also needed in the process of photosynthesis in green plants, therefore oxygen is released during photosynthesis</p> <p>Due to the respiration process oxidation of glucose in animal cells carbon dioxide is given off in the air</p>	

Animals use the oxygen in the air during respiration

Plants and animals both uses Oxygen in the oxidation process of glucose in the cells

Respiration is taking place in both plant and animal cells

6 + 1

---

Vincent O<sub>2</sub> is a gas that takes up  $\pm 21\%$  of the gas in the atmosphere. In the years the amount of O<sub>2</sub> in the atmosphere has decreased.

Photosynthesis releases O<sub>2</sub> that is used up by respiring organisms during the combustion of energy burning e.g. wood, coal, petrol and oil. Carbon dioxide is released in the air which contain (0.03%) of the gas in the atmosphere. O<sub>2</sub> is used by plant cells and animal cells for respiration and back to carbon dioxide. During this process photosynthesis is made use of for green plants. O<sub>2</sub> is released back into the air.

8 + 2

---

Bongani Oxygen ( $\pm 21\%$ ) is necessary in the non living things like wood, coal, petrol and oil, in the process of burning combustion. Also oxygen in air is necessary as oxidation of glucose in plant/animal cell in the form of respiration.

Carbon dioxide is also important for carbohydrates in green plants in the form of photosynthesis, where buy plant use CO to breathe. CO is necessary to all products of photosynthesis. As the CO, oxygen is used by the animals to breath so he can survive.

This cycle is about the living and nonliving things where by they use oxygen and carbon dioxide in the ~~from~~ form of respiration and photosynthesis.

4 + 0

---

Fourie Oxygen is made up of +-21% in the air.

It is taken up or used by burning

It releases carbon dioxide or given off

Oxygen in the air is also taken up or used and releases oxidation of glucose in animals cells in respiration.

Oxygen in the air is also taken up by oxidation of glucose in plant cells in respiration

through respiration photosynthesis and synthesis of carbohydrates in green plants takes place

The product of photosynthesis is taken up (used) again by the oxygen in the air.

4 + 0

---

Nokuzola Oxygen linked to the carbon dioxide.

photosynthesis releases oxygen that is used up by respiring organisms during the combustion of energy-rich carbon-containing compound.

The amount of oxygen released during photosynthesis is directly proportional to the amount of carbon fixed into organic compound.

The concentration of oxygen in the atmosphere increases as the

quantity of organic material in living organisms and in fossil fuels increase.

The amount of oxygen in the atmosphere has steadily increased over the years and had an important and continuing influence on the evolution of early life forms.

In recent years the concentration of oxygen in the atmosphere has decreased because of the continuous combustion of fossil fuels for energy purposes.

This however does not have a significant effect on living organisms. 6 + 1

---

Funeka	<p>Oxygen is release during photosynthesis and is being used up for respiration during the combustion of energy-rich carbon.</p> <p>Oxygen when it is released during photosynthesis it is proportional to the carbon fixed into compound.</p> <p>The amount of oxygen in the atmosphere increases the quantity of organic material in living organisms and fossi fuel increase.</p> <p>In previous years the oxygen in the atmosphere has decreased because of combustion of fossil fuels for energy purposes</p> <p>Oxygen plays a major role in the respiration because respiration give off the carbon dioxide in respiration</p> <p>The living organism and non living organisms needs oxygen carbon nitrogen for their survival</p> <p>The decaying produced CO<sub>2</sub> when the oxygen is present</p>	3 + 0
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#### 4.2.3.2 Activity 3: Tutorial 4

Here the question the students had to answer was: *How do high levels of carbon dioxide lead to global warming?(4)*

A correct expected answer to this question was:

**It acts like a blanket and prevents heat from escaping into space.**

Table 4.4 shows the answers students gave on the question on high levels of carbon dioxide. It is observable that Student B once more provided a correct answer to the question. This time however Student D also provided a correct answer.

**Table 4.4** Answers provided by the six students on the question on high levels of carbon dioxide

Student	Answer	Score
Zoleka	Because higher percentage of air in the atmosphere is carbondioxide. 20% of it is being made by man.	0
Vincent	The increase in carbon dioxide led to global warming. Carbon dioxide is transparent to light but rather opaque to heat rays. CO act like a blanket and prevent heat from escaping into space.	4
Bongani	Up to 80 % of ecosystems could lose animals & plant species if the carbon dioxide level doubles in the next 100 years. Species could become extinct. An example is the reefs, which are very sensitive to increased water temperatures.	

	So in addition, the warming could lead in certain species expanding their habitat ranges, including mosquitoes that carry malaria.	0
Fourie	These gases act like a blanket and prevent heat from escaping into space.	4
Nokuzola	Scientists think that this will lead to higher global temperatures, causing sea levels to arise as a result of ice melts in the Arctic and Antarctic.	0
Funeka	It causes sea level to rise as a result of ice melts in the Arctic and Antarctic, The changes in climatic pattern could cause intense storms and prolonged droughts.	0

#### 4.2.4 Performance of students in writing activities

**Table 4.5** Breakdown of the students' performance in answering one question for each activity in the pre-test phase

Student	Performance (%)			
	1	2	3	4
Zoleka	0	47	0	0
Vincent	0	67	100	60
Bongani	0	27	0	0
Fourie	0	27	100	0
Nokuzola	0	47	0	0
Funeka	0	20	0	0

Table 4.5 shows the breakdown of the students' performance in answering the four questions (one question per activity). As stated in the description of the sample, all the students are poor performers and therefore the information in the table just serves to confirm that throughout the year their overall performance was poor. Writing activities 2 and 3 were tutorials in which they had access to class notes and text books in order to answer the questions. The nature of the questions also differed. In Activity 2 (Tutorial 1) they had to describe a cycle from a given diagram whereas in Activity 3 (Tutorial 4) an explanation of what a greenhouse gas is had to be given using information from an accompanying passage. Activities 1 and 4 were both formal tests - that were carried out at the end of the first term and the fourth term respectively - where they had to rely on their retention-, memorising- and application skills in order to answer the questions. Since it was found that the identified main writing strategies were present in the answers of all the students, the next step will be to look at the frequency of these sub-strategies of each main writing strategy in all four activities.

**Table 4.6** Breakdown of the students' performance in activity in the post-test phase

<b>Student</b>	<b>Performance (%)</b>
Zoleka	52
Vincent	50
Bongani	56
Fourie	87
Nokuzola	58
Funeka	53

Table 4.6 shows that in the post-test phase the students fared much better than they had in the pre-test phase. This suggests that there was a better understanding in answering the different questions they were asked to respond to.

### Writing strategies of students

**Table 4.7** Scoring of writing strategies

MAIN WRITING STRATEGY	SCORE
Lexical density	High (>6)
	Low (0-6)
Coherence	Good
	Little or no attempt
Semantic discontinuity	Evident
	Not evident
Semantic simplification	Something else
	Ungrammatical
Risk avoidance	Topic avoidance
	Message reduction



As stated in Chapter 3 the concrete terms, i.e. the manifest content is coded as it is collected from the students in the form of written assignments. Codes were predetermined based on earlier research done by experts in the field of English second language speakers and how they write. The written assignments of the students were coded manually – a time-consuming process that involves great effort (Cresswell, 2009) since the original handwritten texts of the students did not allow for the use of computer software.

The writing activities used in the study were representative of the year's work – ranging from the first test of March to the final October test with the tutorials being done in May and July. Certain questions which best fit the purpose of the study were singled out in each of the writing activities. The answers to these questions were then coded manually in order to record the writing strategies employed by the students and then scored according to the taxonomy that was described in Chapter 3. The writing strategies identified were lexical density, coherence, semantic discontinuity, semantic simplification and risk avoidance. For the purpose of the study each writing strategy was then scored (see Table 4.7). The names used in the taxonomy of the writing strategies and the scores are drawn from the research done by other researchers in the field (Chimbganda, 2000; Halliday, 1987; Inglis et al., 2007).

#### **4.2.6 Lexical density**

Lexical density is determined by dividing the number of lexical words by the number of clauses – a clause is indicated by [ ] and the lexical words are printed in bold as shown

in the first answer in the Table 4.8 The lexical density for the first answer (Fourie) is therefore calculated as follows:

Lexical density = number of lexical words divided by the number of clauses

$$= 7 \div 2$$

$$= 3,5 \approx 4$$

According to Halliday (1993) lexical density of the spoken word is much lower than that of the written word. He elaborates further by distinguishing between lexical density in formal writing is usually between four and six. For scientific writing it can be as high as

**Table 4.8** Lexical density used in the answers of some of the students

Student	Sentence	LW	C	LD
		(N)		
Fourie	[These <b>gases act</b> like a <b>blanket</b> ] and [ <b>prevent heat</b> from <b>escaping</b> into <b>space</b> ]. (CORRECT ANSWER)	7	2	3.5≈4 (LOW)
Bongani	Up to 80 % of ecosystems could lose animals & plant species if the carbon dioxide level doubles in the next 100 years. Species could become extinct. An example is the reefs, which are very sensitive to increased water temperatures. So in addition, the warming could lead in certain species expanding their habitat ranges, including mosquitoes that carry malaria (WRONG ANSWER)	32	5	6.4≈6 (LOW)
Vincent	O <sub>2</sub> is a gass that takes up ± 21% of the gass in the atmosphere. In the years the amount of O <sub>2</sub> in the atmosphere has decreased. Photosynthesis releases O <sub>2</sub> that is used up by respiring organisms during the combustion of energy burning e.g. wood, coal, petrol and oil. Carbon dioxide is released in the air which contain (0.03%) of the gass in the atmosphere. O <sub>2</sub> is used by plant cells and animal cells for respiration and back to carbon dioxide.	54	7	7.7≈8 (HIGH)

	During this process photosynthesis is made use of for green plants. O <sub>2</sub> is released back into the air. (MOSTLY CORRECT ANSWER)			
Nokuzola	Scientists think that this will lead to higher global temperatures, causing sea levels to arise as a result of ice melts in the Arctic and Antarctic. (WRONG ANSWER)	14	2	7 (HIGH)

Note: LW = Lexical Words, C = Clauses, LD = Lexical Density

thirteen (Halliday, 1989). In this study that is focused on scientific writing, lexical density was classified as low if it is 6 and lower or high lexical density if it was more than 6. Table 4.8 provides examples using students; B = Vincent, C = Bongani D = Fourie, E = Nokuzola.

When comparing the use of high and low lexical density to the correctness of the required answer it becomes clear that lexical density is not actually a measure of the performance of the students. In the case of the example of a low lexical density as an indicator, the answer provided by Fourie with a low lexical density of 4 was correct and the answer by Bongani with a low lexical density of 6 was also wrong. In another example the answer given by Vincent with a high lexical density of 9 was correct while the answer by Nokuzola with a high lexical density of 7 was wrong.

**Figure 4.2** Distribution frequency of lexical density in writing activities

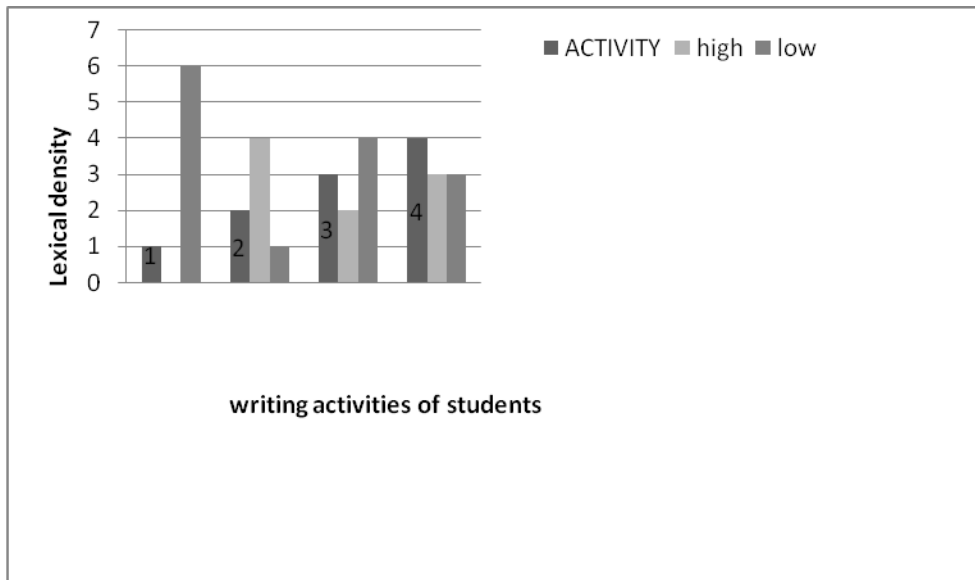


Figure 4.2 illustrates the use of lexical density in the writing activities 1 to 4. In activities 1 and 2 the majority of the students namely five out of the six displayed high lexical density with only one student featuring low lexical density. However in activity 3 only two of the six students showed high levels of lexical density and the remaining four had low lexical density levels. In activity 4 the picture is totally opposite from activities 1 and 2, with only one student displaying high lexical density and the remaining five students displaying low lexical density.

#### 4.2.7 Coherence

Coherent writing was determined by the use of logical connectors. This entailed students linking their thoughts on paper in such a way that it made logical sense. So, their writings should reflect a semblance of order when describing a process or when they have to give their own opinion on a certain phenomenon. In this study, the coherence of their written answers was classified as:

*Good* the answer made sense and there was logical order in the arrangement of their ideas

*Little or no attempt* there was no logical order and ideas were written in a haphazard way

Examples regarding this analysis are depicted through responses by Vincent and Funeka. In this case an illustration of coherent writing is provided. For instance Vincent wrote coherent sentences although the answer for the first part was wrong (see Example 1). On the other hand, an answer by Funeka as well as Zoleka is used to illustrate *little or no attempt* in terms of coherence as shown in Example 2.

#### EXAMPLE 1 (Vincent)

Student	Sentence	Coherence
Vincent	The light intensity don't have an effect on the grapes at 10°C (WRONG ANSWER)	Good
Vincent	The increase in carbon dioxide led to global warming. Carbon dioxide is transparent to light but rather opaque to heat rays. CO act like a blanket and prevent heat from escaping into space. (CORRECT ANSWER)	Good

#### EXAMPLE 2 (Funeka & Zoleka)

Student	Sentence	Coherence
Funeka	Because both grape producer produce the same	little or no attempt

---

amount of grapes

(WRONG ANSWER)

Zoleka Number of growing grapes at both low and high little or no attempt  
light intensity is concetant [sic] it's the same.

(WRONG ANSWER)

---

Vincent displayed good coherent writing in both cases, but one answer was wrong and the other one was incorrect. However Funeka's incorrect answer showed that she made little or no attempt to write coherently. Similarly Zoleka wrote an incorrect answer with little or no effort to write coherently.

**Figure 4.3** Distribution frequency of coherence in writing activities

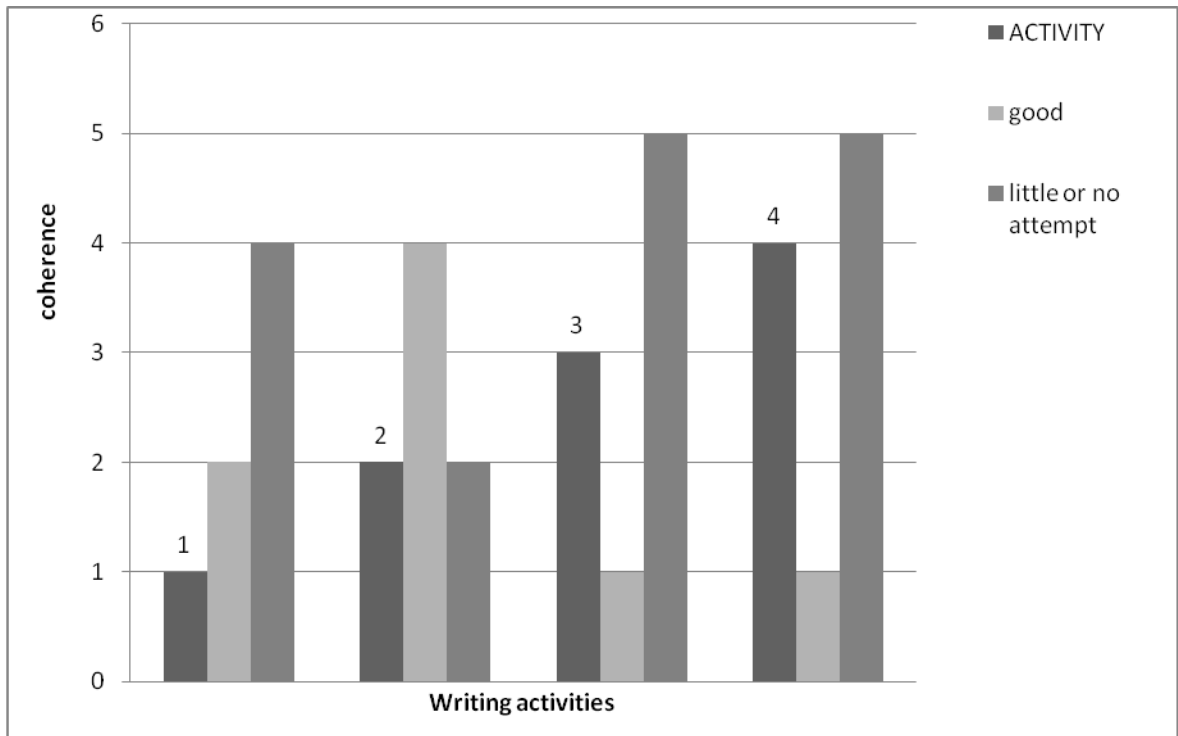


Figure 4.3 illustrates the ability of the students to write coherently. The use of coherence shows quite an interesting pattern with the same trend present in activities 3 and 4. In both these cases only one student wrote the answer in a coherent manner and the rest of the group, i.e. the majority made little or no attempt to write coherently. For activity 1, two of the students mastered the skill of coherent writing whereas the other four did not display the same mastery of coherent writing. In activity 2 the numbers for good and poor coherent writing have swapped from what it was in activity 1 – four students displayed good coherence with the other two displaying lack of coherent writing.

#### 4.2.8 Semantic discontinuity

As stated previously in Chapter 3, semantic discontinuity occurs when the message of the written text is not clear to the reader. The reader is expected to supply logical connectors between chunks of information in order to derive at a conclusion of some sorts (Halliday, 1989). Semantic discontinuity is classified as being evident or not evident based on whether the intended message is communicated clearly or not to the reader. In example 1, here semantic discontinuity is illustrated through responses by Vincent and Nokuzola. It is worth noting that the answers by both students convey a clear message. In fact logical connectors like *BECAUSE*, *AS WELL*, *WHEN* and *AS A RESULT OF* are used to connect important facts or phrases in such a manner that the reader has a clear idea of why DDT should not be used. The correctness of the answers was not the issue or unit of analysis in this case. Importance was rather placed on whether semantic discontinuity was evident or not.

##### EXAMPLE 1 (Vincent & Nokuzola)

Student	Answer	Semantic discontinuity
Vincent	I think that DDT should not be used because this drug kills other organism as well in the food chain. When spreading this drug some of the parasite can survives and build up resistans against this drug and the other drugs as well and the cycle go's on.	not evident



---

(CORRECT ANSWER)

Nokuzola Scientists think that this will lead to higher global temperatures, causing sea levels to arise as a result of ice melts in the Arctic and Antarctic. not evident

(WRONG ANSWER)

---

Regarding semantic discontinuity, Vincent wrote a correct answer in which semantic discontinuity was not evident. This student made use of logical connectors like *BECAUSE*, *WHEN* and *AS WELL* to link his ideas in a logical structured manner. The answer provided by Nokuzola for instance was wrong while semantic discontinuity was not evident. The words *CAUSING* and *AS A RESULT OF* were used to connect ideas in a sensible and meaningful way. In the same vein with respect to the answer given by Fourie, this was incorrect however semantic discontinuity was also evident. Each sentence consisted of a separate piece of information that did not relate to each other adding to the incorrectness of the answer.

EXAMPLE 2 (Fourie)

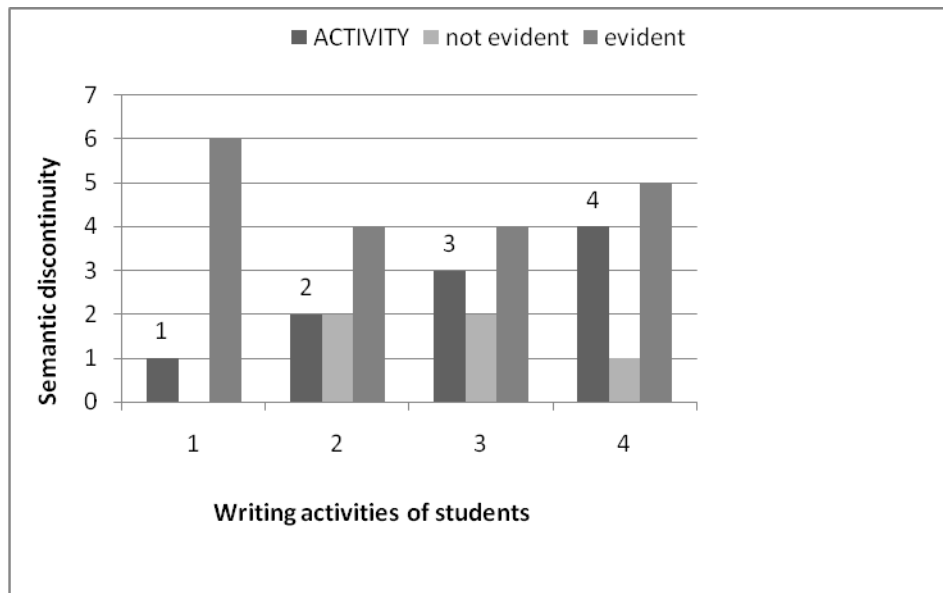
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Student	Answer	Semantic discontinuity
Fourie	Every South African should be injected with DDT.  Just to prevent this disease to increase. This is a harmful and deadly virus. The government should take responsibility to provide DDT to the people. There is a lot of foreigners coming to South Africa.  (WRONG ANSWER)	Evident

---

Example 2 which illustrates an instance of the evidence of semantic discontinuity was written by Bongani. In his wrong answer the sentences have a totally different meaning. None of the sentences relate to each other and there are no logical connectors that link these separate chunks of information. Semantic discontinuity is very evident in this case. Once more it is important to note that in the analysis the fact that the answer was wrong was not really material.

**Figure 4.4** Distribution frequency of semantic discontinuity in writing activities



In Figure 4.4 semantic discontinuity as a writing strategy of the students is displayed. Even though it was evident in all four activities, it was especially in activity 1, that students were inclined to leave out important parts of phrases or clauses that forced the reader to supply his own linkages in order to make sense of what the students are expressing. In activities 2 and 3 two of the six students wrote sensibly. In activity 4 only one student did not display semantic discontinuity.

#### **4.2.9 Semantic simplification**

For the purpose of this study the researcher used the classification of semantic simplification by Chimbganda (2000) that states that to simplify the message it is communicated either by ‘expressing something else’ or by means of ‘ungrammatical uses’ (p. 313). For illustrative purposes two examples are provided. The first example

was an answer by Fourie while the second example carries an answer by Funeka. In terms of semantic simplification, the answer by Fourie was found to contain ‘*ungrammatical uses.*’ The answer by Funeka on the other hand, was classified to be ‘*expressing something else.*’

EXAMPLE 1 (Fourie)

Student	Answer	Semantic simplification
Fourie	<p>Oxygen is made up of +-21% in the air.</p> <p>It is taken up or used by burning</p> <p>It releases carbon dioxide or given off.</p> <p>Oxygen in the air is also taken up or used and releases oxidation of glucose in animals cells in respiration.</p> <p>Oxygen in the air is also taken up by oxidation of glucose in plant cells in respiration through respiration photosynthesis and synthesis of carbohydrates in green plants takes place</p> <p>The product of photosynthesis is taken up (used) again by the oxygen in the air.</p> <p>(SCORED 4 MARKS OUT OF A TOTAL OF 15)</p>	ungrammatical uses

EXAMPLE 2 (Funeka)

Student	Answer	Semantic simplification
Funeka	<p>Oxygen is release during photosynthesis and is being used up for respiration during the combustion of energy-rich carbon.</p> <p>Oxygen when it is released during photosynthesis it is proportional to the carbon fixed into</p>	expressing something else

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compound.

The amount of oxygen in the atmosphere increases the quantity of organic material in living organisms and fossil fuel increase.

In previous years the oxygen in the atmosphere has decreased because of combustion of fossil fuels for energy purposes

Oxygen plays a major role in the respiration because respiration give off the carbon dioxide in respiration

The living organism and non living organisms needs oxygen carbon nitrogen for their survival

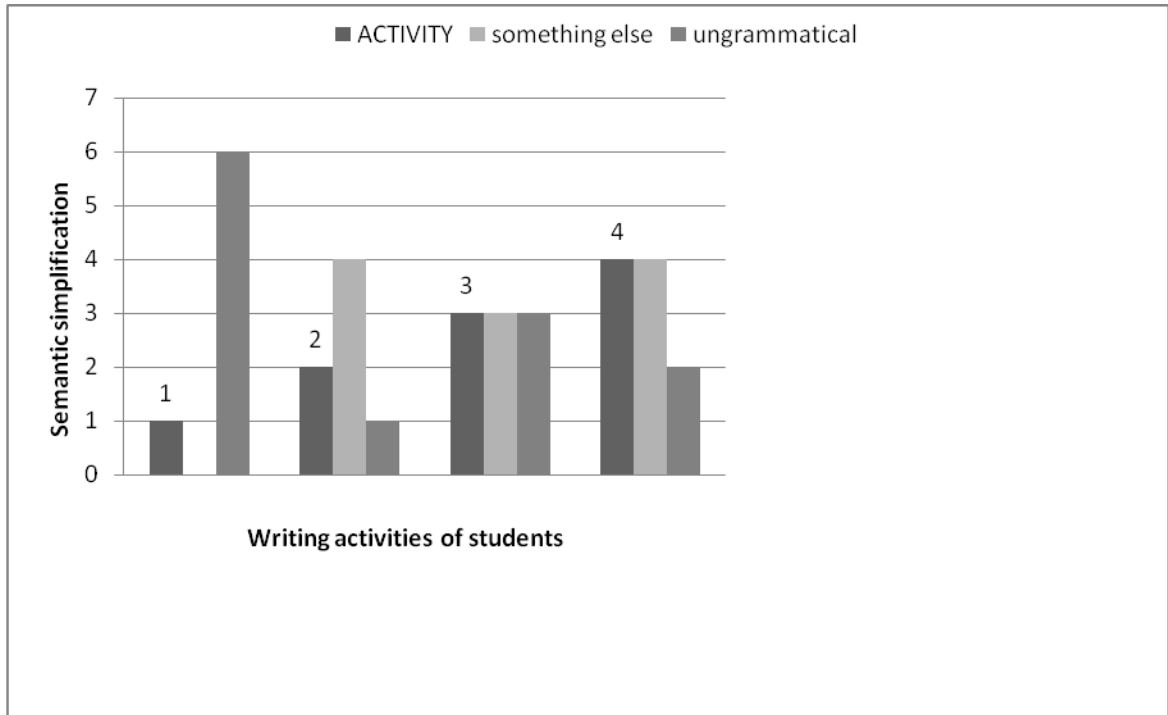
The decaying produced CO<sub>2</sub> when the oxygen is present

(SCORED 3 MARKS OUT OF A TOTAL OF 15)

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The relationship between semantic simplification and performance is illustrated by the two examples above. In example 1, Fourie opted for ‘ungrammatical’ uses such as ignoring the rules of grammatical concord, incorrect structure of sentences and spelling mistakes resulting in the scoring of poor marks. In example 2, Funeka was ‘expressing something else’ which appeared to be coherent and grammatically and factually sound, but it was something different from what was demanded by the question. This lead to the student scoring poor marks for this question.

**Figure 4.5** Distribution frequency of semantic simplification in writing activities



Semantic simplification in which students tried to cope by either *expressing something else* or by making use of *ungrammatical style* is illustrated by Figure 4.5. In activity 1 all the students wrote their answers in an ungrammatical fashion. In activity 2 one student scored a high mark and was competent enough and did not make use of either sub-strategy of semantic simplification. Four of the students did not answer the question pertinently but rather wrote something different and one student used ungrammatical language. In activity 3 there was a fifty - fifty split by the students in utilizing the sub-strategies. Activity 4 showed a similar trend like activity 2 with four students expressing something else instead of the required answer but with two students displaying ungrammatical language.

#### 4.2.10 Risk avoidance

The last main writing strategy that was singled out was risk avoidance which was expressed either by avoiding the topic or by reducing the message of the answer required by the question of the writing activities. Risk avoidance strategies refer to the phenomenon where the ESL learner either minimise or miss the intended communication goal or simply abandon it by avoiding the topic (Chimbganda, 2000). Risk avoidance is illustrated by the answers obtained from Bongani and Funeka.

##### EXAMPLE 1 (Bongani)

Student	Answer	Risk avoidance
Bongani	You must wear the safely clothes in order to prevent malaria  You must eat health food to get healthy body  You have to avoid to mix your blood with somebody who already infected  (WRONG ANSWER)	avoiding the topic

##### EXAMPLE 2 (Funeka)

Student	Answer	Risk avoidance
Funeka	The DDT is used to kill the Anopheles malaria in South Africa. If the DDT doesn't work the government will provide more of it to kill the anopheles. If we could not	message reduction

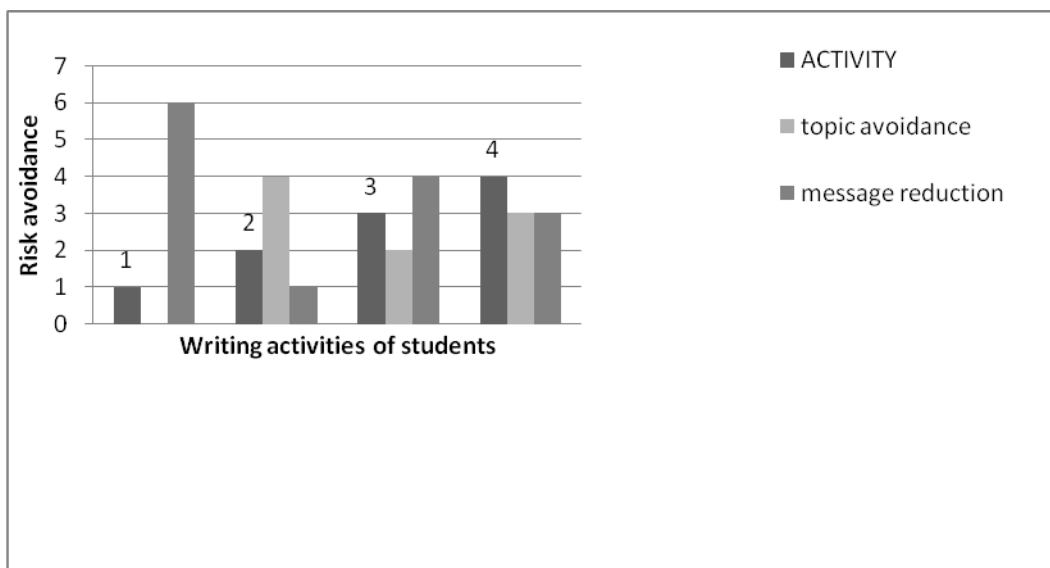
use DDT the environment will be damage. More use of DDT will make the leftover anopheles to be dead.

(WRONG ANSWER)

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The relationship between risk avoidance and the correctness of the answers was demonstrated by Bongani who wrote an incorrect answer that does not come close to what is required by the question, resulting in zero marks awarded. The answer by Funeka even though incorrect, contained some elements of the correct answer. This is a case of message reduction because the intended message was not communicated clearly.

**Figure 4.6** Distribution frequency of risk avoidance in writing activities



In activity 1 where students had to describe a cycle from a given diagram all the answers were not accurate enough resulting in the actual answer being diluted, i.e. message reduction. In activity 2 the majority of the students, namely four opted to avoid the topic and one student displaying message reduction. Only one student that scored high marks

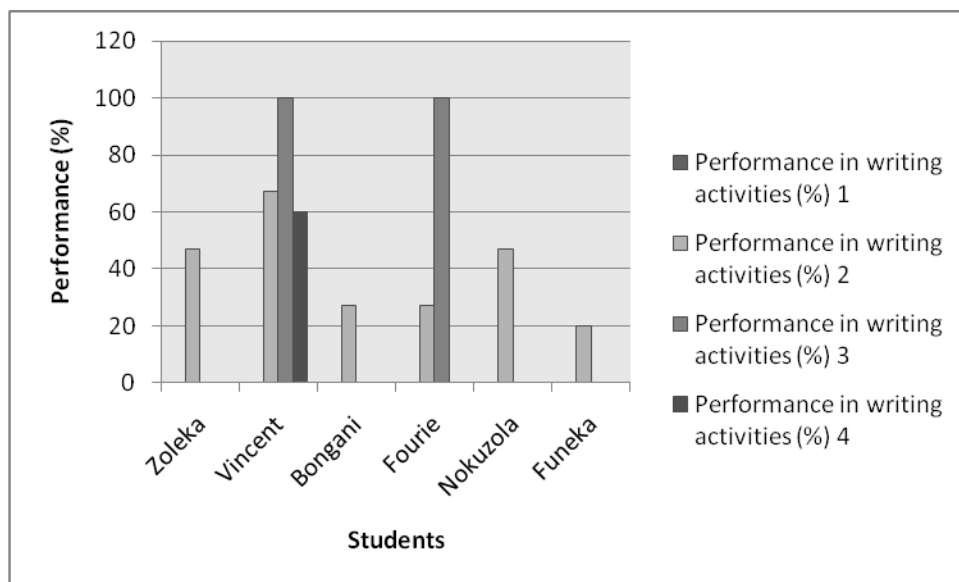


for his answer did not make use of risk avoidance in order to cope with English Second Language. In activity 3 two students made use of topic avoidance and the other four students favoured message reduction. The answers of activity 4 were again fifty– fifty for both topic avoidance (three students) and reduction of the intended message (three students).

#### 4.2.11 Performance of Afrikaans and Xhosa speaking students

Figure 4.7 illustrates the difference in performance between the students in the writing activities 1 to 4 indicated as series 1 to 4. Students Vincent (B) and Fourie (D) are Afrikaans speaking while Zoleka (A), Bongani (C), Nokuzola (E) and Funeka (F) are Xhosa speaking.

**Figure 4.7** Performance of Afrikaans and Xhosa speaking students in the writing activities



All the students performed poorly in Activity 1, i.e. scored nil. The trends displayed by the graph shows that Vincent performed overall the best of the group of six students scoring between sixty – and one hundred percent for activities 2 to 4. The other Afrikaans-speaking student, Fourie was the second best performer scoring one hundred percent in activity 3 and twenty seven percent in activity 2. The Xhosa-speaking students only scored marks in activity 2 with all of them scoring nil for all the other activities.

In the tests which were labelled activities 1 and 4 in this study, none of the students were able to supply a correct answer in both cases. Closer scrutiny of their written answers in both the activities revealed that in addition to them being incorrect, in most cases the answers were also written in such a way that they did not make sense. Therefore coupled with the poor performance were the poor scientific writing skills of these ESL students. By exploring the writing strategies employed by the students, one can possibly come across ways in which to improve their scientific writing skills that will eventually lead to an improvement in their performance in Life Sciences 1.

In Activity 2 only one student could describe the cycle with a fair measure of success, i.e. achieved more than sixty percent whereas two students scored just below average and the rest namely fifty percent of the group were incapable of doing so in a satisfactory manner. In Activity 3 only two students could explain what a greenhouse gas is whereas the rest of the group failed to come up with some kind of proper explanation.

### **4.3 DISCUSSION OF RESULTS**

Having explored the extent to which certain writing strategies were utilised by ESL students when writing scientifically in first year Life Sciences, it is necessary to interpret the close analysis in terms of the research questions that were posed at the beginning.

#### **4.3.1 Use of writing strategies**

The extent to which certain writing strategies were used was what the first research question dealt with. Content analysis of the data by the researcher has uncovered that which is subsequently described in an effort to answer this question.

If the ESL student is not familiar with scientific English it could be problematic for that student to acquire scientific knowledge and as such resort to the use of writing strategies in order to solve the problem. The writing strategy which has on average the highest frequency in all four activities was little or no attempt to write coherently. This was followed closely by evident semantic discontinuity. Semantic simplification with message reduction as a sub-strategy has the third highest frequency on average. Low lexical density (ranging from one to six students out of the total number of six) and ungrammatical uses in semantic simplification (also ranging from one to six out of the total number of six students) are equally the least used sub-strategies employed by the ESL students.

Semantic discontinuity was not evident in three of the four writing activities with a maximum number of two students displaying this writing strategy. High lexical density was displayed also in three of the four writing activities by two to four students out of the total number of six students. In all four activities good coherent writing was utilised by between one and four students out of the total group of six students. The students expressed something else when they made use of semantic simplification in three of the four writing activities and the frequency ranged from a minimum of two and a maximum of four out of the six students. Topic avoidance as evidence of risk avoidance was evident in three of the four activities with the number of students using it ranging from two to four students out of the total group of six.

The research subjects have convincingly displayed that the identified writing strategies, namely lexical density (Halliday, 2006), coherence (Katznelson, 2001; Inglis et al., 2007), semantic discontinuity (Halliday & Martin, 1993), semantic simplification (Chimbganda, 2000) and risk avoidance (Chimbganda, 2000) were used in varying degrees irrespective of the mother tongue. It became clear that the students used these writing strategies as conscious plans, systematic and/or conscious attempts and as systematic techniques (Bialystok, 1990; Chimbganda, 2000; Lin, 2007; Tarone, 1981) in order to cope with the communication problem they had to solve in a meaningful way when they had to answer the questions in the tests and tutorials. In doing so the grammatical rules of the medium of instruction, which is English second language, were not adhered to. As novice ESL writers the social and linguistic conventions of the scientific discourse community were disregarded (Siepmann, 2006) and the expectations

of the reader which in this case is the lecturer as well as the researcher were not met. This was evident in the inconsistent use of low and high lexical density, coherence that was mostly absent, the high frequency of semantic discontinuity, the answer was something else or ungrammatical as a result of semantic simplification and risk avoidance where the topic was avoided or the intended message was reduced.

#### **4.3.2 The role of mother tongue and the use of writing strategies**

The second research question was asked with regards to any differences in the extent to which the identified writing strategies were used by Afrikaans - and Xhosa speaking students when they write scientifically.

In response to this research question analysis of the data revealed that which is explained in the discussion that follows. With respect to the role of mother tongue and the use of writing strategies by the four Xhosa- speaking students and the two Afrikaans speakers it was found that each student used the strategies differently. These findings actually indicate that being from the same language background is not a guarantee that writing strategies would be similar. In order to facilitate a logical explanation I will discuss each group of mother tongue speakers under a separate heading.

##### ***4.3.2.1 Xhosa speaking students***

The findings presented here, in fact illustrate the differences among the Xhosa speaking students. Analysis of Zoleka's use of the selected writing strategies showed the following results: little or no attempt to write coherently, evidence of semantic discontinuity, mostly ungrammatical uses in semantic simplification and preferring

message reduction to topic avoidance in order to avoid risks; high and low lexical density were applied equally.

For Bongani there was no preference for high and low lexical density, good coherence was displayed in one activity only, the rest of the activities were characterised by little or no attempt to write coherently; semantic discontinuity was present in all the activities; expressing something else was preferred to ungrammatical use in all but one activity; likewise the topic was avoided in three out of the four activities in order to avoid risks.

With respect to Nokuzola high and low lexical density were present in a fifty-fifty manner as was similar for coherent writing that was good in two out of the four activities and little or no attempt was made to write coherently in the other two activities; in one activity semantic discontinuity was not evident but again the sub-strategies of semantic simplification and risk avoidance were present equally in all four activities.

Finally, for Funeka meanwhile high lexical density was present in all four activities, little or no attempt was made to write coherently; semantic discontinuity was also evident in all four activities; expressing something else was largely favoured to ungrammatical uses in semantic simplification; in one activity the topic was avoided compared to message reduction used in the other three activities.

#### *4.3.2.2 Afrikaans speaking students*

Similarly, the Afrikaans speaking students revealed differences between themselves. The analysis for instance indicated that Vincent displayed low lexical density in three out of the four activities; good coherent writing was practised in all the activities; semantic discontinuity was evident in only one activity; the sub-strategy of ungrammatical use in semantic simplification was practised in all the activities; in order to avoid risks message reduction was applied in all the activities. On the other hand Fourie had equal preference for high and low lexical density in all four activities; good coherent writing displayed in only one of the four activities; ungrammatical use also present in only one activity as is message reduction; expressing something else in two activities and topic avoidance also evident in two activities.

The difference in the extent to which some of the identified writing strategies were used can be attributed to the students' diverse language – and cultural experiences which is vital in making content accessible. To this end the model of Collier as cited by Katz et al. (2004) that places culture at the centre of the interrelationships between the linguistic, academic, cognitive and socio-cultural development of the ESL student is verified. On the surface it seems that there is no distinct pattern of differences in the use of the identified writing strategies between the two groups of mother tongue speakers. However on closer scrutiny it is obvious that good coherence and semantic discontinuity that is not evident are displayed mostly by the Afrikaans –speakers. What was therefore confirmed was the notion of Bialystok (2006) in Chapter 2 that if writing systems correspond such as Afrikaans and English, problem solving is enhanced that is the

writing task is executed successfully depending on how the writing strategies were used. For the rest of the writing strategies, i.e. semantic simplification and risk avoidance there are no convincing patterns as they are applied equally by both Afrikaans – and Xhosa- speaking students. Lexical density which is regarded as a measure of the level of scientific writing and which develops over time, was used inconsistently by both groups of mother tongue speakers. To this end it can then be contended with a fair degree of certainty that the Afrikaans- and Xhosa – speaking students used some of the identified writing strategies differently.

#### **4.3.3 Writing strategies, mother tongue and performance**

The aim of this study is captured in the third research question and this was to investigate the relationship between writing strategies utilised by the English Second Language students, poor performance in first year Life Sciences and mother tongue. The presence of the identified writing strategies - namely lexical density; coherence; semantic discontinuity; semantic simplification and risk avoidance – and the way in which they were used, highlighted the problems that the participating students experience when writing scientifically.

High lexical density was found to be present in their answers from the tutorials. In the tutorials students could make use of class notes and textbooks. This was the only activity in which all the students scored marks. These copied answers were written in scientific language which characteristically has high lexical density. This however was not by the design of the students but because the availability of the answers made it easy



for them to respond to the question. Of note is that the lower the lexical density the lower the marks that were scored by students. This was evident in the writing activities like tests where the students had to rely on their own linguistic proficiency in order to answer questions. Lexical density in this case is a good indicator of the level of scientific writing but not really of the level of performance of the students. This is because a wrong answer can also contain high lexical density. Another possible reason for poor performance even though the lexical density is high, could be that the scientific language that the student read in textbooks and notes is written in such a way that it creates what Halliday (1989) calls “a distance between reader and writer” (p.84) making the reading of scientific text a problem. That distance may mean that the explicit meaning of the text is lost to the ESL student so that misconceptions are formed. Such misconceptions may ultimately result in poor performance when the student has to reproduce the correct intended meaning of the particular text. In this sample lexical density could not be used to measure the level of scientific writing for the different mother tongue speakers, since both Xhosa- and Afrikaans speaking students made equal use of high and low lexical density. Likewise, as explained earlier, since lexical density cannot be used as a yardstick to measure performance in first year Life Sciences one also cannot use it as a measure to compare the performance of the two groups of mother tongue speakers.

Evident semantic discontinuity was utilised by all the students who scored low to zero marks in their answers. This writing strategy is compounded by the use of metaphorical language which is popular with scientific writers who as specialists are able to infer the

meaning of phrases that contain separate chunks of information. For ESL students however it is a nightmare because they have to rely on the availability and expertise of the lecturer to point out or clarify the intended meaning of text written in this way in their textbooks. In the absence of such an expert these students fail to comprehend and communicate their knowledge in a meaningful way. In the same vein, semantic discontinuity is not evident in the written answers of those students who scored good marks. The necessary links and logical connectors were used to string ideas together in a logical and sensible way. Thus semantic discontinuity if it occurs definitely has a negative impact on performance in Life Sciences. This is further corroborated by the fact that the Afrikaans speaking students who on the whole performed much better than the Xhosa speaking students in most of the activities were in most instances not guilty of semantic discontinuity in phrasing their answers.

Semantic simplification was used more by those students who scored poor to average marks. Although the semantic field was correctly identified the information provided in their answers was too skimpy to the point where the intended purpose of communication was not met. Students who made use of this writing strategy have limited linguistic repertoires and they might not know the answer at all. Possible reasons for this could be gleaned from an interview with Vincent who indicated “I know my work but I do not know how to answer the question in English. Can I write it in Afrikaans?” In this regard the researcher agrees with Chimbganda (2000) who stated that “it could be argued that perhaps it was more of a common problem than not knowing the answer which affected the way they answered the questions” (p.320). If not carefully monitored and correctly

applied such as in paraphrasing, semantic simplification in the extreme can lead to students losing unnecessary marks. This however did not seem to have a marked effect on the performance of the Afrikaans and Xhosa speaking students.

Students who were awarded low to zero marks expressed their ideas so poorly that the meaning was lost to the reader, who is the lecturer in this case. Linking strategies were absent or vaguely attempted so that sentences in sections as well as the sequence of the sections did not form a logical sensible and coherent structure. Information was either too little or irrelevant. On the contrary those students who scored good marks wrote in a coherent fashion making the necessary links and sequencing the subsections of their answers. Good coherent writing is a prerequisite for scoring good marks - a fact that was clearly demonstrated by the Afrikaans speaking students who wrote more coherently and performed better overall than the Xhosa speaking students.

Risk avoidance was obvious in those students who performed poorly in all four activities described as being utterly deficient in their cognitive abilities (Chimbganda, 2000). Answers are diluted to the point where they have no meaning and the result is a zero mark awarded. These students use a cryptic style of writing that gives no descriptions or elaborations of any kind. The intended message is therefore unsuccessfully communicated. It is not good enough to say that the students did not know the answer since the first year ESL students have not yet acquired the necessary skills to write scientifically in a second language in first year Life Sciences. Coupled with this is the conceptualisation of the correct answer which in itself is difficult for the

poor performer. For both Afrikaans and Xhosa speaking students, where the student performed better message reduction was displayed and where the student scored low or no marks, the topic was avoided in an effort to avoid any risks taken.

Central to answering the third research question is the statement made by Buffler et al. (1997:85) that the written word is also useful to measure “learning objectives in academic settings”. When the writing is done in a second language, the role of conceptualisation in the mother tongue is to be considered (Cummins, 2000 as cited by Shoebottom, 2007). If the ESL students are to be rated according to the language proficiency theories of Cummins (1980) then all of them have acquired BICS (see 2.2) , i.e. they are orally fluent but how competent they are in terms of CALP (see 2.2) which is based on their cognitive development, is questionable. One way of ascertaining this competency is the nature of the written task that can be according to Cummins (1996) either cognitively undemanding but context-embedded as the tutorials that they had to complete or cognitively demanding and context-reduced as in the tests that they had to write (see Fig 1.1). Poor performance does not necessarily equate difficulty in conceptualisation but can be a possible result of lack of understanding of the medium of instruction. This is supported by the incorrect use of sources (Inglis et al., 2007) to construct knowledge when they had to complete the tutorials (see Table 4.4) and the linguistic inability of the ESL students to express them correctly when answering test questions (Table 4.2). Furthermore as pointed out in 4.3.2 the use of good coherence and absence of semantic discontinuity by Afrikaans-speaking students resulted in them performing overall better than the Xhosa-speaking students. On the other hand no clear

link could be made between the use of semantic simplification and risk avoidance in the scoring of marks. Lexical density should be regarded as a surface feature (Halliday, 1989) rather than a measure of performance. It could also be added that consideration should also be given to other factors such as learning styles, emotions, background and personality that affect learning in another language. Two examples that illustrate the role of motivation is that of Vincent who stated in the interview that he will improve his command of English “by working very hard” and Funeka who relied on the use of the dictionary to improve her English.

Finally it seems then that certain writing strategies and the extent to which they are used by different mother tongue speakers has an effect on the overall performance of the ESL students in first year Life Sciences.

#### **4.4 CONCLUSION**

It became evident that not only is each writing strategy worth analysing but it is important to step away from the close analysis to view the way in which these students write as a whole and to look at the way in which the writing strategies as part of the whole scientific writing process affected their performance. This discussion also outlined a few aspects that have emerged in the research process. The first of these is the key aspect of learning in a language other than the mother tongue and the significance of second language learning to the research process and to pedagogy in general. This led into a discussion of the use of identified writing strategies by ESL students when they have to write scientifically. Subsequently the role of mother tongue

in the extent to which writing strategies were utilised is discussed. Finally a possible link between the extent to which the identified writing strategies were used, the role of mother tongue and performance in first year Life Sciences is explored.

The conclusion that this researcher arrived at is that there is a relationship between how certain writing strategies are utilised by different mother tongue speakers and their performance in first year Life Sciences when they have to write scientifically in English Second Language. On the basis of the findings presented here, Chapter 5 provides the summary, conclusions and recommendations.

## **CHAPTER 5**

### **SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 INTRODUCTION**

This research study was undertaken to identify the problems that ESL students in first year Life Sciences at a university in the Western Cape experience in scientific writing. In other words the researcher investigated how the scientific writing skills or the lack thereof influence the performance of ESL students in first year Life Sciences. The rationale for the study stemmed from the fact that the majority of the students are ESL speakers whose mother tongue is either Afrikaans or Xhosa. Also all the students gained entry to the university studies without being subjected to for example, language proficiency tests. The students participating in this study performed poorly in written assignments because (a) they do not communicate in their mother tongue but in a second language and (b) they lack the skills to write scientifically. There are possibly a number of factors that may have been responsible for the findings presented here. Amongst others, these factors could include cognitive ability and the affective domain for instance. Unfortunately these factors were beyond the scope of this particular study. Nonetheless the two aforementioned aspects reported here seemed to have contributed largely to the poor performance of the ESL students.

In order to identify the problems that ESL students experience a number of questions were explored. The exploration was meant to establish reasons for ESL students' lack of

scientific writing skills. Findings from this study were seen by the researcher to be useful in recommending improvements on written communication and performance.

The explored questions were:

- What are the extent to which certain writing strategies are used by English Second Language students in first year Life Sciences when they have to write scientifically?
- Are there any differences in the extent to which the identified writing strategies are used by Afrikaans - and Xhosa speaking students when they write scientifically?
- How did the extent to which the identified writing strategies are used, affect the performance of the English Second Language students in first year Life Sciences?

## **5.2 SUMMARY AND CONCLUSIONS**

In Chapter 3 it was explained how the data was collected by means of two research instruments, namely unstructured interviews and the written activities of the students. The results of this qualitative study were discussed in Chapter 4 lead to the conclusions that are summarised in this chapter. The limitations of the study are highlighted and recommendations that have educational implications are made for improving the practice of writing in English Second Language at the institution involved in this research and probably with adjustments to any other contexts.



### **5.2.1 Writing skills of students**

The examination of data from the interviews and writing activities revealed that ESL speakers whether they were Afrikaans or Xhosa speaking had similar high school experiences with regards to English as a second language. For both these groups of students English was just taught as a requirement to pass matric. This means that it was simply a subject that students learned to pass. In many ways therefore it is taught in isolation rather than for example being taught in conjunction with subjects like Life Sciences and Mathematics. For the Xhosa speaking students supposedly being taught in English would have been an advantage. Bongani's response of "I understand English" is not anything to go by if one considers his poor performance in the given tasks. However this is not the case in many instances because researchers like Afonso and Ogunniyi (2010) have pointed out that teachers mainly use code-switching in their classroom. This argument suggests that students in such a situation may not be competent in English as would otherwise be expected. At best the only advantage that they may have had was familiarity with some terminology related to Life Sciences in English. Best practice would be for the lecturer to create an environment of trust or raise the level of confidence of the students so that they will be at ease to 'risk' making mistakes. Perhaps the lecturers should also know how to address students in their mother tongue. Further, they should in the preparation of notes and study material take cognisance of the multilingual nature of their students.

Since the analysis of all the written texts of all the students in the Life Sciences 1 class would have been an arduous task, a limitation of this study is that some of the writing

activities of only a few students were selected. This means that the findings may not be generalised to all Afrikaans and Xhosa speaking students in general or contemporaries of those who participated here. There are a number of reasons for such generalisations to be inappropriate. For instance, it has been argued that other factors beyond this study's scope were not investigated. Also, the variety of differences even among the study participants suggests that this may have been a distinct possibility even if the entire class participated.

On the other hand constant referral to or citing of particular examples and cases is another way of establishing the reliability of the analysis against the data in which it is grounded. It must be mentioned that the danger of overgeneralisation is limited in a qualitative study because non-probability sampling that was used in this research study entails pre-meditated selection of subjects that will yield a variety of responses that are worth taking note of (Gibbs: 2009).

Students have come through a system of schooling where teaching was based on preparation for the examinations and not on the basis of conceptual understanding. Added to this is the inadequate fluency of the students in the English language. Further research by Afonso and Ogunniyi (2010) has shown that language plays a significant role in conveying context and understanding the nature of science. The interviews in this study revealed that the experience of the participants was that at high school language was left to the language teachers and science was taught in isolation. This is illustrated by Nokuzola who stated: "We did English only in the language class." It is important

therefore that teachers in multilingual classrooms should be conscious of the additional task of dealing with different language needs especially for English second language students whose first language is not the language of teaching and learning (Essien, 2010). If it is argued that better learning takes place through the medium of English, then the question remains whether the medium of instruction can be regarded as equivalent to the quality of education. Answering this question is an aspect that is worth exploring through further research.

### **5.2.2 Performance in writing activities**

The students did not perform remarkably better in the tutorials than in the tests. This was even though the circumstances under which these were carried out were different. For instance, the tutorials were conducted in an environment where resources such as textbooks and notes were available while these were not there in tests. This in a sense showed that irrespective of the nature of the writing activity the poor performing ESL students had a writing difficulty. In both tests the students had to give their own opinion about the effect of light intensity on the growth of grapes at 10° C or the use of DDT to combat malaria, in other words they had to interpret the question and come up with their own explanation in order to answer the question. It became evident that coupled with the possible lack of knowledge and poor vocabulary skills in order to provide an acceptable answer, there is also the severe deficiency to construct a plausible answer that is symptomatic of the cognitive incapability – an aspect which is addressed in Chapter 2. Poor pass rate in Mathematics and Life Sciences for that matter is attributed to English

being the medium of instruction which is usually the second and sometimes the third language of especially the students who participated in this study.

The Afrikaans speaking students on the whole performed better than the Xhosa speaking students who scored zero marks in most of the writing activities. The Xhosa speaking students scored marks only in one tutorial, wherein they had to describe the cycle. In the other tutorial where they had to define what a greenhouse gas was, none of the Xhosa-speaking students were able to provide a correct answer. This was even in a situation where the answer was to be found in the accompanying passage. In all the tests the Xhosa-speaking students failed to come up with any answer worth any marks. One Afrikaans speaking student scored the highest marks in one test and one tutorial. He was also the only one that scored marks in the October test (Activity 4). Both Afrikaans speaking students scored full marks in tutorial 3.

Even though there is not convincing proof as the sample is fairly small and the research study was limited to only one institution of higher education it seems that there is an opportunity in future research to prove whether there is a relationship between students' mother tongue and performance writing strategies within Life Sciences.

### **5.2.3 Students' writing strategies**

On the writing strategies employed by the ESL students, this investigation showed that coherence, semantic discontinuity and semantic simplification as well as risk avoidance were areas that needed attention. Lexical density too needed to be addressed although this was to a lesser extent compared with the other strategies.

### ***5.2.3.1 Xhosa speaking students' strategies***

The findings revealed that all the Xhosa speaking students displayed little or no attempt to write coherently, semantic discontinuity, semantic simplification either as something else expressed or ungrammatical uses and risk avoidance equally present as either message reduction or topic avoidance. In light of previous discussion in this study relating to these areas, the negative impact on the performance of these students becomes apparent in their performance. For these particular students it appears that lexical density did not seem to have influence on performance. However, it does have a place in the improvement of performance if the idea is to improve the scientific writing skills of the students and subsequently their performance in Life Sciences 1.

### ***5.2.3.2 Afrikaans speaking students' strategies***

There was a variable pattern as to the writing strategies favoured by the Afrikaans-speaking students too. For instance Fourie displayed good coherent writing in all of the activities, no semantic discontinuity and low lexical density in 75% of the activities and ungrammatical use and message reduction in all the writing activities. The other Afrikaans speaking student, Vincent on the other hand, did not display similar writing strategies compared to his counterpart. He wrote coherently in only one activity; did not reveal a definitive preference for high or low lexical density, semantic simplification and risk avoidance.

In a way, this study has revealed that there was no convincing evidence as to the kinds of writing strategies employed by the Afrikaans speaking students to account for the

difference in performance from the Xhosa speaking students. This perhaps is an important area and opportunity for further research if students' problems are to be addressed adequately.

#### **5.2.4 Performance and writing strategies**

This study invariably revealed an association between the performance of the students and the writing strategies they employed. Poor performers on the other hand were shown to write (a) incoherently with semantic discontinuity (b) avoided the topic or reduced the message so as not to take risks (c) expressed something else at the most or write ungrammatically with high lexical density when copying an answer or low lexical density when writing out of their own efforts. In this study it appeared that the strategies that could be associated with good performance were (a) high lexical density, (b) coherent writing and (c) no evidence of semantic discontinuity. Coupled with these strategies was the absence of both semantic simplification and risk avoidance. The researcher does acknowledge that a limitation in this study stems from the fact that only five writing strategies were identified and investigated. The crux of the matter is that there are many more strategies displayed by ESL students that could be investigated. Nonetheless, the five investigated here have provided a basis for identifying students with specific problems and finding methods to address these. Also, this study has contributed to the body of knowledge on which further research may scaffold in order to build on this area.

### 5.3 RECOMMENDATIONS

One of the accomplishments institutions of higher education in South Africa strive to achieve is to produce competent and well articulated teachers. Such teachers should be able to cope among others, with the demands of multilingual classrooms which are the norm in our schools today. In this country the National Curriculum Statement (NCS) of Life Sciences (DOE, 2003: 4-5) has outlined the kind of learner envisaged and the educator as well. For learners these envisaged qualities are:

- is one that has access to, and succeed in, lifelong education and training of good quality;
- demonstrate an ability to think logically and analytically, as well as holistically and laterally; and
- be able to transfer skills from familiar to unfamiliar situations.

ON the other hand the kind of envisaged teacher is:

- teachers who are qualified, competent, dedicated and caring.
- they will be able to fulfil the various roles outlined in the Norms and Standards for Educators. These include being mediators of learning, interpreters and designers of Learning Programmes and materials, leaders, administrators and managers, scholars, researchers and lifelong learners, community members, citizens and pastors, assessors, and subject specialists.

On the basis of the findings of this study as well as the expectations enunciated in the NCS the researcher has focused on a number of recommendations. Good & Govender, (2010) have called for a new kind of teacher to be trained who will have a holistic understanding of scientific literacy in its totality that will allow for amongst others the development of critical thinking skills. Also, the new kind of teachers should be able to design appropriate strategies for developing this kind of literacy to inform their teaching practice. This seems to be a challenge that has to be taken up by higher education institutions involved in teacher training.

Importantly teachers of English should perhaps work with teachers of science and mathematics in order to share ideas on the teaching of the different subjects. Related to this, it has been argued that "... the teaching of grammar should not be taught as an end in itself, but as a means to achieve overall communicative competence" (Chimbganda, 2000: 323). In a similar vein, it has been opined that team teaching between the English Language lecturer and content lecturer in Life Sciences should minimize comprehension failure - based on needs analysis to identify and address problem areas (Miller, 2002). In this regard the researcher agrees with the recommendation that advocates the communicative approach where, students are prepared to be able to cope with the discourse and multi-linguistic and multicultural aspect of higher education institutions. Therefore current practices in ESL teaching at high school level should be revisited and revamped to render more effective facilitation of second language learning. This also holds for current teacher training practice at universities where the focus should be on what Chimbganda (2000) refers to as "cognitive language proficiency and discipline-



specific language competency” (p. 323). All this boils down to an improvement of the reading skills of the ESL students which hopefully will have a knock-on effect on their writing skills. When that happens students should be able to follow good strategies that will allow them to become independent and competent in their studies.

Specifically, in the relation to the findings of this study closer collaboration between the Life Sciences content lecturer and the English Communications lecturer must take place. This kind of collaboration would be a solution to Zoleka who, when asked how she will improve her command of English, commented: “I will get help with English from somebody else.” Such collaboration it is envisaged will allow for regular feedback of individual students’ needs and progress as well as looking at the needs of the class as a whole. This collaborative approach, referred to as the process approach should encompass an integration of the content to be taught by the Biology lecturer and the grammatical aspect such as coherence and syntax of the same content to be addressed by the Communications lecturer (Chimbganda, 2000: 323). The process approach which is also interactive can be introduced as a scaffold including oral presentations, followed by ideas written freely through context maps (Patterson, 2001). The context maps should help students organise their thoughts. Following these thoughts, students will be able to edit their own and peer-written work. Hopefully this experience will help to gradually develop ESL students who can write meaningfully. The limitation of this approach is that it can be time consuming given the limited teaching time, will demand a lot of preparation on the part of both the content and the Communications lecturers and might prove not to work quite well in a situation where there are large classes.

Group work is also another way that affords student - student and student - lecturer contact. This is an effective way of subjecting students to oral communication where students talk amongst themselves and their written attempts are subjected to repeated peer-review (Inglis, et al., 2007). The role and purpose of the lecturer in this case will then be support and guidance for the students to achieve the intended communicative goal.

Finally such a collaborative programme to improve the scientific writing skills and ultimately the performance of ESL students in first year Life Sciences can include the following:

- they should be exposed to stringent practice with the help of the English Communication lecturer
- use mind maps/concept maps to plan their writing in a logical and structured manner as proposed by Patterson (2001) in Chapter 2
- expand the use of logical connectors so that it is not only limited to AND and BECAUSE but also words like THUS, HENCE, HOWEVER and ON THE CONTRARY to name but a few
- feedback from lecturer after writing activities not only in terms of the marks they scored but also to show them examples of poor or little attempts at coherence and examples where good coherence was practised
- gradually increase the length of the written texts from sentences to paragraphs to longer essays that include sections like an INTRODUCTION, BODY AND

CONCLUSION so that the logical sequencing of ideas in these sections and between the sections themselves

- the notes set by the lecturer should also be written in a coherent manner

To improve semantic discontinuity the following is recommended:

- introduce the use of logical connectors gradually in order to get students to write longer meaningful sentences
- highlight and explain the meaning of logical connectors like HENCE, EVEN THOUGH and IN ADDITION to name but a few
- check for semantic discontinuity in the text of books and other literature and point it out to the students when that particular section of the work is covered
- give students exercises in this regard so that they can indicate how they understand a certain piece of text or even the phrases

In order to avoid or minimise semantic simplification the following is recommended:

- improvement of reading skills to allow for correct interpretation of instructions or questions in a test
- expansion of the vocabulary of the student
- correct use of scientific terms or technical words

Students can be taught how to prevent risk avoidance by means of the following:

- correct method to paraphrase without losing vital information
- shown how to summarise long pieces of text
- be made aware of plagiarism and its wider implications

- trained the correct ways of acknowledging other sources by means of in-text- and end-text referencing

With reference to lexical density the researcher feels that this is one strategy of scientific writing that is totally new to the students. They will gradually master the art of writing scientifically using high lexical density over the years as their scientific writing skills improve. In first year at university the best examples of good scientific writing with high lexical density will be found in the text books that these students use and hopefully the more they are exposed to these texts, the more they will become aware of the difference between high and low density levels.

Finally a great deal of research has been carried out on the role of language in education and in pre-service teacher training in institutions of higher education. However a lot remains to be said for the multilingual classroom where the English second language speakers are from diverse language backgrounds such as Afrikaans and Xhosa, particularly when ESL students are expected to think, write and express their thoughts in a Life Sciences context at university level.

#### **5.4 LIMITATIONS OF THE STUDY**

What could be regarded as a limitation to this study is the small sample that consisted of four writing activities of six students only. In each writing activity the answer of one question was analysed according to the five strategies that were selected - lexical density, semantic discontinuity, coherence, semantic simplification and risk avoidance.

Since in a qualitative study like this, where the aim was to illustrate the diverse ways in which the identified writing strategies were used in the multilingual classroom the size of the sample might compromise generalisation issues. The issue of the generalisation of the findings however was not the goal of this study. The generalisation of the aspects investigated here may be reached in a further study that would be more comprehensive. The limitation of the study was perhaps the fact that it was not as comprehensive. A more comprehensive study could include students from all higher education institutions where English is the medium of instruction for instance. The writing activities selected namely the tests and the tutorials were the best representative examples of the students own written work since their assignments and projects were mostly rife with internet plagiarism and as such could not be regarded as reliable products of their written communication abilities in English second language. The findings of the analysis of the data generated from the sample satisfied the researcher's curiosity and hopefully will to a certain extent those of other researchers in the field, as to why English second language speakers in first year Life Sciences write the way that they do.

## **5.5 SUGGESTIONS FOR FURTHER RESEARCH**

This study highlighted some important aspects pertaining to second language instruction that need further research for clarification.

This study because of its limited scope could not venture into the situation that prevails at other institutions of higher education with multilingual classrooms where English second language is the medium of instruction. As has been pointed out earlier (Chapters

1 and 2) the aspect of writing strategies in relation to other contributing factors such as performance, the role of the lecturer or teacher and mother tongue, in scientific writing are all areas where future research is needed. Contextualising all these aspects within the South African educational setup prove to be all the more necessary seeing that utterances in connection with mother tongue instruction at higher levels of education are on the increase.

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## APPENDIX 1

### Student Consent Form

Name of participant: .....

Date: .....

Thank you for agreeing to participate in my research project, “ Exploring English Second Language speakers’ scientific writing skills: strategies of first year Life Sciences students”.

I value your participation and look forward to working with you on this project.

Your involvement will require the use of two of your tests and two of your tutorials designed as part of the coursework in Life Sciences 1 as well as interviews and discussions based on your writing experiences.

The Ethics Committee of the University of South Africa (UNISA) requires that all research participants give consent when participating in a university research project.

This form is to indicate that you understand the research process and that you are not exploited in any way.

### Consent

I, the undersigned understand that I will be interviewed for research purposes and some of my writing activities will be used to analyse how students write scientifically in first year Life Sciences at CPUT.

I understand that my responses will have no bearing on my assessment and status as a student at CPUT.

I understand that my name will be kept confidential. I agree to take part in this research project. I understand the research process.

I freely give my consent.

Signature: .....

Thank you for your participation.

Vanessa van Staden

E-mail: vanstadenv@cput.ac.za

APPENDIX 2

Example of content analysis done by means of coding: Activity 1 - Vincent

LIFE SCIENCES 1 - Nutrient cycles

Question 1

40

few

C1 C2  $O_2$  is a gas that takes up 21% of the gas in the atmosphere. In the recent years the amount of  $O_2$  in the atmosphere has decreased.

C3 C3 that is used up by respiring organisms during the combustion of energy bearing, eg. wood, coal, petrol, and oil.

C3 C4 Carbon dioxide is released in the air which contains (0.04%) of the gas in the atmosphere.

C4 C5  $O_2$  is used by plant cells for respiration and animal cells for respiration and back to carbon dioxide.

C5 C6 this process photosynthesis is made use of for green plants.

C6 C7  $O_2$  is release back into the air.

LD =  $\frac{LW}{c} = \frac{54}{7} = 7.7 \approx 8$   $8 + 2 = 10$

Question 2

### APPENDIX 3

**\*Coding frame of content analysis of Activities 1 - 4**

Activity ↓	← Writing strategies →									
	LD		CO		SD		SS		RA	
	Sub-set		Sub-set		Sub-set		Sub-set		Sub-set	
	h	l	g	la	e	ne	se	ug	ta	mr
<b>1</b>	(2)	(4)	(1)	(5)	(2)	(4)	(3)	(3)	(2)	(4)
<b>2</b>	(5)	(1)	(2)	(4)	(0)	(6)	(0)	(6)	(0)	(6)
<b>3</b>	(5)	(1)	(4)	(2)	(2)	(4)	(4)	(1)	(4)	(1)
<b>4</b>	(2)	(3)	(1)	(4)	(1)	(4)	(4)	(1)	(3)	(2)

LD = lexical density; h= high, l= low

CO = coherence; g = good, la = little or no attempt

SD = semantic discontinuity; e = evident, ne = not evident

SS = semantic simplification; se = something else, ug = ungrammatical

RA = risk avoidance; ta = topic avoidance, mr = message reduction

( ) = number of cases

\* adapted from Barbour (2008)