AN ANALYSIS OF THE ERITREAN GRADE 9 BIOLOGY TEXTBOOK

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A mini-thesis submitted in partial fulfilment of the requirements for the degree of Magister Philosophiae in the Faculty of Education, University of the Western Cape, South Africa

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Physical features

ABSTRACT

Teachers, during various seminars, workshops and departmental meetings, continuously complained about the inadequacy of the grade 9 biology textbook used in the Eritrean secondary schools. Among others, the teachers concerns has provided a necessary stimulus for embarking on this research which sought to determine the role, quality readability and relevance of the Eritrean grade 9 biology textbook, based on the teachers' and students' perceptions.

Interviews, questionnaires, Cloze test and Word Difficulty Index were used to collect the data. The interview and questionnaires provided information on how the textbook was being used by both teachers and students. In addition they provided information about quality of the textbook and its relevance to the daily life experiences of the students. Moreover, Cloze test and Word Difficulty Index provided information on the readability of the textbook.

The finding of this study reveals that both teachers and students use the textbook as the major source of information. Also, the factors that determine quality of the textbook were found to be poor except the physical features and organisation. With respect to relevance, very limited attempts were made to link biology to the daily life experiences of the students. The Cloze test and Word Difficulty Index show that the students clearly experience difficulty in understanding what they have read.

In conclusion, this study makes some recommendation to writers on how to improve the quality of the textbook. The results obtained in this study are by no means exhaustive. Finally, areas warranting further investigation are suggested.

DECLARATION

I declare that *An analysis of the Eritrean grade 9 biology textbook* is my own work, that it has not been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

ALI SULEMAN ABDELLA DECEMBER 2000

Signed.....

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CHAPTER ONE
INTRODUCTION

1.1. Background

Eritrea is a small country located on the northeast coast of Africa along the Red Sea border, between Sudan and Djibouti. Ethiopia lies to the south (see Fig 1.1). The area of Eritrea is estimated to be 123,300 square kilometres. The population of Eritrea is estimated to be 3.5 million. Like all African states, Eritrea came into being during the European colonial period, after Italian colonisation. Italy gained control of Eritrea in 1889. During the World War II, British defeated the Italians and took over Eritrea in 1941 and established a protectorate over Eritrea. In 1952, Eritrea was federated with Ethiopia by UN resolution as an autonomous state and when Ethiopia forcefully annexed Eritrea, the armed struggle for independence started in 1961 (Cliff and Davidson, 1988). After 30 years of bitter-armed struggle, the war finally ended in 1991, with a victory of the Eritrean Peoples' Liberation Front (EPLF) over the Ethiopian government. Eritrea achieved its independence in 1993.

Eritrean educational system was shaped under Italian rule and expanded under British rule. The long civil war severely disrupted the educational system. As a result, most of the Eritrean children have not received much formal education. As soon as independence was realised and a new government of Eritrea was formed, educational guidelines that promote equal opportunities for all in terms of access, equity, relevance and continuity of education was adopted (Ministry of Education, 1998).

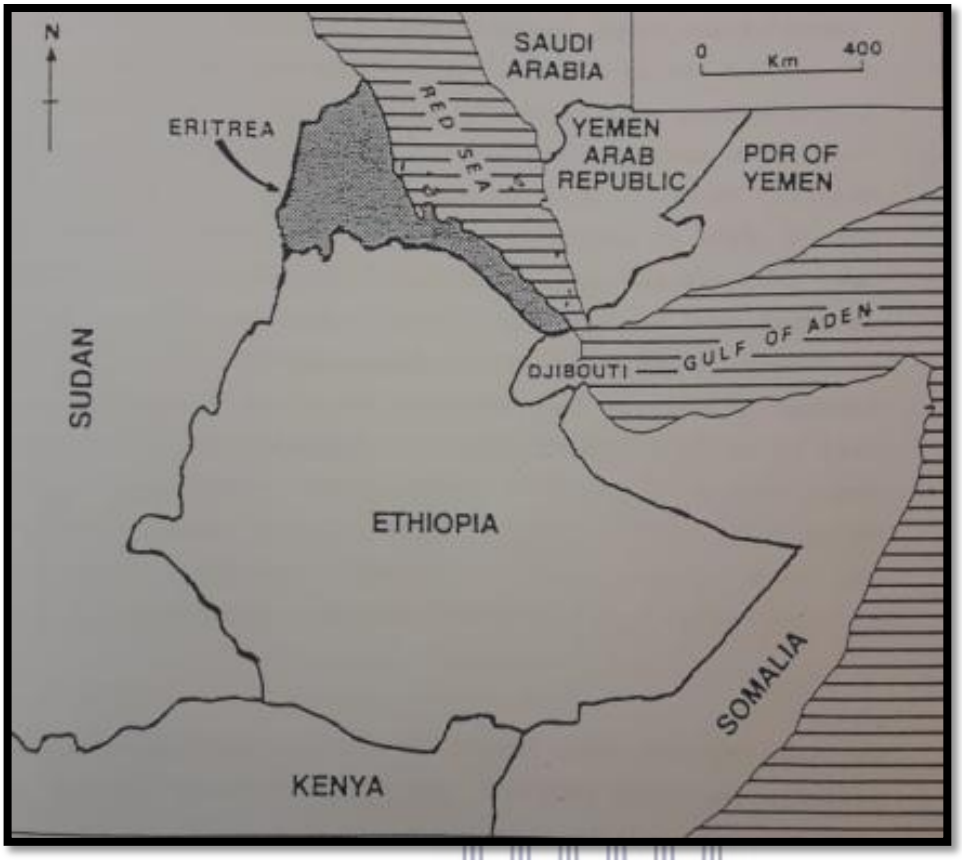


Figure 1.1 Map of Eritrea

According to the Curriculum Development Division (1997), the development of the current biology curriculum was started in 1976, during the struggle for liberation. Since then, it has been revised three times and the last one was in 1981. After independence, in 1993, a preliminary survey was conducted on the syllabus and based on the syllabus new textbooks were prepared after two years.

There is sufficient evidence to show that textbooks are essential tools in teaching and learning process (Harrison, 1980; Ogunniyi, 1982; Yager, 1983; Chiappetta, Sethna and Fillman, 1991). So far, there is no study done in Eritrea to show the importance of

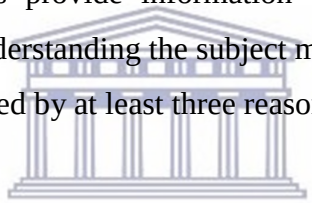
biology textbooks in the teaching and learning process. Nevertheless, from the investigator's personal experience, Eritrean teachers and students depend much on textbooks. They use them as reference and as guide for teaching and learning. However, there are some doubts as to how effective these texts are as teaching and learning aids.

Even though textbooks are central to the teaching-learning process in Eritrea, they might not be readily accessible to students. This is because students in Eritrea are second language learners and are as such might experience difficulty in comprehending the text. Children are introduced to English language starting from grade two. It becomes medium of instruction in junior and senior secondary schools and beyond (Education Brief, 1999). This language transition might create a problem. Teachers encounter this problem by repeating every lesson once in the mother tongue and another time in English. Often, teachers express concern about the linguistic difficulties experienced by their students. It is against this background that the present study was conducted. It was an attempt to determine the readability and comprehensibility of the single grade 9 biology textbook used throughout Eritrean secondary schools.

Students propensity or otherwise to read a textbook is a complex matter. However, as suggested by Vachon and Haney (1991) readability of a text is not only determined by text factor, but also by readers' motivation, background knowledge and their level of maturity. Students' reading difficulty is perhaps compounded by the fact that even their teachers are not proficient in English. As second language speakers they are chained to the use of textual language rather than a simplified version of the material. Added to this is the fact that there are very limited opportunities to practice and use English outside classrooms.

Teaching science in Eritrean classrooms is generally by lecture method, with little or no involvement of students in construction of knowledge through either interactive or investigatory approaches. A typical science class begins with a summary of the previous day's work followed by a short lecture containing new material. In most lessons, the new content is written on the chalkboard in the form of isolated notes, which the students spend a good proportion of class time copying down verbatim. As a result, science is constructed by the students as rhetoric of conclusions rather than an investigative, reversionary and debatable inquiry (Ogunniyi, 1986). As shown in a plethora of studies (e.g. Ogunniyi, 1983, 1984, 1996), science teachers' main goal is to prepare their students for information-seeking centralised examinations. After all, results of such examinations are critical in determining access to extremely limited opportunities to higher institutions.

In Eritrean classrooms, teachers provide information which students memorise and reproduce without necessarily understanding the subject matter. The dominance of lecture method might have been influenced by at least three reasons:



- the cultural practice whereby an elder (in this case the teacher) is expected to pass all necessary knowledge to youth,

- the tendency of inexperienced teachers to imitate their own college instructors rather than adopt new methods of instruction, and

- the fact that these textbooks are scarce and are generally above the linguistic competence level of students (Ogunniyi, 1984).

In other words, the language of instruction does not match the cognitive readiness of the students (Ogunniyi, 1999). In such circumstances, the teaching-learning of science becomes a ritual activity rather than a platform for inquiry.

1.2. Statement of the problem

According to Anderson (1997), the grade 9 biology textbook was prepared on a trial and error basis by non-experts to satisfy the needs of the time. He further contends that the prescribed grade 9 biology textbook is not appropriate for the grade level and relevant to Eritrean context and hence needs revision.

During several workshops, seminars, and departmental meetings I attended, biology teachers complained about the fact that the small group responsible for writing the textbook did not seem to be fully aware of Eritrean situation. Not only was the language difficult, the content seemed incapable of engaging the intellectual interests of the students. To many biology teachers, a substantial portion of the grade 9 biology textbook contained too much details for the students to understand, while other portions only contained a list of disconnected facts lacking logical connectives and a clear theoretical framework. Furthermore, the teachers complained about the inadequacy of the text, and at various seminars and workshops teachers suggested the need to conduct a readability study of the textbook. It was against this background that the present study was conducted.

The issues of readability of science texts are not peculiar to Eritrea. It is one of the ways for determining how a given curriculum has been interpreted or implemented. For example, Ogunniyi (1982) discovered that the four most popular biology textbooks used

in Nigeria were not accessible to the students. Likewise, Wegerhoff (1981) found that many of the secondary school science textbooks in South Africa were beyond the comprehension level of the students for whom these texts are intended.

1.3. Purpose of the study

This study attempted to examine a number of issues related to the quality of grade 9 biology textbook prescribed to all Eritrean secondary schools. More specifically, the study attempted to:

- Investigate the role of the grade 9 biology textbook in teaching and learning process.
- Investigate teachers' and students' perception about quality of the textbook.
- Examine readability of the textbook using Cloze test and Word Difficulty Index.
- Investigate teachers' and students' perception about relevance of the textbook.
- Make recommendations on how to improve quality of the textbook.

In pursuance of the purpose of the study, answers were sought to the following questions.

- What is the role of grade 9 biology textbook in teaching and learning process?

- What are teachers' and students' perceptions of the quality of the textbook?

- How readable is the textbook?

- What are teachers' and students' perceptions of the relevance of the textbook?

1.4. Limitations of the study

Since the study was conducted in five secondary schools, the result could not necessarily be generalised for all schools in the country. Only schools that the researcher could access easily were chosen for the study. The large class size usually about 60 or more students could possibly affect the validity of the Cloze test result.

1.5. Structure of the study

Chapter 2 deals with literature review about the importance of textbooks and the various methods used in analysis of textbooks.

Chapter 3 details the methods used to develop instruments and how to collect generate data for the study. It outlines the procedures used to generate data.

Chapter 4 presents the results.

Chapter 5 discusses findings of the study.

Chapter 6 presents conclusion and recommendations. The focus of recommendations is to create awareness among future authors and publisher of grade 9 biology textbook and suggest issues warranting further investigation.

1.6. Significance of the study

It is assumed that textbooks are potentially of great value to both teachers and students in terms of gaining access to critical knowledge. However, textbooks that cannot be used or which do not fulfil such roles are not important assets but a liability to the users, particularly in developing countries like Eritrea. In view of the critical role that textbooks can play in the acquisition of essential knowledge, it is important to determine their quality and relevance to their potential users. It is hoped that the findings of this study would prove to be useful and informative to the writers and users of the grade 9 biology textbook in Eritrea.

As far as can be ascertained, no other study of this nature has been conducted in Eritrea. Although this is a pilot study, it is hoped that the issues raised would stimulate further investigation and awareness not only about the grade 9 biology textbook, but other science textbooks currently used in Eritrea.

CHAPTER TWO
LITERATURE REVIEW

2.1. Introduction

If a textbook is to be of value to students, it should be meaningful to them. In other words, they should be able to read, understand, learn and develop new ideas from it.

The theory of "meaningful learning" which underpins this study is a complex idea that has been defined in various ways by cognitive psychologists (e.g. Piaget, Bruner, Vygotsky, Ausubel etc.). Despite the variation in their interpretations, there is consensus among these researchers that a learner's predisposition to acquiring, learning or making sense of new information is largely determined by his/her prior learning experience, schemata, or world view (Schnotz, 1984; Osborn, Jones and Stein, 1985; Williams, 1985). Ausubel (1963) contends that meaningful learning presents learning as a process of assimilation whereby new knowledge is linked to existing cognitive structures. To him, "cognitive structure" refers to "the stability, clarity, and organisation of learner's subject-matter knowledge in a given discipline" (Ausubel, 1963: 76). The actual ideas and information embodied in this knowledge are what Ausubel calls the "cognitive content" with respect to a given subject matter. Hilgard and Bower go further by asserting that:

> *The sentences processed by a person refer to things in the world and help him to construct by induction an internal "picture" of that world. Accordingly, questions are answered by referring to his "world view" rather than by*

scanning through a file of sentences he has stored away in his memory (Hilgard and Bower, 1975: 470).

Although worthy of closer consideration, space limitation would not allow a further discussion of meaningfulness of learning, or more specifically, elaboration of meaningfulness of what is to be learned in science. Rather, the emphasis of this chapter is to provide a synoptic review of relevant literature dealing specifically with quality of textual materials and different ways in which researchers have attempted to measure the readability of textbooks and related factors which presumably impact on the meaningfulness or otherwise of such reading materials. Hence, in this chapter the predominant role played by textbooks in the learning process is explored. Secondly, issues relating to quality of textbooks and different ways for measuring their readability are summarised. Several studies have indicated that the readability measures of textbooks are largely determined by features such as physical features, presentation, organisation, content complexity and laboratory activities included in a textbook. These features may either activate and assist the reader in the process of reading and learning from the text or de-motivate and confuse them (Ogunniyi, 1982; Yager, 1983; Chiappetta et al., 1991). Thirdly, since reading is an interactive process between a reader and a text, the nature of reader has also been summarised. Finally, learning does not occur in vacuum. It is affected by social, cultural and political conditions. Hence, an issue of relevance in science education has been alluded to in this survey.

In the sections that follow, efforts have been made to identify certain factors that have been reported in the extant literature as having direct or indirect effects on readability of science textbooks.

2.2. Role of science textbooks

Science textbooks constitute a major component of science instruction and both students and teachers depend on them as their source of information (Ogunniyi, 1982; Yager, 1983; Chiappetta et al., 1991). Despite the current explosion in scientific information, textbooks still occupy an indispensable place in any educational system (Wagiet, 1991). Yager (1983) points out that, textbooks appear to imprison science teachers by being a major source of information and dictating them all instructional sequences. He suggests that status of whole science education could be summarised as a single word "textbook". He further states that:

> *Textbooks determine the order, the examples, and the application of science topics.... Science is the facts and concepts...restricted...between two covers of a textbook* (Yager, 1983: 581).

The high dependence of teachers on textbook is therefore not only because a textbook prescribes what should be taught in a classroom, but it also guides how teaching should take place (Yager, 1983). Moreover, Graves (2000) describes textbook as a key element in teaching learning process firstly, it provides security for students by acting as a road map indicating what to expect and highlighting what is expected of them. Secondly, it provides visuals, activities, worksheets that save teachers' time in finding or developing such materials. Thirdly, textbook provides teachers with a basis for assessing students'

learning. Finally, textbook provides consistency across a given grade level provided teachers use the same textbook (Graves, 2000). However, Chiappetta et al (1991) argue that too much dependence of teachers on textbooks gives students a false impression about the nature of science that is they may see science as a body of absolute facts to be copied down and learned by rote.

What one teacher considers as advantage of a textbook may be a disadvantage by another teacher (Graves 2000). Thus, teachers use textbooks in a variety of ways and to differing degrees which in turn determines the attitude of students towards the value of textbooks (Harrison, 1980). From a study in South Africa on critical analysis of the aspects pertaining to teaching of the ecology section of the standard eight biology syllabus, Wagiet (1991) found that 87% of teachers used no literature outside the prescribed textbooks in teaching ecology. Only 13% of the teachers used other resources such as newspapers and magazines. In another study done in the USA, 90% of the teachers were found to use a textbook 95% of the time (Hams and Yager, 1980).

From studies conducted in Nigeria, Ogunniyi (1982) explains that both teachers and students depend on textbook as their major source of information. He contends that teachers' and students' dependence on textbooks is more serious in the developing countries where laboratory facilities are scarce, curriculum is driven by examinations, and where teachers have not learned to contextualise science teaching.

Wright (1982) also indicates that it is impossible for students to become aware of all scientific facts, concepts, principles, and theories through first-hand observation and experimentation, much science content knowledge must be gained through reading textbooks. Nevertheless, she believes that students do too little textbook reading. Reading

appears to be only for answering questions from the textbook and for completing assignments. Furthermore, Johnson (1979: 562) defined a textbook as “a book that no one would read unless they had to” indicating the low motivation of students for reading science textbooks.

A review of the literature shows that there are at least three major factors that contribute to reading problems in high school biology: (1) inadequate student reading abilities; (2) the nature of scientific writing; and (3) textbooks that have higher level of readability than the grade level for which they are used (Wright, 1982).

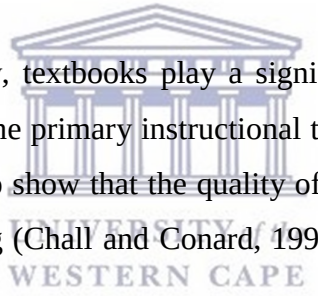
Little research into the use of science textbooks in Eritrean secondary schools appears to have taken place. However, my personal observation and well-informed opinions would reveal that most Eritrean teachers and students depend on textbooks most of the time. Teachers use their biology textbooks as reference for planning lessons, preparing notes for their students, and for setting questions for assignments and examinations. It is assumed that, as in other developing countries, both teachers and students in Eritrea depend on textbook as their main source of information. As Young and Nuttall (1989) have argued, a strong dependence on textbooks is largely caused by the extremely close correspondence between the official syllabi and content of the text.

Given the setting, it seems appropriate to ensure that the texts used by teachers and students are relevant and useful and that there is no mismatch between readers and textbooks. The subject of mismatch has been printed in the extant literature as one of the main causes of learning difficulty in science at the secondary schools (Yager, 1983). The quality of textual material, as alluded to earlier, is crucial to the meaningfulness or otherwise of such a reading material. Ausubel (1963: 78) cited Koch as arguing that:

> *Correct and illuminating explanations are no more difficult and are often easier to grasp than ones that are partly correct and therefore too complicated and too restricted...Making material interesting is in no way incompatible with presenting it soundly; indeed a correct general explanation is often the most interesting of all.*

Of course, the substantive principle underlying the quality of a reading material implies that what is presented is not only valid in terms of its scientific content, but also accords with the learners' cognitive readiness, interests, values and purposes for reading the material. The question is what factors influence the quality of school textbooks?

2.3. Quality of school textbooks



As has been pointed out already, textbooks play a significant role in the education of teachers and students. They are the primary instructional tools in all Eritrean classrooms. There is considerable evidence to show that the quality of textbooks has both immediate and long-term effects on learning (Chall and Conard, 1991). They can either enhance or limit learning.

Several researchers have identified features that they believe determine the quality of a textbook. The features they identified include physical and mechanical conditions, content complexity, organisation (text structure), and presentation (language aspect) (Simpson and Anderson, 1981; Doidge, 1990; Chall and Conard, 1991). Similarly, Long (1991) points out how the use of complex language, poor organisation of text and the variety of typescript used can disadvantage a potential reader. These factors are discussed in some detail in the following sections.

2.3.1. Physical and mechanical conditions

According to Long (1991), the physical and mechanical conditions of a textbook includes size of the book, durability, quality of illustrations (diagrams and photographs), and legibility (such as print size, line spacing, line length and type style) of the print. These are important aspects of readability since they motivate the reader to read the material. Harrison (1980) explains legibility in terms of typography, which determines how readily the letters and words of a textual material will be interpreted. This aspect of readability is of importance to the less-able reader because it plays a significant part in motivating the reluctant reader to be engaged in the process of reading (Long, 1991). Harrison (1980) has identified the following typographic elements of readability:

- *Upper and lower-case letters* – words in upper case letters are less readable than words in small letters, since they have no distinct shape and they appear rectangular. However, they can be more readable when used for emphasis as in the case of labels in diagrams.

- *Design of typeface* - for less-able reader, the design of typeface can be crucial. Different typefaces can have slight effect on readability a of text by affecting the way that readers can discern words and letters. A greater legibility of the text leads to a greater ability to recognise and consequently to a greater ability to read the text. Serif fonts, such as Times Roman, Courier, New Century Schoolbook, and Palatino are more desirable for printed text because they are considered easier to read than sans-serif fonts, such as Helvetica, Avant Garde, Arial, and Geneva.

- It is found that l legibility between serif typefaces and sans serif typefaces. For example: “g” appears to be more readable than “g”. However, Harrison (1980)

argues that readers have found the typeface, which they were familiar with to be more readable.

- Shaikh's (2005) research also confirms these findings, he has concluded that there is no difference between perceived legibility of serif and sans serif fonts. A number of scientists believe that serif fonts are read faster. For example, Romney (2006) has written that serif fonts are believed to be read faster due to their invisible horizontal line made by serifs, so it increases the saliency of letters as Arditi & Cho (2005) have stated. Another reason for their belief about superiority of serif fonts over sans serif fonts is that the horizontal strokes that sit along the baseline help the readers to track the lines easier; therefore, they lead to faster and more efficient reading (Arditi & Cho, 2005). Moret-Tetay & Perea (2011) are against the prominence of serif fonts.

- *Size of print,* line length and spacing also affect readability. Readability increases when font size increases from 18 - 22. Tinker indicates that readability decreases for smaller size fonts because eyes have more fixations and move slower and have more pauses for recognizing the letters and words. The minimum font size recommended for publishing textbooks is 10 or 11 (Tinker, 1963). With regards to line length, optimum readability is obtained when a line contains between 9 – 12 words. Conversely, a line with more than 12 words becomes tedious to read. Line spacing has no significant effect on readability, but extremely narrow spacing negatively affects comprehension.

- *Margins* - unjustified text is less readable than justified text. This is because the irregular margin might cause an interruption to the smooth movement of the readers' eye across the text.

- Quality and texture of paper also affect readability by affecting the brightness and text appearance there by cause miscommunication about text stimulus, processing and perception.

- *Colour* - for example black print on purple paper is hard to read. Black, blue and green prints are more readable than red, orange and yellow prints.

- Print variation for emphasis can make a difference in reading comprehension. To emphasise words, or phrases or sentences **bold printing**, *italic script* or underlining should be used.

It would be unrealistic to expect great gains in reading speed or comprehension because of using more legible texts. In other words, although less legible texts do lower the readers' motivation, more legible texts do not necessarily turn a poor reader into a good one overnight (Harrison, 1980).

2.3.2. Presentation (language aspect)

Reading is an active process by which a writer communicates with a reader through a text (Chapman, 1983; Rush, 1985; Langhan, 1993). Williams (1985) compares the relationship between a writer and a reader with the relationship that exists between a radio transmission and a reception. The transmitter at the radio station encodes sound into signals whereas the radio set decodes signals into sound. The same is true of writing and reading a textbook. The writer encodes his/her message into words and the reader is expected to decode the words into message. He further argues that reading is an act of communication between the reader and writer through the text (Williams, 1985).

According to Meyer (1984), a crucial question in the study of reading centres on how a reader constructs a mental representation intended by the writer. However, this is very difficult to achieve due to two major reasons, namely difficulties associated with the reader and difficulties associated with the written text. As indicated in the introductory section, the reader's background experience serves as a useful platform or context for incorporating the new information into his/her cognitive structures.

Ogunniyi (1999) found a mismatch between the cognitive demands of the syllabus and the cognitive readiness of the students. Williams (1985) and Harrison (1980) seem to have clarified this issue quite succinctly. Firstly, there may be inability of the readers to reconstruct meaning out of the text, due to: 1) insufficient prior knowledge of the subject, 2) insufficient knowledge of the word that interlock with the subject matter, 3) cross-cultural ambiguity, 4) second language reader competence in English, 5) poor motivation, 6) insufficient intelligence, 7) inadequate reading strategies, and 8) health of the reader. Secondly, there may be obstacles in the written text itself. The language and grammar of the text also affects the ability of the students to learn from the text. Difficulties related to vocabulary choice, and sentence length and complexity are the main text factors affecting readability (Williams, 1985; Harrison, 1980). Since the latter factors are relevant to this study, they are further discussed in the following sections.

Vocabulary choice

Choice of vocabulary is the single most important factor determining text difficulty (Williams, 1985). According to Fry (1988) one way of lowering readability scores is to use simple vocabulary and it is important that writers should be aware of students' perceptions of the vocabulary used.

A problem lies in the number of these words that need to be learned by students. Long (1991) indicates that the difficulties that students have in understanding and retaining specialist vocabulary are greatly underestimated. In line with this, Ogunniyi (1999) indicates that one's ability to read, write, and express ideas depend on the familiarity and conceptual understanding of technical words. He further contends that technical vocabulary poses enormous difficulties for students. However, some argue that technical terms such as "photosynthesis" and "respiration" are more readable because of their high frequency or familiarity (Rush, 1985).

In another study Wandersee (1985) contends that excessive emphasis on specialist technical terminology in biology may promote memorisation of words, which hinders understanding of concepts. Harris and Sipay (1979) argue that knowing meaning of words is essential and it is a prerequisite to understanding. However, comprehension involves much more than simply knowing the meaning of individual words. Therefore, presenting merely a list of new unfamiliar vocabulary items in a text does not guarantee improved reading comprehension of the text (Clark, 1993). The problem of comprehension also lies with the non-technical vocabulary of science texts because readers must know the meaning of these words to make sense of the whole text (Langhan, 1993; Clark, 1993; Ogunniyi, 1999). Many non-technical words can also be used to convey many different meanings. For example, the word "set" which may be used as verb or noun has many distinctly different meanings according to context used. The words "mole" and "nucleus" also have different meanings in both chemistry and biology.

Langhan (1993), in an overview of recent literature on vocabulary in content area textbooks, highlights the following significant points which are likely to affect the readability of textbooks prescribed for young second language students. Williams (1985) also mentioned many of these aspects viz.:

- Using words of high frequency or familiarity to a reader will contribute to a more readable writing. For example, using seed, allow and drinks are found to be more readable than using grain, enable and beverages respectively (Williams, 1985).

- According to Williams (1985), using words that represent concrete objects are more readable than words that represent abstract objects. One abstract word by itself, although less readable, is unlikely to produce a major problem in comprehension. Nevertheless, in association with other factors (such as long and complex sentences, and paragraph structure) one abstract word might be the main factor for impaired comprehension. Furthermore, abstract words pose problem when presented in quick succession (Williams, 1985).

- Active verbs are more readable than passive words (William, 1985). This is because active verbs are shorter, more familiar and promote stronger mental image than passive verbs (Langhan, 1993).

- Shorter words are usually more readable than their longer synonyms. For example, words such as send, buy and meet are more readable than dispatch, purchase and encounter respectively (Williams, 1985; Long, 1991).

- Students often get confused with words which "sound alike" and "look alike" For example: "reflection" and "refraction", "Consistent" and "constituent", and "fusion" and "fission" (Long, 1991).

- Compound nouns cause problems for readers. Long (1991) identified that compound nouns in scientific writing are sequencing nouns that unite to describe a single entity; e.g. "copper was deposited on the cathode as a ***bright salmon pink solid***". Can be reduced to a sentence still having the same meaning, "copper was deposited on the cathode" (Long, 1991: 26).

- Modal verbs such as might, could, may, and should cause comprehension difficulty for L2 readers (Long, 1991).

- An idiom is a phrase that means something different from the meanings of the words in it. Idioms and idiomatic expressions can cause great difficulty for second language readers (Williams, 1985). For example, *microscopic* stands for size of organisms invisible with naked eyes.

Sentence length and complexity

Long and complex sentences are difficult to read. Thus, the following sentence:

> *If you were provided with three black painted metal rods, one of which is made of brass, one of magnetized steel and one of unmagnetized steel, describe how, without scratching the black paint you would identify each of the black rods (Long, 1991: 27).*

There is no doubt that such long sentences pose difficulty in reading because they contain a lot of information and our short-term memory can hold a limited number of words at a time (Clark, 1993). Short sentences are more readable than long sentences. This is because during the process of reading short sentences, the brain has fewer pieces of linguistic information and meaning to interrelate, therefore can do the job more efficiently and faster. An experiment proved that when this limit is exceeded in a learning situation, very little or even no useful learning takes place (Dechsri, Jones and Heikkinen, 1997).

Even though shorter sentences are more readable than longer sentences, it is important to note that changing long sentences into shorter sentences may not necessarily increase readability. Fry (1988) contends that nothing is a more boring reading than a long series of choppy sentences. Likewise, Osborn et al (1985) assert that too many short sentences lacking logical connectives disrupt the flow of reading and hence impede comprehension. For example:

> *A cell is made of living stuff. A cell can grow. It takes in food. It changes the food into more living stuff* (Armbruster 1985: 20).

Therefore, it is necessary for a text to be composed of both short and long sentences to enable a reader to comprehend it.

Passive voices are typical features of a scientific text (Sutton, 1989). They give more emphasis to the action by trying to separate facts from ideas. Turk and Kirkman (1982) point out that even though using passive voice is a useful grammatical device, many scientific texts contain unnecessary passives that create additional comprehension burden for second language readers.

2.3.3. Content

Several questions should be taken into considered while assessing the content of a textbook. For example, does the book contain up-to-date content and accurate information? Does the book contain concepts manageable to the students? Are the objectives of the syllabus in harmony with the general themes of scientific literacy?

According to Parkinson (1994) there are two distinct types of emphasis placed on science contents. Those that are essentially knowledge based and those that are process based. Traditionally, science courses have laid great emphasis on recall of knowledge and understanding of content. Several courses that were developed during the last 10 years have placed much emphasis on the processes of science. This is because for most students the scientific method is much more important than remembering scientific facts. Curriculum developers have difficulty in deciding which item of content should be included in the syllabus. They also need to consider which skills and processes to include. Most modern syllabuses have a balance between knowledge, skill and processes. It is perhaps, the emphasis given by the syllabus writers to the skills and processes that gives each syllabus its distinct flavour.

It is important to look at quality of science textbooks in terms of their emphasis given to knowledge, skills and also the emphasis they give to the development of attitudes such as honesty, tolerance and respect for others (Dechsri et al, 1997). While assessing the quality of subject matter of a textbook, several factors need to be considered. One should make sure that the application of the concepts included in the book must be familiar to the students' daily life situations. This is the most fundamental idea of what should be evident in school science textbooks. Chiappetta, Sethna and Fillman (1993) argue that textbooks should present the nature of science within a relevant context for the students not only in parts but also conspicuously throughout the whole text so as to motivate them to read the textbooks.

The familiarity of the content has been found to affect the comprehension capacity of readers by which they construct meaning from the text. According to Schnotz (1984), it is easier for a reader to process a text on a subject of which he/she has prior knowledge. He further indicates that materials that are relevant to the lives of students are not only

meaningful but are also more interesting to them and thus motivate them to be engaged in reading.

Another factor that needs mentioning here while assessing the content of a textbook is to look at the extent to which the textbook under consideration reflects the following themes of scientific literacy, namely a) science as a body of knowledge, b) science as a way of investigating, c) science as a way of thinking, and d) the interaction of science, technology, and society (Chiappetta et al, 1993; Fensham, Gunstone and White, 1994).

From a study on the analysis of biology textbooks in the USA, Chiappetta et al (1991, 1993) found that all the textbooks examined appear to possess little balance in their approach to various themes of scientific literacy. The textbooks analysed were totally devoted to only two aspects of scientific literacy, namely science as a body of knowledge and science as a way of investigation giving little or no emphasis to the interaction of science, technology and society and science as a way of thinking.

2.3.4. Organisation (text structure)

Text structure (organisation) is another important factor that determines quality of a textbook and contributes to ease either or difficulty in comprehension. Osborn et al (1985) uses the idea of text structure to describe the arrangement of ideas in a text and the nature of relationships connecting ideas in the text. Likewise, Wood and Wood (1988) consider text structure as one of the ways by which ideas in a text are organised. Organisation of text enables ideas to flow in a logical manner and activate a reader to construct meaning. They further assert that well organised texts assist comprehension in two ways. First, processing of information by the reader can be minimised if the text has

well-organised structure. Second, well-structured knowledge in the memory of the reader can enhance and guide retrieval of information.

As indicated earlier, reading is a process by which a reader actively engages with a text. Hence, the background knowledge which the readers bring with them should be taken into consideration while analysing readability of a text. Johnson (1981) asserts that inaccessible background knowledge is the single most significant factor observed in reading comprehension.

The issue of coherence is another area that needs considerations while assessing texts. Most of the science textbooks used in developing countries are developed by writers from developed countries. Thus, the cultural experiences of the writers are quite different from that of the readers. As indicated by Ogunniyi (1982), most of the science textbooks used in developing countries are written outside the countries where the books are used. In addition to concept load and terse language complexity on second language readers, such textbooks provide contexts that the students cannot access. This is because the contents they contain are far away from the life experience of the students. Carrell (1982 cited in Langhan, 1993) suggests that if a reader fails to access the background knowledge underlying the text, all the cohesive devices in the world would not help that text to cohere for that reader.

Poorly organised school textbooks often pose complex cognitive demands especially on lower achieving students (Wood and Wood, 1988). According to Osborn et al (1985: 14) "... good readers have strategies for dealing with poorly organised texts, but ... lower achieving readers benefit from well-organised texts". Therefore, the more organised and readable a text is, the more the students will like it and learn from it.

While assessing the quality of text structure (organisation), several features need to be considered. Holliday and Braun (1979) call for science textbook writers to organise their instructional materials in a clear, unambiguous and coherent manner, knowing that coherence (flow of ideas within a text) is a significant factor affecting students' ability to construct meaning out of the text. Moreover, Williams (1985) suggests the following seven general guidelines for making a coherent text:

- The heading should be meaningful and predictive.
- The contents of the heading should be reinforced as soon as possible.
- Each chapter should provide an overview of its contents, sequence and interrelationship.
- Paragraphs should be structured.
- Information should be sequenced in a natural and consistent manner.
- Tabulation is often more readable than prose.
- Readers read illustrations as well as prose.

Pictures, charts, and tables are important aspect of text structure for they facilitate comprehension, especially when the illustrations are closely integrated with the meaning of the text (Osborn et al, 1985). According to Ogunniyi (1982), pictorial representations make a text interesting to read and thereby facilitate learning. In addition, Williams (1985), claims that tabulations are more readable than prose, and that readers have an opportunity to read both artwork and prose.

On the other hand, there are some researchers who still believe the opposite effect of illustrations on comprehension. Kulkarni (1988) and Peacock (1997) point out that illustration that are not relevant or not clear tend to decrease comprehension, because children fail to interpret them. Hence students should be taught the conventions of interpreting illustrations to extract meaning. While the merits and demerits of pictorial representations are yet to be clearly determined, there is a consensus among researchers about readability of a text. For a text to be readable its structures (organisation) should address the knowledge base of readers, that is, their familiarity with the topic and the complexity of concepts (Osborn et al, 1985).

Questions which test different levels of comprehension, and which are situated within and at the end of the text, are also claimed to assist learning (Harrison, 1980). Ogunniyi claims that questions included in a textbook act as a stimulus to inquiry as well as create a purpose for reading and hence the more questions a textbook uses the better for the reader He categorises and defines text questions into four groups, viz.: factual, rhetorical, leading and probing. Factual questions demand direct identification or recall facts. Leading questions are those that direct the reader towards an answer given later in the text. Probing questions require the reader to give personal opinions. Rhetorical questions are obvious questions that require no answer. He further indicated that leading and probing questions in a textbook facilitate higher level reasoning among readers (Ogunniyi, 1982).

2.4. Nature of the reader

2.4.1. Availability of schemata

Reading is often considered as a passive activity. In fact, it is an active process in which an enormous amount of activities take place in the brain of a reader (Chapman, 1983; Rush, 1985). In a successful reading a reader creates meaning through interaction with a text. According to the constructivist approach, reading is a process by which readers construct meaning from the text (Ausubel, 1963; Williams, 1985). Meaning reconstruction is a very interactive process. While reading, a reader continually engages in a cognitive dialogue with the absent writer (Williams, 1985). Chapman (1983) and Widdowson (1978) describe a reader as an active participant in the reading process. A reader should interrogate the text for meaning and that the text should give the clues (Clark, 1993).

As indicated in the introduction, comprehension of a text is an interactive process between the readers' background knowledge and the text, and comprehension requires the ability to relate the textual material to one's own knowledge. The readers' background knowledge that facilitates text comprehension is known as schema (Schnotz, 1984; Osborn et al, 1985; Williams, 1985).

The interaction between reader and text occurs within a large context of cultural, social, political and technological influences. The context affects the background knowledge that readers bring with them. In this regard, readers understand the content of a text from their context. Osborn et al (1985) and Clark (1993) argue that if the content and structure of a text being read is related to the context of a reader, then, the reader can comprehend and

recall more. During reading, the new information, which the reader reads can only have meaning if it can be related to something that the reader already knows. Therefore, two readers, having comparable reading skills, but whose prior knowledge varies considerably, according to the schema theory, will have different levels of comprehension of the same text (Schnotz, 1984).

According to Langhan (1993), schematisation operates by way of two modes of information processing, namely bottom-up and top-down processing. Schemata are therefore hierarchically organised, with the most specific at the bottom and the more general at the top. According to the "schema theory", the bottom-up processing occurs when information from the text is mapped against the reader's schemata, which is then modified according to the information encountered in the text. Top-down information processing occurs when readers use prior knowledge to make predictions about the data which will be found in the text, and the text is then checked to confirm or refute those predictions (Langhan, 1993; Clark, 1993). In the ideal circumstances, bottom-up and top-down processing of information occur simultaneously and interact with each other (Langhan, 1993). Clearly, for a satisfactory interpretation of the text to occur, incoming information being processed through bottom-up processing and the conceptual predictions being made through top-down processing must be compatible (Clark, 1993). On the other hand Shymansky, Yore (1991) suggests the exclusive use of either a bottom-up text-driven process, which assumes the majority of meaning is stored in the textual material or a top-down reader-driven model, which assumes meaning is resident in the readers prior knowledge, do not fully address the problems encountered in reading science material.

Osborn et al (1985) and Silberstein (1987) suggest that no text can be considered as either easy or difficult simply based on linguistic features such as syntactic complexity or word

frequencies. However, texts become easy if the structure of the text, concept load and vocabulary of the text are appropriate to the students reading ability.

2.5. Measuring readability of school textbooks

2.5.1. What is readability?

There are various definitions of what is meant by "readability". Johnson (1979) for example sees readability as collective of factors that affect success in reading and understanding of a text. Accordingly, these factors include interest and motivation, legibility of the print, and the complexity of words and sentences in relation to the reading ability of the reader. Graham (1978) defines readability as the aspect of a text that affects its appeal and comprehensibility due to size of print, vocabulary, content, and style.

Readability studies are also defined by Tekfi (1987: 262) as studies which "are concerned with ensuring that a given piece of writing reaches and affects its audience in the way that the author intends". Williams (1985) also indicates that a text is readable if the reader can quickly and easily recall the essentials of the text sometime after reading it.

2.5.2. Measuring readability

The history of readability is inexhaustible. According to Chall (1988) and Chall & Conard (1991), readability formulae as they are known today originated in the 1920s, but interest in readability factor has deep roots in the classical rhetoric of Plato and Aristotle

and in the vocabulary analysis of the Bible by the ancient Hebrew scholars. The readability research grew out of the desire to find "objective" means of measuring the difficulty of printed materials and determine whether textbooks were suitable for those using them.

Even though most of the readability definitions given above account for interaction between a reader and a text, traditional methods of assessing readability of texts have focused primarily on the text in isolation (Langhan, 1993). They focused on the use of text characteristics alone to predict the grade level at which an average reader would comprehend a text (Chall, 1988). For example, the Thorndike Frequency Word List was used to measure vocabulary difficulty. However, later more robust formulae were designed that enabled to predict comprehension difficulty and interest in children's books.

Since readability is concerned with the problem of matching a reader with a text, it can be measured in different ways (Johnson, 1979). To this effect, readability formulae have been developed to measure the complexity of language in student textbooks. They have been quite popular and widely and frequently used for measuring readability. Many of the formulae aimed at predicting and quantifying comprehensibility of texts for intended readers (Rush, 1985). They do so by measuring linguistic variables that correlate with readability such as vocabulary, word length and sentence length (Graham, 1978). There are several readability formulae. Generally, they look at sentence length and word length, judging by the number of syllables. Many of these readability formulae are relatively unknown because they have not been used much and little is written about them. On the other hand, formulae such as Flesch reading Ease Formula (1948), the Gunning Readability Test (cited in Young Nuttall, 1990), the Fry Readability Graph (1968), the Fog Index and the Cloze Procedure (Rye, 1982) are regarded as almost

landmarks in the field of readability research, and have been frequently used, studied and assessed. Harrison (1980) gives full detail of nine readability measures, rated in terms of validity, accuracy and ease of application (see the table 2.1).

Table 2.1 - Summary of readability formulae and their rating of ease of application

Readability Formula	**Validity**	**Age level accuracy (8-16) range**	**Ease of application**
FLESCH formula (Grade score)	****	***	**
Fry graph	****	***	***
Powers-Sumner- Kearl formula	****	*	***
Mugford formula and chart	****	****	**
FOG formula	***	**	****
SMOG formula	***	**	*****
Dale-Chall formula	*****	****	*
Spache formula	****	**	**
FORCAST formula	**	**	****

Key: the more asterisks the better.

Measurements of readability are largely preoccupied with counting syllables and sentence length and hunting for the polysyllabic words (Wellington, 1994; Chall & Conard 1991). This is surely an unfair way of judging the difficulty of a text because long sentences and polysyllabic words are not necessarily more difficult than shorter sentences and monosyllabic words. As pointed out earlier, it is quite possible to present very complicated ideas with very short words and short sentences.

It is important to note that the readability formulae are not appropriate for assessing the readability of texts intended for second language readers, because they do not account for many of the most significant factors affecting the reading process. Armbruster lists factors that affect comprehension but the formulae exclude from consideration, namely

content difficulty and familiarity, organisation of ideas, author's style and page layout. Readability formulae also neglect characteristics of readers that affect comprehension, such as their motivation, interest, purpose and perseverance (Armbruster, 1985). Moreover, there are other problems associated with the use of readability formulae, such as:

- Different formulae predict different scores for the same passage. That is readability level of a prose might be rated as the most difficult by one formula and least difficult by another formula (Langhan, 1993; Armbruster, 1985).

- Readability formulae are set out to judge the difficulty of text after it has been written, but they cannot be used in the production of readable writing, because formula index variables are not sufficient for this purpose (Klare, 1988).

- A good readability score does not guarantee comprehension. Simplifying a text in terms of sentence length and syllable counts may increase the difficulty of the reading task by rendering explicit relationship obscure (Wegerhoff, 1981). For that matter long sentences and long words are not necessarily more difficult than shorter ones.

- The formulae do not account for different passages of variable complexity within a single text (Langhan, 1993).

- Harrison (1980) also points out that there is no perfect correlation between the difficulty of a text as measured by the formulae and the actual difficulty a reader experience.

- The readability formulae concentrate only on text characteristics, totally neglecting how cognitive processing factors influence the comprehensibility of text (Zakaluk and Samuels 1988).

- The reliability of readability formulae decreases sharply on some types of written materials, for example as in mathematics and parts of science where there is language compression (Wegerhoff, 1981).

- Relying on readability formulae as the only index of text difficulty probably does more harm than good. They contribute to the production of poorly written text through substituting of easier for harder words and shorter for longer sentences (Osborn et al, 1985; Chall, 1988; Chall & Conard, 1991).

Although many researchers have indicated serious drawbacks of readability formulae as reliable instruments, they continue to be widely used because of their strong economic advantage. Using them do not require special training and equipment (Lange, 1982).

2.5.3. Teachers' judgments

Teachers have the responsibility of choosing materials, which their students can read and understand (Graham, 1978). The opinions of teachers are of great value in assessing the readability of textbooks. Even though individual teachers may vary in their assessment of the suitability of a text, a number of studies have indicated that teachers' judgments are reliable and consistent if pooled (Harrison, 1980; Rush, 1985). This method works best for experienced teachers familiar with reading materials at several grade levels. Wright and Spiegel (1984) surveyed 1500 biology teachers about the reading level of biology textbooks and they reported that teachers were able to judge readability more realistically

than the Fry graph and distinguish between easier and more difficult material. Rush (1985) recommends teachers to take the following points into consideration while analyzing a text:

- Does the text include difficult vocabulary?
- Are difficult ideas or concepts included?
- Are sentences complex or simple?
- Are relationships between concepts or events clearly stated?
- Does the text require the interpretations of graphics (pictures, charts, tables, diagrams?

Harrison (1980) points out that teacher's opinions or judgments about the incomprehensibility of a text for a target group is the most determinant for the accuracy of the final published reading level. However, he points out that due to less commonality in individual teachers' experience, the teachers' pooled judgments may not coincide.

Given the merits and demerits of the readability formulae discussed above, Cloze procedure was found to be appropriate to analyse readability of the Eritrean grade nine biology textbook. Thus, the following section discusses Cloze test in more detail.

2.6. Cloze procedure

Taylor (1953) was probably the first to introduce the Cloze procedure as a means of measuring comprehension. The Cloze procedure measures the extent to which the reader

can predict deleted words that the author originally used. In a standard Cloze test, the tester deletes every n^{th} word, for example every 7^{th} word, from a passage. The reader reconstructs the author's message through a mixture of perception and guesswork and the higher the percentage of correct response, the more readable a passage will be (Graham, 1978; Harrison, 1980; Rush, 1985).

2.6.1. Interpreting Cloze test results

The score obtained by the reader is the mean percentage of correctly predicted words. The mean results may be used either to rank the passage or the book as to its level of readability or to rank the students as to their reading abilities in terms of comprehension (Wegerhoff, 1981).

Harrison (1980) cites Bormuth (1968) as trying to correlate Cloze scores derived from standard Cloze tests with multiple-choice comprehension tests. The exact replacement on 57% of the blanks on the Cloze test corresponds to 90% comprehension on multiple-choice tests and 44% exact replacement on Cloze corresponds to 75% comprehension on the multiple-choice test. He further suggested the following criteria for judging the match between text difficulty and reading abilities for multiple-choice comprehension tests, namely:

- Independent level: above 90% (the reader can read and comprehend without help).
- Instructional level: 75-90% (the student can read and comprehend with teacher guidance).

- Frustration level: below 75% (the student cannot make satisfactory progress even with teacher's help).

2.6.2. Limitations of cloze procedure

Like readability formulae, the Cloze procedure has its own limitations. Russell (1978 cited in Wegerhoff, 1981) identified the following limitations:

- The Cloze test measures readers' ability to make a guess, but if the reader is a poor guesser, his/her failure may be due to any of a number of possible problems, e.g. lack of comprehension, inability to decode, inability to tolerate frustration etc. In other words, it is difficult to separate "true" comprehension problems from other skill deficiencies which may be interfering with comprehension. Ashby-Davis (1985) maintains that Cloze test reading is not like ordinary reading, that there are marked differences with respect to reading speed, eye movement, and overall reading strategies. She asserts that making an educated guess on an omitted word is not the same as guessing the meaning of an unknown word by checking the context. The reader must search for words best matched to passage meaning, style, logic, purpose, and tone. Thus, the Cloze procedure is a test of production rather than assimilation of the text.

- Readers for certain reasons may perform better on the Cloze test than their abilities would justify.

- Cloze test has a high anxiety producing nature particularly for the disabled reader.

- Cloze procedure is restricted to a high-level range of reading and is ineffective for low-level readers.

- Cloze test is inappropriate for certain kinds of contents, e.g. mathematics that lacks sufficient content discussion to allow a reader to guess.

- Cloze procedure has been criticised for not taking into consideration the interaction that exists between a reader and a text.

Despite the limitations, Cloze test has been widely used and been effective in measuring readability.

2.7. Issues of relevance in science education

The quality of science education in most developing countries has shown a steady decline in the past decades. The reasons for this are extremely complex (Ogunniyi, 1986; Gray, 1999) and extends far beyond purely educational concerns. The key factor, as Gray (1999) suggests is the extent to which the First World hegemony operates to constrain and limit the autonomy of critical persons, such as policy makers, in the developing world. He contends that:

> *... because of the marked difference between First and Third World contexts, there is an urgent need for those working in the developing world to recognize the First World hegemony that exists ... in the developing world. What is needed is for people in the developing world to believe more in themselves and to develop systems, programs and practices that are authentic and contextually relevant and not to uncritically follow the dominant order* (Gray, 1999: 266-267).

In addition, as pointed out by Ogunniyi (1996), there is no simple solution to the multifarious problems facing science education in Africa. Yet realizing the fact that most schooling takes place in a rural setting, it is crucial that the form of science developed is relevant to the context for which it is intended. Hence, there is a great need for relevance. Education for relevance has different meanings for different people (Knamiller, 1984). However, what is beyond doubt though is that science education should reflect the needs of students and society (Ogunniyi, 1986). Knamiller (1984) in dealing with the relevance issues, talks in terms of the need for school science in developing countries to be closely linked to local technology, issue-based studies and environmental education. This approach attempts to deal with human problems at the local community level, to teach the skills of problem-solving and decision making applied to real-life problems, and to increase the production of goods and services among the poor.

As pointed out by Urevbu (1984 cited by Clark, 1993), curricula, methodology and teaching materials should be drawn directly from the life of the community and from the environment. It might be therefore important for textbook evaluators to see whether the information in a textbook is linked to the daily life experience of the students. According to Schnotz (1984), it is easier for a reader to process a text on a subject of which he/she has prior knowledge. Materials that are not relevant to the life experiences of the readers are not only meaningful but are also more interesting to them and thus motivate them to be engaged in reading.

2.8. Conclusion

In this chapter I have examined the various aspects of readability as a means of engendering meaningful learning with specific emphasis on textual materials. The areas

surveyed include: role of science textbooks, physical features of the texts, nature of presentation in terms of language, quality of content, the merits and demerits of readability formulae and Cloze test, and lastly issues of relevance of science education for the intended audience. The next chapter will focus on the methods used to collect data for the study. In addition, it will explain the procedures followed to collect the data and the ways of analyzing the data.

CHAPTER THREE
METHODOLOGY

3.1. Introduction

This study falls primarily within the descriptive, primary and exploratory research paradigm. It is descriptive, in that it describes conditions that exist and events and processes as they occur. It is also a primary research in a sense that the data are generated from primary sources, namely biology teachers and students using the grade 9 biology textbook (Gay, 1981). It is exploratory in that there were no baseline data to rely upon. It is the first in Eritrean context. Hence, the choice for descriptive research was to gather relevant data that could serve as basis for a more in-depth study of issues surrounding textual materials.

According to Wolpert (1991), descriptive research is sometimes assigned an inferior status, particularly by over enthusiastic proponents of experimental research. This is unfortunate because descriptive research does serve several important functions viz.:

- it can provide useful information for decision making,
- it could provide baseline data upon which hypotheses can be posited for testing through an experimental research,
- it may provide a substitute for experimental research in situations where economic, logistic, or ethical considerations make an experimental research impossible (Wolpert, 1991).

To investigate the readability of the Eritrean grade 9 biology textbook, four research instruments were used. The use of two or more methods of collecting data enables the researcher to make use of both quantitative and qualitative data. By cross-checking the result, subjectivity is controlled, thus validity of the result is increased. Exclusive reliance on one method may bias a researcher's picture of the phenomenon under investigation. Therefore, methodological triangulation in which different methods are used on the same subject of study (Cohn and Manion, 1989) was practiced in this research.

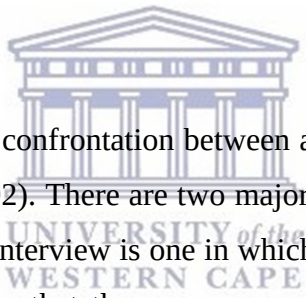
The study was confined to five schools in the central and southern regions of Eritrea. This is because the customised master's program allotted only three months for the collection of data on Eritrea. Unfortunately, a substantial part of this period fell within the end of the semester holidays. In such circumstances only willing and easily accessible schools were selected. In order to protect anonymity of the respondents, letter codes were used to name the schools. These consist of two secondary schools, **A** and **B,** from the central region, Asmara, and three secondary schools, namely **C, D** and **E** from the southern region of Eritrea. The first two schools are from urban setting, whereas the latter three schools are located in the semi-urban settings.

At the beginning of this study, I handled the Head Masters of each secondary school a letter (Appendix 1.1) requesting permission and cooperation in conducting the study in their schools. After granting permission, I introduced myself and briefed the aim of the research. The Head Masters of each school, based on willingness and convenience, recommended the teachers and students who would participate in the study. Some of the teachers who gave their responses wanted to remain anonymous. This was not bad as it permitted them to be more open in their responses to items on the questionnaire and interview. Hence, in accordance to research ethics the respondents' anonymity was respected.

3.2. Instrumentation

Interviews, questionnaire, Cloze test and Word Difficulty Index were the instruments used to analyze the role, quality, readability and relevance of the Eritrean grade 9 biology textbook. The clarity and validity of the questionnaires and interview questions were checked prior to the study. These research instruments were first distributed to 10 experts (researchers and experienced teachers) for rating the validity and clarity of the items on 5-point scale. Based on their comments necessary revision was done to ensure that the research instruments were capable of measuring what they were supposed to measure. Details regarding the development of each research instrument are presented in subsequent sections.

3.3. Interviews



Interview is a face-to-face verbal confrontation between an interviewer and the person(s) being interviewed (Ogunniyi, 1992). There are two major forms of interviews: structured and unstructured. The structured interview is one in which the content and procedures are organised in advance. This means that the sequence and wording of the questions are determined by means of a schedule and the interviewer has little freedom to make modifications. In contrast, the unstructured interview is open, having greater flexibility and freedom (Ogunniyi, 1992).

Using interviews as a research tool has a number of advantages and disadvantages. Gay (1981) suggests the following advantages and disadvantages of an interview.

3.3.1. Advantages of using interviews

- When properly used it can produce in-depth data not possible with questionnaire.
- It is appropriate for asking questions that cannot be effectively structured in a multiple-choice format.
- It is flexible, so that the interviewer can adapt the situation to each subject.
- By establishing rapport and trust relationship, the interviewer can obtain information that subjects would not give on a questionnaire.
- More accurate and honest response can be obtained since the interviewer can explain and clarify the questions.
- An interviewer can follow up on the incomplete or unclear responses (Gay, 1981).

3.3.2. Disadvantages of using interviews

- It is expensive and time consuming.
- It generally involves small samples.
- The response given by a subject may be biased and affected by her/his reaction to the interviewer.
- An interview requires a level of skill usually beyond that of a beginning researcher.

- The respondent is restricted by the interviewer to a specific time and place for the interview.

- Lacks anonymity, especially when the topic or some of the questions are of sensitive nature (Gay, 1981).

The interviews used in this study were of the semi-structured type allowing the respondents to express their ideas freely to a certain degree. The questions were open-ended in that they put minimum of restrains on answers given by respondents. Subjectivity was reduced by ensuring that each respondent was asked the same question in the same way. The semi- structured interview schedule for both teachers and students can be found from Appendix 2.1 and Appendix 2.3 respectively.

3.3.3. Procedure for administering the interview

Four biology teachers and their students from two secondary schools were chosen for the interview. In the first school there were only two biology teachers, and both were interviewed. In the second school there were five teachers of which two teachers were interviewed. Having assured them of anonymity the teachers were quite willing to participate in the interview. The time for interview was scheduled in accordance to the convenience to the teachers.

3.3.4. Summary of interviewee characteristics

Of the four secondary school teachers who were interviewed:

- All were males.
- Two had Bachelor of Science (B.Sc.) in biology and two had a Master of Science (M.Sc.) in biology.
- All had teaching experience ranging between one and ten years.

With the assistance of the teachers, four students (two above average and two below average ability) were selected for the interview. The selection of the two ability categories was to have a clearer reflection of status of the students and their perceptions of the textbook.

As indicated earlier the reason for selecting the two secondary schools was purely determined by accessibility reason. According to Cohn and Manion (1989), this type of sampling is known as 'convenience sampling'. It is a process that involves choosing the nearest individuals to serve as respondents and continuing that process until the required size has been obtained.

Teachers and students were interviewed person-to-person in isolation in order that they will feel confident and express what they felt and believed about the role, and relevance of their textbook. The interviews were conducted in the school libraries and laboratories. With the permission from the respondents, answers to the interview questions were recorded using tape recorder. The tape-recorded interviews were transcribed and analysed. The interviews enabled the researcher to find out about the perceptions of students and teachers on the role, quality, readability, and relevance of the textbook. The interviews were considered as useful supplement to the other techniques in probing further information.

3.4. Questionnaires

Questionnaire is a list of questions or statements to which individuals are asked to respond in writing (Ogunniyi, 1992). In the social science, particularly education, questionnaire is probably the most commonly used method of gathering information. It is an extremely flexible approach for gathering information on almost any topic from large or small number of people. Using of questionnaire has several advantages and disadvantages. Nachmias and Nachmias (1982) suggest the following advantages and disadvantages of using a questionnaire in surveys.

3.4.1. Advantages of using questionnaire

- It is cheaper than an interview. A questionnaire does not require a trained staff of interviewers. The processing and analysis are also simpler and cheaper than those of the personal interviews.
- It reduces biasing errors that might result from the personal characteristics of interviewers and from variability in their skills.
- It assures anonymity especially when the survey deals with sensitive issues.
- It gives chance for the subjects to consult documents.
- It permits wider geographic contact with minimal cost, whereas interviewing would require expensive travel cost and time for the interviewers (Nachmias and Nachmias, 1982).

3.4.2. Disadvantages of using questionnaire

- A questionnaire can be used as an instrument for data collection only when the questions are straightforward enough to be comprehended solely with the help of printed instructions and definitions.
- There is no opportunity to probe beyond the given answer, to clarify ambiguous answers, or appraise the non-verbal behaviour of respondents.
- Researchers have no control over the respondents' environment; thus, they cannot be sure that the right person completes the questionnaire.
- The final disadvantage is that the return rate is usually poor (Nachmias and Nachmias 1982).

Despite the above shortcomings and in view of the advantages of approach the lack of empirical data in the area warranted the use of an approach that could fill the existing gap.

The questionnaires were distributed to both teachers and students in order to get their perceptions about the role, quality, readability, and relevance of the textbook.

3.4.3. Teachers' questionnaire

The items on the teachers' questionnaire (Appendix 3.1) used in this study were partly derived from a questionnaire used by Wegerhoff (1981) and a checklist used by textbook evaluators (Simpson and Anderson, 1981).

The teachers' questionnaire contained both closed and open type of questions. Closed questions were included for easy use, because they are easy to answer and analyze (Cohn and Manion, 1989). Open-ended questions were also included in the questionnaire to provide the respondents with an opportunity to express their opinions without being limited to giving predetermined responses and this enabled the researcher to obtain any additional relevant information. Open-ended questionnaires are effective when used to survey a relatively small group of people who can express themselves in writing (Nachmias and Nachmias, 1982).

The teacher questionnaire used in this study was divided into four sections, namely introductory part, section A, Section B and Section C. The introductory part concerned with biographical data of the respondents. Section A contained items which the teachers were expected to rate the frequency of use in terms 5-point scale. The response choices are frequently used, used, fairly used, occasionally used, and never used. Section B deals with the features of the textbook, namely the content, organisation, presentation, physical and mechanical conditions, and laboratory activities. Teachers were required to rate each item under the headings on 5-point scale. The response choices are excellent, good, fair, poor, and very poor. Section C of the questionnaire consists of open-ended questions to which the teachers were expected to express their opinions (Appendix 3.2).

Procedure for administering the teacher questionnaire

Questionnaires were delivered personally to each of the five selected schools and handed to the selected biology teachers in each school. This approach helped to enhance the return rate. A total of 20 questionnaires were distributed to teachers selected from 29 biology teachers teaching in the five secondary schools. The teachers were given

approximately two weeks to complete the questionnaire. The completed teacher questionnaires were collected back personally. From 20 questionnaires distributed 17 were collected back making a response rate of 85%. The researcher tried to contact the non-responding teachers several times but did not succeed in this endeavour. The data obtained from the teacher questionnaire were analysed in terms of percentages.

Summary of respondents' characteristics:

Of the seventeen teachers who responded to the questionnaire,

- Two were females and fifteen were males (a typical feature of science teaching in Eritrea).
- Two had obtained diploma in biology, nine B.Sc., and five had M.Sc. degree in biology.
- Teaching experience of the respondents range between one and thirty years.

3.4.4. Students' questionnaire

The questionnaire (Appendix 3.3) used in this study was a modified version of the one developed by Clark (1993). The questionnaire contains largely closed questions in the form of multiple-choice. The aim was to avoid obtaining ambiguous answers from respondents and to make it easy for the students to respond. An open-ended question was also included at the end of the questionnaire to provide an opportunity for students who want to include some comments.

Procedure for administering the student questionnaire

The questionnaires were delivered personally to each of the five selected schools. One grade 9 class was chosen from each of the selected secondary schools. All the students in that class were supplied with the questionnaire to be completed. The students completed the questionnaires inside their classrooms during biology period.

The researcher explained carefully to the students how to complete the questionnaire. Students were given an opportunity to ask questions. While students completed the questionnaire, the researcher and the teacher in charge of the class were available to help and clarify any matter the students wanted to know about the questionnaire, particularly instructional issues. The completed questionnaires were collected immediately. Almost all questionnaires distributed were collected back, making a response rate of 94%. Table 3.1 shows the number of respondents in terms of sex, age, and school to which they belong. The schools were coded as 'A', 'B', 'C', 'D', and 'E'.

Table 3.1 - Frequency of the sex and age of the students completed questionnaire

School	Sex		Total	Age							Total
	M	F		14	15	16	17	18	19	20	
A	21	21	42	0	15	14	11	1	1	0	42
B	34	27	61	4	19	22	16	0	0	0	61
C	43	14	57	0	8	20	25	1	2	1	57
D	50	8	58	0	2	13	15	16	7	5	58
E	44	16	60	0	5	13	29	8	3	2	60
Total	192	86	278	4	49	82	96	26	13	8	278

3.5. Cloze test

The Cloze test consisting of 50 blank spaces was constructed from three passages selected from three different parts of the prescribed grade-biology textbook. A modified Cloze test like the one used by Wegerhoff (1980) and Doidge (1997) was adopted in an attempt to make it suitable for English second language users (Appendix 4.1).

Every fifth, sixth, or seventh word deletions are common when using standard Cloze test (Cohn, 1980 as cited by Doidge 1997). Klare, Sinaiko and Stolurow (1972) suggest the seventh word deletion is preferable if the readers are comparatively weak and if the passage is difficult. In line with this suggestion, the researcher decided to use the seventh word deletion approach, except for proper nouns, definite or indefinite articles ('a', 'an', 'the', and, 'and') and words that are difficult to replace (such as numbers, abbreviations etc.). To provide context for the reader, the first and last sentences were left intact. Deletions of words started from the second sentence.

The standard Cloze test was further modified and prepared in a multiple-choice format consisting of three alternatives apart from the deleted words. The alternatives to the deleted words were selected in such a way to fit into the sentence grammatically, though not necessarily making sense.

Each passage was typed out, and the deleted words were replaced by lines of equal length (8-spaces). Each blank space was numbered (1-50). The three alternatives and the deleted words were listed adjacent to the passage. The over-all aim of the Cloze test was to measure the comprehension capacity of the students.

3.5.1. Procedure for administering the Cloze test

The Cloze test was delivered to the five selected schools. Two classes from each secondary school making a total of ten classes completed the Cloze test. Altogether, 607 students completed the Cloze test. Sampling reliability is essential in Cloze test results. In this study, the sample size is sufficiently large, which helps the researchers to avoid making misleading judgements (Harrison, 1980).

Each student was supplied with the Cloze test. The front page had written instructions and an example on how to complete the Cloze test (Appendix 4.1). Despite this, the students were given opportunity to ask question on any instruction not clear to them. This was to ensure that the students knew what to do and did so in a clear and concise manner.

The students worked at ease without time limit. Some students who required extra time were given the opportunity to complete the Cloze test. Despite all efforts to ensure completion of the Cloze test, 38 out of total 607 forms were returned either uncompleted or incorrectly filled. All the 38 forms were therefore discarded.

3.6. Word difficulty Index

A similar approach to the one developed by Ogunniyi (1999) was employed in this research. This process enabled the researcher to find out the students' capacity for understanding biological terms used in the textbook.

The researcher selected one passage from the textbook to which the students responded (Appendix 5.1). The test expects the students to underline words that they do not

understand from the text. In addition, the students were asked to write one sentence, in their own words, that would best describe the passage. The test was expected to measure the comprehension capacity of the students.

3.6.1. Procedure for implementing of word difficulty test

The word difficulty test was delivered to each of the five selected secondary schools personally. One grade 9 class, from each secondary school, was randomly selected to work on the word difficulty test. All students in a class were asked to give their responses to the test. They were asked to underline any word they do not understand. They were also asked to write one sentence in their own word that best describes the passage. The instruction was clearly explained to the students and they were provided with opportunity to ask questions for clarification. Altogether 294 students participated in the test. The number of students, in terms of sex, age and the school they belong, is given in Table 3.2. The schools were coded as 'A', 'B', 'C', 'D', and 'E'.

Table 3.2 - Students responded to Word Difficulty Index test

School	Sex		Total	Age							Total
	M	F		14	15	16	17	18	19	20	
A	24	25	49	9	12	21	7	0	0	0	49
B	33	28	61	7	23	20	8	2	0	1	61
C	53	16	69	4	10	25	15	7	7	1	69
D	45	9	54	1	1	11	15	14	7	5	54
E	48	13	61	0	6	15	23	9	5	3	61
Total	203	91	294	21	52	92	68	32	19	10	294

3.7. Conclusion

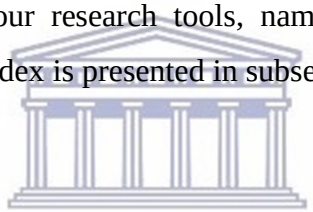
This chapter dealt with the methods of research techniques used to collect the data and the means used to analyze the collected data. The following chapter will focus on the presentation of the results.

CHAPTER FOUR

RESULT

4.1. Introduction

In chapter 2, the role of textbook in teaching and learning process, various text-based factors that influence quality of textbook and which tend to create reading difficulties for readers and the relevance of textbook were discussed in some detail. The text factors are summarised into five categories viz.: physical features, content complexity, organisation, presentation, and laboratory activities. This study has provided the opportunity to explore some aspects of grade 9 biology textbook from the students' and teachers' perspectives. The result obtained from the four research tools, namely questionnaires, interviews, Cloze test and Word Difficulty Index is presented in subsequent sections.



4.2. Questionnaires

4.2.1. Teacher questionnaire

Seventeen teachers from five secondary schools completed the questionnaire. The summary of the respondents' characteristics was given in Section 3.4.3. The questionnaire appears in Appendix 3.1. In the questionnaire, teachers were asked several open-ended questions, in addition to closed questions, to enable them to give their opinion. Tables 4.1 and 4.2 present teachers' responses to the closed questions. The summarised responses for the open-ended questions can be found in Appendix 3.2.

The first major point of interest that comes out of the teachers' questionnaire is the extent to which the teachers depend on the textbook. Teachers depend on the textbook for various purposes and in different degrees. The data obtained from the teachers' questionnaire about the frequency with which they use the textbook is given Table 4.1.

Table 4.1 - Teachers' use of the grade nine biology textbook

Item	**Frequency of use in %**				
	Frequently	**Used**	**Fairly**	**Occasionally**	**Never**
As a reference for preparing lessons	53	29	6	6	6
To illustrate diagrams to the students.	18	18	40	6	6
As a guide for practical work and demonstrations.	6	0	0	29	65
To set class work and home assignments.	12	12	12	52	12
To prepare notes for the students.	41	29	24	6	0
To set tests and examinations	41	29	24	6	0

Key: the percentage in each column refers to the number of teachers providing a particular response.

Teachers' perceptions on the quality of the textbook are categorised into five categories, namely physical features, presentation, organisation, content, and laboratory activities. The responses obtained from the teachers were computed to percentages and are then placed Table 4.2. The numbers recorded in each column refer to the percentage of teachers providing a particular response.

Table 4.2 - Teachers' view about the quality of the grade 9 biology textbook

Item	Percentage (%)				
	Excellent	Good	Fair	Poor	Very poor
a) Physical features					
General attractiveness of the textbook	12	53	29	6	0
Appropriate overall size	35	53	6	6	0
Durability (especially the cover & binding).	12	24	41	12	12
Quality of paper.	53	29	12	6	0
Quality of photographs.	6	0	53	35	6
Quality of diagrams.	6	6	47	41	0
Appearance of pages e.g. spacing, margin etc.	41	53	6	0	0
Print size	53	41	6	0	0
b) Presentation					
Appropriate reading level.	11	18	53	12	6
Length and complexity of sentences.	6	47	41	6	0
Choice of vocabulary	0	17	59	18	6
Technical terms properly introduced and defined.	6	18	29	41	6
c) Content					
The general theme in harmony with the aims and objectives of the syllabus.	6	35	47	12	0
Application of concepts to everyday life.	0	6	53	35	6
Up- to- date content and accurate information	0	18	35	35	12
Attention to students' interest and motivation	0	18	41	35	6
Adequate number of diagrams and photographs	6	6	35	53	0
Adequate data, tables and graphs.	0	6	29	53	12
Relation of biology to other subjects.	0	6	29	53	12
Concepts manageable to the students.	0	12	65	24	0
Types of questions in terms of quality & quantity.	0	6	29	35	30
d) Organisation					
Appropriate choice and sequence of units or chapters.	18	35	35	12	0
Material within chapters organised for easy use.	0	12	41	29	18
Chapter or topic summaries are well organised.	6	6	35	41	12
Questions and exercises are well structured.	0	0	29	41	29
Appropriate placement of chapters according to seasonal changes.	0	18	35	12	35
e) Laboratory activities					
Laboratory activities within the range of students' mental and	0	6	6	35	53

Item	Percentage (%)				
	Excellent	Good	Fair	Poor	Very poor
physical development.					
Inclusion of open-ended activities.	0	6	6	35	53
Contribution to an understanding of concepts being developed.	0	6	18	29	47

4.2.2. Student questionnaire

Two hundred and seventy-eight students from five secondary schools completed the questionnaire. The questionnaire appears in Appendix 3.4. The general characteristic of the respondents was given in Table 3.1. The responses to questions 1&2 of the student questionnaire are summarised in Tables 4.3, whereas, the responses to questions 3-6 are placed in Table 4.4. For the responses to match other responses in the table, only the "Yes" responses are reported for the items under question 6 of the questionnaire. Students' detailed responses to two open-ended questions, in terms of what they like or did not like about the textbook, are displayed in Appendix 3.4.

Table 4.3 - Students' possession and use of the grade 9 biology textbook.

Item	f	%
I have the biology textbook	86	31
I do not have the textbook	192	69
I use my textbook every day	35	12
I use my textbook once or twice a week	131	47
I use my textbook occasionally over weekends	46	17
I use my textbook only during examinations	66	24

Table 4.4 - Students' perceptions about the quality of the grade 9 biology textbook.

Item	f	%
1. I understand all of what I read in the textbook.	6	2
2. I understand most of what I read in the textbook.	102	37
3. I understand some of what I read in the textbook.	114	41
4. I do not understand much of what I read in the textbook.	45	16
5. I do not understand what I read in the textbook.	11	4
6. The diagrams help me to understand biology more clearly.	132	47
7. The diagrams sometimes help me to understand biology.	99	36
8. I often find the diagrams confusing.	25	9
9. I avoid looking at the diagrams because they do not make sense at all.	22	8
10. I always find the English used in the textbook too difficult	50	18
11. I find most of the English used in the textbook too difficult	142	51
12. I sometimes find the words used in the textbook too difficult	70	25
13. The words used in the textbook are easy to read.	3	16
14. I find the sentences in the textbook too long to understand.	170	61
15. Too many big words used in the textbook.	209	75
16. New words should be explained clearly.	231	83
17. There should be more questions at the end of each chapter.	236	85
18. Summaries and glossaries should be added at the end of each chapter.	256	92
19. The text should be written in simple English so that I can understand.	181	65
20. The text is attractive and interesting.	120	43
21. What is in the text is related to my daily life.	145	38

Key: N = 278

4.3. Interviews

Four teachers and four students were interviewed at two secondary schools. The full responses of both the teachers and the students were recorded, and then transcribed. The transcribed interview responses of both a teacher and a student can be found in Appendix 2.2 and Appendix 2.4 respectively. The summarised responses of both the teachers and the students are placed in Table 4.5 and Table 4.6 respectively.

Table 4.5 - Teachers' view of the role, quality and relevance of the grade 9 biology textbook

Item	Teacher (N = 4)
The use of the textbook	
• To set questions for assignments and tests	3
• To prepare notes for the students	4
• As a guide for all instructional activities	4
Quality of the textbook	
a) physical features	
• The external appearance of the textbook is attractive	3
• Size of the textbook is enough and up to the mark	2
• Print is legible	2
• Quality of paper is good	2
• Picture on the cover is not appropriate	2
• Binding is poor	3
b) content	
• amount of information - too much	1
- adequate	2
• description of ideas is some parts is not elaborated	2
• content has no connection with previous and subsequent grades	3
• diagrams - are good, clear, and understandable	1
- There are many unnecessary diagrams.	3
- Some diagrams are not clear	4
- Many important diagrams are absent.	2
- Parts indicated on the diagram are not mentioned in the text.	4
- Labelling of parts is adequate	1
- Labelling of parts is detailed.	2
• Review questions are not enough and understandable	3
c) presentation	
• Language is simple and understandable.	1
• Language is difficult to understand.	2
• The textbook contains a lot of technical words	2
• Language needs simplification.	1
d) Organisation of the textbook	
• Content easy to follow and arranged in a logical manner.	2
• Content difficult to follow and boring.	1

Item	Teacher (N = 4)
• Sequences of units need rearrangement (e.g. microorganisms).	2
• Some parts presented in the form of points hence the ideas lack connection.	2
e) Laboratory activities	
• Not present in the textbook and hence students experience difficulty.	4
3) Relevance to the daily life situation of the student	
• Some information is relevant e.g. diseases.	3
• No need for relevance (students must learn anything for the sake of knowledge).	1
• All the information in the textbook is relevant but students do not notice the connection.	1

Table 4.6 - Students' view of the role and quality of the grade 9 biology textbook

Item	Student N = 4
a) Student possessing the textbook:	2
• bringing the textbook to school	0
• read the textbook - twice a week	1
- once a week	1
- only during examination	2
b) language - too difficult	3
- difficult words	4
- difficult words not defined	1
c) when encountered with difficult words students	
- Try to understand the meaning of the words from the context.	4
- ask a teacher to explain it	2
- look at dictionary for meaning	3
d) Review questions - not important	1
- not enough	3
e) Diagrams - labelling of the diagrams is detailed	2
- some parts on the diagrams are not mentioned in the text	1
- not attractive and colour should be added	1
- adequate and good	2
f) What they liked about the textbook	
- parts dealing with diseases	2

Item	Student N = 4
- the point form of presentation	2
g) What they do not liked about the textbook - the point form of presentation - the difficult words especially the technical words - no connection with previous grades	 1 2 2
h) Grade 9 biology textbook when compared to other textbooks - too difficult when compared to chemistry and physics - like biology more than other subjects - see no difference	 2 1 1
i) Relevance to daily life situations - it is related to daily life situation (e.g. malaria) - most of the information are not relevant - relevance in not important, we must learn any things to acquire knowledge	 1 2 1

4.4. Cloze procedure

As indicated in chapter 3, the Cloze test consisting of 50 blank spaces and which is constructed from three passages was administered to five secondary schools. Altogether 569 students completed the Cloze test. The summaries of their responses are presented in Table 4.7.

Table 4.7 - Cloze test results

Range	Passages			Mean	Reading level
	A	B	C		
91-100%	5 (1%)	_	_	5 (0.33%)	Independent level
75-90%	62 (11%)	30 (5.3%)	11 (2%)	103 (6%)	Instructional level
40-74%	432 (76%)	366 (64.3%)	399 (70%)	1197 (70%)	Frustration level
0-39%	70 (12%)	173 (30.4%)	159 (28%)	402 (24%)	
Mean	53.8%	48.35%	46.39%	49.51%	

4.4.1. Word Difficulty Index (WDI)

As explained in chapter 3, students were asked to underline words that they did not understand in the passage on the feeding of sponges. The words that the students did not understand are placed in the following table.

Table 4.8 - Words students did not understand from the passage

Words	%*	Words	%*	Words	%*
Jelly-like	58	Flagella	10	Consists	3
Hollow body	53	Sponge	8	Within	2
Spicules	48	Protective	7	Thin	2
Collar cells	45	Digested	6	Contains	2
Pores	34	Special	5	Food	2
Current	30	Separated	4	Through	1
Wandering cells	26	While	4	Layer	1
Amoebocytes	23	Draw	3	Absorbed	1
Loose cells	21	Enzyme	3	Enter	1
Incurrent pore	20	Particles	3	Simple	1
Epidermis	15	Wall	3		

*Percentages are rounded off; N = 294

In addition, the students were asked to write one sentence in their own words, which they think describes the passage best. The responses are summarised in Table 4.9.

Table 4.9 - Sentences that the students think describe the passage best

Statement	%	Description
1. The process of feeding and digestion in sponges.	9	Understood the passage
2. The body of sponges is made up of two layers separated by jelly-like substance.	26	Did not understand
3. The passage explains about the life functions of sponges.	14	Did not understand
4. Amoebocytes digest food and distribute oxygen to other cells.	3	Did not understand
5. Water enters into the body of sponges by movement of flagella.	3	Did not understand
6. Sponges are the lowest multi-cellular animals.	4	Did not understand
7. * Others	41	Did not understand

* It stands for the responses not reported here since some of the students did not follow instruction and some of the responses considered to be meaningless.

4.5. Conclusion

This chapter presented the data collected using interviews, questionnaires, Cloze test and word difficulty test. The following chapter will focus on the analysis of the results based on the research questions.

CHAPTER FIVE
DISCUSSION

5.1. Introduction

In this chapter the data collected using four instruments will be discussed based on the four questions posed in chapter one, namely the role, quality, readability, and relevance of the textbook to daily life experience of the students.

5.2. The role of the prescribed grade 9 biology textbook

The role of the prescribed grade 9 biology textbook was investigated through both questionnaires and interviews. Teachers depend on the textbook for various purposes and in different degrees. By combining "frequently used" and "used' categories it seems that the textbook is used quite considerably (i.e. 70% or more) as a reference for preparing lesson plan or notes, and to set tests and examinations (Table 4.1). In addition, the interview reveals that all the teachers depend on the textbook for all instructional activities (Table 4.5). On the other hand, it seems that the textbook is less frequently used as illustrations or as a basis for assignments, and rarely used as a guide for practical work and demonstrations (Table 4.1). From this it is obvious that the teachers depend on the textbook as their main resource for teaching. Yager (1983) reported a similar finding that shows textbooks tend to imprison science teachers by being the major source of information and by dictating all the instructional sequences.

Majority of the students (69%) lacks the textbook (Table 4.3). However, they can use copies of the textbook placed in their school libraries. Students read the textbook infrequently only over weekends or during examination (Table 4.3 and Table 4.6). Similarly, teacher interview reveals that teachers stick to the textbook in order to prepare their students for examinations, because they assume that the questions for the Eritrean Secondary Education Certificate Examination (ESECE) are extracted from the textbook (Appendix 2.2).

If both teachers and students use the textbook for the preparation of examinations, it can be assumed that the types of content to be read and the amount of time to be spent in reading are determined by examinations. This finding corroborates with research findings which indicate that the teacher' and students' dependence on textbook becomes serious if the curriculum is driven by examinations (Ogunniyi, 1982). As in all developing countries, reading in the Eritrean schools is to pass examinations and hence the driving force for reading seems to be an examination. It is also important to inquire why the students are reading their textbook so infrequently over weekends or during examinations. One can assume that many of the students are either unwilling or unable to use the textbook as a resource for learning.

To find their conceptual understanding of content, they were asked "How much of what you read do you understand?" From 278 students who responded to the questionnaire 37% understand most of what they read. Sixty-one (61% sum of category 3,4, and 5) understand some or not much of what they read (Table 4.4). If so many students struggle to understand what they read, then it is not surprising that they read their textbook so infrequently. This infrequency of reading by the students is therefore, assumed to be due to text difficulty. This assumption corroborates with a review of literature that shows

students do not read their textbooks if the reading materials have higher level of readability than the grade level for which they are used (Wright, 1982; Clark, 1997).

From the above discussion one can deduce that the textbook plays an important role in the Eritrean schools. For the teacher, it dictates what to teach and how to teach. For the students the only written material to rely on is the prescribed textbook although they read it infrequently due to text difficulty.

5.3. The quality of the prescribed grade 9 biology textbook

Certain features were identified in the literature as contributing to the quality of a textbook. These features include the physical features, content, and organisation of the textbook. Teachers' and students' viewpoints about the features were sought to determine their importance in the teaching- learning process.

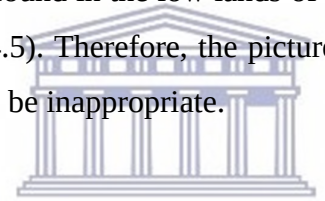
5.3.1. Physical features

A review of literature shows that the physical features of a textbook have a significant impact on the first impression of a student to a textbook (Harrison, 1980; Long, 1991). These physical features among others include size of the textbook, durability, legibility of the print and quality of illustrations.

By combining the "excellent" and "good" categories it seems that the majority of the teachers (i.e. 65% or more) filled the questionnaire and some (2/4 or 3/4) of the teachers interviewed regarded the physical features of the textbook such as the general attractiveness, quality of paper, appearance of pages, and legibility of the print to be

appealing (Table 4.2, Table 4.5, Appendix 3.4). However, durability of the textbook and especially binding was found to be poor (41%) and three out of the four teachers interviewed indicated that binding of the textbook is poor, because the pages come out very easily (Table 4.2 and Table 4.5).

Illustrations have a significant impact in motivating a reader to read the material. Harrison (1980) points out that the poorer the reader the greater is the value of illustrations as a motivating factor. Teacher questionnaire and interview indicate that the qualities of illustrations included in the textbook to be fair in motivating the students (47%) (Table 4.2 & Table 4.5). According to Osborn et al (1985) for illustrations to have meaning they should be an integral of what has to be learned by the students. However, this issue is not taken into consideration when placing a picture of "*Ostrich*" on the cover of the textbook- a bird which is found in the low lands of Eritrea and mentioning nothing about it in the textbook (Table 4.5). Therefore, the picture on the cover is not integrated with the text, and hence seems to be inappropriate.



Nevertheless, students (47%) regarded the illustrations included in the textbook as helpful features in assisting them to understand biology more clearly (Table 4.4). However, one of the teachers interviewed indicated that the diagrams are clear and understandable. The rest (3/4) indicated that most of the diagrams are not clear and are not attractive (Table 4.5).

5.3.2. Content

The harmony of the general themes of the textbook with the aims and objectives of the syllabus is a major ingredient that gives flavour to a textbook (Parkinson, 1994).

According to the Curriculum Development Division (1997) the main aims of secondary education in Eritrea includes the preparation of the student for further education as well as the provision of the essential knowledge, skills, and attitudes that would enhance the job flexibility and adaptability of the students to a new technology. There are varied views on this issue. Teacher questionnaire reveals that the general theme of the textbook is satisfactorily harmonised (47%) with the aims and objectives of the syllabus (Table 4.2). However, both the teacher and student interview reveal the general theme of the textbook is not in harmony with the general aims and objectives of the secondary education in Eritrea (Appendix 2.2 & Appendix 2.4). Moreover, one student indicated that he memorises biology without really understanding the subject matter. According to him:

> *Grade 9 biology is very difficult when compared to other sciences. While I was in grade eight, I had a fear that physics and chemistry are going to be difficult for me. But the situation is opposite and now I realised that biology is more difficult than physics and chemistry. During tests I memorise the information without understanding it. I get good results during tests, but I am not confident with the results that I receive. I can say the results do not reflect my understanding about the subject (Appendix 2.4).*

The examination of content included in the grade 9 biology textbook seems to give much emphasis on the recall of knowledge or facts to be studied or memorised by the students, and little attention is paid to the development of process skills. Millar (1989) suggests that one should examine science textbooks to see whether they are experiment dependent, enabling the students to experience science as a process. According to this concept the grade 9 biology textbook is not experiment dependent, instead it is knowledge oriented. For instance, by combining “poor” and “very poor” categories, it seems that the textbook

is poor (i.e. 76 or more) with regard to its emphasis to the practical activities (Table 4.2) and no single attempt was made in the textbook to engage students in practical activity (Appendix 3.2). Therefore, teachers suggested for inclusion of activity-oriented tasks in the textbook that gives some emphasis to the development of process skills, and some of them also called for preparation of a separate laboratory manual (Appendix 3.2). One student also explained his distress as follows: “Science must be taught practically and I can say we are not learning science” (Appendix 2.4). Hence the textbook seems to be ineffective regarding its emphasis to the practical activities.

The above finding corroborates with earlier studies in USA (Chiappetta et al, 1991), which suggest that textbooks examined appear to possess little balance in their approach to various themes of scientific literacy giving more emphasis to science as a body of knowledge rather than science as a way of thinking. Parkinson (1994) sees such pattern as a typical traditional way of presenting science. Hence, it seems that there is discrepancy between the objectives of the syllabus and what is being achieved by the content.

Another factor affecting the accessibility of a textbook to the students is the manageability of the information that is embedded in the textbook. Even though the questionnaire (65%) and interview (2/4) reveal that the content in the textbook is manageable (Table 4.2, and Table 4.5), there are some different critical opinions obtained from the interviewed teachers and from the open-ended questions. For instance, one teacher during interview expresses his view as follows:

> *The information included in the textbook is too much. All teachers and I always run out of time and rush to finish the content. You know the 40 minutes are used for both writing the notes on the chalkboard and discussing them.*

Since time allotted is only three periods per week, I recommend the amount of information included in the textbook to be reduced (Appendix 2.2).

Some teachers (6/17) responded to the open-ended questions of the questionnaire suggested that the information given in the textbook to be too much and they run short of time to complete the content. According to them:

…the general characteristics written in each phylum are boring for the students. They put in such a way that students should memorise them. That is even though the content seems to be concise the information is too bulky. It needs time and effort to discuss every point in the content (Appendix 2.2).

The information included in the textbook is too much; especially the section dealing with microorganisms is much detailed (Appendix 2.2).

Hence, it seems that the information presented in point format looks condensed, but the concepts loaded in them are not exhaustive. These point formats of presentations are given at the beginning of every chapter under the heading "*General characteristics*" as indicated in the extract of the general characteristics of the phylum *platyhelminthes* below:

General characteristics

1. They have **bilateral symmetry**; their body is made up of three body layers. They have no segmentation of body, but the body is flattened dorsoventrally from head to tail.

2. The epidermis is **soft** and **ciliated**, or covered by a **cuticle**, and has an **external sucker** or **hooks** or both for attachment to the host.
3. The digestive system is incomplete (there is a mouth but no anus), it is usually branched. In tapeworms there is no digestive system.
4. The muscle layers are well developed; the spaces between internal organs are filled by loose cell masses; there is no body cavity.
5. No skeletal, circulatory or respiratory systems are present. The excretory system has many flame cells, it is joined to the excretory duct.
6. The nervous system is well developed.
7. The sexes are usually united (hermaphroditic) but most practice cross fertilization; fertilization is internal.

Ministry of Education (1995: 30-31).

Digisi and Willett (1995) indicated that science textbooks might list too many concepts at a superficial level without dealing with them in sufficient depth. This lack of elaboration coupled with concept load creates a learning situation which requires students to memorise information without understanding the concepts. Viewed from this perspective, it seems that the textbook tries to include as many concepts as possible without being selective. As a result, the textbook is flooded with collection of many superficially treated facts. Such an organisation tends to clutter the critical meanings that should have been derived from such a text. Rather than facilitate comprehension, the reader is faced with an uphill task in interpreting the facts from a muddle of disjoint technical jargon.

Still another factor that requires mentioning here is the familiarity of the content included in the textbook to the students as it has n impact on students' capacity of comprehending a textual material. Ausubel (1963) regards what the student already knows to be important for meaningful learning to occur. The new information is considered to relate

to the appropriate cognitive schemes already existing in the student as a result of the students' experience as he/she interacts with the environment. Meaningful learning therefore occurs when the student negotiates new meaning against the background of the prior knowledge.

The contents of the textbook however, do not seem to be related to the prior knowledge of the students. Two students interviewed indicated that the grade 9 biology textbook deals with classification of animals. They indicated that the information is new for them and has no connection to the content they have learned in their previous grades (Table 4.6). From my experience as experienced teacher, I agree with the views given by the students. For example, the grade 8 biology is totally about plants, whereas the grade 9 biology textbook deals with the taxonomy of animals. I would say there is no link between grade 8 and 9. As indicated by Anderson (1997), the grade 9 biology is like the second-year university course "General Zoology". He argues that if students could understand and remember their grade 9 biology, they would be "A" grade student in the second-year university. He further indicated that this does not happen, because the school curriculum is too detailed, too boring, and largely irrelevant to the Eritrean students. This lack of connection seems to make the information included in the textbook difficult to process and understand. Likewise, three of the four teachers interviewed indicated that the information has neither related to the content of the previous grades nor connected to subsequent grades (Table 4.5). For example, one teacher indicated that the grade 9 biology is devoted to invertebrates, and these invertebrates are not seen in any of the previous grades so the terminologies and contents explained in the textbook are completely new to the students. He suggests that the grade 9 biology textbook should have been prepared in such a way it serves as a platform for higher grades. According to the teacher, this is not the case and he indicated that the textbook lacks connection with the subsequent grades. According to him "One has to know what has to come in grade 11.

Paramecium is given in grade 11, but nothing about this protozoon is mentioned in grade 9" (Appendix 2.2). This suggests that a disparity exists between the information included in the textbook and the background knowledge of the students, and consequently, becomes an obstacle that may hamper their ability to comprehend the textbook.

As indicated in the literature, illustrations are important aspects of text structure for they motivate a reader and facilitate comprehension, provided they are closely integrated with the meaning of the text (Osborn et al, 1985). Teachers' and students' views on the adequacy and quality of diagrams, about their appearance and accuracy were found to overlap with one another. According to them, the illustrations included in the textbook do not seem to be interesting. Teachers interviewed (3/4) describe the diagrams, such as the life cycle of *Plasomdium,* diagram of earthworm, snail and starfish to be inappropriate to the level of the students and poor in quality. They thought that the diagrams are difficult, confusing, incorrectly labelled, uninteresting and unnecessary. They also indicated that many important diagrams such as *Paramecium*, life cycle of hookworm and bird (for example dove) are absent (Table 4.2, Table 4.5, and Table 4.6). The following diagram excerpted from the textbook illustrates some of its difficulties contributing to comprehension of the textbook.

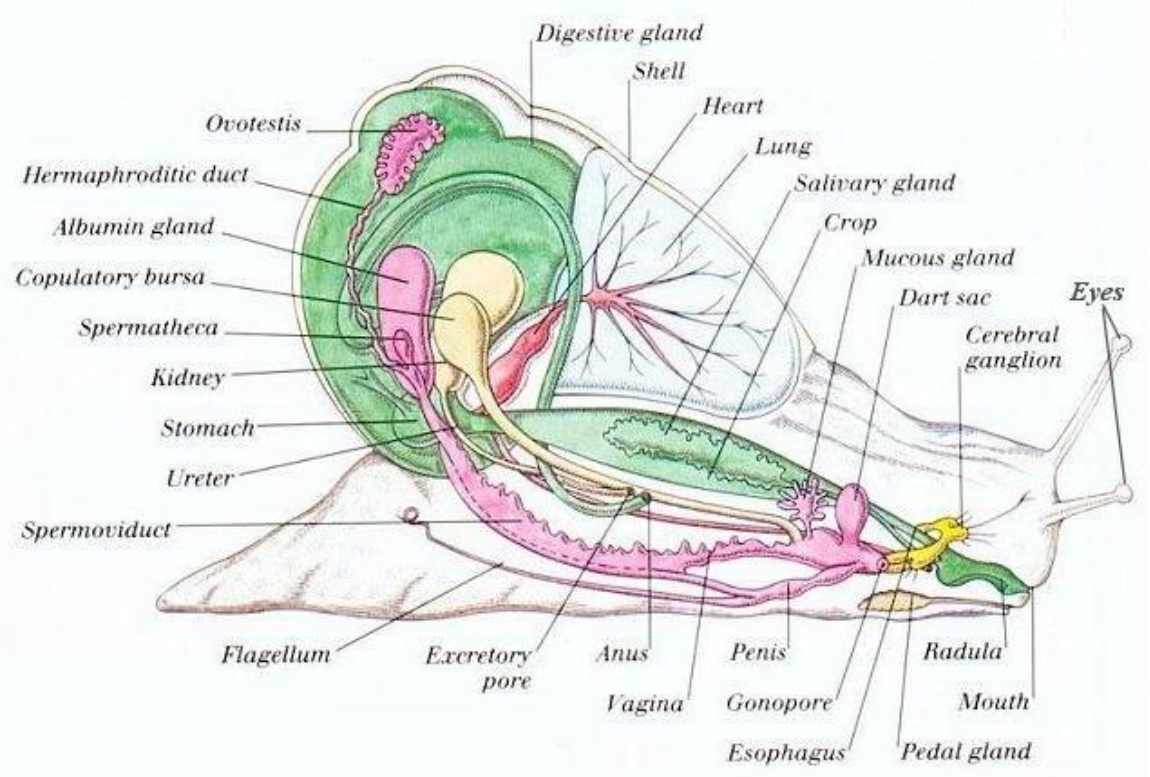


Figure 5.1 - Parts of a Snail

As it can be clearly seen from Figure 5.1, the labelling seems to be detailed. It is difficult for the students to distinguish one part from the other part. If one sees a textbook as self-instructional material for an unsupported study, surely such types of diagrams are not suitable for a student to learn from them independently (Figure 5.1). Soyibo (1996) suggests that clearly labelled diagrams are essential memory guides. If this assertion is valid then the diagrams included in the textbook are not desirable. Such illustrations that are not clearly labelled and not integrated with the text have no instructional value and could be counterproductive and produce more harms than good. This is because an illustration may contain a great deal of information, not all of which will be directly relevant to the learning task or which the students fail to interpret them due to lack of

prior knowledge (Osborn et al, 1985; Peacock, 1997). Not only illustrations must be carefully integrated into the text, but also methods of reading and interpreting pictures have to be learned by the students (Clark, 1997).

The questions included in the textbook also influence students' reading, comprehension and achievement. The more questions a textbook uses the better (Soyibo, 1996). This is because textbook questions create a purpose for reading (Ogunniyi, 1982). The questions included in the Eritrean grade nine biology textbook, however, seem to be inadequate both in terms of quantity and quality and are unable to stimulate higher order cognitive processes. This is because the questions included at the end of the textbook are very few in numbers and are far from sufficient. By combining "poor" and "very poor" categories it seems that the questions included in the textbook are insufficient (65%) (Table 4.2). Three of the four teachers interviewed indicate that the review questions are not enough and do not inquire conceptual understanding (Table 4.5). Three of the four students interviewed also indicate that the review questions are not adequate (Table 4.6).

Forbes (1970) asserts that no matter what else is expected from a textbook, it does serve as the major source of exercise for student assignments. He further contends that the presence of sufficient exercises is an extremely important consideration in the selection of a textbook. If the assertion of Soyibo (1996) and Forbes (1970) are valid, then the grade 9 biology textbook is not a desirable textbook because it contains very few questions. Even then most of the questions included in the textbook seem to inquire mainly short and easy to remember kind of information (Table 4.2, Table 4.5, Table 4.6, and Appendix 3.2). Some examples of questions extracted from the textbook are given below:

Multiple choice

The presence of mesoglea layer is characteristic of the phylum:

a) flat worms b) round worms c) arthropods d) jelly fishes

The hydra reproduces asexually by means of: -

a) buds b) ovaries c) nematocysts d) tentacles

Animals without backbones are called: -

a) chordates b) invertebrates c) vertebrates d) snakes

Completion questions

A hydra possesses a simple nervous system called a (an)_____.

The simplest animals that possess three tissue layers are classified in the phylum_____.

Spiders breathe by means of organs called _____.

True – False questions

The circulatory system of an insect is open.

Lobsters and crayfishes breathe by means of book lungs.

An insect has four pairs of legs.

Thought questions

List five ways in which the earthworm is adapted for burrowing.

What job do Hydra's epithelial cells do besides forming its skin?

Write down five ways in which an insect's body differs from yours?

Ministry of Education (1995: 121-126).

This pattern of questioning may not be unrelated to the fact-oriented type of questions that appear in the Eritrean Secondary Education Certificate Examination (ESECE). The

tendency for using predominantly factual questions has been encountered in earlier studies (Ogunniyi, 1983) a scenario which mainly reflects learning as a mere transmission of knowledge and science as a body of facts to be learned by rote (Chiappetta et al, 1991).

Ogunniyi contends that inclusion of predominantly factual questions to using higher order conceptual questions is associated with methods of instruction that encourage rote learning (Ogunniyi, 1983). Therefore, the way biology is presented to the students is likely to influence the way they perceive it. For instance, if it is presented as a body of certain knowledge, then learning biology will be a matter of acquiring such body of knowledge and the means of acquiring it would mainly be by rote learning. In Eritrean secondary schools teachers tend to impart knowledge, the textbook gives emphasis to biology as a body of knowledge to be studied by the students and the questions included in the textbook and those that appear in examinations inquire facts. Hence, students are trapped by their efficiency of memorizing facts as indicated by Stinner (1992).

5.3.3. Organisation of the textbook

The organisation of the information in the textbook is another important aspect of textbook quality because, a textbook can communicate more to learners than the factual material it contains (Forbes, 1970). Williams (1985) indicates that the “logical” ordering affects the ease or difficulty with which a book can be read. It is apparent from the data that the organisation of information in the textbook seems to be satisfactory. For instance, i) sequence of chapters is appropriate (35%), ii) material within chapter is organised for easy use (41%), and iii) appropriate placement of seasonal chapters (35 %) (Table 4.2). Some teachers (8/17) indicated that the information is placed in appropriate manner from simple to complex (Table 4.5). Similarly, two out of the four teachers interviewed also

indicated that the information in the textbook is arranged in a logical manner from simple to complex (Table 4.5). Even though the information in the textbook is well organised, there is a claim from two teachers that some chapters such as “Microorganisms” and “Arthropoda” still need rearrangement.

Furthermore, the organisation of questions in the textbook seems to be poor. The questions are placed at the very end of the textbook, a pattern that might contributes to the poor organisation of the textbook. The teachers and students interviewed preferred the inclusion of questions at the end of each chapter. One teacher recommends the inclusion of questions not only at the end of the chapter but also within the text (Appendix 2.2 & Appendix 2.4). This suggestion supports the idea that well-placed questions in content section of a textbook are prime mediators of students’ involvement in an active learning process (Forbes, 1970).

5.4. Readability of the grade 9 biology textbook

Textbook language either facilitates or impedes students’ understanding and academic achievement. Long (1991) indicated that readability is not restricted to the weaker students who have low reading capacities, but able students are also disadvantaged by complex use of language. Viewed from this perspective, language becomes an important determinant of what can be learnt meaningfully because it determines the extent to which the students may extract meaning from the textbook. The appropriateness of reading level of a textbook has therefore a major influence in enabling the students to be engaged in active dialogue with the reading material (Clark, 1993).

According to the responses obtained from the teachers' questionnaire the language used in the textbook seems to be satisfactorily matched (53%) to the reading level of the students. However, in the teachers' interview two of the four teachers indicated that language is too difficult for the students to extract meaning from the text (Table 4.5). Likewise, students indicated that the language used in the textbook is beyond their comprehending capacity. Three of the four students who responded to the interview (Table 4.6) and 51% of the students who responded to the questionnaire (Table 4.4) also indicated that they quite struggle with the English used in the textbook and find most of the English used in the textbook to be too difficult. Therefore, from this it seems that the language used in the textbook is too difficult for students to comprehend the textbook. There is similar evidence (Wegerhoff, 1981; Merzyn, 1987) to show that the language used in some science textbooks exceeds the normal experiences of many of the students for whom the textbooks are written. The reason why most students do not read their textbook is probably due to the inappropriateness of the language used in the textbook. Clearly, easier textbooks are more understandable for less able students, however they may not be the best ways to improve their reading abilities (Digisi and Willett, 1995). Recent research suggests that the process of reading hard textbooks, with assistance from the teachers, helps to improve reading comprehension of all students including poor readers (Chall and Conard, 1991). In fact, Memory and Uhlhorn (1991) argue that simplification of textbooks contributes to the decline in reading and science achievement of students during the 1970s.

Earlier in chapter 2, it has been suggested that the length of sentences have an impact on the students' capacity of understanding a text. From the responses obtained through the questionnaire, 61% of the students felt that sentences in the biology textbook were often too long to understand (Table 4.4). Unlike their students, 47% of the teachers indicated the length of the sentences in the textbook to be quite appropriate (Table 4.2).

Nevertheless, they have earlier indicated that some sections in the textbook are presented in the form of points containing discrete facts lacking logical connectives (Table 4.5 & Table 4.6). From this controversy, it seems that the difficulty the students are experiencing are not due to long sentences, but it might be due to a series of short sentences. The grade nine biology textbook is composed of a series of short sentences. For example, the following paragraph is taken from the textbook indicating that it is full of choppy sentences, which are difficult to comprehend.

> *Flukes belong to class trematoda. They are flat and are shaped somewhat like a leaf. Their length may be from 1mm to several cms. They attach to the intestinal wall by an oval or ventral sucker. They are all parasites in animals, including man. These worms may inhabit the intestine, the blood, the liver and the lungs.*
>
> Ministry of Education (1995: 36).

Such series of short sentences are not readable and are boring or monotonous to a read because they disrupt flow of reading. These sentences lack connectives such as “and”, “moreover”, “furthermore” etc., and the only connectives included are referential connectives such as “they”, their, and “these”. The sentences are more or less like a list of facts than explanations. Shortening sentences might make a message harder rather than easier to understand because, the reader must infer the missing connectives. As put by Wellington (1994), even though long sentences are less readable than short sentences, it is quite possible to present complicated ideas with very short sentences. In other words, a series of short sentences are monotonous to a reader and changing long sentences to short sentences does not guarantee for a text to be more readable. Therefore, Armbruster

(1985) recommends a textbook to contain sentences of variable length and of variable complexity. I cannot see any harm either if the students are subjected to reading of easy sections of a textbook and then immediately made to work harder to understand a more difficult section. It is also to the advantage of the students to do so.

In several ways problems are compounded to second language readers of biology textbooks. They are not only faced with point format of presentation which may bear heavy load or series of choppy sentences lacking logical connectives, but they are also faced with new or unfamiliar words. Most of the teachers (59%) indicated that the vocabulary is to some extent adjusted to the students (Table 4.2). However, all the students and two of the teachers interviewed felt that the prescribed grade 9 biology textbook contains a lot of non-technical and technical words that are not defined in the textbook (Table 4.6 and Table 4.5). Such difficult words seem to be contributing to the difficulty of language used in the textbook. Ogunniyi (1982) and Soyibo (1996) suggested that the undefined or late defined terms impede readers from reading the text further. As was noticed in the open-ended questions of the questionnaire, majority of the students felt that the language used in the textbook is too difficult for them (Appendix 3.4). Clearly, they are struggling with the difficult words used in the textbook and expressed their concerns as follows:

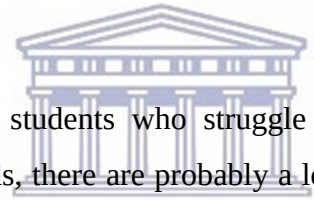
**The textbook is very difficult because so many hard words present in it. So, The words are very hard. Some time they cannot get the meaning in dictionary. I heat my textbook only by the hard of words.*

**Which I do not like about the textbook is the difficult words are not explained in simple words which we can understand them easy.*

**I do not like this book because some words are so difficult to understand (Appendix 3.4).*

Unlike the above comments one student is determined to overcome the language difficulty by putting effort into reading. According to him:

The language used in the textbook is difficult. The language difficulty is caused due to enormous amount of difficult words. However, putting effort into reading can minimise the language difficulty created by difficult words. We should not expect everything from our teachers. Teachers cannot explain everything. Even if the vocabulary is difficult we must read the textbook again and again to understand what it is trying to say. I can say devotion is needed from the side of the students.



Although there are exceptional students who struggle to overcome the difficulty of language posed by difficult words, there are probably a lot of students who are bored by the bombardment of the difficult words.

A definite strategy to address this problem as suggested by one student is to include glossary either at each page or if not possible at the end of each chapter (Appendix, 3.4). Harris and Sipay (1979) and Clark (1993) indicated that comprehension is more than knowing meaning of words and merely presenting a list of new unfamiliar words in a textbook does not guarantee improved reading comprehension of the text. The issue here is not only listing the meanings of the unfamiliar words, but restating the meaning of the words within the context of the original phrase or sentence where they first appeared might prove to be helpful in assisting the students to comprehend the textbook.

Students were asked to indicate how they coped with unfamiliar words in the textbook. They (4/4) explained that mostly they try to understand the meaning of the unfamiliar words from the context or from the sentence as a whole. If they do not understand, then they either look for the meaning of the unfamiliar word in a dictionary (3/4) or ask a teacher to explain it (2/4) (Table 4.6). However, from my experience as an experienced teacher, in a learning environment dominated by transmission modes of teaching, students rarely have the opportunity in class to stop the flow of teacher talk in order to ask for the meaning of an unfamiliar word. In addition, it is unrealistic to expect that the teachers would actively encourage students to ask for the meaning of an unfamiliar word or phrase. In fact, most students do not ask questions in front of their classmates. They get embarrassed to ask questions with the poor command of language they have.

Moreover, effective use of a dictionary when reading a text requires skills. It is difficult to assume that most of the students have such skills. Words may have different meanings in different contexts and it is difficult to assume that the students will always chose the correct meaning from those offered in the dictionary.

Furthermore, teachers and students made subjective judgements on the perceived difficulty of the textbook. There were a range of opinions some of the teachers (Table 4.5) and students (Table 4.6) judging the textbook to be very difficult. Such range of opinions is to be expected since within a group, individuals differ in their perceptions. Cloze test was used in attempt to provide a more objective assessment of the readability of the textbook. The multiple-choice Cloze procedure helps in determining students' ability to comprehend extracts from three parts of the textbook. Perhaps apart from slight variations the results for the three passages appear to show very close similarity (Table 4.7).

According to Bormuth (1968, 1969 cited in Harrison, 1980), a score of 44% and below on the standard Cloze procedure corresponds to 75% comprehension on multiple-choice test and falls under "frustration" category. The Cloze test result reveals that 94% of the students scored below 75%, which indicates that students are reading their textbook at "frustration level" (i.e. the student cannot make satisfactory progress even with the teachers' help). Only 6% of the students are reading their textbook at "instructional level" (i.e. students can understand the textbook with the help of their teacher). The overall average scores for the three passages is 49.51%, which indicates that the students are struggling to understand the textbook and are not making sense of much of what they read (Table 4.7). Weir (1988) suggests that native speakers show high competence in Cloze test than second language readers. If this assertion is valid then it is not surprising that the students scored low results in the Cloze test, because English the language of instruction is never practised outside the classroom and hence students have trouble in comprehending what they read. As indicated earlier, most of the students (69%) do not have the prescribed textbook (Table 4.3). This might be another factor contributing to the low performance of the students in the Cloze test.

The Word Difficulty Index was also administered to the students in the desire to supplement the judgements of the teachers and students obtained through questionnaire and interview. Table 4.8 reveals words that the students did not understand in the passage on the feeding in sponges. Their performance reveals that they have difficulties in understanding both technical and non-technical words. For instance, the students do not understand words such as "jelly-like" (58%), "hollow body"(53%), "spicules"(48%), "collar cells" (45%), "pores' (34%), "current" (30%), "wandering cells" (26%), "amoebocytes" (26%), while 2% of the students do not understand the words like "within", "thin", "contain", and "food". Certainly, understanding the passage would require understanding of these words (Langhan, 1993; Ogunniyi, 1999). If students do not

understand such large number of words from a passage, then it is not surprising if they fail to understand the passage and unable to write one sentence in their own words which they think describes the passage best. Only 9% of the students understood the passage and were able to construct a sentence that captures what is expected. The vast majority of the students (91%) whatever their grammatical errors, did not make any sense out of the passage (Table 4.9). This is also another evidence to support the findings of the questionnaire, interview, and Cloze test results about the language difficulty of the textbook.

5.5. Relevance to the daily life experiences of the students

This is an important aspect affecting readability of a text. Knamiller (1984: 63) indicates as what counts as relevant is the knowledge and skills leading a student to increased productivity in manual occupation, improvements in health, and the ability to participate in local activities. In the literature it has also been described that the familiarity and application of content to the students has been found to affect comprehension capacity of the students. Fifty-three (53%) of the teachers' responses indicated that the application of concepts satisfactorily related to everyday life experiences of the students (Table 4.2). Moreover, the students' responses to the questionnaire also indicated that 38% of them regarded the concept of the textbook to be related to their daily life experiences (Table 4.4). However, to a similar question in the interview all the teachers suggested that only some parts of the textbook especially those parts dealing with diseases are related to the life experience of the students (Table 4.5).

Furthermore, three of the four students interviewed stated that some concepts such as malaria are related to their daily life experiences, whereas many of the topics are not

directly relevant to them. One student during the interview indicated his concerns as follows: “These sponges and coelenterates may be around me, but I do not know” admitting that he could not see and apply what he has learnt. He further indicated that biology does not give him sense, but he is only studying it to get good marks in examinations (Appendix 2.4), or simply he is applying the so called Fatimas’ rule – a kind of school game employed by students to attain high grades in the examinations without understanding the course content (Aikenhead, 1997)

Some of the teachers stated that some of the animals given in the textbook are not present in Eritrea and they suggested for the inclusion of some local examples that may increase the flavour of the textbook for the students and for the teachers who use it (Appendix 3.2). Ogunniyi’s (1986) comment that the type of science taught in African schools provide at best, ready-made knowledge isolated from the relevant context of the students seems to be applicable here. The issue of relevance is complex matter. What counts as “relevant” in one context may not be relevant in another context. However, it seems that there is a desperate need of presenting biology in a real-life situation.

One teacher showed a different view and suggested that not all topics need to be related to the real-life experiences of the students. He further argues that students must learn even those concepts that are not related to their real-life situations for the evolutionary significance and for the sake of enriching their knowledge (Table 4.5). This indicates that teachers have different views regarding the relevance of contents included in the textbook. That is, some teachers who are content oriented want to impart knowledge, while others prefer the textbook to have skill-based activities. From this study it is evident that most grade 9 biology teachers need the textbook to have relevance to the context of the students.

5.6. Conclusion

This chapter dealt with the discussion of data by the development of themes. The research questions were used as themes to triangulate and interrogate the collected data. The themes handled the role, quality, readability, and relevance of the textbook based on the teachers' and students' perceptions. The next chapter will focus on conclusion of the study and gives some recommendations that emanate from the study and which are assumed to be useful for the improvement of the textbook.

CHAPTER SIX
CONCLUSION AND RECOMMENDATIONS

6.1. Introduction

In the previous chapter data generated during the study was analysed. During the assessment, teachers' and students' views on the role, quality, readability, and relevance of the textbook was analysed. Even though teachers and students showed some differing views on the textbook, they have common opinions on the merits and demerits of the textbook. From the results some conclusions were drawn.

6.2. Conclusion

The conclusions that can be drawn from this study include among others the following:

- The textbook is the main source of information for teaching and learning process in Eritrean secondary schools for both teachers and students. For the teachers, it serves as an important reference tool that dictates all the instructional activities, and for the students the only written material available is the textbook.

- The physical condition of the textbook was found to be appropriate and suitable to initiate the process of reading in the students, except the binding, which was found to be poor.

- Regarding the content, the textbook seems to be uninspiring and too theoretical and seems to give too much emphasis on the transmission of knowledge and places less emphasis on the development of process skills. The quantity of the content is not appropriate for the students. Some parts are given briefly without adequately explaining the concepts; while in others for example in the section dealing with "Micro-organisms" the information is much detailed.

- Very limited attempts were made to link the content to the daily life experiences of the students. No attempts were made to provide local examples in any part of the textbook. Hence, the students lack interest on the subject.

- Regarding the text organisation, most of the chapters are organised for easy use, from simple to complex even though some chapters such as "Microoganisms" and "Arthoropda" still need rearrangement.

- Diagrams play an important role in assisting students to understand concepts. The diagrams were found to be poor. Some diagrams are not clear. Unnecessary and detailed labelling was common in the diagrams. A mismatch between the labelled parts on some of the diagram and the explanation given about the diagram in the text was also another factor contributing to the poor quality of the diagrams. Poor diagrams were considered to create a hindrance to student learning.

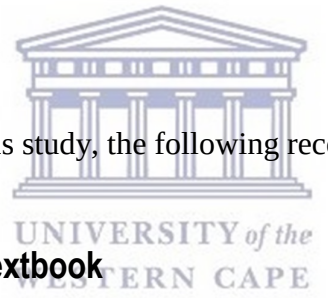
- Questions by which students could evaluate their understanding were poor both in quantity and quality. The questions included in the textbook were found to be insufficient. The few questions are not challenging and do not inquire conceptual understanding but are of the recall type.

- No practical activity, summary, glossary, index, and references are included in the textbook.

- Concerning readability of the textbook, the students are reading their textbook at "frustration" level. The difficulty of the language used in the textbook was found to be due to the difficulty of both technical and non-technical words.

What is needed is, preparing a textbook that is appropriate for most students who are using it, and which both challenges and aids the students in their learning process. Hence, some recommendations are forwarded towards producing a quality textbook that enhances learning.

6.3. Recommendations



On the basis of the findings of this study, the following recommendations are proposed:

6.3.1. Improving the textbook

Textbooks are the primary means by which students are presented with knowledge and reading of certain information helps students learn that information (Memory and Uhlhorn, 1991). Therefore, there is no doubt that the quality of the prescribed grade 9 biology textbook needs improvement with regard to readability, content, organisation, physical appearance, laboratory activities and end of chapter features such as review questions, summary, glossary, index and references. The textbook can be more effective if:

- Laboratory activities are included in the newly revised version of the grade 9 biology textbook so that the students can experience biology as process skill (Yager and Penick, 1987). One reason is that research shows greater achievement where laboratory activities done by students are an integral part of class routine than where such activities are omitted or are performed primarily as demonstrations (Shymansky, Kyle & Alport, 1983).

- More questions at the end of each chapter that encourages students to be creative thinkers rather than being mere reproducers of facts.

- End of chapter features such as glossary, summary, index, and references for further reading are included in the textbook. Including such useful information is helpful in assisting students to learn from a textbook.

- Attempts are be made to integrate Eritrean foods, diseases, and animals into the course.

- Labelling of diagrams is reduced and if the diagrams are closely integrated with the text.

- The content of the part dealing with “Microorganisms” is reduced and if the section is brought to the first part of the textbook, because the microorganisms are simpler than the phylum protozoa (the first chapter).

- The content gives emphasis to process skills.

6.3.2. Recommendation for the writers

As indicated in chapter one, the Eritrean grade 9 biology textbook was prepared by non-experts on the trial and error basis. To improve the quality of the textbook, writers of the newly revised version of the grade 9 biology textbook should consult the experts on the subject.

To enhance implementation, textbook writers should allow participation of some experienced teachers in the development of textual material. For instance, the skills gained in the process could be passed on to other teachers, thus enlarging capacity development of teachers in this specific area. Also, the experience gained could reinforce and enhance the sense of ownership among the teachers, thus providing a greater opportunity for them to use the text in a creative and meaningful way. This recommendation is based on the work of Gray (1999) and according to him the involvement of teachers in material development can significantly change their professional lives in several ways. First, teachers participating in the development of textual material are more familiar with the innovation and become confident in implementing and sustaining it. Second, it promotes the teachers to develop critical skills with respect to curriculum development (including writing skills). Third, it helps them to develop greater confidence in subject and pedagogical knowledge. Forth, exposes them to different teaching resource. Finally, it enables them to develop greater professional confidence and boosts their moral.

It is also important to use the draft version on a trial basis in order to check the feasibility of the textbook before publication. This is because publishing a textbook needs a lot of

money and but trailing the textbook before publication proves useful in saving unnecessary investment.

6.3.3. Improving the reader

Readability is a critical factor for making a text accessible to readers but as pointed out by Sutton (1980: 47), "the development of effective reading abilities is not just a matter of getting the right text". As mentioned in chapter two, simplifying a text by replacing short sentences for long sentences and simple for complex words does not necessarily lead to better comprehension; in fact, it could lead oversimplification and lowering of standards (Chall, 1988). Therefore, in order to bridge the gap between the students' language experience and the language of the textbook, every science teacher should teach their students how to read science (Shymansky et al, 1991). Reading a textual material is an interactive process, which include both the readers' role as well as that of the text (Lyman and Collins, 1990). Many of the students involved in the study seemed to have encountered great difficulty in comprehending the textual material. The comprehension difficulties, which the students experience, may be related to the poor reading skills of the students. Thus, students need to be taught and guided on how to read and make sense of what they read.

6.4. Concluding remarks

This study has raised a number of issues of relevance to textbook production. It provides useful information for policy makers, curriculum developers, publishers, teachers and all concerned with the quality of textual materials. The research has illuminated some issues associated with the quality of textbooks and that it will serve as a platform for future

research studies and has indicated some areas that need further research. Areas that warrant further research include amongst others the following:

As indicated in the literature, the various studies conducted to determine whether illustrations helped comprehension or hindered remains to be inconclusive. The merits and demerits of pictorial representation and the whole question of the interpretation of the illustrations by the students need to be investigated.

Research on the effect of the different types of questions included in a textbook on readability seems to be another area of research.

Although readability is affected by text factor, it is well known that the reader factor is also important. Making a textbook accessible to a reader is not just providing a reader with the right text, but it is also important to equip the reader with necessary skill required for reading. An investigation is needed in instructing students on how they could get such skills in order to be critical readers.

The influence of including glossary on the readability of a textbook is also another possible area that needs to be researched.

BIBLIOGRAPHY

Aikenhead, G. S. (1997). Toward a First Nations cross-cultural science and technology curriculum. *Science Education*, *81*(2), 217-238.

Anderson, D. (1997). Evaluation of higher secondary school textbooks. Unpublished paper. Asmara: University of Asmara.

Armbruster, B. B. (1985). Readability Formulas May Be Dangerous to Your Textbooks. *Educational Leadership*, *42*(7), 18-20.

Ashby-Davis, C. (1985). Cloze and comprehension: A qualitative analysis and critique. *Journal of Reading*, *28*(7), 585-589.

Ausubel, D. P. (1963). *The psychology of meaningful verbal learning*. New York: Grune and Stratton, Inc.

Chall, J. S. (1988). The beginning years. In Zakaluk, B. L. and Samuels, S. J. (Eds.). *Readability: Its Past, Present and Future*. Newark: International Reading Association: 2-13.

Chall, J. S., Conard, S. S., & Harris-Sharples, S. (1991). *Should textbooks challenge students? The case for easier or harder textbooks*. Teachers College Press.

Chapman, L. J. (1983). *Reading development and cohesion*. Heinemann Educational Books Inc., 70 Court St., Portsmouth, NH 03801.

Chiappetta, E. L., Sethna, G. H., & Fillman, D. A. (1993). Do middle school life science textbooks provide a balance of scientific literacy themes?. *Journal of Research in Science Teaching*, *30*(7), 787-797.

Chiappetta, E. L., Sethna, G. H., & Fillman, D. A. (1991). A quantitative analysis of high school chemistry textbooks for scientific literacy themes and expository learning aids. *Journal of Research in Science Teaching*, *28*(10), 939-951.

Clark, J. (1993). An Ethnographic investigation into the development and trialing of more

accessible text materials for second language teaching and learning in Physical Science. Unpublished M.Ed. Thesis. Cape Town: University of Cape Town.

Clark, J. (1997). Beyond the turgid soil scientific prose- STAP's attempt to write more accessible text materials in general science. Proceeding of the fifth Annual Meeting of the Southern African Association for Research in Mathematics and Science Education. Unpublished paper. Johannesburg, University of Witwatersrand: 390-396.

Cohen, L., Manion, L., and Morrison, K. (1989). Research methods in education. London: Routledge.

Curriculum Development Division. (1997). General orientation on the Eritrean curriculum. Unpublished document. Asmara. Department of General Education.

Weir, C. J. (1988). *Communicative Language Testing with Special Reference to English as a Foreign Language*. University of Exeter.

Dechsri, P., Jones, L. L., & Heikkinen, H. W. (1997). Effect of a laboratory manual design incorporating visual information-processing aids on student learning and attitudes. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *34*(9), 891-904.

Digisi, L. L., & Willett, J. B. (1995). What high school biology teachers say about their textbook use: A descriptive study. *Journal of Research in Science Teaching*, *32*(2), 123-142.

Doidge, M. (1990). An investigation into how standard eight biology textbooks are used in Soweto schools and the readability of these textbooks for teacher and student use. Unpublished M. Ed. Minithesis, University of Witwatersrand. Johannesburg.

Doidge, M. (1997). How readable is your biology textbook? Can you be sure? Proceedings of the fifth annual meeting of the Southern African association for research in mathematics and science education, Johannesburg: University of Witwatersrand:

396-401.

Education brief. (1999). Ministry of Education. Asmara. Eritrea.

Fensham, P. J., Gunstone, R. F., & White, R. T. (1994). Science content: a constructivist view of learning and teaching. In Fensham, P. J., Gunstone, R. F., & White, R. T. (Eds.). (1994). *The content of science: A constructivist approach to its teaching and learning*. Psychology Press.

Flesch, R. (1948). A new readability yardstick. *Journal of applied psychology*, *32*(3), 221.

Forbes, J. E. (1970). Textbooks and Supplementary Materials. *National Council of Teachers of Mathematics Yearbook (33rd)*, *89*(109), 70.

Fry, E. B. (1968). A readability formula that saves time. *Journal of reading*, *11*(7), 513-578.

Fry, E. B. (1988). Writability: the principle of writing for increased comprehension. In Zakaluk, B.L. and Samuels, S.J. (Eds.). *Readability: Its Past, Present and Future.* Newark: International Reading Association: 77-95.

Graham, W. (1978). Readability and science textbooks. *School Science and Mathematics*, *22*, 31-37.

Graves, K. (2000). *Designing Language Course, A Guide for Teachers.* Boston. Heinle. Cengage Learning.

Gray, B. V. (1999). Guest Editorial: Science education in the developing world: Issues and considerations. *Journal of research in science teaching*, *36*(3), 261-268.

Gay, R. J. (1981). *Educational research: competencies for analysis and application*. Columbus, Toronto: Charies E, Mariel Publishing Company.

Hams, N. C. & Yager, R. E. (1980). What research says to the science teacher (Vol.3, No.471-114776). Washington, DC: National Science Teachers Association

Harris, A. J. & Sipay, E. R. (1979). *How to teach reading*. New York: Longman.

Harrison, C. J. O. (1980). *Readability in the classroom*. Cambridge University Press.

Hilgard, E. R., & Bower, G. H. (1975). Theory of learning. Englewood Chiffs: New Jersey Prentice Hall Inc.

Holliday, W. G., & Braun, C. (1979). Readability of Science Materials. *Viewpoints in Teaching and Learning*, *55*(1), 55-66.

Johnson, P. (1981). Effects on reading comprehension of language complexity and cultural background of a text. *TESOL quarterly*, *15*(2), 169-181.

Johnson, R. K. (1979). Readability. *School Science Review*, *60*(212), 562-68.

Klare, G. R. 1988. The formative years. In Zakaluk, B. L., & Samuels, S. J. (1988). *Readability: Its Past, Present, and Future*. International Reading Association, 14-34.

Klare, G. R., Sinaiko, H. W., & Stolurow, L. M. (1972). The Cloze procedure: A convenient readability test for training materials and translations. *International Review of Applied Psychology*, *21*(2), 77-105.

Knamiller, G. W. (1984). The struggle for relevance in science education in developing countries. *Studies in Science Education,* 11: 60-78.

Kulkarni, V. G. (1988). Role of language in science education. In Fensham, P. J. (Ed.). (1988). *Development and dilemmas in science education* (Vol. 23). Psychology Press: 150-168.

Lange, B. (1982). ERIC/RCS: Readability Formulas: Second Looks, Second Thoughts. *Reading Teacher*, *35*(7), 858-61.

Langhan, D. P. (1993). *The textbook as a source of difficulty in teaching and learning: A final report of the Threshold Project*. Human Sciences Research Council.

Lyman, B. G., & Collins, M. D. (1990). Critical reading: A redefinition. *Literacy Research and Instruction*, *29*(3), 56-63.

Long, R.R. 1991. Readability for science: Some factors which may affect the students' understanding of worksheet. *The School Science Review,* 73(262): 21-33.

Memory, D. M., & Uhlhorn, K. W. (1991). Multiple textbooks at different readability levels in the science classroom. *School Science and Mathematics, 91*(2), 64-72.

Merzyn, G. (1987). The language of school science. *International Journal of Science*

Education, 9(4), 483-489.

Meyer, B. J. (1984). Text dimensions and cognitive processing. *Learning and comprehension of text*, 3-51.

Millar, R. (1989). Bending the evidence: The relationship between theory and experiment in science education. In Millar, R. (Ed.). *Doing science: Images of science in science education*, London: The Falmer Press: 38-61.

Ministry of Education. (1995). *Biology for grade nine.* Asmara. Biology Panel.

Ministry of Education. (1998). Report on Education. Asmara. Ministry of Education.

Nachmias, C., & Nachmias, D. (1982). Research Methods in the Social Sciences: Alternative Second Edition without Statistics. *London: Edward Arnold (Publishers) Ltd*.

Ogunniyi, M. B. (1982). A comparison of communicational strategies among four widely used biology textbooks in Nigeria. *Journal of STAN*, 21(1): 111-121.

Ogunniyi, M. B. (1983). An analysis of laboratory activities in selected Nigerian secondary schools. *European Journal of Science Education, 5*(2), 195-201.

Ogunniyi, M. B. (1984). *Educational measurement and evaluation*. Longman Nigeria.

Ogunniyi, M. B. (1986). Two decades of science education in Africa. *Science Education, 70*(2), 111-122.

Ogunniyi, M. B. (1992). Understanding research in the social sciences. *Ibadan: University Press PLC, 132*.

Ogunniyi, M. B. (1996). Science, technology and mathematics: The problem of developing critical human capital in Africa. *International Journal of Science Education, 18*(3), 267-284.

Ogunniyi, M. B. (1999). Words used in science and technology. In Ogunniyi (Ed.). *Assessment of grade 7-9 pupil's knowledge and interest in science and technology*. School of Science and Mathematics Education. University of the Western Cape, Cape Town: 122-131.

Osborn, J.H., B.F. Jones, & M. Stein. (1985). The case for improving textbooks. *Educational Leadership*, 42(7): 9-16.

Parkinson, J. (1994). *The effective teaching of secondary science*. London: Longman.

Peacock, A. (1997). The role of text material in representing science knowledge to second language learners in primary schools. In *Proceedings of the Annual Meeting of the Southern African Association for Research in Mathematics and Science Education, (SAARMSE) Johannesburg* (pp. 428-436).

Rush, R. T. (1985). Assessing readability: Formulas and alternatives. *The Reading Teacher*, *39*(3), 274-283.

Rye, J. (1982). *Cloze procedure and the teaching of reading*. London: Heinemann.

Schnotz, W. (1984). Comparative instructional text organization. *Learning and comprehension of text*, 53-81.

Shymansky, J. A., Kyle Jr, W. C., & Alport, J. M. (1983). The effects of new science curricula on student performance. *Journal of research in Science Teaching*, *20*(5), 387-404.

Shymansky, J. A., Yore, L. D., & Good, R. (1991). Elementary school teachers' beliefs about and perceptions of elementary school science, science reading, science textbooks, and supportive instructional factors. *Journal of Research in Science Teaching*, *28*(5), 437-454.

Silberstein, S. (1987). Let's take another look at reading: Twenty-five years of reading instruction. In *English Teaching Forum*, 25(4), 28-35.

Simpson, R. D., & Anderson, N. D. (1981). *Science, students, and schools: A guide for the middle and secondary school teacher*. New York: John Wiley & Sons.

Stinner, A. (1992). Science textbooks and science teaching: from logic to evidence. *Science education*, *76*(1), 1-16.

Sutton, C. (1980). Science, language and meaning. *The School Science Review*, *62*, 47-

56.

Sutton, C. (1989). Writing and reading in science: The hidden messages. In Millar, R. (Ed.). *Doing Science: Images of Science in Science Education.* London: The Falmer Press: 137-159.

Soyibo, K. (1996). A comparison of communication strategies among three Caribbean high-school biology textbooks. *Journal of Biological Education*, *30*(3), 190-194.

Taylor, W. L. (1953). "Cloze procedure": A new tool for measuring readability. *Journalism Bulletin*, *30*(4), 415-433.

Tekfi, C. (1987). Readability formulas: An overview. *Journal of documentation*, *43*(3), 261-273.

Tinker M. A. (1963) Legibility of print. Iowa State University Press, Ames, Iowa. 1963. P.329.

Turk, C., & Kirkman, J. (1982). Effective Writing-Improving Scientific. *Technical and Business Communication*.

Wagiet, R. (1991). A critical analysis of aspects pertaining to the teaching of the ecology section of the standard eight biology syllabus. Unpublished M.Ed. Mini-thesis. Cape Town: University of Western Cape.

Wandersee, J. (1985). Are there too many terms to learn in biology? *The American Biology Teacher*, *47*(6), 346-347.

Wegerhoff, J. B. (1981). A readability evaluation of junior secondary physical science textbooks used in selected Cape Education Department schools. Unpublished M.Ed. Thesis. Cape Town: University of Cape Town.

Wellington, J. (1994). Language in science education. In Wellington, J. (Ed.). *Secondary Science*. London: Routledge: 168-188.

Widdowson, H. G. (1978). *Teaching language as communication*. Oxford University Press.

Williams, R. (1985). Readable Writing. A manual for authors and editors of educational

textbooks. Hong Kong: Longman.

Wood, T. L., & Wood, W. L. (1988). Assessing potential difficulties in comprehending fourth grade science textbooks. *Science education*, *72*(5), 561-574.

Wolpert, E. M. (1991). *Understanding research in education: An introductory guide to critical reading*. Kendall Hunt Publishing Company.

Wright, J. D. (1982). The effect of reduced readability text materials on comprehension and biology achievement. *Science education*, *66*(1), 3-13.

Wright, J. D., & Spiegel, D. L. (1984). How Important Is Textbook Readability to Biology Teachers? *The American Biology Teacher*, 221-225.

Yager, R. E. (1983). The importance of terminology in teaching k-12 science. *Journal of Research in Science Teaching*, 20(6), 577 - 588.

Yager, R. E., & Penick, J. E. (1987). Resolving the crisis in science education: Understanding before resolution. *Science Education*, *71*(1), 49-55.

Yore, L. D. (1991). Secondary science teachers' attitudes toward and beliefs about science reading and science textbooks. *Journal of Research in Science Teaching*, *28*, 55-72.

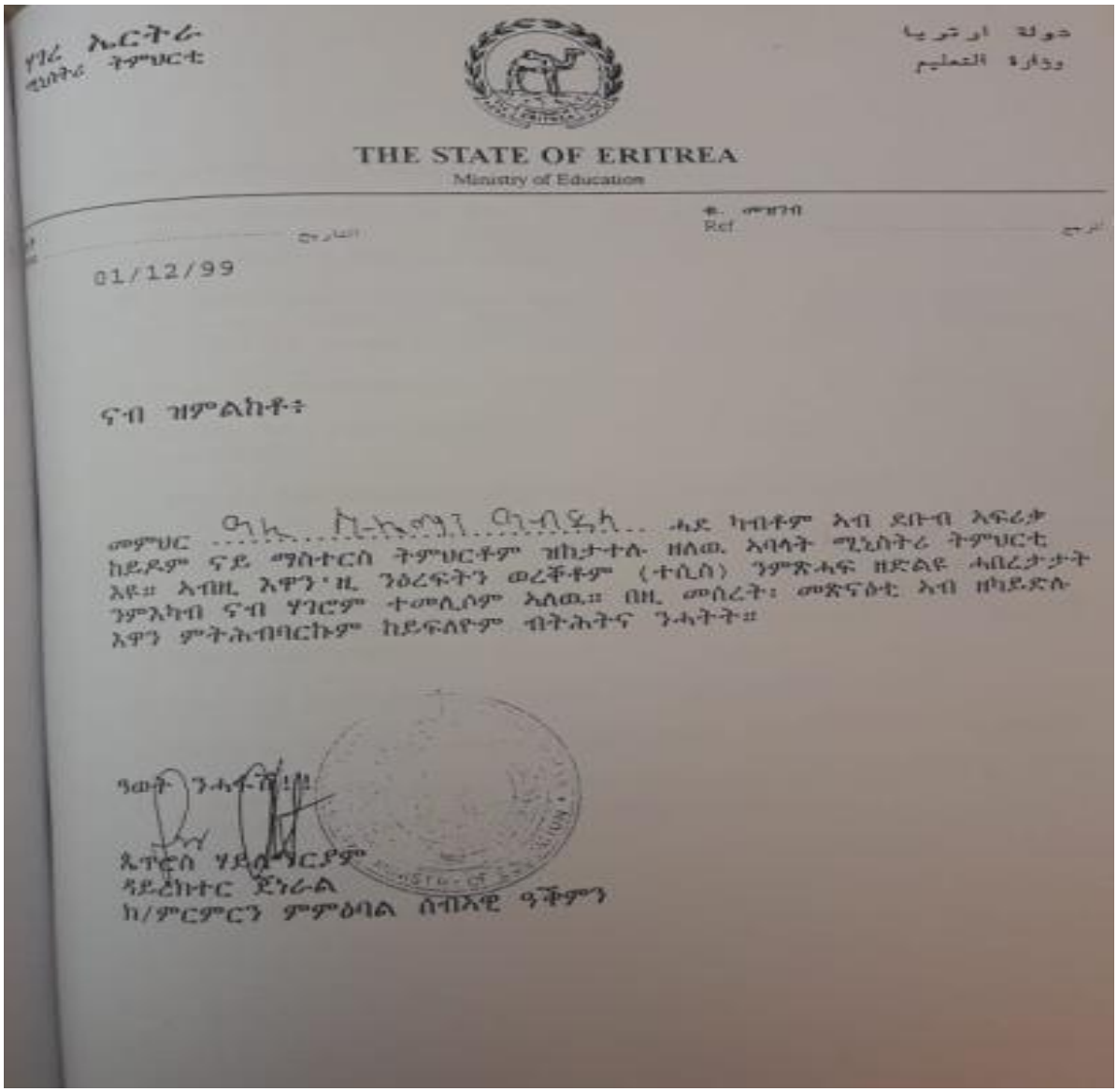
Young, D. & Nuttall, C. (1989). Towards a text analysis model. In Van Der Walt, J.L. (Ed.). *South African studies in applied linguistics*. SAALA, Potchefstroom.

Vachon, M. K., & Haney, R. E. (1991). A procedure for determining the level of abstraction of science reading material. *Journal of Research in Science Teaching*, *28*(4), 343-352.

Zakaluk, B. L., & Samuels, S. J. (1988). Toward a new approach to predicting text comprehensibility. In Zakaluk, B. L. & Samuels, S.J. (Eds.). *Readability: Its Past, Present and Future*. Newark: International Reading Association: 121-144.

APPENDICES

APPENDIX 1.1



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دولة ارتريا
وزارة التعليم

THE STATE OF ERITREA
Ministry of Education

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Ref

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01/12/99

ናብ ዝምልከቶ፡

መምህር ..... ሓደ ካብቶም አብ ደቡብ አፍሪቃ ከይዶም ናይ ማስተርስ ትምህርቶም ዝከታተሉ ዘለዉ አባላት ሚኒስትሪ ትምህርቲ እዩ። አብዚ እዋን'ዚ ንዕረፍትን ወረቐቶም (ተሲስ) ንምጽሓፍ ዘድልዮ ሓበረታታት ንምእካብ ናብ ሃገርም ተመሊሶም ኣለዉ። በዚ መሰረት፡ መጽናዕቲ አብ ዘካይድሉ እዋን ምትሕብባርኩም ከይፍለዮም ብትሕትና ንሓትት።

ዓወት ንሓፕሮ!!!

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University of the Western Cape
Private Bag X17 Bellville 7535 South Africa Telegraph: UNIBELL
Telephone: (021) 959-2911 Telex 52666

10 November 1999

TO WHOM IT MAY CONCERN

Mr Ali Suleman is a registered full-time Master's student in the Faculty of Education at the University of the Western Cape. He has successfully completed the coursework part of the degree and is now starting to do the data gathering for the research based mini-thesis.

Can you please assist Mr Ali Suleman in whatever way is appropriate. We would very much appreciate it if school principals could allow Mr Ali Suleman access to staff and learners for interviews, and to the school and classrooms for observation where needed. Furthermore, the research will have a strong Eritrean relevance and we therefore ask you to make documentation and resources available if you can.

We are excited about the research Mr Ali Suleman is proposing to conduct and are confident that it will make a meaningful contribution to debates about education in Eritrea.

Yours sincerely

.....

Dr. Nelleke Bak

APPENDIX 2.1 - Semi-structured teacher interview

1. What material do you use to prepare your lesson in biology? Does it include the prescribed textbook? How much do you depend on the textbook?
2. I need your opinions about the quality of the grade 9 biology textbook, what are its good points and weak points in terms of its physical appearance?
3. What is your opinion about the content of the textbook?
4. What is your opinion of the language used in the textbook?
5. How is the content organised in the textbook?
6. How do you evaluate the quality of the diagrams used in the textbook?
7. What is your opinion about the laboratory activities? Does the textbook assist you to conduct or carry on practical work?
8. What is your opinion about the review questions?
9. Can you mention some of the strong sides of the textbook?
10. Are the contents of the textbook related to the daily life situations of the students? Explain.

APPENDIX 2.2 - TEACHERS' TRANSLATED TRANSCRIBES

Teacher Interview 1

Q1. What material do you use to prepare your lesson in biology? Does it include the prescribed textbook and how much do you depend on the textbook?

Interviewee: I totally depend on the textbook, because I prepare the year plan and lesson plan on the basis of the textbook. One grade means many teachers teaching the same level. I may tell one thing, another teacher may tell another thing. This may create a problem. Therefore, we must depend on the prescribed textbook. Textbook is very important. Maybe we can add some of the new things which is not there in the textbook, but as to for the grade level or matriculation exam it is important. Matriculation questions are extracted from the textbook. Therefore, we must use the prescribed textbook.

If there are some mistakes in the textbook we can correct with the help of other books. If language is difficult we can simplify it. That is what I feel.

Q2. I need your opinion about the quality of the grade 9 biology textbook? What are its good points and weak points in terms of its physical appearance?

Interviewee: binding of the book is poor, because papers come out easily.

Quality of papers is good.

The print size is good and enough.

Margin is enough. Space between one line and another line is enough.

The external appearance of the book is attractive. The diagram that is given in the first page is not appropriate. It is one bird, which is called ostrich. Nothing about this bird is given in the textbook.

Size of the book is enough, because we are only taking three periods per week. We have to write the content on the chalkboard. Size of the book is enough.

Q3. What is your opinion about the content of the textbook?

Interviewee: - content is enough for grade nine, but rearrangement of chapters is required. In all phyla the general characteristics are given in points. That is the weak

point of this textbook I can say. The general characteristics given in the form of points are absent only in phylum chordata. They mainly encourage memorisation.

Q4. What is your opinion about the language used in the textbook?

Interviewee: - most of the students do not have the prescribed biology textbook. The difficulty of the language depends on the teacher, i.e. how he writes on the chalkboard. So, we can imagine how difficult the language would be. For the teachers the language is ok. We cannot write the entire text on the board, only the extract we can write. We try to simplify this. Language as for the teacher is concerned is simple.

The language used in the textbook needs simplification. Some of the topics are not properly explained. They are brief and difficult for the students.

Q5. How is the content organised in the textbook?

Interviewee: - content arrangement is not good. The chapter rearrangement is required. The sentences and concepts used in the textbook are short and brief. For example, sentences such as "circulatory system is open", Or "circulatory system is closed". Such sentences are brief and not clear. What is "open" and what is "closed" is not given. The students know only about circulatory system. It includes blood, blood vessels, and heart. But they do not know what is "open" and what is "closed".

Q6. How do you evaluate the quality of the diagrams used in the textbook?

Interviewee: - diagrams are not up to the mark. Many important diagrams such as life cycle of hookworms, bird, and paramecium are not there. There are also many unnecessary diagrams. For example, the diagrams of snail which is present on page 54 is not necessary. Diagram of hydra that is present on page 26 detailed and it has many labelled parts which are not mentioned in the text.

Diagrams of primitive chordates on page 74 are not clear at all. The diagrams are not required. What I feel, mentioning name is enough.

There is a need of picture of bird. That is required. That is very important. For example, there is a bird which is easily available – dove, which they can easily find its parts.

The diagrams of mammals given on page 86-87 are not clear. In addition to the diagrams we require inclusion of photographs. Instead of drawing by hand we can give photographs. Photographs are very important. Students can visualise them. Nowadays we prefer photographs. Photographs are very near to the approach.

Q7. What about the laboratory activities? Does the textbook assist you to conduct or carry on practical work?

Interviewee: - no experiment is given in this textbook to do or to conduct. Nevertheless, we can do some experiments. For example, we can bring the animal to the classroom and show them. The textbook does not assist or motivate the teacher or even the student to carry on experiments.

Q8. What is your opinion about the review questions, summary, glossary and index?

Interviewee: Summary is very important. It gives quick reference. There is no summary is this textbook. At the end of each chapter there must be summary.

Glossary is not given, but it is important especially at the end of each chapter. For example, most of the sentences used in this textbook are short and are loaded with technical terms. Some of these technical terms need explanation. It is important to include glossary which explains some technical term. For example, what is “open” and “closed” circulatory system.

Summary, glossary, review questions and index are not given in this textbook, though they are very important.

Q9. Can you please mention some of the strong sides of the book?

Interviewee: Some of the strong points of the textbook are the sequence of chapters and also the general characteristics which are given in the form of points can be mentioned as strong points of the textbook.

Print and paper size and paper quality is good.

Q10. Are the contents of the textbook related to the daily lives of the students?

Interviewee: Yes, some parts are related to the daily situation of the students. Especially the diseases, symptoms and diagnosis are very important. Diseases are always concerned with our daily lives. Both diseases and economic importance are related to the daily life experience of the students. Economic importance is not given in detail this is the weak side of this textbook. It should be given in detail. Economic importance of some is not given. Corals are economically important, but not mentioned.

There are also other topics not related to the daily life experience of the students. For example, if we take phylum Echinodermata are not relevant to the students here. It is

difficult for the students to understand such information. We cannot take the students to field trips to show them the animals not present in their surroundings. Therefore, much of the information included in the textbook lacks relevance for the students.

However not all topics should be related to the daily life experience of the students. The students must study any information for the sake of evolutionary significance. The students must study and know them. We must not expect all the topics to be related to the daily life experience of the students.

Teacher Interview 2

Q1. What material do you use to prepare your lesson in biology? Does it include the prescribed textbook and how much do you depend on the textbook?

Interviewee- I totally depend on the prescribed textbook. I use it for example to prepare notes, to set questions and even answer *Matric* questions. There is only one textbook, which we use throughout the nation. Textbook is very important tool in teaching and learning process. I rely on the prescribed textbook, but sometimes I use or refer to other books present in our library. All teachers use this single textbook. We must follow or go according to the syllabus.

Q2. What is your opinion of the grade 9 biology textbook? What are its good points and weak points, for example in terms of the physical appearance?

Interviewee- externally the textbook is beautiful. Its size is small and seems manageable with regard to the number of pages. Actually this is not the case. We usually run out of time and rush at the end of the semester to complete the textbook.

The quality of the papers and size of print is very good.

The binding is poor, because pages come out very easily.

Q3. What is your opinion about the physical appearance of the textbook?

Interviewee: I feel the content of the grade 9 biology textbook needs some rearrangements. For instance, the sequence of units should be from simple to complex, but in this textbook the units are not organised from simple to complex. Simple organisms such as bacteria and viruses are placed at the last part of the textbook. I suggest that since bacteria and viruses are simple organisms simpler from phylum protozoa, the topics dealing with bacteria and viruses should be placed at the first chapter

and then phylum protozoa and then phylum porifera etc. must follow. Therefore, the textbook needs correction in this regard.

The information included in the textbook is too much. All other teachers and I always run out of time and rush to finish the content. You know the 40 minutes are used for both writing notes on the chalkboard and discussing them. Since time allotted is not enough I recommend the amount of information included in the textbook to be reduced.

Perhaps in some parts the content is described very briefly. For example, as in the case of corals the description given about these beautiful animals is not sufficient.

Q4. What about language used in the textbook?

Interviewee- I suggest the level of English language used in this textbook is not complex. It is not beyond the comprehension capacity of the students. If they show effort in reading I am sure they can possibly understand what the textbook tries to say.

Q5. How is the content organised in the textbook?

Interviewee- the overall organisation of the textbook is good. All the phyla are arranged from simple to complex. As I have explained to you the position of bacteria and viruses is not correct. This is my opinion. You must not go into conclusion based on my comments.

Q6. How do you evaluate the quality of the diagrams used in the textbook?

Interviewee- some of the diagrams placed in the textbook are very important, but not illustrated well. For instance, the life cycles of worms are not placed clearly. These parasitic worms are economically important. Students have to study them. But the diagrams are not clear and attractive.

Secondly malaria is one of the diseases causing much death in many developing countries including Eritrea. The diagram illustrating the life cycle of malaria parasite is not clear either.

Thirdly Red Sea is rich in Corals. The description about these interesting corals is not sufficiently given. No diagram is given about these tropical animals. My students are away from Red Sea. Including some diagrams might help students to understand the corals. I can't take them for field trip to the Red Sea to show them these corals. In such situations the presence of diagrams or photographs might make a difference.

The labeling of some diagrams is fair and it is up to the level of the students. However, some diagrams such as the diagram of snail on page 54, the diagram of earthworm on page 48 and there are some more diagrams which are labelled in much detail. The parts indicated in such diagrams are not discussed in the text. For example, gizzard and prostomium of the earthworm are nowhere discussed in the text. Such diagrams that are labelled in great detail are not attractive and not important in learning.

Presence of photographs in textbook motivates students and hence facilitates learning. Because the photographs are near to the real object. Photographs play a great role in helping students understand the concept. However, there is no photograph included in the textbook.

Q7. What is your opinion about the laboratory activities? Does the textbook help you to conduct or carry on practical work?

Interviewee: As to my opinion practical work helps students to relate what they have learnt theoretically with practice. Doing practical word is very necessary.

No. There is nothing given in the textbook about practical work. This textbook cannot provide any guide to plan practical work. The textbook does not provide help in this regard. I can say with respect to practical work the quality of this textbook is "zero".

Q8. What is your opinion about the review questions, summary, glossary and index?

Interviewee – They are very important aspects of textbooks, which I believe to facilitate the process of reading. None of these aspects appear in this textbook. No review questions, no summary, and no glossary are given in the textbook.

Q9. Can you mention some of the strong sides of the textbook?

Interviewee- I can say there are two major strong sides of the textbook. Some important terms are written in bold letters. This can be considered as one strong point of the textbook. The bold letters facilitate reading.

Secondly the general characteristics of each phylum are given in short points in the form of summary. I feel that this mode of presentation helps the students to summarise while reading.

Q10. Are the contents of the textbook related to the daily lives of the students?

Interviewee- Yes, it is related to the daily lives of the students, but students always do not notice the connection. For example, as in the case of malaria and other diseases present in Eritrea. I can say that if the content of the textbook is related to the daily lives of the students it adds to the motivation and interest of the students in biology.

Teacher Interview 3

Q1. What material do you use to prepare your lesson in biology? Does it include the prescribed textbook and how much do you depend on the textbook?

Interviewee: I use this prescribed grade 9 biology textbook. It is good for reference and for instructional purposes. Not only teachers can understand this textbook if students want to read this textbook they will not understand it either.

Q2. I need your opinion about the quality of the grade 9 biology textbook? What are its good points and weak points in terms of its physical appearance?

Interviewee: - The binding is not good. The papers come out very easily. The quality of the paper is good. Size of the print is also good.

The front cover contains bird (Ostrich) which belongs to the class *Ave* a bird, which is not, mentioned anywhere in the textbook. Therefore, I can say the picture on the front page is not appropriate.

Q3. What is your opinion about the content of the textbook?

Interviewee: The history of this book is not given in any grade. For example, the grade 9 biology is completely about invertebrates. These invertebrates are not seen in any of the previous grades. So, the terms, the items, which are given in the textbook, are completely new. Without the help of the teacher they cannot learn from it. For them it is something which they cannot understand very easily, and for the teachers the matter is not that much enough. It is only prescribed matters. Only short description is given it is not given in an elaborate manner. Selected examples are given. One example I can give from the first phylum protozoa. One must know what has to come in grade 11. Paramecium is given in grade 11, but nothing of this protozoan is mentioned in grade nine. There should be connection between grade 9 biology and other grades.

Q4. What your opinion of the language used in the textbook?

Interviewee: language is simple and appropriate to the students. I believe that the language is quite understandable. Perhaps there are a lot of technical words, if meanings of these words are given at the end, it would have been better, and easy for the students to review and study.

Q5. How is the content organised in the textbook?

Interviewee: I have already responded to this question. Some of the chapters are not correctly placed in the textbook, for example phylum arthropoda must follow phylum annelida.

Secondly the ideas in the textbook are placed in the form of isolated or disconnected facts having no connection with one another. This type of textbook organisation is very difficult to understand or grasp the ideas.

Q6. How do you evaluate the quality of the diagrams used in the textbook?

Interviewee: Some illustrations are wrong. Some are not necessary. Some diagrams given are not clear. For example, internal structure of bacteria is not clear. Students cannot understand it. Items given on the picture and those given in the text do not coincide (see page 91 and page 48).

This diagram (by pointing to diagram of spiny anteater) is shabby. It doesn't have proper head and snout. Simply it is present. This (by pointing again) looks like tail. Students should assume that this is its back and this is its front. Immediately you cannot get into the picture.

This (by pointing to diagram of amphioxis) diagram is totally unnecessary. This is not at all relevant to the topic. I can say these illustrations are unnecessary.

Here (by pointing to the diagram on page 69) they explained about mouthparts, but the mouthpart is not given separately in the diagram. Instead complete picture is given. This diagram shows the whole body part, but this is not given separately. Instead complete picture is given. This is not the correct view. Head should be front.

Diagram on page 60 that indicates about the water canal system of echinoderms is not clear. Students cannot understand it. Which one is incurrent and which one is excurrent pore is not clear. How water goes into the canals is also not clear.

If they had given clear diagrams it would have been good. Biology always needs some coloured pictures. That makes students attracted. Understanding will also be easy. I know that colour printing takes a lot of money even then we can try in some not all.

Q7. What about the laboratory activities? Does the textbook assists you to conduct or carry on practical work?

Interviewee: There is no experiment assigned in this book. Nevertheless, one thing is that if the school can provide facilities, insects such as cockroaches and worm like earthworm can be taken out, dissected and showed to the student. We can show them different internal and external parts of animals so that they can easily understand biology. However, facilities are not available in our school. There is no electricity and running water and therefore it is difficult to conduct practical work. Regardless of facilities the textbook must contain some instructions indicating what type and how to conduct experiments. As an activity it is not given in the textbook. As a project work it is also not given. Teachers can take their own interest to show or demonstrate their students.

There is no experiment. Right from the first page up to the last pages. It is monotonous. It is teacher oriented. It is not student oriented. It does not encourage the students to participate in investigatory work or processes.

Q8. What is your opinion about the review questions, summary, glossary and index?

Interviewee: No single question is given in the textbook, except very few questions included at the end of the textbook. But you see students should know about their lesson immediately not at the end of the textbook. Of course, it doesn't cover all the matters given in the textbook. Information given in the text is more, but questions asked are less. It is necessary to have questions at the end of each unit or even in the middle of each unit.

Meaning of words if they might have given at the end of the textbook or unit it would have been good for the students to understand the meaning of difficult words. There are many technical words which are posing reading difficulty or which hinder the students from understanding the textbook. Inclusion of glossary at the end of the textbook or at the end of each chapter might help a lot in assisting students understand the information.

Q9. Can you mention some of the strong sides of the textbook?

Interviewee: According to my opinion there is nothing in the textbook which can be taken as strong side. I would like to suggest that the whole textbook needs revision. If we compare this textbook with other conventional textbooks I can say it is very poor textbook.

Q10. Are the contents of the textbook related to the daily lives of the students?

Interviewee: Yes, few things given in the textbook have national value. The study of *Plasmodium vivax* and *Plasmodium falciparum* are very significant to the students, because malaria is prevalent in Eritrea. The textbook tries to discuss on some problems that have national significance.

Even though they are not given directly, there are many information right from the phylum protozoa up to the last character i.e. mammals related to the daily life experience of the students. We do see diseases caused by protozoa such as amoebic dysentery that occurs everywhere in Eritrea whether it is a highland or a low land. It touches health and hygienic matter. Certainly it has its values to the day to day life of the students. How people should keep their surrounding clean is mentioned in the textbook. Of course it is encouraging.

Teacher Interview 4

Q1. What material do you use to prepare your lesson in biology? Does it include the prescribed textbook and how much do you depend on the textbook?

Interviewee: There is no way to use other materials or other books except using the prescribed textbook. I must follow this grade 9 textbook because the exams are extracted from the textbook. Especially in the last three or four years the exam questions are taken out from the textbook without even showing much change. This made the teachers to stick to the textbook. Still I also refer to some books to enrich my knowledge about the subject and also to look for some detailed information.

Q2. I need your opinion about the quality of the grade 9 biology textbook? What are its good points and weak points in terms of its physical appearance?

Interviewee: the physical appearance of the book is good. Quality of paper, print size, and binding is good.

Q3. What is your opinion about the content of the textbook?

Interviewee: If I am going to express my ideas about the content of the textbook. I can say that the information load present in the textbook is enough when compared to the comprehension capacity of students. However, in most parts the content or information is given in the form of isolated facts, which leads to difficulty of reading. The ideas are not elaborated.

Secondly this grade 9 biology deals with classification of animals into phylum, class, order etc. These new words are boring to the students. It would have been better if they had shifted some of the grade 9 biology chapters to other grades and replace them with other content.

Moreover the content of the grade 9 biology has no connection with the content of the previous and subsequent grades.

Q4. What is your opinion about the language used in the textbook?

Interviewee: the language used in the textbook is difficult for the second language learners. Even though there is a possibility of using simple English the textbook is full of difficult vocabulary and a lot of technical words which add to the comprehension difficulty.

Q5. How is the content organised in the textbook?

Interviewee: I don't have much experience about the textbook. However I can suggest that the chapters are organised in a logical way, from simple protozoa to advanced chordata. Within the chapters the content is organised in a monotonous manner, first explaining the general characteristics of the phylum, then discussing the life functions of each phylum such as feeding and reproduction and finally giving representative example of the phylum. I can say it is in the form of storytelling or listing all the facts and it is boring to the reader.

Q6. How do you evaluate the quality of the diagrams used in the textbook?

Interviewee: Some of the diagrams are not clear. Some are not clearly labelled. In some diagrams the items labelled on the diagram are not discussed in the textbook. For example, the layers of hydra are explained as "ectoderm" and "endoderm" in the text on page 26 are labelled as "epidermis" and "gastrodermis" in the diagram. It is difficult for the students to correlate the diagram with the text.

Similarly parts labelled as gas bulb, hydranth, column, budding region, and stalk on page 26 are not discussed in the text. I suggest that what is indicated on the diagram must be present in the text.

In another example from page 22 the flagellate cells lying the endoderm are discussed in the text as "collar cells", but they are labelled on the diagram as "choanocytes". How can students know whether these two names stand for the same subject? It is very difficult to

make such correlation. In the same diagram the inner cavity of the sponges labelled as "spongocoel" is not discussed in the text.

Q7. What about the laboratory activities? Does the textbook assists you to conduct or carry on practical work?

Interviewee: - Nothing. It doesn't help me to carry on an experiment. Nothing is mentioned about practical work in this textbook. It is true that there is lack of laboratory facilities in Eritrean secondary schools, even then the school textbooks need to prescribe some activities that can be carried using locally available materials.

Q8. What is your opinion about the review questions, summary, glossary and index?

Interviewee: presence of review questions at the end of each unit is very essential. In this textbook review questions are placed at the end of the textbook. These questions are not enough. They are not also of quality they encourage the students to memorise. The questions are of the recall type. Review questions are very important because they help the student to summarise what they read in short period of time.

As to my opinion it is also important to present some aspects of the content in the form of questions. In order to make students think critically. From my experience of teaching during the process of giving them notes I usually change the subtopics into question form. For example, I usually replace sentences like "food capturing in hydra" into "How hydra captures its food". Reading of such statements facilitates the thinking skills of the students. I can say that it is a good experience.

With regard to glossary I can it is an important feature of a textbook. There is no glossary placed at the end of this student textbook. Students cannot find meaning for the biological terms in the ordinary dictionary. I feel inclusion of glossary at least at the end of each chapter is necessary.

Q9. What are the strong side does the textbook has?

Interviewee: this textbook may have many strong points, which are not visible to me. Let me mention one point, which I feel, answers the question and which I liked most. The presentation of general characteristics of each phylum is in the form of points. This method helps to study the characteristics of the phyla without going through a lot of pages. They are already in the form of summary.

Q10. Are the contents of the textbook related to the daily lives of the students?

Interviewee: from what I have seen so far, yes some parts of the textbook are related to the daily life experiences of the students. Very interesting example is about the malaria parasite. This is because malaria is common in Eritrea in both low land and high lands.

APPENDIX 2.3 -

Student interview protocol

1. Do you have the prescribed grade 9 biology textbook?
2. Do you use the textbook?
3. How often do you read the textbook?
4. How do you feel about the language used in the textbook?
5. How do you solve problems created by difficulty of words?
6. What is your opinion about the importance of review questions, glossary, and summary?
7. What do you feel about the diagrams present in the textbook?
8. What do you like about the textbook?
9. What do you not like about the textbook?
10. Is biology related your daily life situations?
11. How do you compare biology with other subjects?

APPENDIX 2.4 - Student translated transcribes

INTERVIEW 1

Q1. Do you have the grade 9 biology textbook?

Interviewee: No I don't have the prescribed textbook.

Q2. Do you use the textbook?

Interviewee: Yes, I use the textbook by sharing it with my friends or sometimes I go to the library and read it.

Q3. How often do you read the textbook?

Interviewee: as I said even though I use the textbook sometimes most of the time I rely on my exercise book. I read some times during weekends, but mostly I read during examinations.

Q4. How do you feel about the language used in the textbook?

Interviewee: the notes contain very difficult words, which I cannot get them in the ordinary dictionary I have.

Q5. How do you solve problem created by difficulty of words?

Interviewee: I try to understand the meaning of words from the paragraphs (context) or I try to ask a friend. My suggestion is to replace all these difficult words with easy words.

Q6. What is your opinion about the importance of glossary, review questions, and summary?

Interviewee: since we all have problems with the biological terms, which we cannot find them in the ordinary dictionary, it is very essential to have the glossary at the end of each chapter. This could possibly help in reading the book.

What is your opinion about summary?

Summary is also important. The presence of summary at the end of each chapter could have saved out time in grasping the idea of the whole chapter.

What is your opinion about review questions?

Yes, review questions are important. Nevertheless, there are no questions at the end of chapters. Review questions placed at the end of each chapter helps to evaluate oneself after reading the chapter and also give ideas about what type of questions that will appear in exams. I wish to see more questions at the end of the chapters.

Q7. What do you feel about the diagrams present in the textbook?

Interviewee: When I compare the diagrams with the diagrams present in other books they are not good, because some of the diagrams are labelled beyond our capacity. For example, the diagram of hydra present on page 26. All the items labelled are not present in the written matter.

Q8. What do you like about the textbook?

Interviewee: I like the general characteristics given in points. This is because they are short and in the form of summary. They help me to distinguish the characteristics of one phylum from another phylum. For example, in the case of phylum protozoa, the general characteristics of the phylum are given in page 5-6. These features summarise the phylum and provide a lot while studying.

Q9. What you don't like about the textbook?

Interviewee: I don't like the difficult words given in the textbook. Many students don't like the textbook because it deals entirely with insects and insect-like animals. It has no connection with grade eight biology students textbook. What we learned in grade eight did not help us in understanding the grade 9 biology.

Q10. Is biology related to your daily lives?

Interviewee: Yes, there are some aspects of the textbook, which are related to our life experiences. For example, the cause and symptoms of malaria and how to control malaria is what I can see in my surrounding.

Q11. How do you compare the grade 9 biology with other textbooks?

Interviewee: the biology textbook is difficult when compared to other textbooks. I always hear from senior students that grade 9 biology is difficult. This is because it totally deals with classification of animals and their names. On the other hand, I can say it deals with insects and insect like animals.

Interview 2

Q1. Do you have the grade 9 biology textbook?

Interviewee: Yes, I have.

Q2. Do you bring the textbook to the classroom?

Interviewee: No I do not bring it to the classroom. At classroom we take notes given by the teacher. I don't use it in classroom. Our teacher gives us the summarised notes on the chalkboard, which we copy down on our exercise book. I use the textbook only to compare the notes given by the teacher with the notes present in the textbook and secondly I use the textbook to draw some diagrams on my exercise book.

Q3. How often do you read the textbook?

Interviewee: I read the textbook about once during the weekends. However during exams I read it more than once a week. I read the textbook during the weekends when I get ample time to read it again and again until I grasp some ideas.

Q4. How do you feel about the language used in the textbook?

Interviewee: I can say the language used in the textbook is difficult. There are many biological terms, which we cannot understand easily which again we cannot find them in the English dictionary.

What creates difficulty in this textbook is that the biological terms are not defined immediately in the textbook and it is also difficult to understand the meaning of the different words from the paragraph. For example, in the sentence "amoeba is radially symmetrical", no explanation is given about what the words "radial" and "symmetrical" means. By reading such sentences it is difficult to understand the message. We mainly depend on the explanation given by our teacher for defining such terms.

Q5. How do you solve problem created by difficulty of words?

Interviewee: as I mentioned earlier when I face such difficult words I simply try to understand the meaning of the words from the context. If not I depend mainly on the explanations given by the teacher, or sometimes look for meaning of the unfamiliar words in dictionary.

Q6. What is your opinion about the importance of glossary, review questions, and summary?

Interviewee: there are no review questions in this textbook, except very few questions included at the last portion of the textbook. Review questions placed at the end of each chapter are very important. They help to summarizing the chapter. I consider this as a weakness of the textbook.

With regard to glossary as I indicated earlier this textbook contains many difficult biological terms. Glossary could have been of great help in assisting us. Unfortunately this textbook does not contain glossary.

Summary is also very essential. However, there is no summary in this textbook.

Q7. What do you feel about the diagrams present in the textbook?

Interviewee: I can say the diagrams are adequate since we are grade 9 students it is difficult to study more than this. I can say they are adequate. They are also good.

Q8. Would you please explain the easy aspects of this textbook?

Interviewee: No part of this text is easy. All the grade 9 students preparing for national exams express their concerns about the difficulty of this textbook. As I heard from the senior students, grade 9 biology is more difficult than grade ten and grade eleven biology. Therefore, I suggest shifting some of the contents of this textbook to higher grades. May be the senior students could manage to understand it.

Q9. What you don't like about the textbook?

Interviewee: I don't like the biological names of the animals, because they are difficult to understand and remember.

Q10. Is biology related to your daily lives?

Interviewee: science must be taught practically and I can say we are not learning science. For example, in the case of unicellular organisms such as Eugenia and Amoeba we did not see them. Our teacher told us that amoeba moves by pseudopodia. It doesn't give us sense. Another example we do not know much about sponges and coelenterates. I have not seen them. I have seen them only on diagrams. These sponges and coelenterates may be around me, but I do not know. I cannot identify them. We are studying them only to

pass examination. I can say most what of we are learning in grade 9 biology are not related to our life situations.

Q11. How do you compare the grade 9 biology with other textbooks?

Interviewee: Grade 9 biology is very difficult when compared to other sciences. While I was in grade eight I had a fear that physics and chemistry are going to be difficult for me. However, the situation is opposite and now I realised that biology is more difficult than physics and chemistry. During test I memorise the information without understanding it. I get good result, but I am not confident with the results I receive. The results do not reflect my understanding about the subject.

Interview 3

Q1. Do you have the grade 9 biology textbook?

Interviewee: No I don't have the textbook.

Q2. Do you use the textbook?

Interviewee: I use the textbook from the library or borrow from my friends. Since I am new to this area I don't know much people. Whenever I get time I go to the school library and try to read the textbook.

Q3. How often do you read the textbook?

Interviewee: I try to read the textbook almost twice a week, but during examinations I spend a lot of time reading.

Q4. How do you feel about the language used in the textbook?

Interviewee: the language used in this textbook is difficult because there are many new words and names of many animals. The concept is also new and difficult to understand. Grade eight biology textbook is simple when compared to grade 9 biology textbook. I can say the textbook is difficult. Without the help of teacher one cannot understand what the book is trying to say. But if there is help from the teachers' side I can say it is manageable.

Q5. How do you solve problem created by difficulty of words?

Interviewee: I try to understand it from the context. If it is not possible I try to look for it in a dictionary or ask a friend. But most of the time I try to understand the message of the whole paragraph.

Q6. What is your opinion about the importance of glossary, review questions, and summary?

Interviewee: There are many difficult words in the textbook. Therefore, glossary is very important. This textbook is more difficult than grade eight and grade ten biology.

What about summary?

Interviewee: Summary is also very important, it helps to save time during preparing for examinations. Instead of reading the whole chapter, presence of summary helps to read the concepts of the whole chapter within a very short period of time.

What about review questions?

Interviewee: I don't think review questions are important. I prefer summary from review questions. I can formulate my own questions while reading the textbook.

Q7. What do you feel about the diagrams present in the textbook?

Interviewee: mostly the diagrams are ok, but some of the diagrams are not clear. For example, by looking at the diagram it is hard to believe that starfish belongs to animals. I have never seen this animal before. Even now I have simply accepted that it is an animal. Our teacher told us if you cut the starfish into pieces, each piece could grow into new organism. It is hard to believe.

I can say a good diagram is better than ten paragraphs of prose, if the diagram is correctly and adequately labelled.

Q8. What do you like about the textbook?

Interviewee: I like the information included in chapter one of the textbook because it deals with diseases such as malaria caused by protozoa. I like reading about diseases, what causes them, and how to control them. I like the information because I see people suffering from diseases and I hope that one day I will be a doctor and help these people suffering from different diseases.

Q9. What you don't like about the textbook?

Interviewee: I don't like the short notes. Since they are not elaborated they create problems in understanding.

Q10. Is biology related to your daily lives?

Interviewee: There is no much relation of grade 9 biology with my life experience. For examples the echinoderms are not related to my life. I study them only for the sake of knowledge. I memorise the characteristics of each phylum and mechanisms of reproduction to get good marks in examinations.

However, there is one section, which is of interest to me i.e. about the malaria parasite. The part, which deals with malaria, is related to my daily life experiences. I like that part.

Q11. How do you compare the grade 9 biology with other textbooks?

Interviewee: I can say all other textbooks are similar to biology textbook. They are not better than the current biology textbook. All of them lack review questions, summary, and glossary. I can say they are all the same with regard to the aspects discussed earlier.

Interview 4

Q1. Do you have the grade 9 biology textbook?

Interviewee: Yes, I have.

Q2. Do you use the textbook?

Interviewee: I do not bring it to class. Most students do not have the textbook; hence I do not bring it to classroom. The textbook has no use in classroom. In classroom we use the short notes given by our teacher. I use the textbook at home to draw diagrams or sometimes to answer questions given by the teacher as homework. Most of the time I need the textbook or the exercise book during examinations or tests.

Q3. How often do you read the textbook?

Interviewee: I don't have schedule for reading the textbook. Mostly I read it when examinations or tests approach. Other times I don't read the textbook.

Q4. How do you feel about the language used in the textbook?

Interviewee: the language used in the textbook is really difficult. This language difficulty is caused due to enormous amount of difficult words. However the language difficulty

created by difficult words can be minimised by putting effort into reading. We shouldn't expect everything from our teacher. Teacher cannot explain everything. Even if the vocabulary is difficult we must read the textbook again and again to understand what it is trying to say. I can say devotion is needed from the side of the students.

Q5. How do you solve problem created by difficulty of words?

Interviewee: mostly I try to understand the meaning of the words from the sentence and continue reading. If I find very difficult words I occasionally look for the meanings of the difficult words in a dictionary.

Q6. What is your opinion about the importance of glossary, review questions, and summary?

Interviewee: these are very important aspects of a textbook. Since the textbook contains many difficult words, the presence of glossary might provide a great support in reading. Review questions and summary of chapters are very essential end of book features. The questions included in the textbook are very few. There is also no summary. There is no doubt that summary is important.

Q7. What do you feel about the diagrams present in the textbook?

Interviewee: so far I have seen the diagram of hydra. My opinion about this diagram is negative. This diagram is not sufficient. Inclusion of colour is very important. There is no colour in this textbook. The diagrams are drawn in black and white colour. They are not attractive. Secondly the labeling of the diagrams is too much. Therefore, I don't give much emphasis to the diagrams. I usually skip them and read the prose.

Q8. What do you like about the textbook?

Interviewee: there is nothing, which I like from the textbook. The textbook all in all is very boring. Many students do not like the grade 9 biology. I like biology more than any other subjects but not grade 9 biology.

Q9. What do you not like about the textbook?

Interviewee: The main thing, which I do not like about this textbook, is the content included in this textbook is not related to my daily life. I don't see any of these animals in my surrounding.

Secondly if we take, for example the classification of phylum protozoa, I can say it is incomplete. There are five classes of the phylum mentioned of which only three are discussed. Two classes were not discussed. That is what I don't like from the textbook.

Q10. Is biology related to your daily lives?

Interviewee: as I told you earlier the content of the grade 9 biology textbook is not related to my daily life. Since the animals mentioned in this textbook are many in number I cannot find them in my surrounding. However, we must not expect everything to be related to our daily life. It is also important to read about things, which we are not familiar with, in order to acquire or get knowledge.

Q11. How do you compare the grade 9 biology with other textbooks?

Interviewee: I like biology very much when compared to other subjects. This is due to the fact that biology deals with living things. If we compare the textbooks I can say all the textbooks are the same. All the textbooks lack summary, glossary and coloured pictures. However chemistry and history textbooks possess a little bit more review questions than the biology textbook.

APPENDIX 3.1 - Teacher questionnaire

Introduction

Name of School …….

Sex: Male ☐ Female ☐

Qualification …….

Experience in teaching in years…….

Date ___ /____ /1999

There is only one prescribed biology textbook used throughout Eritrea. I need your opinion about the quality of the textbook.

Please read through the following questions and answer them. It is suggested to look through the textbook as you answer these questions.

Section A

Please rate the grade 9 biology textbook in terms of "frequency of use" by ticking ( ) the appropriate column for each item.

5 = Frequently used; **4** = used; **3** = Fairly used; **2** = Occasionally used; **1** = Never used.

Please don't fill more than one column per item.

Item	**5**	**4**	**3**	**2**	**1**
1. As a reference for preparing lessons.					
2. To look at diagrams and illustrations with your students.					
3. As a guide for practical work or demonstration.					
4. To set classroom or home assignments for your students.					
5. To prepare notes for your students.					
6. To set tests and examinations.					

What else do you use the biology textbook for?

…….....
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.....
Section B:

Rate the items in this section in terms of the following keys:

Points	Qualitative	Quantitative
5	Excellent	Very much / very high
4	Good	Much / high
3	Fair	Satisfactory
2	Poor	Little / low
1	Very Poor	Very little / very low (none)

1. Physical and mechanical condition

Item	**5**	**4**	**3**	**2**	**1**
1. General attractiveness of the textbook.					
2. Appropriate over-all size.					
3. Durability (especially cover and binding).					
4. Quality of paper.					
5. Quality of photographs.					
6. Quality of diagrams.					
7. Appearance of page, for instance length of line, spacing, width of margins etc					
8. Print size.					

2. Presentation

Item	**5**	**4**	**3**	**2**	**1**
1. Appropriate reading level (level of language related to students reading level).					
2. Length and complexity of sentences.					
3. Choice of vocabulary (adjusted to students).					
4. Technical terms properly introduced and defined.					

3.Content

Item	5	4	3	2	1
1. The general theme is in harmony with the aims and objectives of the syllabus.					
2. Application of concepts to everyday life.					
3. Up-to-date content and accurate information.					
4. Attention to students' interest and motivation.					
5. Adequate number of diagrams and photographs.					
6. Adequate data, tables, and graphs.					
7. Relation of biology to other subjects.					
8. Concepts manageable to the students.					
9. Type of questions included in terms of quality and quantity.					

4. Organisation:

Item	5	4	3	2	1
1. Appropriate choice and sequence of units or chapters.					
2. Material within chapter organised for easy use.					
3. Chapter or topic summaries are well organised.					
4. Questions and exercises are well structured.					
5. Appropriate placement of chapters according to seasonal change.					

5. Laboratory program

Item	5	4	3	2	1
1. Laboratory activities within the range of students' mental and physical changes.					
2. Inclusion of open-ended activities.					
3. Contribute to an understanding of concepts being developed.					

Section C:

Please give your comments on the following:

a) Is the textbook written in a way that makes it easy for your students to read? (e.g. in terms of level of difficulty with respect to style and language).

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b) Is there too much information, the right amount, or too little detail in your biology textbook? Discuss.

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Do you think the information in the textbook is related or relevant to the daily lives of the students?

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Is the sequence of chapters appropriate? If you answer is no, please write the chapters in correct order?

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e) What is your view about the adequacy of the diagrams and adequacy of the illustrations? Are the diagrams adequately labelled, unlabelled or labelled in great detail? Please put your comments below.

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f) Does the textbook assist you to plan an experiment or practical work in any way?

If yes, in what way?

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If your answer is no, in what way?

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g) Do the questions in the textbook encourage high order reasoning, viz.: critical thinking, creativity or problem solving as opposed to recall of facts? Explain.

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h) Can you please make any other comments about things that concern you about the biology textbook?

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Thank you for your co-operation.

APPENDIX 3.2 - Teacher response to the open- ended questions of the questionnaire.

(Number in the brackets corresponds to the number of responses).

a) Is the textbook written in a way that makes it easy for your students to read? (e.g. in terms of level of difficulty with respect to style and language).

Yes, the textbook is written is simple way the students can understand (7).

No students find the English language used in the textbook too difficult (3).

Terminology is difficult (3).

It has no connection with previous grades and therefore students lack prior knowledge (1).

The style of the textbook is not good (1).

b) Is there too much information, the right amount, or too little detail in your biology textbook? Discuss.

Content is not explained in detail. In some sections the explanation are given in the form of points which looks condensed but we always run out of time to complete the contents (3).

The information included in the textbook is too much, especially the section dealing with "microorganisms" is very much detailed (6).

The information is too little (6).

The right amount of information (1).

Do you think the information in the textbook is related or relevant to the daily lives of the students?

Yes, it is related to the life situations of the students (6).

Some parts are related to daily life situations of the students especially sections dealing with diseases and food preservation (4).

The information is not related to the daily life situations of the students (2).

Is the sequence of chapters appropriate? If you answer is no, please write the chapters in correct order?

Yes, the chapters are arranged in appropriate sequence (8).

Microorganisms should come first or all in all omitted (7).

Phylum “Arthropoda” should come in between “Annelida” and “Mollusca”.

What is your view about the adequacy of the diagrams and adequacy of the illustrations? Are the diagrams adequately labelled, unlabelled or labelled in great detail? Please put your comments below.

Some diagrams such as the life cycle of *plasmodium*, life cycle of hook worm, earthworm, snail, starfish, and fish are not clear (3).

Some important diagrams such as corals, sponges, nematodes, crustaceans, birds and amphibians are absent (3).

The diagrams are not well labelled (6).

The labeling of the diagrams is adequate (1).

The diagrams are labelled in great detail (4)

Does the textbook assist you to plan an experiment or practical work in any way?

If yes, in what way? No response.

If no, in what way?

The textbook does not provide any assistance in conducting an experiment. It never tells what type of experiment to do and how to do it (17).

The textbook is all in all knowledge-oriented (1).

It invites to practice only lecture method (2).

Do the questions in the textbook encourage high order reasoning, viz.: critical thinking, creativity or problem solving as opposed to recall of facts? Explain.

The questions included are very few, not enough and are not encouraging (7).

No they are not because they are of recall type (8).

They encourage only memorisation (1).

They should be prepared in such a way they challenge the students (1).

Can you please make any other comments about things that concern you about the biology textbook?

The textbook needs revision and teachers must participate in the revision of the new version (4).

A separate teacher guide has to be provided (3).

Laboratory manual should be prepared (2).

The textbook has no links with previous and subsequent grades. Therefore, it has to be prepared in such a way it has linkage (2).

Some concepts such as *serological text, complement fixation*, and *Wassermann* reaction are difficult for the students and for the teachers as well (1).

Activity oriented tasks should be included (3).

Summary, glossary, and index should be included (2).

More questions at the end of each chapter (2).

Local examples should be given in the textbook so as to increase the relevance of the textbook for the students (1).

APPENDIX 3.3 - Student questionnaire

Name of school……..

Age ……. Sex: male ☐ female ☐

Section ……..

Date ……../……./1999

I want your opinion about the quality of the grade 9 biology textbook.

Please read the following questions and answer them. If you have a textbook, look through the textbook as you answer these questions.

Choose one of the options and put a tick mark (/) in the box.

1. Do you have the grade 9 biology textbook? Yes ☐ No ☐

2. How often do you read the textbook?

☐ a) Every day

☐ b) Once or twice a week

☐ c) Occasionally over week ends

☐ d) Only during examinations

3. How much of what you read do you understand?

☐ a) All of what I read

☐ b) Most of what I read

☐ c) Some of what I read

☐ d) Not much of what I read

☐ e) Nothing of what I read

4. How do you feel about the diagrams used in the textbook?

☐ a) They help me to understand biology more clearly

☐ b) They sometimes help me to understand biology.

☐ c) I often find the diagrams confusing.

☐ d) I avoid looking at them because they just do not make sense at all.

5. How do you find the English used in the textbook?

☐ a) Always too difficult

☐ b) Mostly too difficult

☐ c) Sometimes too difficult

☐ d) Sometimes too difficult

☐ e) Easy

6. State whether or not you understand the textbook. Tick the appropriate column that indicates your opinion.

Item	Yes	No	Not decided
a) The sentences are often too long to understand.			
b) There are too many big words used in the textbook.			
c) New words should be explained more clearly.			
d) There should be more questions.			
e) Summaries and glossaries should be added at the end of each chapter.			
f) The text should be written in simple English so that I can understand.			
g) The textbook is attractive and interesting.			
h) What is in the textbook is related to my daily life.			

7. I would like your opinion of your biology textbook. Think about your textbook (the difficulty of language, appearance, the information given, the diagrams, tables, exercises etc.). Write one or two sentences to answer each question.

What do you like about your textbook?

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What do you not like about your textbook?

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Thank you for your co-operation.

APPENDIX 3.4 - Student responses to the open-ended questions

(The number in the brackets corresponds to the number of responses)

What do you like about your textbook?

I like the appearance of the textbook (30).

I like the diagrams included in the textbook (65)

I like the biological words used in the textbook (3)

I like the information present in the textbook (10).

I like the print (10)

I like the size of the book (5).

I like the general characteristics of the phyla (5).

I like the questions present at the end of the textbook (10).

I like the textbook because it helps me to know about my surrounding (5).

What do you not like about your textbook?

I do not like the difficult sentences and words (185).

No glossary (10).

Questions are few and not enough (31).

The information is not adequate (3)

The information is too much (3).

Most of the diagrams are not drawn clearly/beautifully (15).

I do not like the textbook because the diagrams lack colour (3).

I do not like the textbook because it has no summary (8).

I do not like studying about the phylum (3).

The tables are not clear (3).

I do not like biology because there is no experiment or field trip (3).

APPENDIX 4.1
Student Cloze test

Instructions for the Cloze test
You will be asked to read few passages taken from grade 9 biology textbook, in which every seventh word has been deleted out and replaced by a number.
Next to the passage is a list of numbers and each number is followed by four words. Choose the best word out of the four words to fill in the blank space and put a cross mark in the box in front of your choice.

For example,
Malaria

The most familiar example of sporozoan parasite is Plasmodium, which causes malaria. The parasite is transmitted to man ___ 1 ___ the female anopheles mosquitoes. The disease ___ 2 ___ caused much suffering in man ___ 3 ___ ancient times. It has caused a large amount of illness and a lot of deaths, especially in the tropical and sub tropical regions.

1. ☐ on	☑ by	☐ from	☐ for
2. ☑ is	☐ been	☐ has	☐ was
3. ☑ since	☐ because	☐ as	☐ by

A. Class mastigophora (Flagellates) *General characteristics* - Flagella are characteristics of the class mastigophora. One of these whip-like projections ___ 1 ___ the means of locomotion in this ___ 2 ___. The organisms in this class possess a tough flexible covering, or pellicle ___ 3 ___	1. ☐ have ☐ provide ☐ get ☐ obtain 2. ☐ flagella ☐ cilia ☐ movement ☐ group 3. ☐ which ☐ them ☐ of ☐ because 4. ☐ changing ☐ surrounding ☐ expecting ☐ according

surrounds the protoplasm. This prevents the ___ 4 ___ from, which is seen in amoeba. A ___ 5 ___ cell is usually elongated in shape ___ 6 ___ flagella which extend from anterior (i.e. head or front) ___ 7 ___ have distinct food-getting devices, such ___ 8 ___ a mouth and a gullet. Reproduction ___ 9 ___ achieved by longitudinal binary fission.

Many ___ 10 ___ the organisms in this group possess ___ 11 ___ which are characteristics of both plant ___ 12 ___ animal kingdoms. Thus, some biologists consider them to represent a bridge between the plant and animal kingdoms.

B. THE HYDRA

The characteristics of the phylum can be seen in hydra which is a genus of common fresh water coelenterates.

Hydra is a small fresh water polyp (sessile); it ___ 13 ___ a slender (10 to 30 mm) long. Its lower end is closed as a "foot", ___ 12 ___ attaching to objects. The body of the ___ 15 ___ consists of two layers of cells. ___ 16 ___ are separated by a jelly-like ___ 17 ___, the mesoglea. The outside layer is the ___ 18 ___, and the inner layer is the ___ 19 ___. The bag-like body of the animal ___ 20 ___ a single opening (mouth). This is surrounded ___ 21 ___ tentacles which bear stinging cells. Each

5.	☐ happily	☐ usual	☐ typical	☐ feeling
6.	☐ as	☐ with	☐ of	☐ and
7.	☐ one	☐ some	☐ what	☐ same
8.	☐ is	☐ so	☐ was	☐ as
9.	☐ which	☐ is	☐ as	☐ was
10.	☐ at	☐ for	☐ of	☐ to
11.	☐ properties	☐ passage	☐ kind	☐ cells
12.	☐ or	☐ with	☐ and	☐ end
13.	☐ was	☐ is	☐ are	☐ were
14.	☐ Which	☐ by	☐ as	☐ for
15.	☐ Sponge	☐ hydra	☐ mosquito	☐ bird
16.	☐ This	☐ Whose	☐ What	☐ These
17.	☐ shape	☐ material	☐ structure	☐ properties
18.	☐ mesoderm	☐ mesoglia	☐ ectoderm	☐ endoderm
19.	☐ mesoglia	☐ endoderm	☐ mesoderm	☐ ectoderm
20.	☐ is	☐ called	☐ has	☐ as
21.	☐ to	☐ for	☐ in	☐ by
22.	☐ from	☐ of	☐ to	☐ with
23.	☐ known	☐ as	☐ of	☐ called

___ 22 ___ the stinging cells contain a structure ___ 23 ___ a nematocyst. Nematocysts are characteristics of ___ 24 ___ phylum only. *Food capturing* - When a small animal ___ 25 ___ into contact with one of the ___ 26 ___ of the hydra, many nematocysts ___ 27 ___ explosively discharged. They pierce the ___ 28 ___ body with tiny, hollow barbs (sharp hooks). Each ___ 29 ___ is attached to the tentacle ___ 30 ___ a thin thread, the combined effect ___ 31 ___many threads prevents the escape ___ 32 ___the helpless victim. The nematocysts also ___ 33 ___ poison; this paralyzes the victim (i.e. makes them unable to move). The tentacles push the prey into the mouth and into the body cavity of the animal. **C. The Flukes** Flukes belong to the class trematoda. They are flat, and are shaped ___ 34 ___ what like a lead. Their length ___ 35 ___be from 1mm to several cms. ___ 36 ___attach to intestinal wall ___ 37 ___ an ov4l or ventral sucker. They ___ 38 ___ all parasites in animals, including man. ___ 39 ___ worms may inhabit the intestine, the ___ 40 ___, the liver and the lungs.	24. ☐ those ☐ this ☐ these ☐ that 25. ☐ become ☐ joins ☐ comes ☐ being 26. ☐ Legs ☐ mouths ☐ cavities ☐ tentacles 27. ☐ Are ☐ is ☐ had ☐ were 28. ☐ Hydra's ☐ victim's ☐ host's ☐ parasite's 29. ☐ Ovary ☐ polyp ☐ nucleus ☐ barb 30. ☐ With ☐ as ☐ since ☐ by 31. ☐ To ☐ of ☐ with ☐ in 32. ☐ Of ☐ with ☐ for ☐ among 33. ☐ Eat ☐ lay ☐ fetch ☐ secrete 34. ☐ As ☐ some ☐ if ☐ on 35. ☐ To ☐ has ☐ had ☐ may 36. ☐ They ☐ Which ☐ Never ☐ Either 37. ☐ As ☐ by ☐ with ☐ for 38. ☐ May ☐ can ☐ will ☐ are 39. ☐ Those ☐ These ☐ This ☐ Since 40. ☐ Fluid ☐ blood ☐ oil ☐ skin

APPENDIX 5.1 - Word Difficulty Index

Name of school.....
Sex: male ☐ Female ☐
Age.....

Instruction 1: Read the following paragraph and underline any word that you **do not** understand.

Life functions of sponges

A simple sponge consists of a hollow body, whose wall contains many pores. The wall is made up of two layers of cells; a thin layer that contains a jelly-like substance, loose cells, and spicules separates these layers. The outside layer, or epidermis, is protective. While the inner layer contains special collar cells with flagella. The flagella of these cells set up currents that draw water into the sponge through the pores (incurrent pores). Food particles enter with the water, they are digested by enzymes within the collar cells. Digested foods are absorbed into the cells with the help of special cells, which are known as amoebocytes (amoeba-like wandering cells). The amoebocytes digest food and distribute oxygen to other cells.

Instruction 2: writer down one sentence in your own words, which you think, describes the passage best.

.....

.....

Thank you for your co-operation.