On Developing Reading Skills for Biology: The role of the Communication in Science module (SCOM).

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Coursework/Half Dissertation submitted in partial fulfillment of the academic requirements for the degree of Master of Education (M.Ed.) in the School of Education at the University of KwaZulu-Natal, South Africa.

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December 2013

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ACKNOWLEDGEMENTS

I would like to express my special thanks to Ansurie Pillay for her lasting support, and encouragement and for tolerantly reading those countless drafts until we got to the final stage of the study.

Thanks to my husband Xola, my children Mfundo, Belesi, Sinazo and Athi for their devoted static support during my studies. I cannot forget my brothers Biggs Mandlakapheli, my sisters Ntombenkosi and Nombeko, including my sisters in law Nothembile (Sbhedlele) Tutshana and Nomonde Gazi for their support, impulsive and courageous words throughout my studies.

ABSTRACT

This is an interpretive study to determine the role of the Communication in Science (SCOM) module in developing reading skills for the Biology mainstream module. Module course outlines, interviews with SCOM and Biology tutors and ex- SCOM students were used in this study. To better understand the role of Communication in Science in developing the reading skills for Biology, interviews, course outlines and ex-SCOM students' written work were considered. The critical questions that framed the study were: 1.What are the reading requirements for Biology? 2. How are students expected to demonstrate their understanding of these requirements? 3. How does the SCOM module prepare students for the demands of the mainstream Biology module? The theoretical framework adopted in this study is the constructivists' theory in which students actively construct their learning. Using an interpretive paradigm, qualitative data was collected. The Biology course outline was used to identify the disciplinary reading fundamentals of Biology. The SCOM course outline was used to evaluate the perceived impact of SCOM. Students' written work was examined to assess their demonstration of their understanding of the use of basic reading for Biology. An interrogation of these tools provided answers to the research questions. From this study, it was found that the SCOM coordinator and ex-SCOM students believed that the module played a crucial role in developing reading skills for Biology. However, the researcher acknowledges that there could have been other factors that contributed to their performance besides the SCOM module. The students indicated that SCOM should be incorporated into the Science mainstream module so that it may assist other students who are struggling to read effectively. On the whole, the use of comprehensive approaches when teaching reading can significantly contribute to comprehension, especially for students who struggle with reading.

CHAPTER 1

1.1 INTRODUCTION

This dissertation is located broadly within the field of academic literacy development, and more specifically, in the field of the development of reading skills. The study has used the constructivists' theoretical framework. Constructivism originates from Vygotsky's (1978) sociocultural learning theories. Learning is viewed as a sociocultural process in which learning is constantly constructed by the students through the scaffolding process, provided by 'knowledgeable others' such as tutors (Walqui, 2006). The objective of the research is to examine the role of the Communication in Science (SCOM) module in developing reading skills for the Biology mainstream module. The research also aims to establish how the information gathered during the investigation may assist in improving the Communication in Science module.

This chapter considers aspects of concern such as background information, the strategy of using scaffolding and the relevancy of the Standard Assessment Test for Access and Placement (SATAP). The statement of purpose is also considered. Critical questions are incorporated, and the structure of the research is outlined. This chapter provides background information and also provides a brief description and history of Communication in Science.

1.2 BACKGROUND INFORMATION AND A BRIEF DESCRIPTION OF COMMUNICATION IN SCIENCE (SCOM).

The Centre for Science Access (CSA) is located within the College of Agriculture, Engineering and Science at the University of KwaZulu-Natal (UKZN). It aims to provide access to science-related degrees for students from disadvantaged schools. B.Sc.4 Augmented is a four-year Bachelor of Science degree and is for students from disadvantaged schools who are interested in science-related degrees, but whose matriculation results are slightly below school entry requirements, although they have full matriculation exemption. Students are admitted into first-year BSc4 with at least 28 matric-points[1] but initially take fewer courses,

[1] Matric point system is a grading system for the national certificate point score. Students are admitted on a competitive basis, upon their admissions points score (APS) calculated from their matriculation examination marks. The required APS varies from course to course, and between universities. Students without the matriculation endorsement, or bachelor's pass, from Umalusi (South Africa's council for quality assurance) may

including Communication in Science (SCOM), with extra tutorials and practicals. SCOM is a stand-alone accredited science content-based module.

1.3 A HISTORY AND DESCRIPTION OF COMMUNICATION IN SCIENCE (SCOM)

Before the module became Communication in Science, it was called Academic Communication in Study (ACS). ACS was designed to provide students with critical reading and writing competence in the discourse required by the Humanities and Social Science disciplines. However, ACS did not provide for discourses necessary for the science disciplines. ACS was originally called Learning, Language and Logic (LLL). The LLL courses comprised Effective Writing for the Social Sciences, Effective Research for the Social Sciences, two semesters of reading and writing development for students who had mainly, but not exclusively, English as an Additional Language in their Matriculation. Students were also referred to LLL due to slow progress in their degrees.

The Students' Standard Assessment Test for Access and Placement (SATAP) was also used for students' access and placement into the relevant academic stream. Students' performance on the application of the reading strategies in the language part of the SATAP helped to assess what reading capabilities students bring with them. The information acts as a literature life history of students' reading capabilities. To be able to know how to improve something, it is always useful to understand its original condition.

The current module, Communication in Science (SCOM), includes scientific concepts in reading, writing and presentations. To develop the reading skills necessary for academic literacy, students need to develop a range of reading strategies including: decoding meaning from texts through bottom up and top down processes of reading, skimming, scanning, making inferences, drawing conclusions, reading for main ideas, summarising, paraphrasing, analysing and evaluating texts. Communication in Science (SCOM) sets students on the path to acquiring scientific literacy by providing opportunities to communicate in science. This is done by engaging with scientific texts, producing original work, and attaining the behaviour and values of science through collecting, analysing, and writing about real data.

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enrol at universities. Umalusi (South Africa's council for quality assurance) may enrol at university of technology. (Umalusi, 2010).

The teaching and acquisition of academic literacy considers the two relevant participants - the academic literacy practitioners and the students registered for the academic literacy module. According to Lea and Street (2006), those who teach from an academic literacy perspective view student writing as an issue of epistemology and identities, rather than of skills acquisition or academic socialization alone. For students, the main feature of academic literacy practices is the requirement to change their writing styles and genres between one setting and another, to position a list of reading and writing literacy practices appropriate to each setting, and to handle the social meanings that each setting suggests (Hyland, 1992).

There are various strategies used by tutors to assist SCOM students to read a text effectively. Jackson et al. (2006) state that when students read a text, they need to be able to identify relevant information and organize it in a coherent and cohesive way. Because textbooks are the source of reading allocated to science students and laboratory reports are the principal kind of writing (Parkinson et al., 2008), it is essential that these genres be highlighted in an academic literacy course for science students. Thus, SCOM assignments topics for assessment are based on different genres appropriate to science.

The potential strength of this module is that materials can be carefully designed to rehearse the significant written genres expected from a science student (laboratory reports, essays and oral presentation), while drawing on texts appropriate both in level and in genre. Issues of language (such as sentence structure, or the use of the passive voice) can be integrated into content-based work, as can summarising, note-taking, and paragraph construction. Acquisition of the multiple elements of academic literacy proceeds through an interactive process of reading, writing, and analysis on the part of students. Teaching can proceed at a rate appropriate to students' needs, rather than being driven by the need to cover the curriculum, as happens in most university modules. Since academic literacy staff mark repeated drafts, they are able to pay attention to individual students and can thus assist in improving features, such as content, organization, language and the discourse features of target forms.

The module aims to use a scaffolding process, conceptualized as a process in which a teacher supports a student in an apprenticeship-like relationship, helping them do what they cannot yet do unassisted (Parkinson et al., 2007). Through replication, offering advice, or guiding

with questions, the teacher supports the acquisition of new competencies. As the student becomes more able to do a task, the support is gradually withdrawn. Parkinson et al., (2007) view scaffolding as an effective way of helping students to read authentic texts required for degree study, whilst building their confidence in their ability to deal with texts beyond their independent level of reading ability. Marking of drafts supports the achievement of improved reading comprehension of texts, and better-organised and structured writing.

The table below summarises how the SCOM course scaffolds literacy acquisition for reading assignments.

Examples of some Communication in Science topics

Topic and genre	**Sources**	**Literacies which are the focus of each topic**
Essay on Tuberculosis	Popular science articles, rewritten in textbook style	• Analyse focused topic and plan own writing • Read and take notes from written sources • Integrate information from different sources • Referencing
Scientific Report on Fermentation	Extracts from Textbooks	• Design and conduct an experiment • Record measurements as tables and graphs • Learn and use the features of the different parts of the Report genre
Oral Presentation on different topics, e.g. 1.How does cold drink bubble **2. Explain what causes acid rain** **3. How does static electricity form** **4. Discuss how animals avoid being preyed upon**	Students are assigned to do research on given topics from the library and the internet	To know that presentation should be characterised by : • Good organisation • Thorough preparation, e.g. visual aids • Confidence • Responsiveness to audience, e.g. eye contact • Clarity • Enthusiasm
Comprehension Test	Students are given articles to read and must then respond to questions. They respond to the essay topic drawn from the prescribed readings	To show that they read with understanding by paraphrasing, and to prove that they are able to write an essay, including its conventions.

Source: Parkinson, J., Jackson L., Kirkwood T. and Padayachee V. (2008). Evaluating the effectiveness of an academic literacy course: Do students benefit? *Per Linguam* 24(1):11-29 http://dx.doi.org/10.5785/24-1-37.

The above table outlines the way in which reading materials for SCOM are organised. The topics are varied in such a way that they expose students to different genres, for example, reports, essay, posters, and oral presentations. The table outlines the topics, source materials,

and literacies which SCOM tutors aim to teach. In this module, acquisition of academic literacy is scaffolded through:

- Provision of readings appropriate in terms of level and genre
- Terminal questions to test and prompt comprehension
- Practice in methods of gathering, synthesising, and organising material for writing
- Multiple opportunities to submit drafts of writing

Student reading capabilities differ, some become fast readers and some become slow readers. Research undertaken by Kirkwood (2007) indicates that most of her students are slow readers, reading at an average reading speed of 100 words per minute. She has identified that complex syntax, too-high-a-frequency of new words, or material that is conceptually outside students' range of experience, can have the effect that students do not do the assigned reading. It is therefore argued that reading has to be both accessible in content and appropriate in genre. In the SCOM module, the reading assigned to science students is largely from textbooks, while the assigned writing is laboratory reports, factual essays, and 'short answers'- the last particularly prominent in examinations. It was therefore considered wise to limit assigned reading to the textbook, supplemented by research articles (these have similarities to the laboratory report) or research articles revised to the appropriate level.

Texts are selected from high school or first-year textbooks, however these often need reworking. This involves: limiting difficult vocabulary (whether academic, technical, or 'everyday'); providing footnotes to gloss difficult words, or references to unknown places, concepts, or objects; substituting the unfamiliar with local examples; and generally shortening and simplifying the text (Kirkwood, 2007). Kirkwood (2007) also argues that simplified research articles, organised in the Introduction-Method-Results-Discussion format, act as a valuable model for students' own report writing, and comprehension of academic reading is one of the literacy types tested in the initial and terminal tests, discussed in more detail below. Therefore, to improve understanding and to prepare students for reading a text, the following strategies have been used to prepare students for reading texts on their own.

- Initial class discussion on a topic to encourage the use of existing knowledge.

- Pre-reading activities (such as skimming for overall meaning) or an initial brief summary of the text to develop existing frameworks (Kirkwood, 2007).
- Reading of the first, or key, paragraph aloud before scaffolding and unpacking its meaning (Rose et al., 2003).

These strategies all provide a frame of reference for students so as to prepare them for what they will read or to reinforce their existing frame of reference for what to expect, and key words and expressions, on which much written meaning is built, are learned in more everyday terms. Comprehension questions offer strategies that, it is hoped, can be used with later reading, as students question and puzzle over meaning for themselves. Students may be asked to insert subheadings into texts, alerting them to textual organisation, and thus benefitting their own writing skills (Parkinson et al., 2008).

What SCOM does on a practical level is to teach students how to use the course manuals, a task that includes explicitly showing them how such manuals are structured, from the imprint page to the index, and how to use the manual's resources, from information, to self-testing exercises, to glossaries. Using course manuals as the basis for developing concept maps provides students with some of the scaffolding they need to create concept maps. Concept mapping is typically used as a classroom tool for students to construct their own learning; it is used to illustrate the relationships and linkages between complicated concepts and their component parts. It is developed to facilitate student learning by organising key words and supporting concepts into visual frameworks. It is used to represent knowledge, and as such, to encourage students to think independently (Cherrie, 2008).

Together with concept mapping, SCOM has incorporated the use of mind mapping techniques to improve students' reading comprehension ability at different levels. Mind mapping is a visual method of note taking, and uses words, colour pictures, and symbols. It has a hierarchical or tree-branch format, with ideas branching into their subsections (Anong, 2008). It can help poor readers to read more effectively because the format can show the relative importance of individual points, and the way in which facts relate to one another. Mind mapping techniques are employed to develop reading comprehension skills in SCOM. Mind maps are ideal for preparing an essay, summary, text, or presentations, and they are useful tools for enhancing learning and thinking. For example, students can use mind maps

for revising and clarifying thoughts so as to extract the deep meaning of a text. It is a cognitive strategy that helps to improve students' ability in reading such as in abstracting, and summarising the essential information for better understanding and learning by recalling (Molefe, 2003).

In comparing these two mapping methods (concept mapping and mind mapping) with regard to reading, with mind mapping, students can subsequently explain, elaborate, and take notes by drawing personal mind maps. With concept mapping on the other hand, students test their understanding and recall, and can develop concepts regarding the main contents. Students can also use the introductory conceptual diagram and their own mind map together, formulate a list of the key elements, and then structure them using the rules of concept mapping. However, one of the most significant problems for students using the mind mapping technique is the problem of unknown vocabularies. Learning vocabularies at the pre-reading stage is therefore essential, as it assists students when they are involved in the reading activity.

Some students however need more scaffolding before getting involved in mapping methods. Mapping methods are time consuming and can be inconsistent (Eppler, 2006). Teachers should provide students with activities for which they can draw from their prior knowledge, so as to activate their frame of reference, and the teacher should also give clear guidance. It is argued that talking students through the central ideas of a prescribed text, before expecting them to read it independently, appears to be an effective strategy in facilitating students' development of academic reading skills, and in attempting to address the problems of mapping techniques, namely, time-intensiveness and inconsistency (Eppler, 2006). In the end, all students should have some idea of the main points to be discussed in the text, making it more accessible to them. If students find prescribed texts accessible, it is hoped that they will be able to attempt more reading across modules. Reading texts may become easier if the "rules and conventions" of the text are made explicit to them by the practitioners of the disciplines. Of primary concern are factors that prevent students, not only from reading effectively but from attempting to read the assigned texts. SCOM hopes to offer pedagogical practice that will provide explicit rules and conventions of academic literacy that will prepare students for first-year study.

Thus, the main purpose of SCOM is to set students on the path to acquisition of scientific literacy by providing opportunities to communicate in science. Additionally, it also aims to explicitly assist students to make known the cultural understandings of university and to understand the range of genres and registers used at university. Mgqwashu (2007) highlights the notion that based on the understanding that academic language is no one's mother tongue; practitioners should create true and explicit communication between student and lecturer.

1.4. THE USE OF BICS AND CALP IN SCOM

Most English second language students in South Africa are not adequately prepared for the demands of tertiary education. Although there could be other factors such as the Basic Interpersonal Communication Skills (BICS) and Cognitive Academic Language Proficiency (Cummins, 1984), the majority of students have been disadvantaged by a situation of subtractive bilingualism (Luckett, 1995) whereby mother-tongue instruction switches to English medium instruction in the fourth year of primary schooling in the South African context. While they may have some English language skills that they may use in a social situation, they are not able to deal with academic reading and writing. They have Basic Interpersonal Communication skills (BICS) but not Cognitive Academic Language Proficiency (CALP).

According to Cummins (1984), Cognitive Academic Language Proficiency (CALP) is required because it is the base for a student's capacity to deal with the academic difficulties found in different texts. CALP refers to the students' ability to understand and express, in both oral and written styles, concepts and ideas that are pertinent to achievement in school. It develops through social communication from birth but becomes differentiated from the Basic Interpersonal Communication skills (BICS) after the early stages of schooling. BICS refer to language skills needed in social situations and are used to give students contextual support for the language conveyance to retain understanding. Students need to effectively incorporate these skills to progress successfully through their grades (Cummins 2008). Therefore, the CALP that develops as a result of being exposed to written language enables students to understand and to learn from print information on their own (Pretorius, 2002, as cited in Parkinson et al., 2007).

University students' reading falling below their maturational levels can mainly be attributed to their print-impoverished backgrounds, as reading is a skill that develops mainly through practice (Luckett, 1995). Without any assistance, poor readers at university will have poor performances in their modules, compared to their peers who are efficient readers.

1.5. STATEMENT OF PURPOSE

The researcher, who has taught the Communication in Science module (SCOM) for many years, is interested to find out whether SCOM plays a role in developing reading skills for the Biology mainstream module. The study is further conducted to examine the extent to which the reading skills offered in the SCOM module enable students to gain the necessary reading strategies to assisting them to read in the Biology mainstream module. While the students do Mathematics, Physics and Chemistry, it is in Biology that much reading and writing takes place. It is for that reason that the focus of this study is on Biology.

1.6. CRITICAL QUESTIONS

The following critical research questions underpin the study:

- How does the SCOM module prepare students for the demands of the mainstream Biology module?
- How are students expected to demonstrate their understanding of the reading requirements for Biology?

The aim of the study is to explore the role played by SCOM in developing reading skills for the mainstream Biology modules. The study employs qualitative data: students' literacy experiences; students' understanding of Biology reading versus SCOM reading; and the attitudes and practices of university lecturers towards reading. Assignments and course outlines will be used to examine and compare SCOM and Biology reading skills interventions.

1.7. THE STRUCTURE OF THE STUDY

Chapter 2 provides a brief historical account of the various approaches to developing students' academic writing, in order to explain how these approaches have influenced the theory that underpins responding to students' reading skills. Chapter 3 describes the research as being essentially an interpretive case study. The research methodology, data collection, and data analysis are described, and the research process is outlined. Chapter 4 discusses the findings and finally, chapter 5 focusses on the conclusions and recommendations.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will provides an exploration of the key concepts related to the study such as epistemological access, reading, Vygotskyan perspectives to reading, scaffolding, sequencing and pacing of the curriculum, and the genre approach, and will investigate some of the theories and theorists related to academic reading and academic comprehension.

2.2 EPISTEMOLOGICAL ACCESS

When considering the SCOM module together with its aims and methods, it is essential to consider epistemological access. Morrow (1993) conceptualises epistemological access as access to the ways of constructing knowledge in various disciplines. As an example, he states that making scientific models is one way of allowing access to a way of thinking and of showing what kinds of knowledge are valued in life sciences. Universities tend to lean more toward formal access during pedagogical practice, yet it is argued that formal access alone is insufficient because universities also need to enable epistemological access for success to be achieved. Morrow (1993) suggests that to learn how to become a participant in a particular academic discipline, one needs to gain epistemological access.

Morrow (1993) argues that epistemological access is gained by what the individual student does. The teacher can only facilitate a student's epistemological access. Constructivist learning approaches, that enhance the possibilities for epistemological access, include methods such as active learning and discovery learning. The aim of social constructivist teaching and learning strategies is to assist students to work both independently and collaboratively. This means that when students are engaged in group work, each individual has a specific role and responsibility.

University academic literacy modules are designed to develop students' linguistic and academic literacy skills, such as grammatical rules or academic and critique-based writing, needed to maintain educational practices (Mgqwashu, 2007). Bearing in mind that reading is

a process; teachers should acknowledge the importance of their students' knowledge of the nature of codes of communication, during pedagogy communication (Mgqwashu 2007). Mgqwashu additionally claims that a reflexive pedagogy teaching method should be adopted, especially when teachers are dealing with students. His argument emphasises that there should be balance between skills and the practices.

Brownlee (2004) raises a notion that reading is hypothesis-based. This means that reading can be highly structured and made easy to read, and at the same time it can be less structured, allowing room for predictions and creativity meaning-construction by readers. It is therefore important to consider the processing that takes place when an individual student reads because teachers can vary teaching methods to meet students' epistemological access. Brownlee (2004) further states that teachers with relativistic epistemological beliefs are more likely to conceive of teaching as more transformative than as mere transmission.

Boughey (2002) critically explores the influence of Street's autonomous versus ideological models of literacy. She states that students' problems are attributed to language-related discourses therefore the implication for South Africa is that a more equal society would benefit South Africa needs to create a more equal society. The central issue is not one of allowing formal access to students but rather one of epistemological access to the process of knowledge construction because formal access deprives students, who are from disadvantaged schools, entrance to university.

Clarence (2009:19) states that "students need to understand their discipline's 'epistemological core', in other words 'the kind of knowledge valued by the discipline". Morrow (2009: 78) speaks of, "learning to become a participant in an academic practice or gaining access to the practice in question". Morrow (1993) further notes that epistemological access is not a product that can be bought or sold, given to someone or stolen; nor is it some kind of natural growth, such as the growth of plants or bodies. Epistemological access cannot be supplied, 'delivered', or 'done' to the student; nor can it be 'automatically' transmitted to those who pay their fees, or even to those who collect the hand-outs and attend classes regularly. McKenna (2009) citing Becher and Trowler (2001) likens the practice of epistemological access to that of joining a tribe. The tribe of which a new student is trying to become a member does things very differently. In order for this student to be accepted, the student

needs to crack the code. They have to use the same literary practices as the tribe they are trying to join.

According to Morrow (1993), teachers need to put their emphasis on ways of developing their teaching practice by focusing on trying to understand the difficulties that students experience, as being related to a lack of access to studies. This would result in making the rules and conventions of academic ways of thinking, valuing, acting, speaking, reading, and writing more evident to students, (Boughey, 2002). She further illustrates that literacy is not something which can be openly taught in a convenient introductory series of lectures. People become literate by observing and interacting with other members of the discourse until the ways of speaking, acting, thinking, feeling, and valuing common to that discourse become natural to them (Boughey, 2002). The student needs to be able to use the new language specifically when learning biological or scientific concepts, and when doing practicals. The student needs to be precise and to use the science terminology that they have gained within the discipline, and to be specific.

The necessity to increase the number of Black students studying at tertiary level, particularly in science, has led to the establishment of foundation programmes at many institutions. In spite of attempts to provide formal access, the issue of what constitutes 'epistemological' access still needs further research in South Africa (Boughey, 2007) because there are a complex array of problems associated with epistemological access. A range of other structural and policy related interventions are necessary to adequately address epistemological access problems. Additionally, a high quality and more distinguished curriculum policy, that also allows some flexibility for open-ended epistemological access and the development of reflexivity in response to the problem, is required (Lotz-Sisitka, 2009).

Likewise, Pillay (2010) recognises the importance of accepting and supporting multi-literacies and language diversity, and a variety of textual practices that could create active learning environments that would equip students with the skills required to face a fast-changing world. She points out that multi-literacy in the lecture room supplements traditional literacy teaching but focuses on more than language alone. Pillay (2010) further argues that it is vital that lecturers at institutions of higher education not just hold on to multi-literacy for teaching and learning but accept, integrate, and encourage the existing literacy that students

bring with them to the lecture room. She claims that the reality is that students are expected to use teachers' knowledge and reading ability norms, even if they are not made clear, and when students fail to reach those expectations, they are viewed as incompetent. McKenna (as cited in Pillay, 2010) encourages teachers not to ignore students' existing knowledge because that knowledge has the power to empower and support students.

Brownlee et al. (2009) discuss personal epistemological beliefs that are held by individuals about the nature of knowing and knowledge. From their study, they discovered a relationship between essential beliefs of knowing, and exterior beliefs, which are beliefs about reading to learn. By exploring the manner in which teaching takes place and the manner in which students acquire knowledge, Bar-Yam et al. (2002) found that the disciplinary curriculum context is influenced by a complex and changing knowledge environment. They discovered that a broader understanding of the contemporary knowledge environment was needed.

2.3 READING

While epistemological access may be enabled in a module, it is important to unpack what is meant by reading. Reading is a process that involves application of reading strategies in order to facilitate comprehension of texts (Carrell, 1988b). Reading is widely acknowledged to be an interactive process whereby the reader is able to recognise letters and decode words. Decoding is the ability to ascribe meaning to the written word. It is also the ability to construct meaning from a written word and from various forms and functions of written texts (Pretorius and Machet, 2004). To view reading as an interactive process means acknowledging that reading ability requires that a reader decodes meaning from texts, while drawing on pre-existing knowledge of reading and writing conventions for understanding and interpretation. From an interactive point of view, successful reading implies that an individual processes writing and draws on previous knowledge to comprehend the researcher's meaning. The only route to successful reading comprehension is through success at both language comprehension and decoding (Hoover and Gough, 2000).

Jiang and Grabe (2007) note that reading is a means of language acquisition, communication, and sharing information and ideas, and is culturally and socially situated. The reading process requires continuous practice, development, and refinement. Readers use a variety of reading strategies to assist with decoding (to translate symbols into sounds or visual representations

of speech) and comprehension. Readers may use morpheme, semantics, syntax and context clues to identify the meaning of unknown words (Beare, 1997).

The four basic reading skills include a variety of strategies utilised to accomplish different goals. The four basic reading skills include: skimming, which is used to understand the essence or main idea; scanning, which is used to find a particular piece of information; extensive reading, which is used for pleasure and general understanding; and intensive reading, which is used for accurate reading for detailed understanding (Snow, 2002). Based on the notion that reading is an important skill for second language students in academic contexts, it is of concern that many South African students are insufficiently equipped to deal with the reading demands of tertiary study (Kirkwood, 2007).

Students' reading development demands the use of a variety of reading activities and teaching methods that need reasoning skills. Lecturers and tutors should bear in mind that students differ from one another in transferring cognitive skills in the development of their reading. In consideration of this, Communication in Science staff vary their methods when teaching reading skills, in order to accommodate individual capabilities. The transfer of cognitive skills between learning to read both first and second languages, is a complex information-processing system involving a number of mental operations (Koda, 2004). It has been observed that these individual operations serve different functions, yet interrelate to acquire a visually presented language in the activity of reading. Koda (2004) also points out that the cognitive view posits that reader-text interaction can be subdivided into three processing clusters, namely:

- Decoding, whereby linguistic information is extended directly from print.
- Text-information building, whereby extracted ideas are integrated to uncover text meanings.
- Situation model construction, whereby amalgamated text information is synthesized with prior knowledge.

Koda (2004) believes that the purposes for which texts are read determine the manner in which their information is processed. However, the methods and teaching models in which this reader-text interaction occurs do not guarantee cognitive development and reading skill

acquisition. It is important for teachers to observe students' reading behaviour and attitudes towards books because that influences their behaviour and attitudes towards reading texts (Keskin and Bastug 2014). Implementing teacher modelling of reading and discussion groups may result in a positive experience, as even reluctant readers may improve their attitudes toward reading. De la Torre (2013) concurs that students also benefit from participation in discussion groups centred on a text. Positive effects on attitudes, reading behaviours, and progress in reading resulted. However, the study showed that in as much as modelling helps students to see what it means to interact with the text, not all students benefit from it.

There are various other models, such as manipulative models and interactive models, to use when teaching reading (Wenning, 2011). The two models are used in order to engage students, and to introduce, practice or remediate a variety of scientific concepts. Students have a better chance of understanding and retaining concepts that are taught using these models. Even students who have difficulty learning due to language barriers, auditory deficiencies, or behavioral issues, remain more readily and effectively engaged and on-task. The models also help students to develop critical thinking skills and to learn complex scientific concepts. In a hands-on review activity, for instance, students are able to establish the relationship between concepts and to solidify their knowledge (Wenning, 2011).

The manipulative model is used to view, relate and make predictions. The interactive model describes the process involved when reading a text, as something that includes different strategies that are used to accomplish goals. These different strategies can range from skimming for global meaning, to skimming for a very close meaning, depending on the reader's purpose.

Students' acquisition of reading skills is also influenced by the manner in which they have acquired their first language. Therefore, to be able to transfer reading skills to a second language, will depend on how they have acquired and transferred reading skills from their first language. According to Yuen-Ching and Suk-Han Ho (2008), transferable skills depend on the similarities and differences of first language (L1) and second language (L2), since some languages emphasise more of a specific skill than others. These researchers highlight that the transfer of cognitive skills in learning to read L1 and L2, refers to cognitive skills acquired in L1 reading development that can be leveraged to facilitate L2 reading

development. This is also commonly known as positive transfer (Yuen-Ching and Suk-Han Ho, 2008). Furthermore, it is stated that students learn better in other modules with improved reading skills. A study conducted by Yuen-Ching and Suk-Han Ho (2008) reveals that a lack of ability in reading, blocks students from performing effectively in their studies.

In SCOM reading classes, teachers expect students to learn, not merely the content of texts, but to comprehend ideas and to develop vocabulary, especially the conceptual understanding of scientific terms. Teachers are also expected to strengthen students' ability to use reader resources like phonological and phonemic awareness, word decoding and phonics, fluency, vocabulary, and comprehension (McCardle and Chhabra et al., 2004). Good readers are phonemically aware, understand the alphabetic principle, apply these skills in a rapid and fluent manner, possess strong vocabularies and syntactical and grammatical skills, and relate reading to their own experiences (Lyon, 2000). Therefore, teachers' questions should include awareness of all readers' resources. Student reading rate should not be taken for granted when developing reading skills. The reading rate is the average number of words read and comprehended per minute. An efficient reader has the ability to vary their reading rate according to the type of material provided. For instance, they can go faster on easier material, and have the capacity to suit their speed based on the comprehension that they wish to extract from the material.

However, reading rate is not a simple construct to measure as there are many different ways of reading, depending on an individual's purpose. Kirkwood (2007) argues that it is unlikely that anyone would take the same time to study a text in order to commit to memory the ideas, as they would take to skim through a text for a general idea of its meaning. She also quotes Carver's (1993) 'Rauding Theory' for labels and details on the type of reading referred to when an individual's general reading rate is assessed. According to Carver (1993), 'Rauding' is derived from the combination of two words: *reading* and *auding*. Reading means to look at printed words in order to determine their meaning. Auding means to listen to spoken words in order to determine their meaning. The comprehension process is the same during reading and during auding. A person who is reading is said to be 'rauding' if the thoughts represented by the printed words are being understood.

When the reader moves into 'accustomed' reading mode, they are 'rauding' (Carver, 1993). This is the speed at which students read the paragraph, sentence by sentence, supported by

the teacher, who provides meaning cues and position cues to ensure that each phrase has been understood. These cues enable students to identify wordings from their meanings and to apply what they learn to other texts. It is more effective to give examples of these cues within the context of a whole paragraph. Carver (1993) approximates the selection of appropriate reading processes to changing gears when driving a car. She describes the first reading type - used for the difficult task of memorizing information - and compares it to the most powerful first gear. Reading to learn, and reading to gain understanding, is likened to the somewhat faster and less powerful second gear. That is why it is important for teachers to select texts that assist students to gain full understanding faster and easier.

The basis of inequality in the classroom is in students' differing abilities to independently learn from reading, which is the central mode of learning in tertiary education. Rose (2004) states that, a detailed reading, enables all students to gain full comprehension and accuracy when students' differing abilities in classroom is considered. The methodology, known as Learning to Read: Reading to Learn, has been developed in response to current crucial needs, particularly of ostracised students, to quickly improve reading for educational access and success (Rose, 2004). The methodology draws on two theoretical traditions: the Hallidayan model of language as a text in a social context and the Vygotskyan model of learning as a social process.

The Hallidayan model of language as a text in a social context highlights realisation, where meaning is realised as wording, and wording is realised as sounding or lettering. From his theory, Halliday (1996) believes that experienced readers recognise, predict, and recall written patterns of meaning. Inexperienced readers on the other hand cannot recognise these patterns, and as such, cannot read with understanding. Halliday (1996) critiques structuralist models, and states that some literacy approaches insist on students knowing sounds before they can learn to read texts. He further argues that these approaches are popular in remedial programs but do not enable many students to read beyond a basic level.

The Vygotskyan perspective to reading is discussed below.

2.4 VYGOTSKYAN PERSPECTIVE TO READING

The Vygotskyan model suggests that a teacher can potentially support all students to work at a high level. With the Reading to Learn methodology, scaffolding supports all students to do

the same high level tasks but with support for weaker students. Through this, Vygotsky believes that the unequal moral order can be transformed into a democratic classroom, where success can be distributed equally amongst all students.

Teaching reading skills in the context of meaningful literacy experiences is associated with the constructivist theory. Constructivism is a theory centered on observation and scientific study about how people learn (Mahmud, 2013). People build their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences. Students become engaged by applying their existing knowledge and real-world experience, by learning to imagine, by testing their theories, and ultimately by drawing conclusions from their findings.

The teacher functions more as a facilitator who coaches, mediates, prompts, and helps students to develop and assess their understanding, and thereby their learning. Constructivist theory highlights that teachers need to encourage students to create their own meaning from texts, rather than to impose their interpretation of the meaning upon them. However, teachers may help as resources to bridge the linguistic and cultural gap that students experience in reading a text (Vygotsky, 1978).

From the constructivist approach, however, it is argued that too often, through reading, teachers dominate the lesson by telling students the meaning of the text, rather than assisting them to create meaning for themselves (Huang, 2009). Teacher's questions need to show a genuine interest in the meanings that students construct, rather than in insisting on their own understandings. Students in constructivist classrooms learn to question things and to apply their natural curiosity to the world. Constructivism promotes social and communication skills by creating a classroom environment that emphasizes collaboration and the exchange of ideas (Vygotsky, 1978).

A critical evaluation of constructivism reveals that the active role of the teacher, or the value of expert knowledge, is not dismissed. Instead, the teacher's role is modified so that teachers assist students to construct knowledge, rather than to reproduce a series of facts. For example, the constructivist teacher provides tools, such as problem-solving and inquiry-based learning activities with which students formulate and test their ideas, draw conclusions and inferences, and pool and convey their knowledge in a collaborative learning environment. By so doing,

constructivism transforms the student from a passive recipient of information to an active participant in the learning process. Likewise, students are guided by the teacher because they construct their knowledge actively rather than just automatically ingesting knowledge from the teacher or the textbook (Vygotsky, 1978).

Vygotsky's Zone of Proximal Development (ZPD) is considered because it relates to the student's present levels of understanding. Vygotsky's (1978) approach is based on the knowledge that when working independently, students are able to reach a certain level of problem solving. Vygotsky notes that "the gap between what a student can achieve alone, and what can be achieved with someone else's help, is called the ZPD. The discrepancy between a child's actual mental stage and the level he reaches in solving problems with assistance, indicates the zone of proximal development" (Vygotsky, 1978: p.103).

Vygotsky's (1978) theory has influenced the researcher's teaching style because it emphasises the teaching of reading from a social constructivist point of view. Social constructivism emphasises that learning takes place in a socio-cultural environment. What is learned, and how sense of knowledge is made, depends on where and when the learning occurs. Learning takes place through dialogue and is mediated through language and other systems of signs, such as gestures or diagrams. This dialogue takes place between teacher and student, amongst students, or even between researcher and reader. Thus, learning is both interactive, in the sense that students must interact with a source of ideas or knowledge, and reconstructive, in the sense that students must take an active part in reconstructing ideas or knowledge within their own minds (Vygotsky, 1978).

Vygotsky (1978) further points out that, learning depends on the purpose or motivation for learning. Fundamental to social constructivism is the concept of scaffolding. Too often this is taken to mean nursing students along, whereas Hammond and Gibbons (2001) interpret scaffolding as "high challenge, high support" - enabling students to achieve beyond their current capacity. Therefore, scaffolding cannot be used as the only strategy of achieving reading skills and interacting with a text. Thus, there are various ways to interact with a text. Interacting with a text can involve practices as varied as reading instructions, scanning a newspaper, or reading an academic article. There are also bottom-up strategies that can become an obsession for some English language students who associate reading with using the dictionary to note down translation or corresponding items. Students need to understand

that all readers construct meaning from texts differently, depending on their motivation, their background, and even their state of mind.

There is usually no single, unequivocal meaning in a text. For example, students have expectations of how texts can and should be used, based on their prior experience of texts as social practice. Vygotsky (1978) advises that the best method of teaching literacy is the mediation method, which both guides and evolves through the social interaction that occurs during the learning activity. During this process, the teacher does not impart knowledge. Rather he/she mediates learning through the social interaction between student and teacher (Dixon-Krauss et al., 1990). Vygotsky (1978) felt that classifying reading strategies into the following three areas - vocabulary processing, word identification, and text structure identification - would serve to enable the teacher to teach explicit reading strategies best suited to the intended purpose of that specific text.

Vygotsky (1978) states that efficient readers have large vocabularies and that the words they meet are quick transmitters of thought. On the other hand, inefficient readers have limited vocabularies. As a result, they take time to grasp and understand a particular word. According to Vygotsky (1978)

- Vocabulary processing during reading necessitates interrelated process skills, including constructing a context, accessing stored information through visual words displays, selecting a relevant meaning based on contextual information, and evaluating the appropriateness of the chosen meaning in subsequent sentences,
- Word identification strategies deal with context or print decoding, and
- Text structure strategies include identifying story elements, main points, and supporting information.

The idea is that teachers should consider guiding and reflecting to assist reading strategies. This process includes metacognition. Once the strategy is selected, the teacher is able to guide the student in applying the strategy and adjusts the support when needed**.** Reflection assists in checking whether the student understood the text, and in building the student's self-knowledge through discussion, which includes having the student reflect on the strategies used and how they helped determine the meaning of the piece. Metacognition (thinking about one's thinking and monitoring the process) is an important part of this process (Koda, 2004).

Yang and Wilson (2006) argue that the constructivist view of reading has many implications for language teachers. Firstly, teachers need to stop teaching reading by simply practising reading, and focus on assisting students to extend their capacity to read constructively. Secondly, teachers need to escape from teaching reading through the kind of disembodied texts which are so common in English second language classrooms. This view maintains that reading without a purpose positions the reader as an observer, a silent stranger rather than a text participant. Thirdly, teachers should make sure that they read on behalf of their students. Teachers need to empower students to choose what and how to read in ways that suit students' needs and purposes (Yang and Wilson, 2006). Constructivists see reading as a social practice that affects when, what, where, why, and how reading occurs, as well as with whom the reading occurs (Huang, 2009).

The use of contextual clues can be one of the best ways to improve students' reading skills (Bean, 2001). Unfortunately, students often insist on understanding each word when reading. Realising that a text can be understood in a general sense by using contextual clues can go a long way towards helping students cope with increasingly difficult texts. At the same time, the use of contextual clues can also provide a means by which students can rapidly increase their existing vocabulary base (Beare, 1997).

Students need to have a clear idea of why they are reading and to know how the text relates to other aspects of their course. For example, before tackling a reading passage in a text book, the teacher should set up some context first (perhaps through visual cues), and make sure that the students know which reader role the teacher wants them to take on: making meaning, utilizing the text for useful vocabulary, or looking for a model text for some other task(Bear, 1997). The teacher needs to determine for themselves whether the text is meant to be used as a language resource, or if it is meant to stimulate dialogue (Tinzmann et al., 1990). Students also need encouragement to move beyond this teacher-textbook controlled situation into reading texts which they themselves have selected for their own purposes (Wilson, 2003).

2.5 SCAFFOLDING

Vygotsky's Zone of Proximal Development (ZPD) has become synonymous with the term scaffolding. However, it is important to note that Vygotsky never used this term in his writing. Scaffolding is conceptualised as an instructional strategy that involves supporting

novice students by limiting the difficulty of the context, and by gradually removing those limits as students gain the knowledge, skills, and confidence to cope with the full complexity of the context (Young, 1993). Scaffolding is the concept that encourages teacher-student interaction in understanding a text. Once the student, with the benefit of scaffolding, masters the task, the scaffolding can then be removed and the student will then be able to complete the task again on his/ her own.

When reading a text in class, the researcher scaffolds in order to activate students' frame of reference. This is done to determine students' experience-based knowledge, which will in turn enable their understanding of unfamiliar concepts from the text. This process is important because it serves to realize and recognise student's experiences. For example, scaffolding helps to elicit responses from students in which they feel free to draw from their previous knowledge, in order to understand new information from the reading (Young, 1993).

Huang (2009) indicates that a convenient procedure of scaffolding is to model the reading practices that lecturers want their students to adopt. The teacher could read first to show students how they should read and pronounce words. When students read, their prior knowledge is activated because the teacher offers hints and suggestions. These modeling strategies help students to relate and connect concepts from text to their own lives. Furthermore, by engaging students in small group discussion, students also get time to make sense of learning to read with other students and articulate thoughts verbally. By allocating students time to talk, the teacher gives them the opportunity to process their thoughts as they read a text and this helps to develop their cognitive abilities and to think critically. Also pre-teaching vocabulary assist students not to get bored with reading or text, and this can be achieved by providing pictures or using metaphors to work as a guide. Another scaffolding form to model reading is to make use of visual aids such as graphic, organizers, pictures, and charts which may serve as scaffolding tools that help guide and shape students' thinking. To assess students understanding the teacher may pause and ask questions (Alber, 2014).

Classroom reading practices, which are based on both top-down and bottom-up strategies, may help to scaffold students' development of reading skills. Decoding practices, including both top-down and bottom-up strategies, are usually the main focus of school reading classes. Top-down tactics include predicting meaning from context, predicting, using background

knowledge, using text structure. Bottom-up approaches include looking up unfamiliar vocabulary in a dictionary or glossary, working out sentence grammar, and decoding reference chains (Huang, 2009).

Classroom reading practices which are based on bottom-up strategies may help to scaffold students' development of reading skills. However, the social constructivists' point of view is that if students are not encouraged to go beyond these strategies, they may learn reading practices that are over focused on decoding, to the disadvantage of other reading resources. For example, teachers should teach students how to select appropriate texts by showing them what features to consider. When teaching these strategies, teachers slowly release responsibility for comprehending to students (Huang, 2009).

An effective model that has been used by some teachers is the Gradual Release of Responsibility model (Pearson and Gallagher, 1983). In this model, teachers take all the responsibility for applying a newly introduced strategy by modelling, thinking aloud, demonstrating, and creating meaning. As time passes and students have more exposure to, and practice with using the strategy, teachers scaffold students by creating activities within students' Zones of Proximal Development (Vygotsky, 1978), and slowly withdraw more and more responsibility. Students need to have a clear idea of why they are reading and to know how the text relates to other aspects of their course. For example, before tackling a reading passage in a course book, teachers need to establish the context first by using visual cues, discussion questions, or a link to students' own lives.

Students also need reassurance to move beyond this teacher-textbook controlled situation, into reading texts that they themselves have selected for their own purposes. Teachers work collaboratively with students and the strategy, giving and taking as much as necessary to create meaning. Eventually, students take on more and more responsibility as they become more confident, knowledgeable, and capable. Finally, students are able to work independently. Teachers and students do not always progress in a linear way but often slip back and forth between more and less responsibility, depending on the task, the text, and the strategy (Rose, 2006).

Teachers use their knowledge and understanding of how one learns to comprehend, to inform classroom practice so that they may most effectively help readers develop the abilities to

comprehend texts. Because certain features make some texts more easily comprehensible, teachers help readers understand those features so that they can comprehend effectively. Teachers teach text structure, model appropriate text selection, and provide regular independent reading time. If students are asked to discuss a text, generate questions from it, or come up with a big idea, these kinds of activities form a context within which the reader and text interact for a specific reason - one that is unlikely to occur in exactly the same manner ever again (Pardo, 2004).

Teachers create contexts and learning opportunities which will support the construction of meaning. Environments that value reading and writing that contain a wide variety of texts that allow students to take risks, and that find time for reading aloud and reading independently, are contexts that effectively promote the construction of meaning (Keene and Zimmermann et al., 1997). Comprehending is a complicated process, as discovered and explored in the present work, yet it is one of the most important skills for students to develop if they are to become successful and productive adults.

2.6 SEQUENCING AND PACING OF THE CURRICULUM

While learning may be scaffolded until students learn to read on their own, the idea of curriculum sequencing and pacing is relevant to students' acquisition of reading skills. Rose argues that any child who missed the first stage of reading is destined to struggle forever, since the sequencing and pacing of the curriculum never allows for any form of catch up or for consolidation of any prior stage to take place. The SCOM module addresses Rose's argument because it partially remedies the missed elementary stage. However, SCOM is only a year module, which does not give students enough time to make up for the missed elementary stage because it conforms to University rules. That is why its function as a science access module may not achieve much in developing reading skills for the Biology mainstream module.

If Rose's views on the effects of the sequencing and pacing of the school curriculum are taken seriously, then he does offer significant insights into how differences in university performance between different groups of students might be accounted for. It is a fact that reading skills are not taught explicitly, and even there, they build on assumptions regarding students' experiences of literacy. For example, at university, students are evaluated based on

the assumption that they have already attained basic reading skills, yet they are not coming from the same school background.

The link between schooling and tertiary education is not new, as a variety of examples in this chapter have already demonstrated. However, it has been in response to the injustice of reading experiences and development, examined within the structure just explained, that makes Rose important for this study, as aspects of the methodology he has developed for teaching reading were modified for use in the SCOM module.

2.7 GENRE APPROACH

The SCOM module is designed specifically for students wishing to pursue a degree in science. Their readings and texts therefore have to be genre specific. The genre of a text refers to the schematic structure of a text which helps it to achieve its purpose. The demands of comprehending scientific texts are discipline specific and are best learned by supporting students in learning how to read a wide range of scientific genres. Besides text structures emphasising cause and effect, sequencing and extended definitions, as well as the use of scientific registers, evaluating scientific arguments requires additional skill sets for readers (Lee and Spratley, 2010). Features of the text also influence the transaction where comprehension happens. The structure of the text - its genre, vocabulary, language, even the specific word choices - works to make each text unique. The genre approach allows the teacher to vary the reading rate according to the type of material. For example, a person reads faster on easier materials and has the ability to suit their speed based on the comprehension that they want to get out of the material.

2.8 CONCLUSION

Becoming literate involves becoming acculturated to learning to read and write the culture. For academics wishing to speed up this process, the key to success lies in developing practical ways of making their own understanding of University culture explicit and obtainable to their students. Context of situation and context of culture are both necessary for an adequate understanding of texts. In the next Chapter, the research methodology and the research process are outlined.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

The methodology employed in this research is discussed in this chapter. The interpretive approach, the qualitative method and the sampling technique will be focused on. The Course outlines, students' written work and interviews are considered in the gathering of data and the process of data analysis is described. The ethical clearance and the limitation of the study are also considered.

3.2 RESEARCH PARADIGM

It is imperative for researchers to be mindful of the way in which they reveal underlying beliefs that have influenced how they frame or structure the research, how they conduct the research, as well as how they interpret their findings (Massey and Duffy, 2003). Different assumptions about knowledge, reality and values elicit different orientations to research. The interpretive paradigm has been selected to help understand and interpret results obtained from the data collected as it focuses on shared experiences. Maree (2007) suggests that the human mind is the purposive source of meaning. Interpretive studies attempt to understand phenomena through the meanings that people assign to them. Unpacking how meanings are constructed, can offer insights into the meanings imparted and thereby improve understanding of the whole. The focus will also be on individuals' subjective experiences, and on how they construct the social world when they are sharing meaning.

The interpretive paradigm offers a viewpoint of a situation and the possibility of examining the situation in a manner that provides insight into the way in which a particular group of people make sense of a situation or phenomena. For example, human knowledge informs and directs researchers and influences their understanding of the phenomena that is under investigation. This research was approached from the perspective that students and lecturers would be voluntary participants.

Furthermore, the interpretivist paradigm reflects the view that it is the individual's subjective interaction and experience of the world that creates their perception of truth and meaning, not an externally imposed reality. This approach attempts to understand "the world of human experience" (Cohen and Manion, 1994, p. 36), proposing that "reality is socially constructed" (Mertens, 2005, p.12). The interpretivist researcher therefore relies on the "participants' views of the situation being studied" (Creswell, 2003, p.8) and considers how their own background and experiences impact on the research. A critique of this paradigm is that it is subjective and fails to generalise its findings beyond the situation studied.

3.3 RESEARCH APPROACH

This study has utilized a qualitative research approach as it relies on first-hand accounts and tries to describe what is reported in rich detail (Terre Blanch and Durkheim, 1999). For example, broad, open-ended questions in individual interviews were used to allow the participants to share their views and experiences on the phenomena (Creswell, 2003).

The qualitative component assisted in understanding and acquiring knowledge regarding social issues underlying reading skills that are under investigation. It has provided many sources of information and facilitated the process of exploring and describing the phenomena explicitly (Henning, 2007). The qualitative data allowed for detailed descriptions of people, interactions, behaviours, and events. The research relied on first-hand interpretations to describe what is reported in rich detail (Terre Blanche and Durkheim 1999).

3.4 CONTEXT OF STUDY AND SAMPLING

The study was conducted at a South African university. This study used nine participants (six students and three tutors) as representative of the SCOM community. De Vos et al. (2005) suggest that researchers use the criteria of suitability and transmission in deciding how many participants are needed in a study. Competence requires that the researcher consider whether a range of perspectives has been sampled in order to help the reader identify with perspectives described in the research. Sufficiency was not chosen as a criterion for deciding on sample size but sampling was rather done purposively to capture a range of perceptions regarding the acquisition of reading skills. This study is exploratory in nature (as outlined in

Chapter 1) therefore there was no generalization or inferences made based on the sampling criteria.

3.5 METHODS USED FOR GATHERING DATA

After gaining permission from the gate-keepers and the relevant research committees, the research participants were approached with regard to their expected involvement in the project and ethical issues were explained and agreed upon. According to Denzin and Lincoln (1998), to understand the correct methods to use depends on the research questions and the context in which the research is conducted. Therefore, data was gathered from a number of sources. Firstly, the Biology and Communication in Science course outlines were important to assess the relationship between the modules. Secondly, written work such as essays, report writing and oral presentations, was considered to evaluate the skills necessary for the satisfactory achievement of each task, including the methods used to accomplish this. Thirdly, interviews were conducted with the students and lecturers to obtain their subjective experiences of the efficacy of this process. This multiple-methods strategy assisted in providing validity and reliability for this study.

3.5.1 Course outlines

Aspects of the Biology and SCOM modules course outlines were considered (See Appendices C and M). Content topics, organization of topics, and the methods and weighting from assessment criteria were focused upon. These two course outlines were evaluated because they indicated whether SCOM feeds into Biology or Biology reinforces what SCOM is expected to do. Information from these documents assisted in unpacking how students are introduced to different types and purposes of writing and reading.

SCOM course outline includes oral presentation (see appendix K). The oral presentation requires students to utilise similar skills to those of essay writing and report writing with the added benefit of the need to do independent research and a greater volume of reading, comparable to a literature review. This also involves the ability to present the information in a similar format to that of an essay with an introduction, identifiable paragraphs and a conclusion. It is done at the end of the semester to allow students to practice independent reading, as they are required to do independent research for their chosen topics from the

library or internet. The actual presentation process adds an additional skill to their repertoire of reading with understanding, assimilating a variety of concepts and information and clearly articulating this to an audience.

From these course outlines, the way in which topics have been selected were explored. Comparing these two course outlines assisted the researcher to see whether SCOM feeds relevant skills and demands expected by mainstream Biology or not. The data obtained from these course outlines enabled the researcher to answer critical questions of this study (as outlined in chapter one).

3.5.2 Students Assignments

Three of the Communication in Science assignment questions was chosen as an indication of the effectiveness of developing reading skills for the Biology module. These were essay writing, report writing tests and oral presentations. Although the Biology module does not require an oral presentation (only essay and report writing), it was included as the skills essential for effective oral performance reflect those of essay and report writing.

3.5.2.1 Essay

The first semester essay topic directed students to respond by outlining and discussing the content words of the topic. The direction words in the second semester essay required students to comment, describe and explain the content words of the essay topic. The assumption was that students' marks should prove that students read with understanding. They were capable of identifying relevant ideas from the readings that would enable them to respond to the essay topic and as such, SCOM reading skills should have contributed. Both essays topics began with the quotes from texts (see Appendix G and H). Essay writing, as a measure of reading skills, provides significant insight into a student's ability to comprehend the material (and genre), extract relevant ideas/concepts, collate the information, paraphrase and integrate this into a coherent and pertinent response to the topic question. The assessment marks should reflect the student's ability to utilise the above-mentioned skills.

3.5.2.2 Report

The aim of report writing is to introduce students to different types of genres and to encourage students to become researchers. Research and report writing require similar skills to those necessary for all academic writing. That is, accessing a variety of relevant material; reading and comprehension; analyzing applicable information; collating, paraphrasing and assimilating this all into a coherent and significant text. These skills are essential for the introduction and the discussion parts of the report. However, the discussion requires deductive reading abilities to analyse the data and results with reference to the information contained in the introduction.

Report writing also necessitates the ability to structure and organize information in a logical and reasonable manner, collect and analyse data and stipulate findings in an intelligible way. The abstract enables the students to develop the ability to summarize information succinctly. Therefore, report writing offers the students an opportunity to establish sound reading skills and enhance a variety of other skills (as mentioned above) that are vital for proficient communication in a scientific genre. To be a successful researcher one needs to become an effective reader. When students write reports they should be able to do a lot of reading. This is where their reading skills should be utilised the most. Students were given research topics for the scientific report. The first semester research topic was on the effects of yeast and the second semester was on the rocky shores (see Appendix I and J).

The report format is in stages. Each stage had to be responded to differently. Therefore, students were expected to collect relevant information for specific stages that would need their understanding of the readings. For example at the literature review and the discussion of findings stages, students were expected to demonstrate that they read with understanding which is where the transference of reading skills would be portrayed. The high marks would possibly indicate students' utilisation of the reading skills because they take and make notes by paraphrasing. They also write an abstract, which is the summary of the whole report. The students' reading skill of summarising a text is demonstrated because students summarise the whole report in the abstract stage.

3.5.2.3 Test

The test was divided into two sections. The first section was made up of multiple-choice questions. The multiple-choice included negative marking. The second section was composed of short questions that tested students' understanding of general academic reading- related ability. From the second semester, the first section was also a multiple-choice second questions and the section was composed of questions based on the given diagram for reference (see Appendix K and L).

The three assignments were used to give response to the two critical questions, for example question 2: students' demonstration of their understanding of the reading fundamentals of Biology and question 3: the perceived impact of the SCOM module on the Biology module.

3.5.3 Interviews

Interviews were used to see the world through the eyes of the participants and to obtain rich descriptive data (see Appendix D, E and F). Interviews are a two-way conversation in which the interviewer collects data by asking the respondents questions (Cohen et al., 2003). Interviews create meaning that exists within participants (Keke, 2008). Individual interviews were used as they allow for flexibility for further probing during data collection. Open-ended questions were suitable for this study as the researcher intended to look at the ideas, views, and attitudes about the phenomena and to allow flexibility for further probing during data collection. The interview process is a safe space to give voice to the participants' experiences (Midgley et al., 2013). Qualitative interviews allow the participants lots of flexibility. The interview conducted with the research participants (students and lecturers) was semi-structured. Semi-structured interviews also allow participants the freedom to express their views in their own terms. Participants provided reliable, comparable qualitative data (Cohen and Crabtree, 2006).

A tape recorder was used to record interviews. Corden and Sainsbury (2006) suggest that interviews should be recorded to work reliably with the words of the participants and the researcher has to transform the spoken words into written text. The recordings were fully transcribed and checked for accuracy of transcription by listening to the recordings while reading the transcriptions.

The research participants were reassured that their involvement in this project would not adversely affect them either academically or personally. The researcher realised that she had to remain flexible and provide an approachable and relaxed demeanor to reduce any perception of social or status difference between her and the participants, to assist in obtaining genuine and honest responses from them. The researcher informed the participants that they would have the opportunity to read the interpretation of the data before submission of the research project.

Problematic questions were avoided and the questions for the interviews were designed with an awareness of the dangers of posing too many probing questions without giving participants time to think before responding. Closed questions were considered inappropriate, especially for qualitative interviews, as they do not allow the interviewer to elicit more data. Leading questions were avoided because they influence the interviewee to answer in a specific manner. Cohen et al., (2003) suggests that the nature of leading questions can be used to prompt information that the interviewer believes is withheld by the interviewee. The data obtained from this process assisted in providing answers to question 3: How are students expected to demonstrate their understanding of the Biology basic reading demands?

3.6 DATA ANALYSIS

Qualitative data analysis was used as it involves systematising, accounting for, and clarifying the data. This means making sense of data in terms of the participants' definition of the condition, observing patterns and themes, categories and regularities (Cohen et al., 2003). The first step in the data analysis process was to transcribe the interviews from the audiotape. The course outlines and written work were coded and themes and patterns were found and were looked at for use in the findings.

3.7 ENSURING TRUSTWORTHINESS AND CREDIBILITY

Two Biology tutors, one SCOM coordinator (who is also a SCOM tutor) and six ex-SCOM students who are doing Biology as a mainstream module were chosen as research participants as it was felt that they would provide rich data by sharing information crucial to facilitate the demanding and unique issues of this study. Questions were developed that were considered direct and impartial by aligning them with the study goals and that would give honest

answers and would respond directly to the study questions. Based on Elliot, (2011) the data should be examined using major themes and subthemes to elicit the relevant analysis. Findings were also shared with colleagues, that is, both Biology and SCOM tutors, for further clarification of the results as indicated by Elliot (2011).

3.8 ETHICAL CONSIDERATIONS

An application for ethical clearance was made to the Ethics Committee of the University of KwaZulu-Natal and was obtained before the study commenced. Written consent forms, which described the study and its purpose, were presented and explained to each participant before the data was gathered. Letters of consent were signed by all participants. Participation in the study was voluntary and that was indicated in the consent letters. Prior to the interviews, participants were made aware of the objectives of the study, that their names would not be used, and that students' written work would be confidential.

3.9 LIMITATIONS

This research was conducted at a university at which the researcher teaches SCOM and came with potential biases and prejudices. To resolve the issue of bias and prejudice, a Mathematics lecturer (who is a colleague) was asked to conduct the interviews with the students. A further limitation was the fact that the lecturers interviewed were colleagues of the researcher and might have provided information that was different if the interviews were conducted by another person. This issue was not resolved as the researcher did the interviews with the lecturers.

3.10 CONCLUSION

This chapter outlined the research paradigm, research approach and research methods used in the study. The context of the study and sampling was focused on. The course outlines, students' assignments and interviews were considered in the gathering of data. Data analysis, ethical clearance and the limitation of the study were also discussed. The following chapter presents the findings of the study in the form of tables, graphs and narratives and descriptive analysis of each is provided.

CHAPTER 4

DISCUSSION OF RESEARCH FINDINGS

4.1 INTRODUCTION

In this chapter, the data is presented and discussed in the form of tables, graphs and narratives. In presenting the findings, the critical questions have been used for guidance in the interpretation of the key responses from the data that collected. The data was viewed through the lens of social constructivism and this enabled the researcher to identify themes and categories that relate to the ways in which students construct knowledge in social settings. Using social constructivism as a tool, the analyses of data took into consideration not only the context in which learning takes place but also the social context that the students bring to their learning environment. Social constructivism views the background of the student as an important aspect of learning as it helps to shape the knowledge that the student constructs.

This study examined the perceived contribution of SCOM towards developing reading skills for the Biology mainstream module. The critical questions relevant to the presentation of the results will show the role, if any, played by SCOM in developing reading skills for Biology. To gain insight into the role of SCOM in developing reading skills for Biology, findings from the two course outlines, students written work and students and lecturers interviews, will be discussed in response to the critical questions.

4.2 . FINDINGS

4.2.1 The reading requirements of Biology

In order to gain answers to the critical questions of this study, it is important to identify the disciplinary reading fundamentals of Biology. In order to do that, the researcher has focused on the Biology course outline, interviews with ex-SCOM students and the Biology tutors, and students' assignments.

4.2.1.1 Biology course outline

The Biology course outline (See Appendix C) indicated that students should read from the prescribed textbook and from other texts to which they are referred. They are also asked to

read other Biology textbooks from different libraries for the written work as well as in preparation for their practicals.

The Biology module assessment tasks in the course outline include essays, reports, tests, practicals and an examination. In the Biology course outline, students are provided with information to enable them to access readings from the prescribed textbook, short-loan copies of relevant material in the library and are encouraged to source Biology textbooks from external libraries to use in preparation for assignments and practicals. The assessment comprises writing essays, reports and practicals. There is no oral presentation. Other assessments comprise tests and an end of the year examination. Students preview texts so that they can remember material studied, in preparation for the test and examination. Biology offered practicals, which assist students in the written tasks with the understanding prerequisite that they have utilized the required reading strategies. This is part of the disciplinary reading fundamentals for Biology.

From the Biology course outline, it was observed that students are expected to be independent readers as it was anticipated that Biology students would search for information from textbooks in the library. Scaffolding of reading during practicals was minimal. The assumption was that students' acquisition of reading skills was part of academic literacy in schools. Students had to read independently and to make connections to what was discussed in tutorials and as such some of the important points are left out as Mgqwashu, (2007:319-320) claims that:

> As a result of the difficulties students had with the amount of independent reading required, many texts were unread and unfinished, so much of the significance of what was discussed in class was lost. It is therefore important to consider the process that take place when an individual student reads because lecturers and tutors can vary teaching methods to meet students' epistemological access.

4.2.1.2 Ex-SCOM students' interviews

The researcher believed it was necessary to find out the reading histories of students because their experiences will determine the role played by their reading experiences. Two out of six said they did not enjoy reading as they had not been exposed to reading at home, and at school, the teachers would read and summarise relevant material for them. Four out of six students said that they enjoyed reading, especially in isiZulu, their mother tongue, because

they had been encouraged to read the isiZulu bible and Isolezwe, an isiZulu newspaper. At times, they read books with pictures and/or magazines. Mahmud (2013) states that people build their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences and further mentions that students become engaged by applying their existing knowledge and real-world experience, by learning to imagine, by testing their theories, and ultimately by drawing conclusions from their findings. Those students who enjoyed reading believed that their parents had played an influential role in exposing them to reading strategies at a young age. Readers use a variety of reading strategies to assist with decoding (to translate symbols into sounds or visual representations of speech) and comprehension. Readers may use morpheme, semantics, syntax and context clues to identify the meaning of unknown words (Beare, 1997).

Shoebottom (1996) points out that the factors that influence acquisition of a second language is directed by the manner in which the first language had been acquired. Therefore at an early stage of child development if they were exposed to reading in their mother tongue, this would have a significant impact on their later requisition of language. Transferring reading skills to a second language depends on how they have acquired and transferred reading skills from their first language. However, Yuen-Ching and Suk-Han Ho (2008) argue that transferable skills depend on the similarities and differences of the first language (L1) and the second language (L2), because some languages emphasize more of a specific skill than others. Their argument indicates that not all students are able to utilise reading skills learnt from their first language. Biology staff should consider this limitation when they design the course outline.

To assess current reading skills it was vital to understand the students' school reading background. Five students stated that their teachers read and interpreted for them, meaning that they were passive recipients and not actively involved in the learning process. However, one student out of six mentioned that at school, they usually took turns in reading and the teacher would assist them in the pronunciation of difficult words. At times if they did not understand the content of the reading material, the teacher would provide them with a summary and an explanation of difficult words or concepts. They all stated that the reading requirements of the different disciplines were dissimilar and the key reading challenge with which they were confronted in Biology was that they were expected to be independent readers.

The ex-SCOM students stated that they lacked a facilitator who would have provided appropriate reading interventions and strategies developmentally appropriate to their level. It appeared as if the SCOM module had not adequately assisted them to read independently. From a teaching perspective two models, interactive and manipulative, are used to engage students and to introduce, practice or remediate a variety of scientific concepts. Wenning (2011) states that manipulative model is used to view and relate and make predictions. The interactive model describes the process involved when reading a text, as something that includes different strategies that are used to accomplish goals. These different strategies can range from skimming for global meaning, to skimming for a very close meaning, depending on the reader's purpose. Constructivism theory (Vygotsky, 1978) is centered on the observation and scientific study about how people learn. It emphasizes that the teacher functions more as a facilitator who coaches, mediates, prompts and helps students to develop and assess student understanding encouraging students to create their own meaning from texts. This theory promotes collaboration and exchange of ideas until students can embark on independent reading.

However, other factors may contribute to a students' attainment of reading skills such as aptitude, interest, opportunity and experience. The time allotted for lectures and tutorials in the biology module is limited, and therefore independent reading is promoted. This system of teaching reading does not allow deep and interactive learning. However, the findings from the study conducted by Taylor et al (2000) indicate that time spent engaged in independent reading does make a difference to students' reading achievement. Independent reading boosts vocabulary, reading comprehension, verbal skills and achievement-test scores (Taylor et al., 2000). Independent reading time can boost a student's interest in reading (Thompson 2009). However it has been argued that independent reading might have a causal result on reading development if the readings are difficult or above the students' current independent reading level (Harlaar et al., 2011). Therefore, if textbooks are too difficult to read, especially when students are still acquiring basic reading skills, improvement in reading skills is likely to be slow. Yet, the SCOM module was designed to help students acquire basic reading skills.

Sequencing and pacing of the curriculum is a contributing factor to the time available for teaching and can significantly impact on the ability of lecturers and tutors to assist in the development of reading skills. Consequently students may be at a disadvantage and often unable to make the essential, explicit links between the concepts and knowledge of the

discipline (Kliebard, 1965). Rose (2004) argues that any student who misses the first stage of reading may struggle indefinitely since the sequencing and pacing of the curriculum does not afford time to catch up or consolidate the learned material or skills. There are university rules for meeting deadlines and completion of particular tasks or sections of the curriculum. Consideration of these rules should be fundamental to future solutions for effectively addressing this challenge. It is possible that Biology tutors do not give students enough time to acquire the necessary skills they are expected to have at tertiary level. However, some of these issues should have been addressed by the SCOM module.

At university, students are evaluated based on the assumption that they have already attained basic reading skills, with no consideration for school background or reading experience. Scaffolding of reading in the SCOM course should be considered alongside other variables, for example, enjoyment of reading. Reading ability was only one, yet significant, component of preparedness for tertiary study (Kirkwood 2007).

What was not clearly considered in assessing students' reading ability was the extent to which their reading skills differ from those of mainstream students. This is critical for establishing the development that must take place over the year if students are to cope with the demands of mainstream. The effectiveness of reading skills cannot be the only measure of independent reading ability and marks. For example, a student can be an independent reader but score low marks and yet have applied the reading techniques. However the problem could be that the readings were challenging and/or their frame of reference did not overlap with the writer's frame of reference (Macdonald, 1999). Given these constraints, scaffolding of reading could assist the students in activating their frame of reference. The SCOM scaffolding approach assisted students with reading strategies. It is a core skill for the first year level of study especially for those students with reading problems who were accepted into mainstream Biology. While the students believed that SCOM should be a mainstream credited module, it was clear that the disciplinary reading fundamentals of Biology need further exploration to determine how best to align them with the skills taught in SCOM.

4.2.1.3 The Biology tutors

The most striking response that emerged from all tutors was that SCOM should be a recommended mainstream credited module. They felt that all students need extra reading assistance regardless of their school preparedness.

In their interviews, Biology tutors said that reading is done as homework in preparation for the practicals. They indicated that limited time allocated for tutorials negatively impacted on students' ability to scaffold their reading whilst preparing their work. They also confirmed that students are expected to read independently at home in preparation for the written work.

4.2.1.4 Students' assignments

In SCOM, essays, report writing and tests are used to illustrate students' ability to comprehend and utilise reading strategies and the mark achieved could indicate their level of understanding. A requirement of the students' written work was to show their comprehension skills and to prove that they are in a position to understand and answer questions. The disciplinary fundamentals of Biology for written work are that students should be able to display that they read with understanding. The belief is that students who have scored high marks in the assignments are those who used the reading techniques most effectively. Therefore, if students achieved high marks in Biology it was deduced that SCOM had met some of the reading disciplinary requirements of this course.

For the assignments, students were required to write an essay, scientific report and two tests. In semester one, students were given the essay topic and prescribed readings for the essays. They were introduced to essay writing in terms of structure, for example, introduction, development of paragraphs, conclusion and references. Conventions such as language style, register, the use of transitional linking words and logical connectors were discussed. The goal of writing the essay was to demonstrate their current reading and writing skills.

Students were expected to utilise reading techniques such as, skim-reading for main ideas, scanning, using mind-maps, summarising, paraphrasing, note-taking, critical reading and the ability to respond to direction words for example, discuss, explain, describe and compare. They were also expected to respond to the content words, that is, the 'what' part of the topic

and to consider the limits and boundaries of the question/topic. Application of these strategies is an essential aspect of good reading skills and necessary for the students to engage in scientific discourse. In preparation for the written work, students are given the essay topics (See appendices G and H) and prescribed readings and the Biology tutors expect them to have these core skills.

The second assignment was a scientific report. The aim of the report was to expose students to research in the form of an experiment, field research or observation. In writing the report students were referred to the prescribed Biology textbook, copies on short loan and other general Biology text books to get information that would help them to understand the research topic and to get relevant information for writing the literature review. Students were provided with guidelines and/or a format that they should follow when writing (see appendices I and J). They were expected to read these text-books on their own and expected to collect relevant information for each specific stage of the research, such as during the literature review.

4.2.2 Students' demonstration of the Biology reading requirements

The Ex-SCOM students Biology marks were evaluated. The marks were for their essays and reports and the marks would provide evidence, or not, that ex-SCOM students had grasped the expected reading fundamentals of Biology. Their first and second semester Biology essay marks are presented in percentages in the form of a table below.

Table 1: A table illustrating both semester essay marks for 6 ex-SCOM students doing the Biology module

Essay	S1	S2	S3	S4	S5	S6
Biology 1st sem.	56	50	60	56	57	66
Biology 2nd sem.	60	54	64	68	64	75

For the essay in the first semester, of the six students, one student (S1) got 50%, three students (S1, S4 and S5) got above 50%; one (S3) got 60% and one (S6) got above 60%. In

the second semester, one got above 50%; one got 60%; three were above 60% and one got 75%. From the above table it is evident that all ex-SCOM students passed the essay in both semesters. One student is border-line in the first semester and the rest are in the upper level, between 55% - 66%. This indicates that they are not familiar with the Biology texts. They are both difficult and too long. Students therefore also lack initial scaffolding. Essay wring demands a good understanding of the reading (content) which is also include paraphrasing. In the second semester the student who was border-line in the first semester managed to get 54% and the rest are above 60%, with the exception of student six who got 75%. The six students demonstrated that they had achieved the reading requirements of Biology, even though at different levels. In addition, their marks improved from semester one to semester two.

Table 2: A table illustrating both semester report marks for 6 ex-SCOM students doing the Biology module

Report	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**
Biology 1st sem.	60	62	64	56	62	64
Biology 2nd sem.	66	65	66	62	72	75

The students report marks indicate a slight improvement, especially S5 and S6, in comparison to their essay marks, which might indicate that students are gradually applying some of the reading strategies taught in the SCOM module. 67% of the students got above 60%, 16% got 60% and 16% got 56%. In the second semester, there is more improvement, for example 67% got above 60% and 33% above 70%, which indicate that they may be becoming more independent readers by applying reading skills obtained from SCOM.

Table 3: A table illustrating both semester test marks for 6 ex-SCOM students doing the Biology module

Test	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**
Biology 1stsem.	48	42	56	53	60	67
Biology 2ndsem.	56	54	60	60	62	72

From the above table and graph, it is apparent that two ex-SCOM students failed the test. For example, students one and two got less than 50%, in the first semester two are above 50%, one is at 60% and one at 67%. In the second semester, three are above 50%, two are above 60% and one above 70%. From the performances, it was necessary to interrogate the students' demonstration of their understanding of the reading fundamentals of Biology.

The students' demonstration of their understanding of the reading fundamentals of Biology will be discussed by focusing on Biology tutors' interview responses, the SCOM coordinator's interview responses as well as ex-SCOM students' responses and written work. Biology tutors stated that some ex-SCOM students had demonstrated no interest in reading. For example, they came to practicals having not done their reading homework. The SCOM coordinator had reported that in SCOM students were not expected to read for homework as experience showed that they most often failed to do so, and when they received their marked assignment drafts, they did not pay attention to comments from the tutors.

It has been suggested that students do not read feedback, as they are more interested in the mark attained as opposed to improving their reading and comprehension capacity. This concurred with comments from the Biology tutors that some ex-SCOM students showed no interest in reading. This finding indicates three issues: firstly, the SCOM module does not encourage independent reading and should be adjusted and secondly, the marking criteria and feedback system used by SCOM needs to be re-examined to make feedback useful to students. Thirdly, the Biology module needs to make allowances for students with varying reading abilities and include some measure of scaffolding, at least in the initial stages of the module.

Some ex-SCOM students indicated that the Biology prescribed readings and textbooks were long and difficult to understand. Thus, they are left behind, waiting for their lecturers to tell them what is important, and struggle with their assignments. This could also be a factor in their ability to master the reading fundamentals of Biology and lecturers should select textbooks that enable students to gain understanding, faster and easier (Carver, 1993). Students also indicated that scaffolding the readings could have helped in their understanding of the Biology reading basics. They felt that scaffolding readings should be considered as one of the basic reading methods in assisting inefficient or weaker students. Although scaffolding

is a well-established method, it should not be over-emphasised. It is clear that SCOM needs to wean students off scaffolding earlier and make the students independent readers faster.

Some critics suggest that Vygotsky exaggerated the role of language in thinking and his emphasis on cooperation and assistance has possible drawbacks if facilitators are too helpful. Other critics argue that some children may become lazy and expect help when they can do something on their own. Therefore, the role of SCOM in the development of reading skills for Biology should reconsider its application of scaffolding as a teaching technique.

In the interviews, Biology tutors indicated that students should read daily in preparation for their practicals and assignments because they write at least one practical report per week. They are expected to read feedback from their assignments to improve their understanding but if they repeat the mistakes, it is assumed that they lack reading comprehension. Another point raised by the tutors is that students should be able to articulate the Biology concepts, and this could be achieved by engaging them in small group discussions and oral presentations and tutors should facilitate this process.

Generally, students are expected to identify different academic language styles to enable them to understand and identify the organization of ideas from a text with the help of their tutors or lecturers. For example Boughey (2000) argues that people become literate by observing and interacting with other members of the discourse until the ways of speaking, acting, thinking, feeling, and valuing, common to that discourse, become natural to them. Students need their tutor to model and involve them in the interactive mode of learning to read. An effective model that has been used is the Gradual Release of Responsibility Model (Pearson and Gallagher, 1983) where teachers are responsible for applying a newly introduced strategy by modelling, thinking aloud, demonstrating, and creating meaning. The Vygotskian perspective highlights that teachers should model appropriate reading skills. However, both Biology tutors believed that students should have adequately developed the reading skills by the time they gain entrance to a tertiary level of study and they believed that modelling and involvement were not necessary in the Biology tutorials.

According to Brownlee (2004), reading can be highly structured and made easy to read, and at the same time, it can be less structured, allowing room for predictions and creating meaning-construction by readers. It is therefore important to consider the processing that

takes place when an individual student reads because lecturers can and should vary teaching methods to meet students' epistemological access.

4.2.3 The role of SCOM in preparing students for the demands of mainstream Biology

4.2.3.1 The relationship between SCOM and Biology Module outlines

The SCOM course outline was divided into weeks and tutorial sessions for the semester. The first and second weeks were for the introduction of the course and referencing. Part of week two, three and four were allocated for topic analysis and the prescribed reading articles that were relevant to the assignment topic. All the readings were scaffolded by tutors and these readings were designed with questions to assist students' understanding of the reading article content. The following weeks were given to the writing process of the assignment. The final two weeks were assigned to oral presentations and in preparation for this, students were given a list of scientific topics to choose from. They were expected to independently research their chosen topic and present a summary to the tutor for approval.

The Biology Course outline had a preface that served as an introductory part. It included the three big questions in Biology For example 1. What is biodiversity and how do we measure it? 2. How can we explain the high biodiversity that we see today (has it always been like this and will it always be like this)? 3. Why is biodiversity under threat and what is the human impact on biodiversity? (See Appendix C.). These questions activate students' frame of reference to that of their content material. One of the requirements of effective reading is to include context or use questions that will help students to make sense of the text and read with a purpose. Pillay (2010) argues that to learn knowledge, students need to work actively in focussed ways; integrating new information with previous knowledge.The module content included the theory and practicals. In the practicals, students would learn note-taking and data analysis, scientific paper writing and other forms of scientific communication, such as observation and interpretation skills. Students were expected to attend a seminar series at which local or visiting biologists address scientific issues, open lecturers presented on campus as well as the annual research meeting of the School of Biology. Posters advertising such events are displayed on School notice boards, to which students' attention was directed. They were expected to read and make sense of the information on the notice boards. The next part of the Biology course outline was the name of the prescribed Biology text- book and

copies were made available on short loan at the specific libraries (See Appendix C). Students were expected to read the textbooks and copies on their own.

Unlike SCOM, Biology did minimal scaffolding reading for students. In SCOM, students were not exposed to seminars, open lecturers and annual research meetings. However, when comparing both Biology and SCOM course outlines, they were similar in the approach to introducing students to the different genres of scientific writing, for example, essays and report writing.

4.2.3.2 Biology and SCOM tutors

Biology tutors reported that ex- SCOM students performed fairly well when compared to some of the first year Biology mainstream students. It was clear that their comprehension skills had improved and they were therefore in a better position to understand and respond to questions on the written work. However, they argued that there were still some language related issues, particularly in sentence construction and grammar, which could be substantially improved. They believed that students, particularly those from disadvantaged schools, would not be able to master language during the course of a one-year SCOM programme. They also indicated students' performance might vary because, at the beginning of the year, some students tend to perform poorly but improve as the semester unfolds. Their perception was that students adapt to the system of learning and it could be external pressures like funding, peer pressure, adjusting to university life and academic adjustment that affected their performance. However, Biology tutors concurred that most of the ex-SCOM students were more confident when reading some Biology textbook for the assignments because they were able to utilise some of the reading strategies skills attained from SCOM. This was perceived by both tutors as a positive impact of the SCOM module on the Biology module.

Furthermore, both Biology tutors suggested that the SCOM module should be offered to the mainstream students especially those who were struggling with reading and writing skills as some students struggled with the pace of the work. It is possible that the reading and writing skills had not been adequately developed by the time they reach university-entry level, even though they qualified into the mainstream. They proposed that an English selection test be implemented for all students applying for the programme, to determine which students would need this kind of support and which ones would not.

Both tutors concurred that Ex-SCOM students perform much better in assignments, activities and tests, unlike some students who had gone straight to mainstream. When they were asked about the frequency of reading, their responses were that students should read on a daily basis because they should be prepared for lectures and assignments. When Biology tutors were asked about scaffolding reading for students, the response was that they encourage independent reading therefore students were expected to read at home or at the library as part of their preparation and engagement with their study-materials.

When Biology tutors were asked about students' ability to identify different genres when they read texts, their response was that ex- SCOM students were aware of different genres and understood the purpose of each genre. For example, ex-SCOM students know the difference between an essay and a report. When they were asked about aspects of reading skills that SCOM should improve upon, their response was that SCOM should encourage students to become independent readers because the Biology module offers minimal reading assistance to students. They emphasized that there should be more time allocated for students to work individually or in pairs or groups. Scaffolded reading should be minimal and tutors should facilitate, provide guidance and good instructions and leave students to work by themselves (Ford and Opitz, 2002).

The SCOM coordinator stated that students read in class and there is high level of scaffolding in the first semester that is then minimised in the second semester. SCOM used pairs of students, or small groups, to address reading difficulties and encourage cooperative and independent reading. When asked why SCOM tutors carry on scaffolding reading when students had been introduced to this in the first semester, his response was that students do not read when assigned homework because he believed that they lacked confidence and they need mediation or assistance. Pillay (2010) highlights that when students are not given such strategies like talking, negotiating, mediation, active engagement and helping them recognise that knowledge counts, the learning or reading process fail. However she argues that even though some researchers might think that such a process takes time, but maintains that it is time well spent.

The coordinator further emphasised that both disciplines should work together to strengthen the transferability of essential competencies to ensure they are realised and practiced. He also

indicated that students were expected to do some reading and writing in class where they had access to necessary support. In justifying his reliance on scaffolding readings, he indicated that prescribed reading materials for students may be difficult and indicated that students' readings, articles or texts should be simple and include popular themes, because current articles helped students to negotiate meanings as they could relate the readings to their pre-existing knowledge.

The SCOM coordinator also identified some of the reading strategies that SCOM uses to help students negotiate meaning from readings. These include the four-resources model of Luke and Freebody; the 'What it says and what it does' exercise proposed by Bean (2001) which uses notes in the margin and engaging in a 'conversation' with the researcher; summary writing and exploratory writing in response to critical thinking problems about the texts; writing 'gist statements' next to each paragraph they read; creating outlines and concept maps of the readings; and getting into the habit of using a dictionary. He highlighted that for students to be able to apply these strategies, SCOM tutors should be giving guidance on how students should use them when they read independently.

The SCOM coordinator, when asked whether he would recommend that SCOM should be introduced as a credit module in mainstream university, responded that many students come to university lacking the basic reading and writing competencies that is needed for higher studies. He mentioned that a lack of basic reading skills impacts negatively on students' overall academic achievements. He was therefore in favor of SCOM being a credited module in mainstream classes. He reiterated that there should be closer cooperation between SCOM and Biology tutors with regard to identifying and addressing the needs of the students. He emphasised that more effort should be made by both modules to consolidate the students' transferability of competencies needed to successfully complete academic studies and to make sure that these competencies are realized and practiced.

4.2.3.3 Ex-SCOM students

Ex-SCOM students indicated that they were able to link reading capabilities to the reading skills obtained from the SCOM module. For example, students four, five and six felt that SCOM assisted them in applying reading skills learnt from SCOM to reading Biology texts. They also stated that SCOM should continue to scaffold reading but the module should also

encourage independent reading, especially in the second semester to reduce reliance on the tutor. They suggested that the scaffolding method should be done in the first semester and then in the second semester student should learn to be independent readers so that they are prepared for mainstream reading. According to students one, two and three, a limitation of SCOM was that the intense scaffolding was not helping them with the Biology reading expectations for first year level. For example, student three said, "SCOM is not preparing us for Biology expectations", stating the reason that SCOM used the scaffolding approach in reading yet Biology did not.

Students one, three, five and six stated that SCOM helped them to understand some of the basic reading skills like surveying, previewing, decoding information, using bottom up and top down processes, skimming, scanning and summarizing scaffolded information from the texts. Students two and four said they could sometimes work out the connotative and denotative meanings of the text but most times they consulted with their tutors or asked peers when in small group learning for clarification of the difficult concepts from the readings. Ex-SCOM students indicated that the SCOM module should be extended to mainstream Biology because students who are struggling with reading capabilities, and ex- SCOM students who had not grasped reading skills from SCOM, needed further improvement. Ex-SCOM students suggested that the SCOM module had helped them to be able to read effectively for their research, especially for the reports and essays. This was reflected in their performance marks from these two assignments. In the second semester, they all passed but with most students' marks being borderline.

Students' interview responses showed that they are unable to use a scaffolding approach independently when reading texts for Biology. They also found that they were responsible for finding relevant information for their assignments from the prescribed textbooks whereas in SCOM, they were given prescribed readings and tutors scaffolded readings for them. SCOM is interested in the scaffolding strategy in reading because this is where students benefit in terms of understanding the reading skills. They have an opportunity to utilize their experience in making sense of the text. Kirkwood (2007) argues that comprehension is positively influenced by the provision of scaffolding. However, the SCOM module has to re-examine its use of scaffolding because it appears to make students dependent on the lecturer to scaffold for them and fails to instill independence.

The students report marks indicate a slight improvement, especially S5 and S6, in comparison to their essay marks that might indicate that students are gradually applying some of the reading strategies taught in the SCOM module. 67% of the students got above 60%, 16% got 60% and 16% got 56%. In second semester there is more improvement, for example 67% got above 60% and 33% above 70%, which indicate that they may be becoming readers that are more independent, by applying reading skills obtained from SCOM. There are also various contributing factors to this improvement. The report format is in stages, so each stage is allocated a mark that could be a contributing factor. From table 2 above all six students passed the report. Ex-SCOM students passed the Biology essays and reports. Various factors can explain the reasons for their fair performance. However, two out of six ex-SCOM students failed the 1st semester Biology test and just managed to get above 50% in the second semester. One the reasons could be anxiety of the test conditions or lack of adequate preparation. The other reason could be that the readings were difficult and students had not had developed effective reading strategies that also include the teaching style. The students who struggle with the unfamiliar vocabulary of the academic texts could also be influenced by the manner in which they acquired and transferred reading skills from their first language (Yuen-Ching and Suk-Han Ho 2008).

In Biology, students had to respond to multiple-choice questions and negative marking was used. Therefore it is difficult to assume that SCOM influenced their performance (student one and two) in the test as negative marking is not used in SCOM and including this type of assessment into the SCOM course may help to a familiarize students with the expectations of the Biology course.

4.3 CONCLUSION

This chapter has presented the findings from the various data collected to answer the research questions (outlined in chapter one). Tables and narrative descriptions were used to illustrate the results. It has also analysed and interpreted the findings.

CHAPTER 5

CONCLUSION

5.1 INTRODUCTION

The primary objective of this study was to explore the role of the Communication in Science module (SCOM) in developing reading skills for the Biology module. University expectations of academic literacy play a vital role toward students' academic performance. Some students from previously disadvantaged school backgrounds struggle with reading and writing skills. It is for this reason that SCOM was introduced. As reading is integral to the process of writing, the researcher was interested in studying reading skills. There were critical questions related to the aim of this study that tried to ascertain whether the SCOM module facilitates academic literacy within the Biology mainstream module. This chapter explores the main conclusions from the study, the strengths of the study, the limitations of the study, personal reflections and recommendations.

5.2. MAIN CONCLUSIONS FROM THE STUDY

Firstly, scaffolding reading has been explored as an approach in developing reading skills for SCOM students. It was evident that SCOM should re-examine its use of scaffolding because it encourages students' dependence on the lecturer. The most significant aspect of the research is that scaffolding should not be considered as the only approach that should be used for teaching reading skills. It is vital that SCOM and Biology should vary teaching styles. The course outline comparison revealed that the Biology expectation is that students should be independent readers and that is why they have included a prescribed Biology textbook and placed copies in the library. However, student responses indicated that ex-SCOM students would have preferred Biology to scaffold reading. Biology tutors were concerned with practicals and note taking, but were limited in teaching and scaffolding readings as they expect independent reading. SCOM lecturers scaffold and encourage reading by frequently exposing students to a number of easy readings to help students access meaning from the texts. However, students need to become independent readers and over-exposure to scaffolding prevents them from attaining this.

Secondly, all interviewees agreed that SCOM should be extended to mainstream Biology recognising that it had a positive impact on the Biology students through the development of reading skills. The university should therefore consider incorporating SCOM into mainstream modules. This study could reinforce the importance of the SCOM module as a vital element of the Biology mainstream modules where similar trends of students' inefficiencies in reading skills have been identified.

5.3 STRENGTH OF THE STUDY

The study revealed that reading skills offered by SCOM to students serve as a starting point for developing strategies to equip them for the demands of tertiary study. From the research, it was found that SCOM plays a pivotal role in assisting students with reading skills. The lecturers scaffold students' reading by creating activities within the students' Zone of Proximal Development (Vygotsky, 1978), and slowly withdraw this support. As a result, teachers can vary teaching methods to meet students' epistemological needs. The research indicated that some students might need more time than others to manage this. Those who mastered the reading processes offered by SCOM did not struggle as much when faced with mainstream expectations, as they effectively used the reading strategies acquired from SCOM. This was part of the perceived impact of the SCOM module on the Biology module.

The study also revealed that there is no pedagogical method that can cater fully to students' academic literacy development over the course of one year. Acquiring reading skills is an ongoing process and readers employ a wide variety of approaches to assist them with the attainment, storage, and retrieval of information. This implies that academic reading difficulties, especially those encountered by educationally disadvantaged students, cannot be rectified in one year. However, the study has pointed out the adjustments that might be undertaken by SCOM to meet the reading requirements of the Biology mainstream module.

5.4 LIMITATIONS OF THE STUDY

As the researcher, I was concerned that this investigation of the role of SCOM in developing reading skills for Biology did not adequately cover some relevant aspects. A larger sample of research participants and their written work would have improved the validity and reliability of the study. The data from six ex-SCOM students, a SCOM coordinator and two Biology

tutors was too small to give reliable results in assessing the effectiveness of the SCOM module on the mainstream Biology module. Therefore, it is difficult to extrapolate these results to a broader audience. Another limitation involved my role in the SCOM module and the possibility of bias towards the module had to be constantly noted. In addition, as the students' lecturer, I could have been perceived in a role of power, and thus could have influenced students' responses. In other words, students may have said what they thought I wanted to hear.

5.5 PERSONAL REFLECTION

As an experienced SCOM lecturer, I feel that this is a relevant module for students who come from disadvantaged school backgrounds. Assessment of the module workload and the students' academic challenges indicate that one year is not an adequate amount of time to address the inequalities in education experienced by these students. Language deficits cannot be eliminated within a limited time-frame. As a student myself, I find it exciting to understand the challenges students confront in terms of the reading and writing processes including the organisation and time management of their studies.

Interviewing my Biology colleagues was daunting especially asking them about their expectations of the SCOM course and/or how it impacts on their module. I was concerned about how they would view me. I was also concerned that they would think I was monitoring their lecturing styles. I am concerned that the SCOM and Biology lecturers work in isolation and there is little collaboration with regard to students' academic performance yet the modules are reliant on each other. I believe that my study may assist in closing the gap between the SCOM lecturers and the Biology lecturers, which I believe will make learning and teaching easier and more manageable. I also discovered that an investigation and reflection on bridging programme makes an additional contribution to understanding the challenges inherent in epistemological access initiatives.

The SCOM module is guided by the general academic literacy curriculum, even though it uses scientific concepts, which is why I believe it should be introduced as a mainstream credited module in the School of Science.

5.6 RECOMMENDATIONS

- Universities and institutions of higher learning should introduce a language component for the relevant disciplines that would be of benefit to the students. Various academic literacy skills can benefit all modules.
- The SCOM module should include an independent reading approach and vary it with the scaffolding reading support method to enable SCOM students to develop their independent reading skills as expected in the Biology mainstream module.
- Academic literacy modules, such as SCOM, and mainstream modules, such as Biology, should work collaboratively in developing the skills and competences of students
- The SCOM module should be introduced as a mainstream credited module. Students who are struggling with reading or academic literacy in mainstream modules should be advised to elect to do SCOM as it plays a significant role in developing reading and writing skills for Science. Reading is fundamental to a successful apprenticeship in any field of study and its development cannot be limited as a discrete skill, to the literacy or communication component of a foundation module.
- This study could provide a point of departure for longitudinal studies tracking the progress of specific students throughout their studies in the School of Science to investigate the longitudinal effect of reading skills offered in the SCOM module. In as much as the importance of developing reading skills for Biology has been emphasized, it is also important to investigate the effectiveness of other extensive reading programmes, similar to SCOM.

5.7. CONCLUSION

This study has addressed the need for developing the reading skills for mainstream Biology module on which their academic progress relies. Scaffolding reading has been explored and appeared to be a feasible method of encouraging students to engage with reading texts comprehensively. This chapter has explored the strength of the study, the limitations of the study, personal reflections and the recommendations.

References

Alber, R. (2014). *6 Scaffolding Strategies to Use with Your Students*. Edutopia. Retrieved July 17, from http://www.edutopia.org/blog/scaffolding-lessons-six-strategies-rebecca-alber.

Anong, S. (2008). Using Mind Mapping to Develop Reading Comprehension skills in English for Communication of Mattayomsuksa 3 students. *Master of Education, Curriculum and Instruction.* Khongen University.

Alyousef, H. S. (2006). Teaching reading comprehension to ESL/EFL students. *Journal of language and learning*, *5*(1), 63-73.

Bar-Yam, M., Rhoades, K., Sweeney, L.B., Kaputa, J. and Bar-Yam, Y. (2002). Complex systems Perspectives on Education and Education System. Changes in the Teaching and Learning Process in a Complex Education System *Complex Systems Institute*. Retrieved from http://www.necsi.edu/research/management/education/teachandlearn.html.

Bean, J. C. 2001. *Engaging Ideas: The Professor's Guide to Integrating Writing, Critical Thinking and Active Learning in the Classroom.* Jossey-Bass, Print.

Beare, K. (1997) About .com. English as 2nd Language. Reading. Identifying Skill Language Requirement. Retrieved from http://esl.about.com/od/readinglessonplans/a/l_readtypes.htm

Becher, T. and Trowler, P. (2001). *Academic Tribes and Territories: intellectual enquiry and the cultures of disciplines* (2nd edition). Buckingham: Open University Press/SRHE.

Bernstein, B. (1990). The structures of pedagogic discourse, Vol 1V, *Class, codes and control* London and New York, Routledge. London: Routledge and Kegan Paul. pp. 125–126, 127, 151, 143, 151–152.

Boughey, C. (2002). 'Naming 'Students' Problems: an analysis of language-related discourses at a South African university. *Teaching in Higher Education*, *7*(3), 295-307.

Boughey, C. (2000). Multiple metaphors in an understanding of academic literacy. *Teachers and Teaching: theory and practice*, *6*(3), 279-290.

Boughey, C. (2007). Educational development in South Africa: From social reproduction to capitalist expansion? *Higher Education Policy*, *20*(1), 5-18.

Brownlee, J., Walker, S., Lennox, S., Exley, B. and Pearce, S. (2009). The first year university experience: using personal epistemology to understand effective learning and teaching in higher education. *High Educ.*, 58, 599–618. *www*.apsanet.*org*. pp. 773–776.

Brownlee, J. (2004). Teacher education students' epistemological beliefs: Developing a relational model of teaching. *Research in Education, 72*(1), 1-17.

Carrell, P.L. (1988a). Interactive TextProcessing: Implications for ESL/Second Language Reading Classrooms. In Carrell, P. L., Devine, J. and Eskey, D.E. (eds.). (1988). *Interactive Approaches to Second Language Reading.* Cambridge. Cambridge University Press.

Carrell, P.L. (1988b). *Interactive Approaches to Second Language Reading*. New York: Cambridge University Press.

Carrell, P.L. and Eisterhold, J.C. (1988). Schema Theory and ESL Reading Pedagogy. In Carrell P.L, Devine, J. and Eskey, D.E. (eds). *Interactive Approaches to Second Language Reading*. New York: Cambridge University Press. pp. 260 -270.

Carver, R. P. (1993). Merging the Simple View of Reading with Rauding Theory. Retrived from http://jlr.sagepub.com/content/25/4/439. DOI: 10.1080/10862969309547829 *Journal of Literacy Research* 1993 pp. 25: 439.

Cherrie, D. (2008). Concept Mapping and Reading Comprehension. ERIC Clearinghouse on Information and Technology Syracuse NY: ED407938. http://www.ericdigests.org/2008-1/concept.htm.

Clarence-Fincham, J. (2000). Cummins' Contribution to the Understanding of Language Learning and Achievement at School. In Inglis, M., Thomson, C. and Macdonald, A. 2000. *Language in Learning and Teaching (LILT).* Pietermaritzburg: University of Natal Press.

Clarence-Fincham, J. (2009). Developing an extended curriculum for humanities at the University of KwaZulu-Natal: conceptual shifts, challenges and constraints. *Journal for New Generation Sciences, 7*(3), 70-83.

Clarence-Fincham, J. (2001). Responding to academic discourse: developing critical literacy at a South African university. *Negotiating critical literacies in classrooms*, 245-57.

Cohen, L., Manion, L. and Morrison, K. (2003). *Research methods in education*. (6th Ed.) London: Routledge.

Cohen D, Crabtree B. (2006). "Qualitative Research Guidelines Project." Retrieved from http://www.qualres.org/HomeSemi-3629.html.

Corden, A. and Sainsbury R. (2006). *Using verbatism quotations in reporting qualitative social research: researchers' views.* Social Policy Resource Unit (SPRU). The University of New York.

Creswell, J. W. (2003). *Research design: A Qualitative, Quantitative, and Mixed Methods Approaches*. (2nd ed.) Pretoria: Van Schaik.

Cummins, J. (1984). Wanted: A theoretical framework for relating language proficiency to academic achievement among bilingual students. *Language proficiency and academic achievement, 10,* 2-19.

Cummins, J. (2008). BICS and CALP: Empirical and theoretical status of the distinction. In *Encyclopedia of language and education* (pp. 487-499). Springer US.

De la Torre, I. (2013). *The incidence of tutor/student interaction on student's english performance in the eighth year of basic education, at Julio Maria Matovelle High School in Quito, during the 2011-2012 school year* (Doctoral dissertation, Universidad de las Fuerzas Armadas ESPE. Carrera de Lingüística).

Denzin, N., and Lincoln, Y. (1998). The Landscape of Qualitative Research: Theories and Isues.

De Vos, A. S., Strydom, H., Fouché, C. B., and Delport, C. S. L. (2005). Research at grass roots: for the social services and human services professionals. Pretoria: Van Schaik Publishers

Dixon-Krauss, L. A. (1995). Partner reading and writing: Peer social dialogue and the zone of proximal development. *Journal of Literacy Research, 27*(1), 45-63.

Donoghue, M. R. (2001). *Using Literature Activities to Teach Content Areas to Emergent Readers*. Allyn and Bacon.

Duffy, A. M. (2000). Balance, literacy acceleration, and responsive teaching in a summer school literacy program for elementary school struggling readers. *Literacy Research and Instruction, 40*(2), 67-100.

Edington, S. (2007). Developmental reading: A constructivist approach using reading modules. *The Kentucky Journal of Excellence in College Teaching and Learning, 5*, 17-34.

Elliot, S. (2011). Blog. Making Your Qualitative Data Trustworthy in Focus Groups, Interviews, Qualitative Sampling. Retrieved from http://www.qualitative-researcher.com/focus-group/making-your-qualitative-data-trustworthy/.

Eppler, M. J. (2006). A Comparison between Concept Maps, Mind Maps, Conceptual Diagrams, and Visual Metaphors as Complementary Tools for Knowledge Construction and Sharing. *Information Visualization*, *5*(3), pp. 202-210.

Ford, M. P., and Opitz, M. F. (2002). Using centers to engage children during guided reading time: Intensifying learning experiences away from the teacher. *The Reading Teacher,* 710-

717.Grabe, W. (1991). Current developments in second language reading research. *TESOL quarterly*, *25*(3), 375-406.

Halliday, M.A.K. (1994). *An Introduction of Functional Grammar*. (Second Edition). London: Arnold.

Halliday, M. A. K. (1996). Literacy and Linguistics: A Functional Perspective. In R. Hasan and G. Williams (eds.), *Literacy in Society* (pp. 339–424). London: Longman.

Hammond, J. Gibbons P. (2005). Putting Scaffolding to Work: The Contribution of Scaffolding in Articulating ESL Education. *An Australian Journal of TESOL*, 20 (1), pp. 6–30.

Harlaar, N., Deater-Deckard, K., Thompson, L. A., DeThorne, L. S., and Petrill, S. A. (2011). Associations Between Reading Achievement and Independent Reading in Early Elementary School: A Genetically Informative Cross-Lagged Study. *Child development*, 82(6), pp. 2123-2137.

Henning, E. (2007). *Finding your way in qualitative research*. Pretoria: Van Schaik Academic.

Hoover, W. A., and Gough, P. B. (2000). The reading acquisition framework. *The Cognitive Foundations ofLearning to Read: aframework (www. 5edl. org/reading/framework).*

Huang, Q. (2009). Asian Social Science. English Reading Based on Social Constructivist Approach. Retrieved from http://www.ccsenet.org/journal.html. 5. (7).

Huang, H. C., Chern, C. L., and Lin, C. C. (2009). EFL students' use of online reading strategies and comprehension of texts: An exploratory study. *Computers and Education*, *52*(1), 13-26.

Hudson, (2008). Reading skills tips. Study skills. Retrieved from http://www.studytips.soton.ac.uk/studytips/readingskills.html.

Hyland, K. (1990). Purpose and strategy: Teaching Extensive Reading Skills. *English Teaching Forum*, Vol. 28, N.2, pp. 14-17.

Hyland, K. (1992). Genre Analysis: Just another Fad? *English Teaching Forum*, 2:14-17.

Jackson, R. Jessica Karp, Ellen Patrick, Amanda Thrower (2006). *Social Constructivism Vignette*. Emerging Perspectives on Learning, Teaching and Technology. Retrieved from http://epltt.coe.uga.edu/index.php?title=Social_Constructivism#Social_Constructivism-Vignette

Jacobs, C. (2006). *Negotiated Understanding of the Academic Literacy Practices of Tertiary Teachers.* Thesis. University of KwaZulu-Natal.

Jiang, X., and Grabe, W. (2007). Graphic Organizers in Reading Instruction: Research Findings and Issues. *Reading in a Foreign Language*, *19*(1), 34-55.

Keke, B. (2008). Science Foundation Students Experiences at a Tertiary Institution. Retrieved from http://hdl.handle.net/10413/861 University of KwaZulu- Natal.

Kelly, K. (2006). From Encounter to text: collecting data in qualitative research. In Terre Blanche, M., Durkheim, K. and Painter, D. (eds.). (2006). *Research in Practice.* pp. 285-319. Cape Town: University of Cape Town Press.

Keskin, H. K., and Bastug, M. (2014). A Study of the Correlations among Reading Frequency, Participation in Reading Environments and Reading Attitude. International Journal of Social Sciences and Education, 4(3).

Kirkwood. T. (2007). Reading for a Foundation: *Why SFP Students Struggle and How Scaffolding can help.* Unpublished MA thesis, University of KwaZulu-Natal.

Kliebard, H. (1965). Structure of the Disciplines as an Educational Slogan. *The Teachers College Record*, *66*(7), pp. 598-603.

Knipper, K. J. (2003). Reading Programs don't teach—Teachers Teach. *The Delta Kappa Gamma Bulletin*, 69(2), pp. 34-36.

Koda, K. (2004). *Insight into Second Language Reading Across-Linguistic Approach*. New York: Cambridge University.

Ladson-Billings, G. (1992). Liberatory Consequences of Literacy: A Case of Culturally Relevant Instruction for African American Students. *Journal of Negro Education*, 61(3), pp. 378-391.

Lea, M. R., and Street, B. V. (2006). The" academic literacies" model: Theory and applications. *Theory into practice*, *45*(4), 368-377.

Lee, C. D., and Spratley, A. (2010). Reading in the disciplines: The challenges of adolescent literacy.

Lotz-Sisitka, H. (2009). Epistemological access as an open question in education1. *Journal of Education*, No. 46, pp.57-59. Retrieved from http://www.fgcu.edu/cese/images/lotz-sisitka-epistemological-access.pdf Rhodes University, South Africa.

Luckett, K. (1995). National additive bilingualism: towards a language plan for South African Education. In Heugh, K., A. and Pluddeman, P. (eds). 1995. *Multilingual education for South Africa*. Johannesburg: Heinemann.

Lyon, G. R. (1998). Why reading is not a natural process. *Educational Leadership*, *55*(6), 14-18.

Mahmud, A. A. (2013). Constructivism and Reflectivism as the Logical Counterparts in Tesol: Learning Theory Versus Teaching Methodology. *TEFLIN Journal: A publication on the teaching and learning of English*, *24*(2), 237-257.

Massey, D., and Duffy, A. (2003). The learning and perceptions of teacher researchers and facilitators in a literacy-focused, teacher-research course: A content analysis of system, student, and spheres of influence. *Journal of Literacy Research*, *35*(4), 1019-1050.

McDonald, A. (1999). Academic Communication. A Reader for Academic Communication Studies. School of Language, culture and Communication. Pietermaritzburg. University of Natal.

Mackenzie, N., and Knipe, S. (2006). Research dilemmas: Paradigms, methods and methodology. *Issues in educational research*, *16*(2), 193-205.

Maree, K. (2007). *First steps in research*. Van Schaik Publishers.

Martin, J. R. (1992). *English text: System and structure*. John Benjamins Publishing.

McCardle and Chhabra, 2004; August and Shanahan, 2008; Honig, Diamond, and Gutlohn, (2008). Elements Comprising the Colorado Literacy Framework: The Five Components of Reading. Retrieved from: http://www.cde.state.co.us/coloradoliteracy/clf/eightelements_01-fivecomponents

McKenna, S. (2004). The intersection between academic literacies and student identities. *SAJHE* 18 *(*3): 269–280.

Mertens, D.M. (2005). *Research methods in education and psychology: Integrating diversity with quantitative and qualitative approaches.* (2nd ed.) Thousand Oaks: Sage.

Mgqwashu, E.M. (2007). English studies and language teaching: *Epistemological access and discursive critique in South Africa*. PhD. Thesis. University of KwaZulu-Natal.

Midgley, W., Danaher P. A. and Baguley, M. (2013). The *Role of Participants in Education Research.* Ethics, Epistemologies and Methods. New York: Routledge Research in Education.

Molefe, N. P. J. (2003). *A Comparison of the Effectiveness of the Conventional and Microcomputer-based Methods in Kinematics* (Doctoral dissertation, Potchefstroom University for Christian Higher Education).

Morrow, W. (2009). Entitlement and achievement in education. In: *Bounds of Democracy, Epistemological access in higher education.* pp. 74–81. HRCS Press: Cape Town, South Africa.

Morrow, L.M. (1993). Literacy development in the early years: Helping children read write (2nd ed.). Boston, MA: Allyn and Bacon.

Neuman, W.L. (2000). *Social Research Methods: Qualitative and Quantitative Approaches:* Needham Heights, M. A: Allyn and Bacon.

Pardo, L. S. (2004). What every teacher needs to know about comprehension. *The Reading Teacher*, *58*(3), 272-280.

Parkinson, J., Jackson L., Kirkwood, T. and Padayachee, V. (2007). A scaffolded reading and writing course for foundation level science students. *English for Specific Purposes,* 26. pp. 443-461.

Parkinson, J., Jackson L., Kirkwood T. and Padayachee V. (2008). Evaluating the effectiveness of an academic literacy course: Do students benefit? *Per Linguam* 24(1):11-29 Retrieved from http://dx.doi.org/10.5785/24-1-37.

Pearson, P. D., and Gallagher, M. C. (1983). The instruction of reading comprehension. *Contemporary educational psychology*, *8*(3), 317-344.

Pillay, A. (2010). Embracing multiliteracy for teaching and learning in higher education. *South African Journal of Higher Education*, *24*(5), 771-781.

Pretorius, E.J. (2002). Reading and Applied Linguistics – a deafening silence? *Southern African Linguistics and Applied Language Studies*, 20. pp. 91-103.

Pretorius, E.J. and Machet, M. P. (2004). The socio-educational context of literacy accomplishment in disadvantaged schools: Lessons for reading in the early primary school years. *Journal for Language Teaching*. 38 (1). pp. 45-62.

Reppen, R. (1994). A genre-based approach to content writing instruction. *TESOL Journal*, 4 (2), pp. 32-35.

Rose, D, L Lui-Chivizhe, A. McKnight and A. Smith. (2003). Scaffolding academic reading and writing at the Koori Centre. *Australian Journal of Indigenous Education*, 32: pp. 41-49.

Rose, D. (2004). Sequencing and pacing of hidden curriculum: How Indigenous children are left out of the chain. In J. Muller, A. Moirais and Davies, B. (eds). *Reading Bernstein, Researching Bernstein*. London: Routledge Falmer.

Rose, D. (2006). "*Towards a Reading –Based Theory of Teaching*", Plenary for the 33rd International Systemic Function Linguistic Conference. Sao Paulo.

Smith, J. A., Flowers, P., and Larkin, M. (2009). *Interpretative phenomenological analysis: Theory, method and research*. Sage.

Snow, C.E. (2002). Reading for understanding: Towards a research and development program in reading comprehension. Library Congress Cataloging. RAND-Santa Monica. Retrieved from http://www.dsusd.k12.ca.us/users/christopherg/reading program for teachers.pdf

Street, B. (2003a). What's "new" in New Literacy Studies? Critical approaches to literacy in theory and practice. *Current issues in comparative education*, *5*(2), 77-91.

Street, B. (2003b). Current Issues in Comparative Education, Teachers College, Columbia University, *Current Issues in Comparative Education*, Vol. 5(2) 77 Kings College, London.

Shoebottom, P. (1996). The factors that influence acquisition of a second language. Retrieved from http://esl.fis.edu/learners/support/factors.htm.

Taylor, P., Barbara M., Pearson, D., Clark, K. and Walpole, S. (2000)."Effective schools and accomplished teachers: Lessons about primary-grade reading instruction in low-income schools." *The Elementary School Journal* (2000): pp. 121-165.

Terre Blanche, M. and Durkheim, K. (1999). Research in Practice: *Applied methods for social sciences*. Cape Town: UCT Press.

Thomson, C. I. (2009). *Changing words and worlds? A phenomenological study of the acquisition of an academic literacy* (Doctoral dissertation, Rhodes University).

Thompson, V. (2009). The Importance of Independent Reading in Elementary Schools. *Everydaylife*. Retrieved from http://everydaylife.globalpost.com/importance-independent-reading-elementary-schools-9591.html.

Tinzmann, M. B., Jones, B. F., Fennimore, T. F., Bakker, J., Fine, C., and Pierce, J. (1990). What is the collaborative classroom? New Learning and Thinking Curricula Require Collaboration. *Proceedings of NCREL*.

Umalusi Council for Quality Assurance in General and Further Education and Training (South Africa) and Booyse, C. (2010). *Evaluating South African National Senior Certificate in relation to selected international* qualifications: *A self-referencing exercise to determine the standing of the NSC*. UMALUSI.

Vaughn, S., Klingner, J. K., and Bryant, D. P. (2001). Collaborative strategic reading as a means to enhance peer-mediated instruction for reading comprehension and content-area learning. *Remedial and Special Education*, *22*(2), 66-74.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Walqui, A. (2006). Scaffolding instruction for English language students: A conceptual framework. *International Journal of Bilingual Education and Bilingualism*, *9*(2), 159-180.

Wilson, K. (2003). A Social Constructivist Approach to Teaching Reading: Turning the rhetoric into reality. *English Australia*. Retrieved from English australia.com.au/ea_conference03/proceedings/pdf/037FWilson.pdf 16th Educational Conference Melbourne. University of Canberra.

Yang, L. and Wilson, K. (2006). Second Language Classroom Reading: A Social Constructivist Approach. *The Reading Matrix.* Vol. 6, No.43. Retrieved from http://www.readingmatrix.com/articles/yang_wilson/article.pdf.

Young, M.F. (1993). Instructional design for situated learning. *Educational Technology Research and Development*, *41*(1), pp. 43-58.

Yuen-Ching Keung and Connie Suk-Han Ho, (2008). Transfer of reading-related cognitive skills in learning to read Chinese (L1) and English (L2) among Chinese elementary school children l· Department of Psychology, University of Hong Kong, Hong Kong.

Zhang, Z. L., Hauge, M., Ødegård, J., and Thaulow, C. (1999). Determining material true stress–strain curve from tensile specimens with rectangular cross-section. *International Journal of Solids and Structures*, *36*(23), 3497-3516.

APPENDICES

APPENDIX A

INFORMATION SHEET

This Coursework Masters in Education study's key question is: does the Science Communication module enable students to acquire relevant reading skills that will assist them in comprehending Biology texts?

The purpose of the study is to examine the extent to which reading comprehension skills that students learn in Communication in Science enable epistemological access in the Biology mainstream module. By epistemological access, I mean grasping Biological concepts, ideas, and turning read knowledge into written explanations, descriptions, and discussions, depending on the assessment demands. The extent to which the transfer of these skills is successful is the concern of this study. The study is also concerned with identifying and describing best practice in the process of preparing 1st year students for Biology.

The findings will be useful for teachers of Communication in Science and biology modules. It will also be useful to future curriculum development specialists in improving reading materials for SCOM. If students are able to read efficiently from foundation, their performance will also improve in other courses.

Thank you for your support.

Vivienne Tutshana (Student number: 942417554)

If you have any queries, please contact me on 083 472 8682 or 033-2605695.
You may also contact my supervisor, Ansurie Pillay on Pillaya3@ukzn.ac.za or 031-2603613.

You may retain this sheet

APPENDIX B

FACULTY OF EDUCATION

SCHOOL OF LANGUAGE, LITERACIES AND MEDIA EDUCATION

Researcher: Mrs. Vivienne Nomathamsanqa Tutshana (033-2605893)
Ethical Clearance: Protocol Reference Number:
Supervisor: Ansurie Pillay (031- 2603613)

Dear student

I am studying towards a Master's degree which explores the role of Communication in Science on developing the reading skills for Biology. I ask for your consent to observe documents in the Biology module for which you are registered and to use your tests assignments and your ideas as part of my research data. I also value the issues of confidentiality and assume not to disclose your identity in the research.

Yours faithfully
Vivienne Nomathamsanqa Tutshana

Informed Consent Document and Declaration

I: …… Student No.: ……..

Hereby consent to the observation of documents in the Biology module for which I am registered. I also consent to the use of my tests assignments and project for the purpose of educational research. I understand that my right to confidentiality will be respected and my identity will not be revealed in the research.

……. ……

Signature Date

APPENDIX C

School of Biological and Conservation Sciences
BIOLOGY 102 / 196

2011
LIFE ON EARTH

UNIVERSITY OF
KWAZULU-NATAL

NAME: _____

STUDENT NUMBER: _____

MODULE OUTLINE

PREFACE

Welcome to ***Life on Earth*** (Biology 102 and 196). The main purpose of this module is to introduce you to some components of the enormous diversity of life on Earth.

In the course we will introduce you to some of the "big" questions in biology:

- What is biodiversity and how do we measure it?
- How can we explain the high biodiversity that we see today (has it always been like this and will it always be like this)?
- Why is biodiversity under threat and what is the human impact on biodiversity?

We will give you an introduction into the main plant and animal groups their ecology and evolution.

MODULE CONTENT

Theory

The course covers the following aspects:

- The history of life on Earth,
- The main groups of organisms and their diversity and adaptations to survive in their habitats,
- The importance of and threats to biodiversity, and ways of conserving biodiversity.

Practicals

In the practicals you will learn **note taking** and **analysing data**, **scientific paper writing** and other forms of scientific communication, **observation and interpretation skills**. There is one weekend practical, which involves a **field trip** to the rocky shore.

Seminars, Open Lectures and Annual Research Meeting

Student attendance at a) the School Seminar Series at which local or visiting biologists make scientific presentations; b) other seminars in the School; c) other topically relevant open lectures presented on campus; and d) the Annual Research Meeting of the School is encouraged. Posters advertising such events are displayed on School notice boards, to which your attention is directed. Presentations to be given at short notice (as well as some reminders) are announced at formal lectures.

PRESCRIBED TEXTBOOK

BIOLOGY, 8th edition, Campbell, Reece

Copies of this text book are available on short loan at both the Main Campus and the Life Sciences libraries.

There are also various other general biology text books that can be used for the module, and that are available in the Life Sciences library are.

APPENDIX: D

Interview questions for Biology Tutors

1. How often do students read and write in Biology?

2. What types of genres do you introduce to them?

3. Do you apply scaffolding theories during students reading?

4. Do you allow students independent reading?

5. How do you make students identify different voices from a text?

6. How do ex-SCOM students perform in assignments which require them to get responses from reading materials? Explain why do you think students perform in the manner indicated above

7. How do ex-SCOM students perform as compared to Biology mainstream students in assignments and tests?

8. How do you know that students have read the feedback or comments from their assignments?

9. Does SCOM module assist students to perform better in assignments which require efficient reading?

10. What would you like to see SCOM module do to improve on reading skills that will benefit Biology students reading capability?

11. Would you recommend SCOM module to be a mainstream Academic Literacy module for all science students who are struggling with reading and writing skills or not? Why?

APPENDIX E

Interview questions for SCOM coordinator

1. How often students read and write in Communication in Science?

2. What type readings or genres do you introduce to them? And why?

3. What kind of support do you give students when they read?

4. Do you allow students independent reading? Why?

5. What strategy do you use to encourage students to negotiate meaning from the readings?

6. Do you think Communication in Science module benefit foundation Biology students? Why?

7. Does Communication in Science module help students to perform better in assignments that require effective reading?

8. What would you like to see SCOM module do to improve literacy skills that will benefit Biology students' literacy?

9. Would you recommend SCOM module to be a mainstream Academic Literacy module for all science students who are struggling with reading and writing skills? Why?

APPENDIX F

Interview questions for Ex- SCOM (Biology mainstream) students

1. Do you enjoy reading? Why?

2. What types of readings do you like reading? Why?

3. Are your reading requirements for SCOM the same as for Biology?

4. What do you understand as the reading requirements of tertiary students in the Biology discipline?

5. What reading challenges are you faced with in your Biology Studies?

6. List by order: from the most difficult challenge to the least difficult challenges.

7. How do you resolve these challenges identified?

8. Do you write assignments? And how often do you write them?

9. Do you find feedback /comments from your assignments helpful?

10. How do you get information for your assignments topics?

11. How are your lecturers helping you to understand the reading?

12. How frequent did you read for SCOM module as compared in Biology?

13. Do SCOM reading skills helped you to improve on your reading for Biology module? If yes, how? If no, why?

14. What would like to see SCOM module do to improve more on reading skills that will benefit Biology students reading capability?

APPENDIX: G

Biology Essay Topic: Semester 1

☞**Essay topic**

"The economic wealth of the world is rising; however, the condition of the biosphere is falling. If we were to stop all conservation efforts today and continue to allow the same rates of environmental destruction, we are likely to see half of Earth's species of plants and animals going extinct by the end of this century. If, however, we put all our effort into saving the biologically richest parts of our world, we could cut this species loss by at least half."
Adapted from E.O. Wilson (2002). The Future of Life.

Most human activities that are causing extinctions are not new, but there are many more of us doing those things than ever before. By outlining one major threat to biodiversity, discuss the quote given above.

35 marks

APPENDIX: H

Biology Essay Topic: Semester 2

"The function of a tissue must be considered in context of its structure. Similarly, one cannot consider the structure of a tissue without reflecting on what it is that tissue does". The question was: Comment on this statement by describing two plant and two animal tissues of your choice and explaining the structure-function relationship of each.

APPENDIX: I

Biology Scientific Report Topic: Semester 1

Effects of Yeast.

Now that you have worked through all of the stages in the scientific method, you are going to apply your knowledge by designing and performing a complete experiment in the laboratory.

Read the following background information:

"One of the characteristics living organisms is that they all show metabolic activity. You may not have realized it, but the yeast that you use to make bread rise (or to brew beer) is a type of living organism. These organisms are unicellular fungi, and are heterotrophic. When you mix a little yeast with some sugar, the yeast feeds off the sugar. As digestion (metabolism) proceeds, carbon dioxide gas and ethanol are released as by-products. The bubbles of carbon dioxide make the bread rise (and ethanol makes beer alcoholic). Like all metabolic processes, yeast metabolism is controlled and aided by enzymes. These enzymes are proteins, which become inactive at low temperatures and denatured (destroyed) at high temperatures."

1. Observations

- Yeast is a living organism.
- The metabolic processes occurring in the yeast produce the gas which causes bread to rise.
- Bread rises best in a warm place (neither too hot, nor too cold)

2. Set the question

Having made these observations, you now have the following question:

Does temperature have an effect on the metabolism of yeast?

3. Formulate the null hypothesis

☞**Task 1**

Formulate a null hypothesis that is based on this question.

4. Design the experiment

Experimental design must eliminate as many chance factors as possible, so it is important to define what you are doing very carefully. You need to measure the metabolism of yeast at a range of different temperatures. How do you do this?

- To measure the metabolism of yeast you dissolve sugar in water and add the yeast. Then you leave the mixture at a specific temperature and allow the yeast to metabolize. After a certain amount of time, you measure the volume of the CO_2 foam bubbles that has been produced. (The greater the volume of foam, the more active the yeast metabolism).
- You will have to do this at a range of different temperatures. Discuss this as a class, and decide what these temperatures should be.

Write the temperatures here: _____

4.1 Dependent and independent variables

These are factors that affect the results of an experiment. The independent variable is the one that you change deliberately. The dependent variable is the one that changes in response to the independent variable.

So what exactly are you measuring?

☞ Task 2

What are you going to manipulate (change) and what are you going to measure?

a. What is the independent variable?
b. What is the dependent variable?

4.2 Controlled variables

You also need to establish which variables you need to keep constant in order to ensure that they do not influence the results of the experiment by mistake. These are called the controlled variables.

☞ Task 3

Define the controlled variables by answering the following questions:

a. How much yeast will you use?
b. How much sugar will you use?
c. What kind of container will you use?
d. What total length of time will you let experiment run for?
e. Are you going to do each temperature treatment at the same time, or will you do them one after another? Why?
f. Name one other variable that must be controlled.

NB: Luckily you have 6 benches of students all repeating the same experiment, so you can collect data from 6 repetitions all at one time (otherwise you would have had to set up a number of repeats yourselves).

Can you see any potential problems with collecting data this way?

_____

4.4 Control Experiment vs. Treatments?

A control experiment is used to provide a standard against which you can compare your results. This allows you to see whether the results you got were caused by the variable that you manipulated or by some other factor that you may have been unaware of.

For example: if you wanted to find out whether the CO_2 bubbles were produced by yeast metabolism, you would have one beaker that contained yeast (the experiment), and one beaker that had no yeast, but which was identical to the experiment in every other respect (the control experiment).

Do you need a control for this experiment, or not?

Since you are going to have a range of different temperatures, you already have treatments which you will compare against each other. So in this case, there is no need for a separate control.

5. Conduct the experiment

You are going to work in your bench groups. Each bench will conduct the experiment and write their results on the board. Make sure that each person in the group is aware of exactly what they must do. Work together as a team so that you all follow the identical method at the same time. This will help ensure that your results are reliable. Make sure you draw up a raw data table drawn up so you can enter your data as you collect it.

Method

1. There are 5 water baths in the laboratory, each of which has been set at a different temperature. Measure the temperature of the water in each bath.
2. Each bench has 5 measuring cylinders, one for each water bath. Label each measuring cylinder with the temperature of the water bath that it will be put into.

3. Put 10ml (two **level** teaspoons) of sugar into each measuring cylinder.
4. Fill each measuring cylinder up to 100ml using the water from the correct water bath. (Use the jug provided and be careful not to burn yourselves!)
5. Stir until the sugar is dissolved.
6. Add 5ml (one level teaspoon) of yeast. Stir with a glass rod just until the yeast is mixed into the water.
7. Put each measuring cylinder into the correct water bath, being careful not to let it fall over. Leave them undisturbed for 20 minutes.
8. Remove the cylinders from the water baths (use a cloth if necessary) and measure exactly how much foam has been produced. Be sure to read accurately.

6. Record the results

- As soon as you have collected your results, write them on the raw data table that has been drawn up on the board.
- Once all the results have been written down, calculate the average (mean) for each temperature treatment. Write it in the final column of the table. (If you have any results that are very different to the rest for that treatment, you should exclude them before calculating the mean.)
- Please remember that you do not include the raw data table in your practical report. Instead you will use the mean data to draw up a summary table of your results.

7. Write the report

Once the experiment has been conducted and the results collected, a report has to be written. Over the next few contact sessions you will learn how to write a scientific report.

Writing the report

☞ **Task:** Write up your experiment on the metabolic activity of yeast.

- Give your report a title which briefly describes what you investigated. (1)
- Give your report an abstract. (3)
- Write an introduction in which you give relevant background information. Provide the reason(s) why you did the experiment (the rationale) and include your null hypothesis. (4)
- For the methods section, write a paragraph to describe how you performed your experiment. This description must be detailed enough so that someone else could do it in exactly the same way. You will need to include information on what variable you manipulated (the independent variable), what variable you measured (the dependent variable) and what variables you kept constant (the controlled variables). (8)
- You need to present your summarized results in the form of a table and a graph. You also need to describe your results in a paragraph.

Summary table

Compile a summary table of the mean results. Set out the table properly, following the rules described on page 10 of this practical manual. **(6)**

Graph

- Are you sure that you have included only the relevant information in each section? E.g. make sure you do not explain or discuss results when you should be describing them in the 'results' section; make sure the 'introduction' does not include your results or conclusions etc.
- Have you used the passive voice and the past tense?
- Do your paragraphs and sentences make sense? Have you kept your sentences short and simple? Do you have one idea in one sentence? Does each paragraph have a topic sentence? Do your ideas link together?
- Have you written full sentences (starting with a capital letter and ending with a full stop); have you used correct punctuation; is your grammar correct; is your spelling correct?

(3)

Mark Summary

Report	**Marks**
Title	1
Abstract	3
Introduction	4
Methods	8
Table	6
Graph	8
Paragraph	3
Discussion	6
Conclusion	2
References	1
Writing skills	3
Total	**45**

Model answer - Scientific Methods

Students will have to design and perform an experiment, and then write up a lab report.

This experiment measures the metabolic activity of yeast by measuring the amount of CO_2 produced. Students probably won't know that yeast is an organism. Please read the tutorials on the characteristics of living things (Unit 1) so that you can effectively answer any related questions. Later in the year, we deal with life's six kingdoms, and the characteristics of each. You may like to brush up on some basics re. the fungi (Unit.4).

NOTE FOR MARKING: Tasks 1 to 3 will NOT be counted for marks although they should be marked so that students can correct any errors. The marks for Scientific Method 2 come from the report write-up only (45 marks)

Task 1

Formulate a null hypothesis that is based on this question. (*any sensible hypothesis, in the negative, falsifiable)*

Temperature has no effect on the metabolism of yeast. ✓✓

OR

Yeast metabolism is not affected by temperature. ✓✓ (any one)

Task 2

What are you going to manipulate (change) and what are you going to measure?

a. What is the independent variable?

The temperature ✓

b. What is the dependent variable?

Metabolic activity of the yeast ✓

4.2 Controlled variables

You also need to establish which variables you need to keep constant in order to ensure that they do not influence the results of the experiment by mistake. These are called the controlled variables.

Task 3

Define the controlled variables by answering the following questions:

a. How much yeast will you use?

5 ml ✓ (or ½ a teaspoon)

b. How much sugar will you use?

10 ml ✓ (or 1 teaspoon)

c. What kind of container will you use?

Glass measuring cylinder ✓

d. What total length of time will you let experiment run for?

20 mins ✓

e. Are you going to do each temperature treatment at the same time, or will you do them one after another? Why?

Do them all at the same time✓, to keep conditions in all the treatments as constant as possible, which will minimise the possibility of unexpected variables influencing our results. ✓

f. Name one other variable that must be controlled

The same amount of water ✓ must be added to each cylinder.

4.3 Reliability

An experiment must be repeated a number of times so that you can be sure that the results you get are not due to chance.

NB: Luckily you have each bench of students repeating the same experiment, so you can collect data from 3 repetitions all at one time (otherwise you would have had to set up a number of repeats yourselves).

Can you see any potential problems with collecting data this way?

Different students may have different techniques and may do things slightly differently. Some students may be more careful than others, measure more accurately etc. This could affect the consistency of the results between groups, and they may not be directly comparable.

---

5. Conduct the experiment

- *Please coordinate activities so that every student in the group has a role, and knows what they are expected to do and when.*
- *It is important that students measure the exact water temperature in each water bath. We will try to make sure that they are as close to the ideal as possible, but they may not be exactly what was planned. You need to reinforce the idea that as long as they have measured the exact temperature, they can plot it on a graph in the correct place. So for our purposes in this particular experiment, it does not matter if it is 22^{O}C instead of 20 ^{O}C. We will still end up with a range of temperatures, which can be accurately plotted, and which will show whether temperature has an affect on yeast metabolism or not.*
- *Emphasise the importance of measuring accurately. This goes for measuring out ingredients, to recording results. Watch them very carefully, because your idea of accuracy and theirs are bound to be two different things. They will be inexperienced reading a thermometer and off a measuring cylinder, so please get all the students to check each other, and also check them yourself.*
- *Watch that they are sensible around the hot water baths. We don't want any burns.*
- *Help them to ensure the cylinders don't fall over into the water baths.*
- *Check that they all know exactly whose cylinder is whose (they must be marked clearly).*
- *Ensure that each group writes their results on the board for everyone to use.*

---

6. Record the results

They will calculate the mean results from the raw data table on the board (excluding wildly different results). They do not include all these raw data in their report, but make sure that each student actually makes the effort to write them down themselves. They all need the experience in writing tables, and collating raw data into a useable form. They must not rely on their friends to do this for them, and each person needs their own copy of the results to write up their report in the next practical.

---

7. Write the report (Scientific method 3)

Students will write up their first lab report. It is important that they get the standard format correct from the beginning, so please give them lots of feedback and show them how to improve if their standard is not up to scratch.
The report must be well laid out, with each part clearly headed.
Use your discretion when allocating marks but essentially 1 point is worth 1 mark.

a. Title

The title must briefly describe the investigation. (1)

b. Abstract

In a short paragraph they must summarise what was investigated and what was found. (3)
No more than 3 sentences. *Correct grammar, spelling etc.* ✓✓✓

c. Introduction

They must provide relevant background information and briefly explain why they did the experiment. **(4)**
They should look at the information in the introduction to this practical to get some idea of the kinds of things to mention. But if they copy this verbatim, give them <u>no marks</u> – and point out to them why. ✓✓✓
They must also include the null hypothesis. ✓

d. Methods

Use past tense and the passive voice. **(8)**
A logical and concise description of the experimental method, including the variables. ✓✓✓✓✓
Write clearly, in short simple sentences, in an understandable English paragraph that progresses from one step to the next. ✓✓✓
Please correct the smallest mistakes.

e. Results

<u>Summary table</u> should look something like this: **(6)**

Table 1. Effect of temperature on metabolic activity of yeast

Temperature (^{O}C)	**Mean metabolic activity (mm of CO_2 foam)**
10*	
20	
30	
40	
50	

*Check that the temperatures are those that were actually measured in each water bath.

Allocate marks as follows:

Heading above table. ✓ with an appropriate title, "Table 1....." ✓

Two columns in table, properly labelled: independent in first column✓; mean in second; units of measurement included in heading. ✓

Numbers accurately calculated and filled into both columns (means and not raw data). ✓✓

Graph

Allocate marks as follows: **(8)**

Line graph ✓

X –axis labelled, "Temperature ^{O}C" ✓, and with a suitable scale increasing at regular intervals. ✓

Y- axis labelled, "metabolic activity (mm CO_2) ✓, and with a suitable scale. ✓

Points correctly plotted with a clear mark ✓ (Watch out particularly that the temperature has been plotted accurately).

Line drawn with ruler, neat, graph an appropriate size to fit page etc. ✓

Heading below graph, beginning, "Fig. 1 ....." ✓

Paragraph

A short paragraph describing (not explaining) results. **(3)**

i.e. less metabolic activity at low temps, optimal activity at medium temps and no activity at high temps. ✓✓✓ Any surprising results can be pointed out. *Please correct their grammar etc.*

f. Discussion (6)

Discuss results in some detail. Need a sensible explanation and interpretation of the results. Some kind of scientific basis for their discussion is needed. Discussion revolves around metabolic activities being controlled by enzymes, which are proteins. Their activity depends on maintaining a certain shape (tertiary structure), which is temperature dependent. So metabolism is low at low temps because enzymes are inactivated (*not denatured*), operating at optimum at medium temps, and denatured (*not inactive*) at high temps. ✓✓✓✓✓ On the basis of this discussion, accept or reject your hypothesis. ✓

If prac. did not deliver expected results, they need to discuss these and try and find some scientific explanation for them

g. Conclusion (2)

Summary sentence: the results clearly show that temperature does influence the metabolic activity of yeast, which was inactive at .....blah blah. ✓✓

They can include suggestions for further work.

h. Writing skills

See page 54 of the prac. manual, heading *Scientific Writing* on how to allocate marks. (4)

Mark Summary

Task	**Marks**
Report	
Title	1
Abstract	3
Introduction	4
Methods	8
Table	6
Graph	8
Paragraph	3
Discussion	6
Conclusion	2
Writing skills	4
Total	**45**

APPENDIX: J

Biology Scientific Report Topic: Semester 2

THE ROCKY SHORES REPORT

You already know the standard format for a scientific report – and this one is no different. You will need the following sections in your report:

- Title
- Introduction
- Methods
- Results
- Discussion
- Conclusion

a. Title (1)

b. Introduction (6)

This section includes any relevant background knowledge and the reasons for your investigation. You should also include your null hypothesis.

Go back to the first practical in this series, "The Rocky Shores Environment", to recap the important issues. Revise your initial **observations** of the rocky shores, the **question** you posed and the **null hypothesis** you set (page 54). Describe these in your introduction.

c. Methods (7)

You must describe what you actually did to collect your data. Write a **paragraph** describing the variables of the investigation and the methods you used to collect your data. This description should be detailed enough so that someone else could do exactly the same investigation.

Your methods should not be written in point form. Marks will be allocated according to how well you write the paragraph.

d. Results (24)

You must present the data you have collected in the form of a **table to present your results, a summative table and a graph**. You must also include a short **descriptive paragraph** of your results on the interesting trends in the data. If you have any unexpected results, you can point them out as well.

Table to present results (8)

- Do not include the field notes in this table. You will use those notes in the next part of the report.
- You need to extract the relevant information from the three sheets of raw data that you collected and present them in a single table so that someone can make sense of them.
- You need to include the names of the main types of organisms you found in each zone **and** how many different species of each type you counted.
- The raw data is too complex to include in detail. You must first work out the **mean** number of species of each type of organism on your raw data sheets, and then use this figure in the table. (Calculate to one decimal place)
- The table must obviously have the independent variable in the first column and the dependent variable in the remaining columns. Include a column at the end where you can show the **total mean number of species** found in each zone.

Summative table (4)

- You do not want to include any names of the different types of organisms in each zone.
- This table is a summary of only the total mean number of species in each zone.
- It is this total number of species in each zone that you will use to plot your graph.

Graph (9)

- Decide on the best type of graph to present your results. (Fig. 1)
  Give the table and the graph suitable headings.

Paragraph (3)

- Describe the trends in the data and point out anything interesting or unexpected, but do not try to explain your results.

a. Discussion (25)

In this discussion you need to explain your results and discuss their importance. (All the field data that you collected and the readings on the Rocky Shore Environment (page 49) will come in very useful here).

How can you explain the composition of animal species in the three zones? There are two main issues to look at:

- ***Is there a difference in <u>the total numbers</u> of animal species in the three zones?*** Look at your graph and your table. Can you explain the differences? Is one zone more stressful to live in than another? How do the environmental conditions vary between the zones and can they account for the results you found?

  (6)

- ***Is there a difference in the <u>type of animals</u> found in the three zones?*** Why do you think you found the results you did? Are different types of organisms more suited to one zone than another? In this section you should discuss some examples of specific animals that you have listed in each zone, and give ways in which they are **adapted** to their specific environments. (Choose at least six animals to discuss in detail) (18)

On the basis of this discussion, accept or reject your null hypothesis. (1)

b. Conclusion **(1)** Write a very brief statement which summarizes your findings.

Mark summary

Title	1
Introduction	6
Methods	7
Results	24
Discussion	25
Conclusion	1
Presentation	1
Total	**65**

Model answer- The Scientific Report

c. Title (1)

A suitable title

d. Introduction (6)

They need a sensible introduction which sets the scene for the investigation. They must introduce the intertidal region; briefly explain how environmental conditions in each zone differ. ✓✓✓

They can explain that organisms adapt to their environments, and since conditions in each zone are so different, the type of organisms found in each would be expected to be different✓. Also the number of organisms in each zone would be different since conditions are more suitable for life in some zones than others. ✓

They should include the hypothesis ✓

e. Methods (7)

They must write in the past tense, passive voice.

✓✓✓✓✓ for what they did, exactly. (i.e. where, when, and how (how many repetitions and what data they collected) etc.

✓✓ for how well they wrote (none if it is in point form)

f. Results (24)

Summary Table **(must show type and number of species)**

(12)

For example (though it will be somewhat different to this):

Table 1. Animal species composition of the intertidal region. ✓

Shore ½✓	**Species composition** ½ ✓		**Total**
	Type ½ ✓	**Number** ½✓	
High	They must write the common name of each species		1 ✓

	e.g. Littorina ✓	1 ✓	
Mid	Oysters	1	
	Barnacles	1	
	Crabs	2	
	Sea urchins	2	
	Chitons etc. ✓	1 ✓	7 ✓
Low	Zoanthids	2	
	Sponges	2	
	Sea urchins	2	
	Mussels	1	
	Sea anemones	2	
	Octopus	1	
	Starfish	1	
	Chitons etc. ✓	1 ✓	12 ✓

Check for inconsistencies – like mussels on the high shore – and deduct marks for improbable info. You can be quite ruthless. They have to be perfect to get the full mark for each part of the table.

Graph **(9)**

Allocate marks as follows:

Bar graph ✓

X-axis - "Shore" ✓: high ,mid and low (suitably spread out) ✓

Y-axis - No. of species ✓; suitable scale ✓

Correctly plotted ✓

Drawn with a ruler, suitable size and well-spaced on paper with room for heading ✓

Heading: "Figure 1. Animal species in the intertidal region of the rocky shore" ✓ or something similar; **below graph ✓**

Paragraph **(3)**

They must describe the trends in the data, point out anything interesting or unexpected, but not try to explain results. Deduct marks if they have written the paragraph very badly: only one sentence, or no punctuation, or unintelligible etc.

g. Discussion

(25)

The emphasis is on explaining the differences in the composition of animal species in the three zones.

- *Is there a difference in <u>the total numbers</u> of animal species in the three zones?*

Give ✓✓ for each zone

They should discuss which zone is the most stressful and why, which zone is more suitable and why, how different environmental conditions impact on the numbers of species that can live in a zone.

(6)

- *Is there a difference in the <u>type of animals</u> found in the three zones?*

Give ✓✓✓ for each animal they discuss. They must choose at least 6 animals; make sure that there is at least one representative from each zone. For one full✓, they must describe an adaptation <u>and</u> explain how it aids survival in the conditions of a particular zone. (e.g it is not good enough to say that the *littorina* have a shell with a small opening. They must also explain how this helps it survive the conditions in the zone: i.e. reduces heat absorption from the rocks, which experience extreme heat during the long exposed period etc.). *Mark strictly. They must be able to demonstrate their knowledge, and feedback all your hard work from the field trip. They have no excuse not to know how the organisms are adapted.* **(18)**

On the basis of this discussion, they should reject the hypothesis.

(1)

h. Conclusion

This is a brief statement which summarizes their findings. **"This investigation has shown that the environmental conditions in the intertidal region affect both the type and numbers of animal species in each zone blah blah. Two or three sentences at most.**

(1)

Mark summary

Title	1
Introduction	6
Methods	7
Results	24
Discussion	25
Conclusion	1
Presentation	1
Total	65

APPENDIX: K

Biology Test: Semester 1

STUDENT NUMBER:_____

BIOL102 TEST 1 (May 2011)

Answer all questions. Total = 40 marks

A. MULTIPLE CHOICE QUESTIONS: Total 20 marks (10 x 2)

Please note that there is negative marking for MCQs. Each incorrect answer will result in 0.4 marks being deducted.

Circle the correct answer:

1. In the life cycle of flowering plants, meiosis
    a. occurs before seed formation
    b. occurs in the ovule.
    c. gives rise to microspores.
    d. gives rise to megaspores.
    e. All of the above.

2. Gymnosperm megaspores are produced
    a. within ovules.
    b. within seeds.
    c. by pollen grains.
    d. by the gametophyte.
    e. by the union of egg and sperm cells.

3. The triploid tissue that results from double-fertilization become the
    a. endosperm.
    b. zygote.
    c. new sporophyte.
    d. seed coat.
    e. megaspore mother cell.

4. Which of the following statements is false?
    a. Mosses do not have xylem and phloem.
    b. Mosses do not have true leaves.
    c. Mosses do not have true stems.
    d. Mosses use rhizoids, not roots, for attachment and absorption.
    e. Mosses are different from all other plants in that they have an independent sporophyte generation and a dependent gametophyte generation.

5. Sporangia are borne by
    a. the gametophyte stage.
    b. haploid organisms.
    c. spores.
    d. the sporophyte stage in diploid organisms.
    e. the spores of the sporophyte stage in diploid organisms.

6. All except…….are characteristics of chordates.
    a. amniotic egg
    b. hollow nerve-cord
    c. notochord
    d. pharyngeal slits
    e. post anal tail

7. Adaptations to flight in birds include...
    a heavy jaw
    b notochord
    c hollow bones
    d ectothermy
    e large body size

8. Insects differ from other arthropods by …
    a. having two pairs of legs per body segment
    b. their ability to fly
    c. having three pairs of legs

d. their ability to fertilize eggs internally

e. having a cephalothorax and abdomen

9. All except…….are characteristics of an amniotic egg.

a. a waterproof shell

b. a yolk

c. a chorion

d. scales

e. the allantois

10. The Chordata include

a. sea squirts

b. snakes

c. lancelets

d. All of the above

e. Echinoderms

B. SHORT QUESTIONS : Total 20 marks

1. Referring to the practical exercise on gymnosperms and angiosperms as well as lecture notes, what are the main differences between gymnosperms that you observed? (10)
2. List SIX major evolutionary events/innovations in vertebrate history (3)
3. Explain how any TWO features contributed to the radiation of reptiles and give reptiles advantages over amphibians (4).
4. Briefly explain how any THREE features contributed to the success of insects (3)

APPENDIX: L

Biology Test 2 October 2011

Examiners: B. Keke, N. Kirby, P. Seaman, S. Shaik

1 hour **50 marks**

Question 1 Multiple choice questions. Circle **only the letter** of your choice.

1.1 The primary ecological role of plants is that of _____

A. decomposers.

B. consumers.

C. **producers.**

D. nitrogen fixers.

E. detritivores.

1.2 What is the role of detritivores in an ecosystem?

A. Primary consumers that feed only on living organic matter.

B. Secondary consumers that feed on animals that consume dead organic matter.

C. **Consumers that feed on dead organic matter.**

D. Primary producers that are chemosynthetic.

E. Decomposers that feed on dead organic matter.

1.3 Fossil fuel is derived from:

A. hard-bodied organisms.

B. **organic material of ancient trees.**

C. artefacts.

D. petrified bones.

E. microfossils.

1.3 The fossil record indicates...

A. that species have changed over time.

B. how the earth may have looked during the time sedimentary strata were formed.

C. that hard-bodied organisms fossilize more easily than soft-bodied organisms.

D. the evolutionary relationships between organisms.

E. **All of the above are correct.**

1.5 Studies of the fossil record, experimentation and deduction:

A. are not relevant because they clash with religious beliefs about the evolution of life.

B. have allowed scientists to prove how life evolved.

C. **have allowed scientists to develop well supported theories about how life evolved.**

D. have not been accepted or well supported by scientists around the world.

E. have given unreliable results so scientists only have hypotheses about how life evolved.

10 marks

Question 2

Study the diagram below and answer the questions that follow.

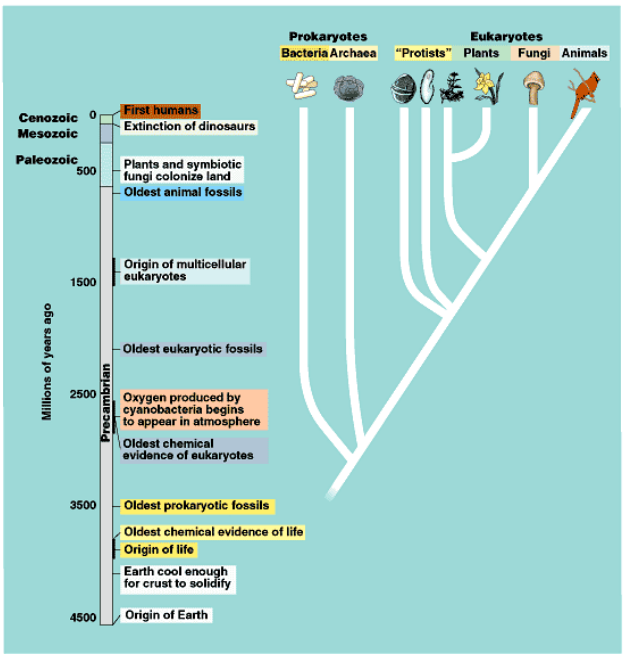

Figure 1: Evolution timeline

2.1 Describe **<u>two</u> atmospheric** conditions of the early Earth. **(2)**

Earth's atmosphere was anaerobic, ✓ i.e. no free oxygen was present ✓

Atmosphere consisted of hot gases released from ancient volcanoes and from the formation of the Earth's crust. ✓This atmosphere was primarily made up of a mixture of gaseous hydrogen (H_2), nitrogen gas (N_2), carbon monoxide (CO), carbon dioxide (CO_2) and large amounts of water vapour. ✓ *Any 2*

2.2 By referring to the 'chemical evidence', **<u>describe</u>** and **<u>explain</u>** how the first cells were formed. **(3)**

The oceans were filled with organic molecules, like lipids, carbohydrates, amino acids, proteins, and nucleotides. ✓These organic molecules, the building blocks of cells, ✓ have an affinity for one another and so they clumped together. ✓Chemical reactions occurred between them✓ and nucleic acids were formed with the ability to produce proteins and to replicate. ✓Lipid and protein membranes formed around these organic molecules. ✓Metabolic reactions were now enclosed by membranes and separated from the environment: the first primitive cells had evolved. ✓ *Any 3 points*

2.3 Where did the **first cells** get their energy from? Explain your answer. **(2)**

The first cells satisfied their energy requirements by consuming organic compounds available from the environment. ✓They were heterotrophic. ✓

2.4 a. Approximately how many million years ago did the first aerobic atmosphere arise? Get your answer from the timeline. **(1)**

Approximately 2.7 mya ✓

b. Which group of organisms produced this first aerobic atmosphere? Get your answer from the timeline. **(1)**

Oxygen was produced by cyanobacteria ✓

c. Exactly how did these organisms produce the aerobic atmosphere? **(1)**

Cyanobacteria must have been photosynthetic ✓$^1/_2$ resulting in the production of oxygen ✓$^1/_2$ -which accumulated in the atmosphere for the first time.

d. How did the aerobic atmosphere change the course of evolution from that point onwards? Give **two** well explained reasons.

(4)

The accumulation of free oxygen allowed the development of the ozone layer✓. This ozone layer protects living organisms from harmful UV light (which can cause damage to DNA, mutations, cancer etc). ✓

The presence of free oxygen allowed the development of metabolically more efficient organisms which use oxygen in the process of cellular respiration to generate useable energy. ✓ This more efficient use of food (glucose) allowed the evolution of larger (multicellular) more efficient forms of life ✓

Life originated spontaneously in an atmosphere that was anaerobic. ✓ With the creation of an oxygen-rich/aerobic atmosphere, no further spontaneous origin of organic compounds or living organisms occurred. ✓ *Any 2 reasons*

2.5 Describe and explain the theory that suggests how the organisms mentioned in **2.4 b** helped in the evolution of eukaryotes.

(6)

The theory of endosymbiosis✓ explains how eukaryotes evolved. This theory suggests that a large heterotrophic prokaryote ingested a smaller prokaryote i.e. cyanobacteria, that had the ability to perform photosynthesis. ✓ The small prokaryote remained undigested, and survived, trapped inside the larger prokaryote✓ which eventually become a chloroplast ✓ . Both organisms benefited from this association✓: the smaller prokaryote was protected in a nutrient-rich environment, and began to produce food for the host and the host began to utilize and depend on this food to grow and metabolize. ✓ Both prokaryotes divided at the same rate, so successive generations of the large prokaryote continued to be inhabited by the offspring of the small one. ✓ *6 max*

2.6 **a.** Describe the consequences of the evolution of the multicellular eukaryotes reflected in the timeline. **(3)**

The efficiency and size of eukaryote cells allowed the evolution of large, multicellular organisms ✓ as with their efficient metabolic pathways they could exploit new conditions✓ and associations with other organisms. Some of these were autotrophic, some were heterotrophic. ✓ Thus evolved the fungi, plant and animal kingdoms from the unicellular, eukaryote kingdom, the protists. ✓

Max 3

b. Describe **ONE** theory of how multicellular organisms may have evolved. **(4)**

Description of evolution of multicellularity through formation of colonies OR compartmentalization of a coenocyte. ✓✓✓✓

27 marks

APPENDIX M

COMMUNICATION IN SCIENCE

Semester I

February – June 2011

SCOM Course Outline

Semester I: February – June 2011

Week 1: 7-11 Feb 2011

Tutorial 1: Introduction to the course/ Referencing

Tutorial 2: Introduction to the course/Referencing exercises

Week 2: 14-18 Feb 2011

Tutorial 3: Natural disasters brainstorming/ Topic analysis

Tutorial 4: Reading 1 start *Natural Disaster*

Week 3: 21-25 Feb 2011

Tutorial 5: Reading 1 finish including Qs

Tutorial 6: Reading 2 *Epidemics after Natural Disasters* start

Week 4: 28 Feb-4 March 2011

Tutorial 7: Reading 2 *Epidemics after Natural Disasters* contd.

Tutorial 8: Reading 2 *Epidemics after Natural Disasters* finish including Qs.

Week 5: 7-11 March 2011

Tutorial 9: par writing and exercise

Tutorial 10: par writing ctd, breakdown of 3 par assignment

Week 6: 14-18 March 2011

Tutorial 11: par writing finish up

Tutorial 12: Lab report begins topic analysis and breakdown of report writing

students submit 3 par draft end of week

Week 7: 21-25 March 2011

Tutorial 13: reading 1 Esig

Tutorial 14: reading 2 Mcadams and Qs on Esig/Mcadams

Week 8: 28 March-1 April 2011

Tutorial 15: reading 3 Smith et al.

Tutorial 16: Experiment in class pulse rate

3 par assignment draft returned to students

Week 9: 4 April-8 April 2011

Tutorial 17: report writing

Tutorial 18: report writing *students submit final 3 par assignment*

Week 10: 11 April-15 April 2011

Tutorial 19: report writing

Tutorial 20: report writing *students submit draft report*

Week 11: 18 April-20April 2011 Shortened week: Monday – Wednesday

SCOM Class Test

Mid-semester break: 21 April – 2 May 2011

Week 12: 3 May-6 May 2011 (*2 May – Holiday*) TUESDAY - FRIDAY

Tutorial 21: Oral presentation preparation *draft reports returned to students*

Tutorial 22: Oral presentation preparation submit

Week 13: 9 May-13 May 2011

Tutorial 23: Oral presentations *students submit final report*

Tutorial 24: Oral presentations

Week 14: 16 May-20 May 2011

Tutorial 25: Oral presentations

Tutorial 26: Oral presentations lectures end