

**A STUDY ON THE READABILITY OF THE
ERITREAN
BIOLOGY TEXTBOOK FOR GRADE EIGHT**

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**A STUDY ON THE READABILITY OF THE ERITREAN
BIOLOGY TEXTBOOK FOR GRADE EIGHT**

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A mini-thesis submitted in partial fulfillment of the requirements for the degree of Magister in Educationis (M. Ed.) in the Faculty of Education, University of the Western Cape, South Africa.

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KEY WORDS

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ABSTRACT

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The purpose of the study was to determine the readability of the Eritrean biology textbook for grade eight. The study was conducted in Eritrea in four selected senior secondary schools.

The motivation for the study was the significant role textbooks play in the educational setting as a primary source of information. Drawing on the assumption that students and teachers depend heavily on textbooks as a major source of information, the study is premised on the assumption that students must be provided with materials, particularly, the textbooks, that take into consideration the language ability of the students for whom they are written. With this in mind, the research sets out to determine the readability of the grade eight biology textbook to find out the congruence or otherwise with its intended grade level learners.

To collect data for the study, both quantitative and qualitative research methods were used. The quantitative research methods were the Flesch, the Frequency of Gobbledygook (FOG), and the Fry readability formulas, cloze test, Word Difficult Index (WDI) test, and a questionnaire. These were used to ascertain the congruence or otherwise of the readability of the prescribed biology textbook for grade eight level students. The questionnaire was included for the purpose of data triangulation. The qualitative research method was a set of interviews with students, teachers and the biology curriculum designer. They were used to reveal first hand information from the subjects of the study about the appropriateness of the language used in the prescribed biology textbook in relation to its intended grade eight level students.

The correlating results of the Flesch, the FOG, and the Fry readability formulas indicated that the Eritrean biology textbook for grade eight is unreadable for the grade eight students. The cloze and the WDI tests revealed that the grade eight students have difficulties in comprehending the prescribed biology textbook. The questionnaire and the interview responses disclosed that the prescribed biology textbook is written beyond the language ability of its intended grade eight students.

All the evidence emerging from the study revealed that the Eritrean biology textbook for grade eight is difficult for the Eritrean grade eight students. In view of the findings of the study, it is reasonable to suggest an urgent revision of the prescribed biology textbook in a way to fit the readability level of its intended audience of grade eight student.

September 2003

DECLARATION

I declare that *A study on the readability of the Eritrean biology textbook for grade eight* 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.

Ghebremichael Ogbagebriel Elekal

September 2003

Signed _____

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“Acknowledgements and citations are a matter of distributive justice, the currency in which we pay our intellectual debts” (Walzer, 1995: xvii).

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I am sincerely grateful to my beloved wife and my children. I extend my heartfelt thanks for her unstinting encouragement and for all kinds of sacrifice she made so that this study could be completed.

DEDICATION

This mini-thesis is dedicated to my father and mother for instilling in me the value of education.

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CHAPTER ONE

ORIENTATION OF THE STUDY

1.1 Introduction

The purpose of this study is to determine the readability of the Eritrean biology textbook for grade 8. The motivation for this study is the role that textbooks play as a major source of information in the educational setting. Wagiet (1991) and Potter and Rosser (1992:669) contend that textbooks are written materials used for school purposes and occupy an indispensable place as a source of information in any educational system.

The following section of this chapter discusses the background for the study. Then, the rationale for the study will be discussed. In the fourth section, the explanation of the study problem is provided, followed by a discussion of the purposes of the study. Towards the end of this chapter, I highlighted the significance, the scope, the limitation, and the organization of the study.

1.2 Background for the study

This section will provide an overview of the schooling level, colonial education system, and the development of the currently used biology syllabus in Eritrea.

In Eritrea there are three levels of schooling: elementary, secondary, and tertiary. The elementary level includes kindergarten and grades 1-5. The secondary level includes junior secondary level (grades 6-7) and senior secondary level (grades 8-11). The tertiary level includes training institutions, colleges and universities. In Eritrea, English as a medium of school instruction starts from grade six, which is a second language for the students. In Eritrea secondary school textbooks are written in English. The students read their textbooks through a language which is not their home

language. For this reason, the grade eight students tend to find the biology textbook for grade 8 difficult. However, how difficult the textbook is, is not well known. Research has not been done to determine this. Therefore, I selected to study the readability of the biology textbook for grade 8 since this grade is the starting point of the senior secondary school. Where it is most important that students be provided with a textbook appropriate for their reading and comprehension level.

Since this study is located in the context of Eritrea, it is appropriate to contextualize the study. The people of Eritrea struggled for independence against the Ethiopian colonial regime from 1961-1991, and achieved de facto independence in 1991. Eritrea declared its official independence in 1993. In Eritrea during the Ethiopian colonial rule, the educational system deteriorated, was poorly organized and consequently, the academic status of the learners was poor (Science Panel, 1992:20; Department of Education, 1998:8). According to the Science Panel (1992:40), in the aftermath of independence in 1991, a large part of the Ethiopian syllabi was discarded or rewritten either due to its ideological orientation or its omission of the Eritrean identity.

To address the need for appropriate syllabi, the then provisional Government of Eritrea started to use the syllabus that was in use during the armed struggle for independence. This syllabus has been used to teach the fighters and the civilians in the few liberated areas since 1976. According to the Curriculum Development Division (1997), the development of the biology syllabus started in 1976 during the struggle for liberation. Since then the biology syllabus has been revised three times, the last being in 1981. After independence in 1993, a preliminary survey was conducted on the biology syllabus and based on that the currently used biology textbook for grade eight was prepared in 1995. Since its preparation this textbook has been used as a source of information to both students and teachers.

1.3 Rationale for the study

In this section, I will provide the rationale for the study by highlighting the importance of textbooks in education and some problems of textbooks.

Skilbeck (1984:15) argues that education is the conveying and exchange of ideas. In education, the conveying and exchange of ideas take place mostly through textbooks. Ogunniyi (1983) argues that textbooks are essential tools in the learning and teaching process. Lynch (1984) further asserts that science textbooks play a major role in shaping the way science is taught and indeed how it is taught in the classroom. Furthermore, Wagiet (1991) contends that despite the current explosion in scientific information technology, textbooks still occupy an indispensable place in any educational system.

Clark (1997:390) argues that regardless of the future curriculum, it is inevitable that science textbooks in one form or another will remain as the primary sources for teaching and learning in the majority of the world. This is especially true in developing countries where schools are under-resourced and parents are financially incapable of affording other learning resources for their children besides the prescribed textbook. Eritrea as a developing country faces the above mentioned problem. Students depend on textbooks as a guide to learning. Teachers depend on textbooks as a teaching guide and a reference.

Despite their importance to both teachers and students, Wagiet (1991) argues that many textbooks use abstract and complex language and often are written beyond the readability level of many students. Furthermore, Vachon and Haney (1991:343) point to factors that contribute to textbook difficulty, among others, are the readability level of the textbook and the level of sophistication or abstraction of the textbook.

It is important to be able to determine whether students can read their textual material with understanding or not because these textual materials are frequently used to convey a great deal of information that the students get in education.

Influenced by the dependence of students and teachers on science textbooks and the need to determine whether the students can read their textual material with an understanding, the current study sets out to determine the readability of the Eritrean biology textbook for grade eight.

1. 4 Statement of the problem

In the preceding section, the role of textbooks in education has been highlighted. In addition, despite their importance, textbooks are prepared beyond the level of their intended students/users is indicated. In this section, the condition of the Eritrean biology textbook for grade eight will be outlined.

In Eritrea, the Ministry of Education centrally prepares textbooks. From my personal experience as a biology teacher, the writers of the biology textbook for grade 8 do not seem to write a meaningful textbook which is easily accessible by most of the students. Moreover, the prescribed biology textbook writers have not paid sufficient attention to the communication strategies used in the textbook. When the grade 8 students are asked to comment on the prescribed biology textbook, most of them claimed that the textbook is difficult for them to understand. They also perform poorly in classroom activities, tests, and examinations in this subject.

Moreover, in my personal observation as a teacher, there appears to be a gap between the expectations of the Ministry of Education of Eritrea and students' performance. Students' low performance, particularly in science has been a great concern both to the government and to the public in general. There is a public outcry that many students fail in their respective grade levels. There is a massive failure of students in the Eritrean Secondary Education Certificate Examination (ESECE). More serious, according to the review of ESECE in 1998, the results for biology were the poorest (Ministry of Education and University of Asmara, 1998:38).

Thus, students need to be provided with a textbook appropriate for their reading and comprehension ability. In order to comprehend the textbook the students ought to be

able to read and comprehend what they read on their own without anyone's help. Okpala (1982:102) contends that if students are provided with a textbook that is difficult to read they may be frustrated with it and may stop reading or their comprehension of the textbook will be poor.

It is from this point of view that I was motivated to study the readability of the Eritrean biology textbook for grade eight.

1.5 Purpose of the study

Textbooks are important tools in the teaching and learning process (Oginni, 1983). In this regard, Lynch (1984) affirms that both students and teachers depend on textbooks as a major source of information.

With this in mind, the purpose of the current study is to determine the readability of the Eritrean biology textbook for grade eight. In pursuance of the purpose of this study, the main research question is:

"How readable is the Eritrean biology textbook for grade 8?"

The subsidiary questions posited are:

1. Is the textbook readable for grade 8 students?
2. How much do students understand what they read on their own from the textbook?
3. What are students, teachers and Biology curriculum designer's perceptions of the appropriateness of the language used in the prescribed textbook for its intended grade eight students?

1.6 Significance of the study

The study will furnish useful information for the biology curriculum designer, the biology textbook writers and others interested in producing readable texts. Moreover, the study will serve as a platform for ongoing research on textbook readability studies.

1.7 Scope of the study

This mini-thesis was limited to a study of the readability of the Eritrean biology textbook for grade eight at the senior secondary school level in Eritrea. The study was confined to two administrative zones namely Southern Zone (Zoba Debub) and Central Zone (Zoba Maekel), out of the six administrative zones in Eritrea. To implement the study, four senior secondary schools were selected, that is two senior secondary schools from each of the two selected Zones. In the study, for data collection purpose, I employed both quantitative and qualitative research instruments.

1.8 Limitations of the study

Time was a major limiting factor in the study. I was given only three months for data collection in Eritrea. Unfortunately, this time coincided with first semester examination time and first semester vacation of the schools in Eritrea.

As a result of the time constraint, I was confined only to two administrative zones out of the six administrative zones in Eritrea. The study was confined only to four senior secondary schools in the two zones out of forty nine senior secondary schools distributed in the six administrative zones. Moreover, data for analysis of the readability of the textbook was based only on selected pages of each unit of the textbook. However, it is obvious that a single study cannot address all these issues at a time. Therefore, it is important to keep these limitations in mind if a research project is to be done in the future on this topic.

However, the findings of this study are applicable to the other senior secondary schools, if the situation of the other schools is the same as the schools where the study was carried out.

1.9 Organization of the study

For the sake of simplicity, the study is divided into five chapters. Chapter One serves as an introduction for the study. It deals with background, rationale, purpose, significance and limitations of the study. Chapter Two covers the literature review relevant to the study. It discusses the role of science textbooks in education, the need for readable textbooks, the role of language in teaching learning, and the measurements of readability. Chapter Three is concerned with the research methodology. This chapter focuses on the development of the different research instruments, sampling procedure, and administration of the instruments. Chapter Four deals with data presentation, analysis, and discussion. In Chapter Four the data collected through the different research instruments are presented, analyzed and discussed against the research questions by interrogating the available literature. Chapter Five provides a summary, recommendations and a conclusion of the study. This chapter summarizes the major findings of the study and provides recommendations that emerged from the study. A bibliography and appendices are included at the end of the study.

This chapter gives a general introduction to the study. It lays the foundation for the rest of the study by outlining the important points to be discussed in each chapter. In the next chapter, the literature review relevant to the study such as the role of textbooks in education, the need for readable textbooks, and the issues related to language will be discussed.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The extant literature review indicates that textbooks are the focal point of teaching and learning in schools. Appreciating the significant role that these important teaching-learning tools play in the educational process, careful selection of suitable textbooks is crucial. However, in Eritrea the centralized nature of the education complicates this matter, since schools are supplied with prescribed textbooks.

Emphasizing the role of textbooks in education, Clark (1997:390) contends that education by and large is a textbook activity. According to Strube and Lynch (1984:321), a textbook is defined as any written material designed to inform and to be used in schools. Textbooks are considered as written materials for school purposes (Potter & Rosser, 1992:669). If a textbook is to be of value to the students, it should be meaningful to them. In other words, they should be able to read, understand, learn, and develop new ideas from it. According to Ausubel (1968:76), “meaningful learning presents learning as a process of assimilation where new knowledge is linked to existing cognitive structure.” Cognitive structure refers to the stability, and organization of learner's subject matter knowledge in a given discipline. The actual ideas and information embodied in this knowledge are what Ausubel calls the cognitive content with respect to a given subject matter. Smith, Blakeslee and Anderson (1993:111) further note that meaningful learning of science involves coming to understand scientific ideas as they are used for their intended purposes, including description, prediction, and explanation of phenomena in the natural world.

This chapter commenced with a broad idea that textbooks serve as a major source of information in education. In line with this, the introductory section also signalled that textbooks should be meaningful for the students for whom they are written.

With this in mind, the next section of this chapter will focus on a discussion of the role science textbooks play in conveying information in education. In the present study, all the discussions pertaining to science textbooks will be applicable to the study of biology textbook, as biology is one of the science subjects. Section 2.3 reviews on the significance of readable textbooks as well as the literature pertaining reading and comprehension. Section 2.4 sets out the effect of language used in textbooks in teaching and learning process.

Section 2.5 highlights a discussion of the various methods used to measure readability of textbooks. Finally, the chapter is concluded by highlighting the main issues reviewed in the literature.

2.2 The role of science textbooks

Science textbooks constitute the major component of science instruction and both students and teachers depend heavily on them as their source of information (Ogunniyi, 1982; Yager, 1983; Chiappetta, Fillman & Sethna 1991). Wagiet (1991) argues that despite the current explosion in scientific information, textbooks still occupy an indispensable place in any education system. Clark (1997:390) affirms that irrespective of the future curriculum, it is inevitable that science textbooks, in one form or another will remain to be the primary source for teaching-learning science in the majority of the world, particularly in the developing nations. The heavy dependence of teachers and students on science textbooks is more critical in developing nations like Eritrea where firstly, laboratory facilities are inadequate (King, 1990:148). In other words, the students will not be able to gain additional understanding through hands-on activities which could help them to broaden their understanding. Secondly, when the syllabus is examination dominated which leads to the learning of factual information rather than comprehension and application of knowledge and skills. Thirdly, the lecture method is the predominant teaching strategy (Glasgow, 1988:20). This method of teaching does not allow students' participation in discussion where they could enrich their understanding.

The high dependence of teachers on textbooks is not only because textbooks prescribe what should be taught in the classroom, but also because they guide how teaching should take place. Teachers' reliance on textbooks as a source of information for their students' results in textbooks playing a decisive role in determining classroom events (Potter & Rosser, 1992:699). In this regard, Lynch (1984) points out that science textbooks play a major role in shaping why science is taught, and how it is taught in the classroom. Yore, Craig and Maquine (1998:27) ascertain that learning from traditional printed and electronic scientific texts has been and will continue to be an important method of achieving and maintaining science literacy.

Yager as cited in Yore (1991:56) points out that textbooks appear to imprison science teachers by being a major source of information and dictate the status of the whole instructional sequences. Yager suggests that the status of the whole science education can be summarized in a single word "textbook". Yager states further 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" (Yore, 1991:56).

From their research, Yager (1983) and Renner, Abraham and Grzbowski (1990:35) note that over 90% of all science teachers use a textbook 95% of the time. A study conducted by Wagiet (1991) in South Africa reveals that 87% of the teachers did not use any literature outside the prescribed textbook in teaching the ecology section of the standard eight biology syllabus, while only 13% of the teachers used other additional sources. This indicates that the content to be learned, teacher demonstrations to be done, students' investigations to be carried out, and the concepts to be formulated by the students are usually found in the textbook. Digisi and Willette (1995:123) summarize much of the current research on the beliefs about science textbooks, science curriculum, science instruction, and science reading. They argue that relatively few textbooks determine the science curriculum and dictate the mode of science education.

Science textbooks are frequently used to convey a great deal of the information that students receive in science course. Science textbooks influence how science teachers

organize the curriculum, and how students perceive the scientific enterprise (Exline, 1984; Harnes & Yager, 1981).

According to Wellington (2001), most science teachers assume that textbooks are an important part of science education. In practice, science textbooks have been used in a variety of ways during their relatively short history: to guide/control practical work, as a lesson filler, to provide professionally drawn diagrams, as a source of illustration (for example color photographs), to initiate a topic and generate interest in it, for providing questions/exercise either for classwork or home work, as a reference book or as a revision guide, for students' independent self-study (that is, for notes making), as a general source of homework, as a support for the teacher (for example, in lesson preparation and checking of key facts), in covering for an absent colleague and for propping up apparatus (Wellington, 2001:72).

Having in mind these purposes of science textbooks in education, the students who are supposed to use these textbooks should be able to read and understand the textbooks without any problem.

Language as a communication strategy in textbooks determines whether or not a textbook is comprehensible to the students. Pearsal (1999:293) defines comprehension as the "action or capacity of understanding." In addition, Laroche (1989) contends that the readability of a textbook is likely to be a major cause of learner difficulty, particularly for second language (L2) readers. This is particularly the same case in Eritrea where secondary school textbooks are written in English, a second language for the students. In Eritrea, the English language as a medium of instruction starts from grade six. Clark (1997:390) argues that the failure on the part of the textbook to communicate basic concepts due to a too advanced level of language use could lead to students' frustration, which in turn interferes with the development of favorite interest and academic success on the part of the students.

A great deal of the extant literature argues for the importance of textbooks in any educational system. In Eritrea, the use of the biology textbook for grade eight both by students and teachers is unlikely to be different from the literature reviewed. Then, if a textbook is to be valuable to students, it should be meaningful to the students.

However, the anecdotal evidence suggests that writers and publishers of the Eritrean biology textbook for grade eight have not paid sufficient attention to the readability level of the prescribed biology textbook for its consumer students.

The question is, is the Eritrean biology textbook for grade eight meaningful to the grade eight students? Therefore, as a researcher, it is from the spirit of the importance of these science textbooks in educational settings that motivated me to study the readability of the Eritrean biology textbook for grade eight.

2.3 Readability, Reading and Comprehension

The following section will focus on readability as a central aspect of matching a text with a reader (Jones, Evanchiew & Anderson, 1995). I describe the basic characteristics of readability followed with discussions on reading and comprehension.

2.3.1 Readability

Readability research grew out of the desire to find objective ways of measuring the difficulty of printed materials and determining whether or not textbooks were suitable for those using them. Research on the area of readability started in the 1920s. Since then, various authors have been defining the term readability in different ways. For instance, according to Jones *et al* (1995:28), "Readability is the matching of a text with reading and with understanding level of the learners." To Drew, Mikulcky and Pershing (1988), readability refers to the ease of comprehension.

In the broadest sense, Wagiet (1991:62) defines readability as the sum total (and interaction) of all those elements in a given piece of printed material, which affect the success that a group of readers have with it. Success in this context includes the extent to which readers understand or comprehend a printed material, read the printed material at optimum speed and find the printed material interesting. Furthermore Johnson (1979) asserts that readability is all the factors that affect success in reading and understanding of a text. These factors include interest and motivation, legibility of

print and complexity of words and sentences in relation to the reading ability of the readers. Graham (1978) sees readability as the aspect of a text that affects its appeal due to print size, vocabulary, content and style.

Gilliland as cited in Wagiet (1991:62) defines the concept of readability as the matching of a reader with a text. However, Gilliland argues that the ease of reading, the ease of comprehension, and the ease of finding a text interesting govern readability. Of the three factors governing readability, ease of comprehension is the most easily quantifiable and measures the length or frequency of words, or the length and complexity of sentences. From the three factors governing readability, the ease of comprehension has been the most adopted by researchers. In the current study, I was concerned to investigate the comprehension of the prescribed textbook for the grade eight students.

The readability level of a text is typically the average of readability levels of several pages sampled from the text. The readability level of a text is the grade level for which the text is appropriate according to a readability formula. (Armbruster, Osborn & Davidson, 1985:18).

The question, then, is what is a right textbook for students? According to Rog and Burton (2001/2002:348), "A just right textbook for instructional purposes is in one where the student/reader can read 9 out of 10 words and comprehend the meaning of the passage with little difficulty." Given that textbooks should be readable/comprehensible by their readers, it is apposite to ensure that there is no mismatch between readers and textbooks. The subject of mismatch has been discussed in the extant literature as one of the causes of learning difficulty in science at secondary schools (Yager, 1983). Regarding this, a study conducted by Soyibo (1996) in three Caribbean high school biology textbooks using the Flesch readability formula and the Frequency of Gobbledgook index formula indicated that none of the textbooks was likely to be readable and comprehensible for the target students (grades 9-11). Also a study conducted by Okpala (1982) in Nigeria, Oyo State, to determine the reading difficulty of five physics textbooks using the Flesch reading formula revealed that three out of the five physics textbooks were fairly difficult for their intended grade level learners, the third year high school students (grade 9 students). The

present study therefore sets out to identify the match or disparity of the grade eight biology textbook with its intended grade level learners.

2.3.2 Reading

Reading has a multiplicity of meanings (Smith, 1982:102). Influenced by this assumption, different outlooks on reading will be highlighted.

According to Smith (1982:104), “Reading is extracting information from a text.” To Bialystock (1994), reading is one of the most complex forms of cognition in which people routinely engage. It is the result of information extraction from visual, auditory, semantic, conceptual, and linguistic sources combining instantly to provide a rendition of each sentence or fragment. This must be combined with the background and inferential information and coordinated with the context and meaning of the whole passage. This is made more complex if the text is written in a language known imperfectly to the reader, or if the written code on the page is not the same as the one that is used to code the reader’s first language (Bialystock, 1994:4934).

Rush (1985) and Williams (1985) construct reading as an active process by which the writer communicates with the reader through the text. Moreover, according to Williams (1985), the writer codes the message into words and the reader decodes the words into messages. Therefore, reading is an act of communication between a writer and a reader through a text.

Meyer (1984) notes that a crucial question in the study of reading centers on how a reader constructs a mental representation similar to that intended by a writer. Osborn, Jones and Stein (1985) note the difficulties associated with constructing a mental representation similar to that intended by a writer are linguistic features such as syntactic complexity (word complexity), structure of the text, concept load, and vocabulary of the text. Also Harrison (1980) and Williams (1985) point out the difficulties associated with constructing a mental representation similar to that intended by a writer are: insufficient knowledge of the words that interlock the

subject, second language reader incompetence in English, insufficient intelligence, inadequate reading strategies and poor motivation.

If the above mentioned text difficulties and reader problems are resolved and students are provided with an appropriate textbook, then the students can construct a mental representation similar to that intended by a writer. Jones *et al* (1995:31) note that selecting texts that have appropriate reading levels motivate students' interest in reading. It is argued that if students are provided with appropriate reading materials, they would be able to read independently to cope with the dynamic technological changes.

Flanagan (1995:7) argues that the overall role of reading is to create an independent reader. An independent reader is someone who, reads for purpose, makes meaning from a text, identifies main ideas in a text, reads critically, and applies what is being read to certain situation in lifetime and who can learn from reading and learn about reading every time.

The present study will try to uncover whether or not the grade eight students will demonstrate if not all, some of the characteristics of an independent reader, such as reading critically, making meaning from a text, and identifying of main ideas in a text

2.3.3 Comprehension

It is hardly satisfactory to state baldly that estimating readability is a matter of predicting the extent of a reader's comprehension. We need to have some idea what is meant by comprehension. Smith (1982) provides a useful definition of comprehension:

As we read, as we listen to a speaker, as we go through life, we are constantly asking questions, and as long as these questions are answered we comprehend. We do not comprehend speakers of a foreign language if we cannot answer questions like, 'what are they trying to tell me'? And we do not comprehend a book or a newspaper article if we cannot find answers to our own questions concerning information that we believe resides in the print. Thus prediction is asking questions and comprehension is getting these questions answered (Smith, 1982:55-56).

Bond and Wagner (1960:200) suggest that comprehension is "a part of communication process of getting the thoughts that were in the author's mind into the reader's mind." Further, Pearsal (1999:293) defines comprehension as "the action or capacity of understanding" of written or spoken items. Ezel (1996:64) contends that most educators agree that reading comprehension is an essential skill for children's learning and for achieving success in school.

Comprehension is made up of a number of basic abilities, like skill in recognizing words and their meanings, in grouping words into thought units and giving the proper emphasis to the thought units so that the sentences can be understood. Moreover, comprehension is the ability to ascertain the relationship between the sentences in order that their meanings may be generalized into the meaning of the paragraph. Even the relationships between the paragraphs need to be understood so that the reader is able to arrive at the meaning of the total passage (Bond & Wagner, 1960:200).

Some factors which could contribute to text comprehension as outlined by Wood and Wood (1988), and could influence the ease with which a reader can process and retain information from a text, are complexity of the content idea, structural form of the text, and text reading level. Complexity of the content area is the historical development of the content to a given point of discipline in a given time. Science, the systematic ordering of causal sequences of phenomena, is one of the most established formal systems. Text structure refers to the way ideas in the text are organized to flow in logical manner to activate associations that enable the reader to reconstruct representation of the information, which can then put in schemas and retained in memory. The text reading level refers to a quantitative evaluation, which determines the grade level of the text.

Schnotz (1994) succinctly points out that in any educational setting, understanding a written discourse is a central point in knowledge acquisition. Schnotz considers reading comprehension as an active internal processing where in an individual constructs new knowledge structures on the basis of prior knowledge. Reading comprehension is an extraction of certain meaning from a text by a reader. Readers actively construct mental representations during comprehension based on their prior knowledge and certain processing strategies. Thus, the text is not a carrier of semantic

units, but a trigger for the mental construction process during comprehension (Schnotz, 1994:4940).

Developing this view further, (Wood & Wood, 1988:561) assert that the ability to comprehend science textbooks continues to be a major determinant of students' achievements in science. According to Runelhart and Norman cited in Wood and Wood (1988), comprehension of written material is an interactive process which occurs between the reader and the written material. Information is retained in the memory in the form of knowledge structure of schemata (worldview), which may be connected to one another to form meaning association between concepts.

Language as a communication strategy in textbooks determines whether or not a textbook is comprehensible to the students. In this regard, in the following section, the impact of language used in textbooks will be discussed

2.4 Aspects of language in textbooks

In Eritrea English language as a medium of instruction starts from grade six. Hence the current study focuses to explore whether or not the language used in the Eritrean biology textbook for grade 8 influences the prescribed textbook readability and thereby the students' comprehension of the subject matter of the prescribed textbook.

Ruis (1988:72) argues that authors of science textbooks assume that scientific concepts will mediate themselves irrespective of the language used and that language is somewhat neutral or transparent. This assumption, however, is invalid, because the language in which a text is written to a great extent determines whether or not the text will be comprehensible to the readers.

According to Thiji and Van-Der-Berg (1995) language interferes with science learning especially when English is used as a medium of instruction to second language (L2) learners. Rollnick and Rutherford (1996) assert that a second language learner could be alienated in the classroom due to language duality.

Furthermore, developing the same idea Thijs and Van-Der-Berg (1996) clarify the effect of language duality for second language learners in the following way:

The student in Africa has a language for school and a language for home. There is one name, which is used at school, and another used at home. One type of behavior is accepted at school and one at home. Because of this the student identifies the home and the school as two separate worlds and the student becomes, too, two people (Thijs & Van-Der-Berg (1996:93).

This dual language and behaviour hamper the students to use the language used at school with their parents and their peers outside the school. This results in lowering the students' ability to exercise the school language. This in turn results in lowering the ability of the students to understand the concepts that they learn at school.

Williams (1985) and Harrison (1980) contend that the language and grammar of a text affects the ability of the students to learn from a text. Furthermore, educators such as Chiappetta *et al* (1991) and Soyibo (1996) tried to describe the mismatch between the importance of textbooks and the language used by the textbook authors.

From their extensive studies in language, Cassels and Johnstone (1980) conclude that the problem in learning science is not only a matter of English as a second language but also of the technical language of science. To them, the language constraints with science learning is not only when English is used as a medium of instruction with second language users. They highlight that technical/scientific language is another constraint for the students, whether or not they are primary or secondary language users.

Moreover, Clerk and Rutherford (2000:702) indicate that the language used in science textbooks tend to become more and more specialized where the lengths, the connections, the embedded clauses and ellipsis have all added to the difficulties students' face in a written textbook. In addition, Laroch (1989) contend that the language of a textbook is likely to be a major cause of a learner's difficulty, particularly for second language (L2) learners as in Eritrea.

Flanagan (1995:109) notes that language can be used to learn the subjects in the curriculum, gain conceptual understanding of school knowledge, and develop thinking skills. Thus language is used as a tool with which to think and learn.

Developing this view, Vachon and Haney (1991:351) suggest that written curriculum materials, particularly, the textbooks, are basic tools in most educational system. Thus students must be provided with materials that take into consideration the language ability of the students for whom they are written.

2.5 Measuring readability

2.5.1 Readability formulas

As indicated earlier, readability is concerned with the problem of matching reader and text (Johnson, 1979). Readability can be measured using readability formulas. Readability formulas developed from an interest in matching reader's ability and text difficulty. Educators like Longe and Dale and Chall cited in Rush (1985:275) wanted to determine whether reading materials were suited for readers of given ability levels. Other researchers like Flesch and Gunning worked as writers, evaluating writing in progress to see if it matched the assumed reading skills of an intended audience (*Ibid.*).

According to Armbruster *et al* (1985:18), readability formulas are handy, objective, quantitative tools for measuring the difficulty of written materials without testing the reader. Readability formulas assess texts that have a wide range of content prose and style (Rush, 1985:275). Many educators use readability formulas to determine the appropriateness of texts and other curriculum materials for students at different grade levels. In other words, the educators determine the readability level of textbooks using the scores obtained from readability formulas.

The readability level of a text is typically the average of readability levels of several pages sampled from the text (Armbruster *et al*, 1985:18). According to Vachon and Haney (1991:345), the value for readability is determined independent of the reader

and takes into account the surface features of the passage, such as word and sentence lengths.

A number of formulas have been developed to measure readability of text materials. However, it is important to make judgement about which formulas are the best to use. According to Harrison (1980), a good readability formula needs to have the following attributes: it must be valid, it must be reliable and it must be reasonably straightforward. Based on these criteria, the Flesch formula, the Frequency of Gobbledgook (FOG) index and the Fry graph are preferred in the current study. Moreover, according to Harrison (1979), these formulas are frequently used because of their easy of sampling procedure, the simplicity in the equations, and that the factors measured reflect aspects of the difficulty of reading single word and sentence.

Flesch reading ease formula

The Flesch reading ease formula developed by Rudolf Flesch 1948 is still widely and frequently used. It measures the reading ease of a text using the variables of word length and sentence length. Reading ease represents the grade level/reading level that is required in order to be able to read the passage independently. Flesch reading ease ranges from 100 (very simple to read) to zero (very difficult to read). However, Harrison (1980) preferred the term "reading level to age level." The age level indicates the age at which those students whose reading competence is about average for their age should be able to cope with the passage. Instructions and interpretations of Flesch ease formula are present in Appendices A and B respectively.

Frequency of Gobbledgook (FOG) index

The FOG index is one of the easiest readability indices to work out and this fact makes it popular for readability measurement. The FOG index uses the variables of sentence length and number of polysyllabic words (words of three or more syllables) to measure the grade level of a text/passage (Harrison, 1980:79). Using the FOG index to calculate the readability of a sample passage is easier than the Flesch, since the polysyllabic word counts is easier than the total number of syllables in a sample passage and requires less time to calculate. For procedures of the FOG index see Appendix C.

Fry graph

The Fry reading graph developed by Fry in 1948 is the most straightforward way of obtaining a readability index for a text. Its graphical form is helpful for a number of reasons. The user of the graph can tell at a glance if the passage is, in comparative terms, more difficult than average in vocabulary or in sentence length (Fry, 1988). The Fry graph uses the variables of sentence length and word length (total count of word syllables) to determine the grade level of a passage/text (Long, 1991/1992:32). The curve of the Fry graph represents normal texts (Fry, 1968). Points above the line (towards top right quadrant) represent passages with higher than average vocabulary difficulty and points below the curve (towards bottom left quadrant) represent passages with greater than average sentence length. Instruction for the Fry graph is found in Appendix D.

Criticisms of readability formulas

Despite their wide usage, a number of criticisms are levelled at readability formulas. Some of the criticisms pertaining to these formulas are outlined below.

Readability formulas fail to measure the conceptual difficulties of a passage and are tedious and time-consuming (Duffelemeyer, 1982:4). Different readability formulas predict different grade level for the same passage/text (Armbruster *et al*, 1985:18).

Readability formulas, being strictly text based, do not address the interactive nature of the reading process-that is no direct account is taken of the reader (Anderson, 1994:1078 & Wellington, 2001:78). Popular readability formulas enjoy only a syntactic (sentence length) and semantic factor (vocabulary diversity) and do not directly address factors related to the communication of meaning (Rush, 1985:274). Also they fail to take into account many characteristics of text that are known to affect comprehension, for example, content difficulty and familiarity, organization of ideas, author style and page layout.

Readability formulas neglect characteristics of a reader that affect comprehension such as interest, purpose, and motivation (Dreyer, 1984). They focus on the 'surface feature' of printed materials and do not necessarily give accurate estimates of a student's ability to comprehend a written passage (Vachon & Haney, 1991:351).

Moreover, there is no causal relationship between the difficulty level measured by readability formulas and the actual difficulty a reader is likely to encounter (Wellington, 2001:78).

A good readability score does not guarantee comprehension because simplification of a text in terms of sentence length and syllable count may increase the difficulty of reading by rendering explicit relationships obscure (Wegerhoff, 1981). In this case long sentences and words are not necessarily more difficult than short ones.

Although readability formulas have a number of serious shortcomings as reliable instruments in measuring readability, they continue to be used widely. One of the reasons for their wide usage is that any person without any special training and special equipment can administer them.

Readability formulas deal only with one side of matching reading texts. To determine the readability of a text, the interaction between a text and a reader is crucial (Anderson, 1994:1078). Thus a two-way interaction between the text and the reader is vital to estimate the reading level of the students. Due to the drive to involve the reader in the reading interaction to make reading more interactive, researchers usually apply a cloze procedure.

2.5.2 Cloze Test

Development

The term cloze test procedure was first developed by an American researcher, Wilson Taylor, in 1953 to describe a new way of testing comprehension. Taylor explained his choice of the Gestalt principle of closure. According to him, closure is used to describe the tendency for a person mentally to complete or to make a whole an incomplete pattern (Harrison, 1980:84). Furthermore, closure is the completion of a written test or spoken test from which certain words had been deleted (Spearritti, 1994:3930). The cloze procedure measures the extent to which a reader can predict deleted words that the author originally used. Puhl (2000) also substantiates the use of cloze procedure by saying that it is a language rich resource that can be reconstructed

by any teacher and even by the students themselves for one another. Sparritti (1994:3931) affirms the appropriateness of the cloze test for testing reading comprehension, both in the mother tongue and for second and foreign language learners.

In a standard cloze test, the tester deletes every n^{th} word, for example, every 5^{th} or 7^{th} word from a passage. There are a number of alternatives as to the rate of deletion of words in a standard cloze test. Some researchers claim that 5^{th} word deletion is attractive, as it is cheaper to obtain more items per printed page. MacGinitie cited in Harrison (1980) argues that if the deletion rate falls below five, a cloze test becomes increasingly difficult because the amount of information available is too low to allow the normal process of redundancy to occur. MacGinitie adds that once the rate of deletion rises above seven, the reader does not gain enough information by being shown increasingly longer stretches of running text between deletions. Klare, Sinaiko and Stolurow (1972) suggest that 7^{th} word deletion is preferable if the readers are comparatively weak or the passage is likely to be found difficult.

The readers are required to reconstruct the author's message through a mixture of perception and guesswork. Success at this task has been shown to be a measure of reader's comprehension of the reading material. The higher the percentage of correct responses, the more readable a passage is understood to be (Graham, 1978; Harrison, 1980). The cloze procedure focuses on how the students make meaning from a text and on how the idea of a text comes together. It takes into consideration the appropriateness as well as the functions of the various words.

Advantage

According to De Santi cited in Vachon and Haney (1991:350), a cloze procedure measures the reader's reading comprehension, logical language production, ability to deal with grammatical structure of printed language, words recognition and word identification. Furthermore, Ballstaedt and Schnotz (1994:968) and Anderson (1994:1078) note the dual advantage of the cloze procedure in that it measures two aspects: the readability of the text and the subject's/reader's comprehension of the text.

During readability measurement, cloze procedure can measure readability of a text but not predict readability of a text. This is because it only indicates whether or not a text is readable for a given target group/grade level, but it does not indicate to which target group/grade level a text is readable/appropriate as the readability formulas do.

Cloze procedure has three main advantages. First, it measures the difficulty of a passage itself. Second, it measures what a reader brings to a passage in terms of content knowledge. Third, it measures the difficulty of every single word, phrase and sentence in the entire passage.

In standardized comprehension tests the cloze procedure gives a general indication of the overall level of reading attainment of the reader. In diagnosing individual reader's abilities or deficiencies, cloze procedure reveals the reader's redundancy utilization—that is the ability of the reader to use the information surrounding a deletion as a basis for correctly predicting the missing word. From the answer that the reader offers, it helps a researcher to understand about an individual reader's attempt to interrogate the text and reconstruct its meaning.

Shortcomings of cloze procedure

Just the readability formulas have a number of shortcomings in determining readability of a text, cloze procedure also has a number of shortcomings in its application and in determining the reading difficulty of a text and comprehension ability of the students.

Cloze procedure measures readers' ability to make educated guess. But if the reader is a poor guesser, the failure to complete the blanks may be due to a number of problems such as lack of comprehension, inability to tolerate frustration and inability to decode. It thus becomes difficult to identify true comprehension problems from other skill deficiencies which could interfere with comprehension (Wagiet, 1991). In a cloze procedure, for certain reasons, readers may perform better than their actual ability. One of the reasons that readers could perform better than their actual abilities could be due to guess work or by chance.

Cloze procedure is inappropriate for certain kinds of contents, for example, mathematics. Sufficient content redundancy should be presented so as to allow guessing of the missing words. The requirement that only exact responses be counted as correct is questioned by teachers and students (Leeser, 1978:162). This is because during counting only the correct answers will be taken into consideration.

Cloze procedure fails to measure how meaningful a text is and is unable to examine the comprehension ability of the students. Ashby-Davis (1985) argues that making an educated guess on omitted words is not the same as guessing the meaning of an unknown word by checking the content. The reader has to read to reach the words best matched to the passage's meaning, style, logic, purpose, and tone. Thus, cloze procedure is a test of production rather than assimilation of the text

Despite its drawbacks, cloze procedure has been widely used as a criterion of choice for measuring comprehension and has proven an effective method of measuring readability of textbooks (Doidg, 1997).

To compensate for the limitations of the cloze procedure, researchers such as Ogunniyi (1999) employed Word Difficult Index test.

2.5.3 Word Difficult Index (WDI) test

According to Daniels (1996:62), there has been interest over a considerable time in the problems students are thought to have with the understanding of written resources in science. Daniels adds that one problem has been perceived to be the variation commonly used in scientific writing in the use of language so that it is appropriate for the purpose, situation and the intended audience. Gray (1999:265) notes that learning of science makes its own demands due to the complex and often abstract nature of the concepts evolved and the specialized terminology that has evolved in science. Martin cited in Daniels (1996:62) affirms that students need to understand the particular technical terms used in science textbooks and that science is unthinkable without the technical language it has developed to construct its worldview.

Koch and Eckstein (1995:625) note that understanding of technical and non-technical words used in texts is an essential skill for the future for the students to keep abreast of new developments in their future studies. Further, according to DiGisi and Willette (1995:123), the importance of being able to understand and explain in clear language the meaning of fundamental scientific concepts is central to scientific literacy. Ogunniyi (1999:122) affirms that science has its own language and it is important that the language and the underlying assumptions and generalizations in the textbook is fully understood by the students.

It is, therefore, important to be able to determine whether the students can read their textual materials with understanding.

The WDI developed by Ogunniyi (1999) has a central task to measure the extent to which the students understand or fail to understand both technical and non-technical words used in a text. It is also concerned, unlike the readability formulas and the cloze procedure, with how meaningful a passage is rather than with measuring word and sentence length. When Ogunniyi (1999) applied the WDI test in his study, he was also concerned with determining the understanding of second and third language readers with regard to scientific texts.

2.6 Conclusion

In this chapter the wide usage of science textbooks in conveying educational information, the need for readable textbooks and the role of language in the teaching and learning process have been discussed.

The literature pertaining to science textbooks, supported by empirical studies, indicate that both students and teachers depend on textbooks as a major source of information in the teaching and learning process. It is also indicated that textbooks should be readable for the students for whom they are written. Despite their importance, however, the literature reviewed indicated that science textbooks are usually written beyond the readability level of the students for whom they are written.

Regarding language, it is indicated that language as a means of communication plays a decisive role in the teaching and learning process. The literature reviewed signalled that language is not only used as a means of communication with others socially, but also used as a tool with which to think and learn. However, it is indicated that the language used in textbooks becomes a major concern in education, especially, for second language learners. This condition is very relevant to the current study where the Eritrean biology textbook for grade eight is written in English, a second language for the Eritrean students.

A broad discussion on the measurement of readability of textbooks indicated that each measurement instrument has its own merits and demerits. It is highlighted that proper and wise usage of these readability measurements could provide a substantial understanding about the readability of a textbook.

In the succeeding chapter, the methods and procedures used for data collection in the study to determine the readability of the Eritrean biology textbook for grade eight will be discussed.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter commences with a discussion of the research design used to collect data to determine the readability of the Eritrean biology textbook for grade eight. Then, I discussed the importance of using more than one research method for data triangulation. The next section sets out the development of the different instruments used in the study. A fourth section of this chapter addresses sampling and sampling procedure. The fifth section deals with the process of administering the different instruments. Finally, the procedures used in data collection and analysis are highlighted.

3.2 Research design

A careful and artful combination of quantitative and qualitative research methods greatly strengthens a research design (Reviere, Berkowitz, Carter & Ferguson, 1996:54). Influenced by this assumption, I preferred to design the study within the quantitative and qualitative research methods.

Quantitative research is a process of data collection and data analysis that involves the collection, aggregation and analysis of numerical data or that, which can be expressed in numeric form (*Ibid.*). Moreover, Maykut and Morehouse (1995:2) contend that quantitative research is based on observations that are converted into discrete units that can be compared to other units by using statistical analysis. Statistical analysis is an essential part of quantitative research.

In line with this, Fuller and Petch (1995:200) confirm that

Quantitative research refers to data which is in numerical form, lending itself to producing frequency counts, averages, and percentages. ... Quantitative research has come to mean objective inquiring based on measurable variables and provable propositions.

Similarly, for Fitz-Gibbon and Morris (1987:10), quantitative data comes in numbers. Quantitative data analysis assumes that data, if it exists, it exists in some quantity and can be measured.

However, quantitative research is confronted with some criticism. According to Parker (1998:2), quantitative research attempts to screen out interpretations, and to imagine that it is possible to produce a clear and unmediated representation of the object of study depending on solely on data for definite conclusion. Silver (2000:29) affirms that a dependence on purely quantitative methods may neglect the social and cultural construction of the variables which quantitative method seeks to correlate.

In the current study to address the criticism of the quantitative research method, I incorporated the qualitative research method.

Qualitative research is defined as the interactive study of a specific issue or problem in which the researcher is central to the sense that is made (Parker, 1998:2). Silver (2000:9) argues that qualitative research is essentially a matter of immersing a researcher in a naturally occurring set of events in order to gain firsthand knowledge of the situation. Silver adds that the researcher is attempting to document the world from the point of view the people studied. Hammell and Carpenter (2000:5) maintain the same argument as Silver that fundamental to qualitative research is a concern to describe and understand how people make sense of their lives and every day realities. Taking a similar position, Jongbloed (2000:14) and Reviere *et al* (1996:54) contend that the most salient reason to use qualitative research is that it offers an opportunity to create an in-depth understanding of a particular group of people in a particular setting. Jongbloed and Reviere *et al* add that qualitative research helps to explore respondents' views and perspectives in the respondents' own terms and framework of understanding. As Maykut and Morehouse (1995:2) observed, qualitative research

generally examines the words and actions in a narrative or descriptive way more closely representing the situation as experienced by the participants.

However, like quantitative research, qualitative research has some limitations. Fuller and Petch (1995:200) point out that qualitative research usually deals with a small sample size. In a similar way, Berg (2001:10) criticizes qualitative method in that it fails to allow for representativeness and sufficiency of sample size to allow statistically meaningful results. Moreover, a critique of qualitative research forwarded by Silver (2000:10) relates to the problem of anecdotalism revealed in the way in which research reports appeal on a few telling examples of some apparent phenomena without any attempt to analyze less clear or even contradictory data. In addition, Gay (1981) and Nachmias and Nachmias (1990) criticize qualitative method in terms of cost. For them, the qualitative method of collecting data is expensive and time consuming, and the cost involved in organization, travel, collecting and processing the data is high.

However, according to DePoy and Gilten (1994), quantitative and qualitative research methods can be combined in three ways. Firstly, quantitative and qualitative methods can be used to increase understanding about a particular issue. Secondly, one primary framework (quantitative or qualitative) may be used, but strategies from the other can be borrowed. Thirdly, the frameworks of the two methods may be used within a single research project to address different questions. More precisely, Jongbloed (2000:20) contends that quantitative research aims to explain or predict relationships between variables and to verify theory while the qualitative research aims to enhance understanding of multiple perspectives of reality and to develop theory. Therefore, both methods can be used within a single study to answer different questions or different parts of the same research question.

Influenced by this assumption, I employed both quantitative and qualitative methods to collect data for the study. Through the quantitative method, I was able to capture a larger sample size than that through the qualitative method. I was therefore able to get broader statistical information for the study. Through the qualitative method, I could get the reflection of the subjective reality of the readability of the biology textbook for grade eight from the subjects of the study (students, teachers, and biology curriculum

designer). Moreover, in a survey study, data is collected to make conclusions. Hence, I used both quantitative and qualitative research methods to capture reliable data to make sound conclusions in the study.

In the research, as mentioned above, I used more than two instruments to collect data for the study. The use of more than two instruments enables a researcher to triangulate the data collected for a study. Moreover, the triangulation of data helps a researcher to crosscheck the results, to control subjectivity, and to increase the validity of the results. Berg (2001:5) asserts that triangulation is not a simple combination of different kinds of data but an attempt to relate them so as counteract the threats to validity identified in each method. Furthermore, Berg contends that triangulated data collection uses multiple data gathering techniques to investigate the same phenomena. Excessive reliance on one method may bias a researcher's picture of the phenomena under investigation. Therefore, methodological triangulation in which different methods are used on the same subject of the study (Cohon & Manion, 1989) was preferred in this research. With triangulation in mind, I used different research instruments to investigate the readability of the Eritrean biology textbook for grade eight.

In the following section, the development of the different research instruments used for data collection in the study will be discussed.

3.3 Research instruments

To determine the readability of the Eritrean biology textbook for grade eight, I used five different instruments of data collection. These instruments are readability formula, cloze test, word difficulty index, questionnaire, and interview.

3.3.1 Readability formulas

In the study, I determined the readability of the Eritrean biology textbook for grade eight using three different readability formulas. They are the Flesch readability formula developed by the Flesch (1948), the Frequency of Gobbledgook (FOG)

index, and the Fry readability graph developed by Fry (1968). These readability formulas were selected for their simplicity, precision, ease of interpretation, adaptability, and popularity (Harrison, 1979). Moreover, they use easily quantifiable aspects of a text such as word length and sentence length. (See 2.5.1 and Appendices A, C, and D).

3.3.2 Cloze test

The Cloze procedure developed by Taylor in 1953 is a test done to measure the comprehension ability of a subject/subjects to a given text material (Taylor, 1953). The cloze procedure has been in use since 1950s, first to test readability of text materials, then for testing language proficiency and for teaching purposes (Puhl, 2000).

Procedure for the cloze test

The procedures of the standard cloze procedure as outlined by Harrison (1980), Anderson (1994:968) and Ballstaedt and Schnotz (1994:1078) are:

- systematically selecting a passage relevant to the study from text at least 200 words in length
- leaving the first sentence of the selected passage intact, every n^{th} word is mechanically deleted
- the deletions are represented with equal space.
- the passage is usually typed
- the students/examinee fill in the missing words, using their guesswork or predictions to fit the content of the passage
- in scoring only exact word replacement is counted correct.

In a standard cloze test, regarding the rate of deletion of words, there are a number of alternatives. Some researchers claim 5th word deletion, as it is cheaper to obtain more items per page. Klare *et al* (1972) suggest that 7th word deletion is preferable if the readers are comparatively weak or the passage is likely to be found difficult. In the present study based on Klare *et al* (1972) claim the 7th word deletion was used.

Modification of the cloze test

Since its development, a number of modifications have been reported over the original cloze procedure. Of the many modifications two are appropriate for this study. According to Anderson (1971:80), the deleted word should be replaced with a blank of the same length as the word deleted. As Baldauf and Propst (1978:453) note the examinees should be provided with a multiple choice from which to choose to fill the blank space. In the present study, the modified cloze procedure, particularly, the multiple-choice format that also had been recently developed by Ogunniyi (1999) was used. This multiple-choice completion cloze test helps students as a guide to fill the missing words from the passage.

Interpretation of cloze test scores

In the cloze test, scoring is based on the percentage of words filled by the readers that match the original text exactly. These figures used as yardsticks in interpreting cloze test scores as identified by Bormuth (1967 &1968) are referred to as reference criterion. Wegerhoff (1981) contends that the scores obtained by the readers in the cloze test are the mean percentage of the correctly predicted words. The mean results may be used either to rank the students/readers as to their reading ability in terms of comprehension or to rank the passage/text as to its level of readability, that is, reading difficulty.

Rush (1985 citing Bormuth 1968) indicates the following criteria for judging the match between text difficulty and reading ability on cloze comprehension tests:

- 57% exact replacement places the material at the readers' independent reading level
- 44% to 56% exact replacement places the material at the readers' instructional level
- below 44% exact replacement places the material at the readers' frustration level.

In the present study, to determine the reading difficulty of the grade eight biology textbook for the grade eight students, I adopted Bormuth's (1967 and 1968) reference criterion. Bormuth's (1967 &1968) reference criterion suggests the following

criterion for judging the match between test difficulty and reading abilities for the modified cloze test (multiple choice comprehension test):

- independent level (a score of 90% and above) where the reader can read and understand without any help
- instructional level (a score of 75%-89%) where the reader can read and understand with little help from a teacher
- frustration level (a score below 75%) where the reader cannot make any satisfactory progress even with the help from a teacher.

3.3.3 Word Difficulty Index (WDI) test

In the current study, the word difficulty index developed by Ogunniyi (1999) was used. The WDI test is expected to measure the comprehension capacity of the subjects to a given passage. The word difficulty index process enables a researcher to determine the students' capacity for understanding technical terms especially, in the current study, biological terms used in the Eritrea biology textbook for grade eight. In the WDI test, subjects are expected to underline any word that they do not understand in a given passage. The subjects are also required to write one sentence in their own words that they think best describes the passage.

3.3.4 Questionnaire

Since I could not interview all the students who participated in the study, I used a questionnaire to obtain more contextual information for the study from all the students.

A questionnaire is a set of questions/statements distributed to individuals for self-completion, most generally by ticking predefined categories or writing in answers (Fuller & Petch, 1995:56). Questionnaires are a very flexible approach for gathering information on almost any topic because they are used to reflect attitudes, perceptions, views, and opinions of people about certain issues (Black, 1999:215). Using a questionnaire has a number of advantages and disadvantages. Some of the advantages

and disadvantages of using questionnaire in surveys agreed by Nachmias and Nachmias (1990) and Sudman and Bradbrum (1991), are the following.

Advantages

Using a questionnaire is cheaper than using an interview because it does not require a trained staff of interviewers. Processing and analyzing data are simpler and cheaper than that of the personal interview. It reduces biasing errors that might result from personal characteristics of interviewers and from variability in their skills. It ensures anonymity especially when surveys deal with sensitive issues. It gives a chance for subjects to consult documents. It permits wider geographic contact with minimal cost, whereas interviewing could require expensive travel costs and time for interviewers.

Disadvantages

A questionnaire can be used as an instrument for data collection only when the questions are straightforward enough to be completed solely with the help of printed instructions and definitions. There is no opportunity to probe beyond the given answers, to clarify ambiguous answers, or to appraise the non-verbal behaviour of respondents. Researchers have no control over the respondents' environments, thus they cannot be sure that the right person completes the questions. There is little control over the completeness of the answers. When the respondents do not understand or do not want to say something, they may just leave out a question. The final disadvantage is that the return rate is usually less than for personal interviews. This higher rate of non-respondents could have a bearing on the research finding. Therefore, the effect of the non-respondent group is likely to introduce a serious bias into the study.

3.3.5 Interview

Interviews were the final source of data collection in the study. An interview is one of the research instruments used in a qualitative research. One of the advantages of the qualitative research is to explore respondents' view in their own terms and framework of understanding. Influenced by this assumption, to explore the views of the

respondents of my study (students, teachers and Biology curriculum designer) I used an interview.

An interview is a face-to-face conversation between an interviewer and an interviewee (Ogunniyi, 1999). Furthermore, an interview is a conversation with emphasis on the researcher asking questions and listening and the respondent answering (Warren 2001:83). An interview is a conversation with a purpose (Burman, 1998:51). The purpose of an interview is to find out what is in the people's mind and what they think or how they feel about something (Fraenken & Wallen, 1997:383). An interview has two major forms: namely unstructured and structured forms (Burman, 1998:51). The unstructured interview is open, having greater flexibility and freedom. In contrast to it, a structured interview is one in which the content and procedure are organized by means of a schedule (Ogunniyi, 1992).

According to Gay (1981) and Brewer and Hunter (1989), using interviews in research have a number of advantages and disadvantages.

Advantages

When properly used an interview can produce in-depth data not possible with a 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 a trusting relationship, the interviewer can obtain information that subjects would not give on a questionnaire. More accurate and honest responses can be obtained since the interviewer can explain and clarify the questions. An interviewer can follow up on the incomplete or unclear response, that is, the interviewer can probe. Probing has the advantage that it motivates the respondents to elaborate or explain the reasons behind an answer and helps to focus the conversation on the specific topic of the interview. In interviews, there is higher rate of returns, and complete answers to all questions can be obtained, which can contribute to accuracy, validity and reliability of data and thereby to valid conclusions.

Disadvantages

Using interviews as a means of data collection in research is more expensive and time

consuming than questionnaires. Interviews, generally, involve small samples. With the expense indicated above, it will be difficult to interview many people and thus the information that can be obtained from a small number of population may not be as valid as needed. The response given by an interviewee may be biased and affected by her or his reaction to the interviewer. An interview requires a level of skill usually beyond that of a beginner researcher. The interviewee lacks anonymity, especially when the topic or some of the questions are of a sensitive nature. Nachmias and Nachmias (1990:242) contend that the interviewer knows the interviewees. Consequently, the interviewee may feel threatened or intimidated when the topics or some of the questions are of sensitive issues.

3.4 Sampling procedure

For the study four senior secondary schools were selected by purposive (convenience) sampling. According to Cohon and Manion (1989), convenience sampling is a process that involves choosing the nearest individuals to serve as respondents. Furthermore, with purposive sampling, the sample units are selected subjectively by the researcher who attempts to obtain a sample that appears to be representative of the population. The chance that a particular sampling unit will be selected for the sample depends upon the subjective judgment of the researcher (Nachmias & Nachmias, 1990:185).

Based on the above merits of purposive sampling, the schools were selected based on their proximity and ease of access for me, as a researcher. Two of the schools were selected from the Southern Zone where I stayed while collecting the data for the study, and the other two were found in Asmara the capital city of Eritrea in the Central Zone. The two schools in the Southern Zone were situated in the semi-urban context while the two schools in the Central Zone were in the urban setting. This helped me to compare the readability of the Eritrean biology textbook for grade eight between semi-urban and urban students.

To comply with the ethics of research principles, informed consent, anonymity, confidentiality, accurate portrayal of situations and persons were exercised.

In research, according to Nachmias and Nachmias (1990:322) and Hammell and Carpenter (2000:9), there should be informed consent and participants should know that their involvement is voluntary at all time. They should receive a thorough explanation beforehand. Furthermore, according to Tindall (1998:15) and Sierpinska, Kapatick, Balacheff and Howson (1993), closely interwoven ethical issues are informed consent, protection of participants, anonymity, confidentiality and accurate portrayal of situations and persons in a research.

From the ethical point of view, to safeguard anonymity of the schools, the schools were coded as School A, School B, School C, and School D. School A and School B are found in the Southern Zone and situated in the semi-urban context, while School C, and School D are found in the Central Zone and situated in the urban setting.

From each school one class/section of grade eight students were selected randomly. In the context of Eritrea a class/section is a group of students having the same level taught together under one roof. Random sampling is a procedure that ensures that every sample unit of the population has an equal and known probability of being included in the sample for the study (Nachmias & Nachmias, 1990:187). This strategy reduces bias in the sampling. In each of the selected school, I wrote the names of all grade eight sections each on a piece of paper. I rolled up each piece of paper and collected in a box. I mixed up all the pieces of papers. I randomly picked up one paper. Then, the section written in the paper became the subject of my study. All in all four sections (one section from each school) were selected. As a result, 229 students (134 male and 95 female students) were selected for the study. The role of the students in the study was to be involved in a cloze test and word difficult test, and to fill in questionnaires. Eight students were to be interviewed. These eight students were those who scored the lowest in the cloze test (see 3.5.5.1).

Table 3.1 shows the students in terms of sex, age and school to which they belong.

Table 3.1 Students who participated in the study

School	Sex		Total	Age in years												Total
	M	F		12	13	14	15	16	17	18	19	20	21	22	23	
A	49	22	71	-	-	5	10	10	14	16	13	3	-	-	-	71
B	36	20	56	-	-	2	9	7	9	10	7	9	-	2	1	56
C	24	25	49	1	3	8	18	7	3	6	3	-	-	-	-	49
D	25	28	53	-	3	12	7	17	8	3	3	-	-	-	-	53
Total	134	95	229	1	6	27	44	41	34	35	26	12	-	2	1	229
Percentages				0.44	2.6	11.8	19.2	17.9	14.9	15.3	11.4	5.2	-	0.87	0.44	100

From the four selected schools, four biology teachers (one teacher from each school) were selected for an interview. The teachers with the longest teaching experience (in years) in biology grade eight were selected. The underlying assumption for selecting teachers with the longest teaching experience is that they could have a great deal of knowledge about the strengths and weaknesses of the biology textbook for grade eight. In addition, they will be able to identify the problems that the students faced while using the textbook.

3.5 Administering the research instruments

Before the collection of data, to comply with ethical research principles, permission was sought and received from the Eritrea Human Resource Development (EHRD) office and the Ministry of Education (MOE) in Eritrea.

At the beginning of the study, I visited each school and the office of the biology curriculum designer. Then, I submitted the letter requesting access to the principals of each school and the biology curriculum designer. After gaining access, I introduced myself and explained the aim of the study. The principals of each school allowed me to select randomly one section of grade eight students from their respective schools. The selected students were briefed about the study. From the code of ethics point of view, to comply with informed consent (Hammell & Carpenter, 2000:9), I requested

the students to participate in the study. All the students in the four schools were willing to participate in the study.

Again, I requested the principal of each school to allow me to discuss the aim of the study with all grade eight biology teachers in her or his school. After securing permission, I discussed my study with the biology grade eight teachers, and that I needed one teacher with the longest teaching experience (in years) in grade eight biology for an interview. Accordingly, I interviewed four grade eight biology teachers. In the study all the subjects remained anonymous and the information from them remain confidential.

3.5.1 Readability formulas

The grade eight biology textbook has eight units. To collect data to determine the readability of the textbook, twenty four (24) different sample passages each of one hundred (100) words length were selected from the textbook. From each unit, three different sample passages of a hundred words length (one sample passage from the first page, one sample passage from the middle page and one sample passage from the last page before the review question page) were selected. These twenty four sample passages were analyzed to determine the level of readability of the prescribed biology textbook using the Flesch reading ease, the Frequency of Gobbledgook index and the Fry graph formulae. (For calculations and interpretations of each formula, see Appendices A, B, C and D respectively).

3.5.2 Cloze test

In administering the cloze test, I constructed a passage (see Appendix E) from the topics already discussed by the students in their biology lessons. In the cloze test passage, except in the first sentence, every seventh (7th) word was deleted. Fifty words (numbered 1-50) were deleted from the passage. Each deleted word was replaced with an equal space, that is, with six dots. For each deleted word, four possible answers designated by, A, B, C, and D were provided in a separate answer sheet (see Appendix F).

The students were requested to choose the best answer and write the letter for that choice in the space given. The students were allowed to ask for clarification in the meanwhile. They were also given enough time to avoid time constraint while doing the cloze test. I administered the cloze test in a classroom setting. All the students selected (see Table 3.1) from the four schools participated in the cloze test.

3.5.3 Word difficulty index (WDI) test

The passage for the word difficulty index (see Appendix G) was selected from the topics already covered by the students in their biology lesson. The students were asked to underline any word that they did not understand in the passage, and also to write one sentence in their own words, which they thought best described the passage. I administered the WDI test to the 229 students already selected from the four schools.

3.5.4 Students' questionnaire

I developed the questionnaire items. All the questions were closed. Each question was provided with multiple choices from which the students were supposed to choose. According to Johnson (1994:114), the students' level of literacy must also be considered in constructing the questionnaire items. In line with this idea, the questionnaire items, which were first prepared in English, were translated into Tigrigna (Eritrean language), assuming that the students could understand and answer the questionnaire items properly in their own language. The detail of the questionnaire is found in Appendix H.

I distributed the questionnaires to all 229 selected students in the four schools in a classroom setting. I clarified the procedure for the students while completing the questionnaire. The students were given enough time to complete the questionnaire. I collected the completed questionnaires personally. All the questionnaires distributed were returned, that is, a 100% return rate was achieved.

3.5.5 Interviews

Kane and Brun (2001:15) contend that a semi-structured interview allows flexibility while collecting data. A semi-structured interview enables an investigator to sufficiently probe the response made by the interviewee and to control the interviewee not to deviate from the topic intended (Denzin & Lincoln, 1998:52). Influenced by this idea, I decided to use a semi-structured interview to obtain more information about the readability of the Eritrean biology textbook for grade eight from the subjects of the study (students, teachers, and the biology curriculum designer). To solicit the permission and cooperation of the interviewees, I met each interviewee individually. Moreover, to comply with the research ethics, I promised that anonymity and confidentiality would be preserved.

The interviews were conducted at a mutually convenient time and place for the interviewer and interviewees. The interviews were conducted in laboratory rooms, duplicating rooms and other places preferred for their silence. All the interviews were conducted individually to safe guard anonymity of the interviewees. In addition, in order to keep the names and identities of the interviewees, I coded the names of the interviewees. All the responses were tape-recorded.

3.5.5.1 Students' interview

Before interviewing, the interview questions that were originally developed in English were translated into Tigrigna (Eritrean language). This was done on the assumption that the students could properly understand and answer the questions better in their own home language than in English.

Eight grade eight students were interviewed. Two students (with the lowest results in the cloze test) were selected from each school. This selection was done in order to identify their problems in the readability of the biology textbook for grade eight. The responses that were in Tigrigna were transcribed and translated into English. The students' interview questions are found in Appendix I.

3.5.5.2 Teachers' interview

Regarding qualification, except one teacher a diploma holder in science education, the others were bachelor's degree holders in biology. As already mentioned in 3.4, the interviewee teachers were selected on the basis of the longest teaching experience in biology for grade eight. Based on this, four biology grade eight teachers (one teacher from each selected school) were interviewed about the readability and other matters relating to the prescribed textbook. The responses were tape recorded and transcribed for analysis. A detail of teachers' interview is present in Appendix J.

3.5.5.3 Biology curriculum designer's interview

The biology curriculum designer has a bachelor's degree in biology and a Masters degree in Education (M. Ed.). The biology curriculum designer has a teaching experience of eighteen years. He has only two years of experience in the biology curriculum designing to date. In Eritrea, there is only one biology curriculum designer for all senior secondary grades: grades 8, 9, 10, and 11. An interview was conducted with the biology curriculum designer about the readability of biology textbook for grade eight. The responses were tape recorded with the permission of the respondent. The responses were transcribed for analysis. Detail of the interview questions is present in Appendix K.

3.6 Data collection and analysis

As indicated in the preceding sections, data regarding the readability of the biology textbook for grade eight were collected using different instruments. The following section discusses the processes of data collection and data analysis.

Flesch reading ease formula

The Flesch reading ease formula uses the variables of sentence length and total syllable counts to determine the readability of a written material. In the study, I selected three samples of passages of 100 words length from each unit (see 3.3.1). I collected the data for each sample passage applying the Flesch reading ease formula

(see Appendix A). I analyzed the result using interpretations of the Flesch reading ease formula (see Appendix B) to suite each sample passages to its appropriate grade level. Following the same procedure, I collected the data for every sampled passage of the unit and analyzed using interpretations of the Flesch reading ease formula.

To obtain the average sentence length of each unit, I added the three sentence lengths of the three sample passages, and divided by three to get the average length of each unit. To obtain the average syllable count of each unit, I added the three syllable counts of the three sampled passages of each unit and divided by three. Using the average sentence length and the average syllable counts, I analyzed the readability of each unit. At last, I determined the readability, that is, grade level of the textbook by taking the average readability of all the units.

Frequency of Gobbledgook (FOG) index

The Frequency of Gobbledgook (FOG) index uses the variables of sentence length and the percentage of polysyllabic words (words of three syllables or more) to determine the grade level/reading level of a written text. As mentioned above, I selected three samples of passages of 100 words length from each unit (see 3.3.1). I collected data for each sampled passage of each unit using the FOG index formula (see Appendix C). The number obtained using the FOG index formula, by rounding it off to the nearest whole number, was analyzed to be the grade level for which the sample passage is appropriate.

To obtain the average sentence length of each unit, I added the three sentence lengths of the three sample passages, and divided by three. To obtain the average polysyllabic words of each unit, I summed up the three polysyllabic counts of the three sample passages and divided by three. At last, I determined the grade level of each unit using the average sentence length and the average polysyllabic counts applying the FOG index formula to situate each unit to its appropriate grade level.

Fry reading graph

In the Fry reading graph, the variables used to determine the grade level of a written text are the number of sentences and syllable counts. In the study, as mentioned above, I selected three sample passages of 100 words length from each unit. I

collected the data for each sample passage of the unit applying the Fry reading graph procedure (see Appendix D). Then, I plotted the number of sentences against the number of syllable counts on the graph. The reading on the graph indicates to which grade level the passage is suitable.

I collected the data for each unit by adding the number of sentences of the three sample passages and dividing by three to obtain the average number of sentence for each unit. To obtain the average syllable counts of each unit, I added the syllable counts of the three sample passages of each unit, and divided by three. To determine the grade level of each unit, I plotted the average number of sentences against the average number of syllable counts on the Fry reading graph.

Cloze test

The cloze test is a procedure used to estimate the comprehension level of students. It requires students to fill deleted words in a passage (see 3.3.2 & 3.5.2). In the study, I extracted a passage from the prescribed textbook (see Appendix E). For the questions in the cloze test, a separate answer sheet was prepared on which the students to give the answers (see Appendix F). I scored the work of the students out of 100%. I analyzed the results of the students using the Bormuth (1967 & 1968) criterion-referenced scores (see 3.3.2). Students who scored 90-100% were categorized at an independent level, where no help is needed to both read and comprehend the passage. Students who scored 75-89 were categorized at an instructional level, where with help from a teacher, they can comprehend the passage. Those who scored below 75% were put at a frustration level, where they could not comprehend the passage, even with help from a teacher.

Word difficult index (WDI) test

The WDI is a tool used to examine the comprehension of students of technical and non-technical words in a text. It also tests students' ability to explain in clear language what they understand (see 2.5.3, 3.3.3 & 3.5.3). To collect data for the WDI, I extracted a passage from the prescribed textbook (see Appendix G). The students were requested to underline any word/words that they did not understand in the passage; also to provide a sentence in their own words which best described the passage.

I collected the words that the students claimed they did not understand (see Table 4.12). Considering the performance of the students to describe the passage in their own words, the students were grouped into two. The groups were those who understood and were able to describe the passage in their own words and those who did not. To define the percentage of students who understood the passage and expressed their ideas clearly, I analyzed using percentage.

Questionnaire

In the study, I distributed the questionnaires to all students who were involved in the study. I collected the completed questionnaires. I analyzed the data using percentages in relation to the questionnaire item responses.

Students' interview

Students' responses recorded on the tape were analyzed in terms of possession of the textbook, when they read the textbook, their ability to understand what they read on their own from the textbook, appropriateness of the language used in the textbook in relation with their English ability level, problems facing them while reading the textbook, their performance in the cloze test, and suggestions to improve the textbook.

Teachers' interview

Teachers' responses recorded on the tape were analyzed on the bases of

- appropriateness of the language used in the textbook in relation with the students English ability level,
- problems facing students while reading the textbook,
- helping students to understand what they read on their own,
- differences in readability of the textbook with respect to the two genders of the students,
- the author's ability to consider students English ability level while preparing the textbook,
- suggested changes to be done in terms of language to fit the students ability,
- relevant suggestions pertaining the textbook.

Biology curriculum designer's interview

Responses of the biology curriculum designer were analyzed in terms of appropriateness of English language used in the textbook with students ability level, the author's ability to consider students English language ability level while preparing the textbook, and changes needed to be done on the textbook in terms of language usage to fit the students ability.

3.7 Limitations

In the current study, only the students who scored the lowest in the cloze test from each school were selected for an interview (see 3.5.5.1). Therefore, in the data collection process, as a limitation, the students who scored highest marks in the cloze test were not interviewed.

3.8 Conclusion

The procedures described in this chapter may appear too complex. However, careful follow-up of the steps for each procedure during data collection enabled me to obtain the needed information for the study. In other words, both the quantitative and qualitative research methods helped me to capture the necessary information from different sources for triangulation of data. The data from different sources strengthened the conclusions made in the study.

The subsequent chapter will deal with presentation of the data. Thereafter I analyzed and discussed the data in relation with the readability of the Eritrean biology textbook for grade eight.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1 Introduction

As indicated in Chapter One, the study is concerned in determining the readability of the Eritrean biology textbook for grade eight. To implement the objectives of the study as outlined in Chapter Three, I employed different research instruments to collect data relevant to the study. These different instruments are readability formulas, a cloze test, a word difficult index, a questionnaire, and interviews. In this chapter, there will be a two fold focus approach. Firstly, the analysis section will focus on the readability of the prescribed biology textbook in relation to its intended grade level audience of grade eight learners. In the second section, the results of the data will be discussed in relation to the research questions. In this section the relationship between my findings and the literature will be explicated.

4.2 Data presentation and analysis

4.2.1 Readability formulas

To determine the readability of the Eritrean biology textbook for grade eight, using the Flesch, the Frequency of Gobbledgook (FOG), and the Fry readability formulas, I selected 24 sample passages each 100 words in length from 8 units of the textbook- that is 3 sample passages from each unit. In the following section, presentation and analysis of the data for readability of the textbook using the above mentioned readability formulas will be discussed.

4.2.1.1 Flesch readability formula

To determine the readability of the sample passages, I used the Flesch reading ease scores to interpret the data (for details see Appendix B). According to the interpretations for the Flesch reading ease scores,

- 90-100 indicates that written material is of a standard appropriate for grade 5 students
- 80-90 indicates that written material is of a standard appropriate for grade 6 students
- 79-80 indicates that written material is of a standard appropriate for grade 7 students
- 60-70 indicates that written material is of a standard appropriate for grade 8 and 9 students
- 50-60 indicates that written material is of a standard appropriate for grade 10-12 students, and
- 30-50 indicates that a written material is of a standard appropriate for college students.

Table 4.1 shows the general picture of the readability data score distribution for the 24 sample passages.

Table 4.1 Flesch readability scores for the sample passages

Readability scores	Sample passages from the textbook							
	Units							
	1	2	3	4	5	6	7	8
90-100								
81-90								
71-80			1			1		2
61-70	1	1	1	1	1		1	
50-60	2	2	1	2	2		1	1
30-50						2	1	
0-30								

Applying interpretations of the Flesch reading ease scores, an examination of Table 4.1 reveals the following points about the readability of the sample passages extracted

from the prescribed textbook. Generally the sample passages fall within the readability score interval of 30-80. Considering the distribution of readability scores for the sample passages, 4(16.7%) of the sample passages are in the interval of 71-80, 6(25%) of the sample passages are in the interval of 61-70, 11(45.8%) of the sample passages are in the interval of 50-60, and 3(12.5%) of the sample passages are in the interval of 30-50.

Applying interpretations of the Flesch reading ease scores to the distribution of the readability scores in Table 4.1 indicates that:

- 4(16.7%) of the sample passages (those within the interval of scores 70-80) are easy for grade 8 students but standard for grade 7 students
- 6(25%) of the sample passages (those within the interval of scores 61-70) are standard for grade 8 students
- 11(45%) of the sample passages (those within the interval of scores 50-60) are difficult for grade 8 students but standard for grade 10-12 students
- 3(12.5%) of the sample passages (those within the interval of scores 30-50) are very difficult for grade 8 students but standard for college students.

Briefly, from the distribution of the readability scores of the sample passages, one can deduce that 4(16.7%) of the sample passages are easy for grade 8 students but standard for grade 7 students, 6(25%) of the sample passages are standard for grade 8 students and 14(58.3%) of the sample passages are difficult for grade 8 students but standard for higher grades (grades 11-12 and college level). From this result, it can be concluded that a considerable number of the sample passages are inappropriate for grade 8 students.

In Table 4.1, the readability scores for the sample passages used in the study are presented. In Table 4.2, the data for the readability of the 8 units present in the prescribed textbook will be presented.

Table 4.2 Flesch readability data for the 8 units

Unit	Mean readability scores	Average Sentence length (ASL)	Average syllable Counts (ASC)	Description
1	60	15.7	154.7	Difficult for grade 8 students
2	58.8	18	153.3	Difficult for grade 8 but standard for grade 10-12 students
3	61.8	13	155.8	Standard for grade 8 but standard for grade 10-12 students
4	58.7	12.7	160	Difficult for grade 8 but standard for grade 10-12 students
5	58	13.9	159.3	Difficult for grade 8 but standard for grade 10-12 students
6	54.5	15.8	161	Difficult for grade 8 but standard for grade 10-12 students
7	56.6	18.6	155.3	Difficult for grade 8 but standard for grade 10-12 students
8	65	13.5	151.5	Standard for grade 8 students
The text	59.2	15.2	156.4	Difficult for grade 8 but standard for grade 10-12 students

Using the Flesch readability formula, Table 4.2 reveals:

- a mean readability score of the units ranging from 54.5 for unit 6 up to 65 for unit 8
- an average sentence length ranging from 12.7 for unit 4 up to 18.6 for unit 7
- an average syllable count ranging from 151.5 for unit 8 up to 161 for unit 6.

From the 8 units presented in the textbook, only 2 units (units 3 and 8 with mean readability scores of 61.8 and 65 respectively) are found to be standard for grade 8, while the other 6 units (units 1, 2, 4, 5, 6 and 7 with mean readability scores of 60, 58.8, 58.7, 58, 54.5, and 56.6 respectively) are identified to be difficult for grade 8 students but standard for grade 10-12. From the data, one can deduce that 2 out of 8 units in the prescribed textbook are standard for grade 8 students, while 6 out of 8 units presented in the textbook are found to be difficult for grade 8 students but standard for grades 10-12 students.

Based on the data at hand from the Flesch readability formula, the textbook has an average sentence length of 15.2 and an average syllable count of 156.5. Inserting this data into the Flesch readability formula (see Appendix A) yields a value of 59.2. This is, then, the mean readability score of the textbook. Applying the interpretations of the Flesch reading ease scores, a readability score between 50- 60 suggests written material that is suitable for grade 10-12 students. Based on this interpretation, the Eritrean biology textbook for grade 8 is identified to be difficult for grade 8 students but standard for higher grades-that is, grade 10-12 students.

4.2.1.2 Frequency of Gobbledgook (FOG) index

Table 4.3 shows a general picture of the grade level of the sample passages extracted from the prescribed textbook using the FOG index.

Table 4.3 Distribution of grade level for the sample passages using FOG index

Grade level	Units							
	1	2	3	4	5	6	7	8
6								
7						1		
8		1		1				
9					1			
10	1	1	2			1	1	2
11	1	1		1	1			
12	1					1		
13				1	1			
14			1					
15							1	
16								

Applying the FOG readability formula (see Appendix C), Table 4.3 reveals the following points. From the 24 sample passages extracted from the textbook for the study:

- 1(4.2%) of the sample passages is easy for grade 8 but standard for grade 7 students
- 2(8.3%) of the sample passages are standard for grade 8

- 2(8.3%) of the sample passages are difficult for grade 8 but standard for 9 students
- 8(33.3%) of the sample passages are difficult for grade 8 but standard for grade 10 students
- 4(16.7 %) of the sample passages are fairly difficult for grade 8 but standard for grade 11 students
- 2(8.3%) of the sample passages are very difficult for grade 8 but standard for grade 12 students and
- 5(20.8%) of the sample passages are very difficult for grade 8 but standard for college level students.

Generally from the 24 sample passages:

- 3(12.5%) of the sample passages are standard for grade 8 and lower students,
- 16(66.7%) of the sample passages are difficult for grade 8 students but standard for grade 11-12 students, and
- 5(20.8%) of the sample passages are very difficult for grade 8 but standard for college level students.

Thus, the result indicates that the majority 21(87.5%) of the sample passages are difficult for grade 8 level students.

Table 4.4 depicts a general picture of the grade level of the 8 units present in the prescribed textbook using the FOG index (see Appendix C).

Table 4.4 Grade levels for the 8 units in the textbook using FOG index

Unit	Average sentence Length (ASL)	Average words of 3 Syllables or more	Average reading Level	Description
1	15.7	13	11	Difficult for grade 8 but standard for grade 11
2	18	14.2	12	Difficult for grade 8 but standard for grade 12
3	13	12	10	Difficult for grade 8 but standard for grade 10
4	12.7	12.3	10	Difficult for grade 8 but standard for grade 10
5	13.9	13.6	11	Difficult for grade 8 but standard for grade 11
6	15.8	16	12	Difficult for grade 8 but standard for grade 12
7	18.6	15.2	13	Difficult for grade 8 but standard for college level
8	13.5	15.3	11	Difficult for grade 8 but standard for grade 11
The text	15.2	13.9	11	Difficult for grade 8 but standard for grade 11

A close examination of Table 4.4 shows an average sentence length ranging from 12.7 for unit 4 up to 18.6 for unit 7. The average number of words with three syllables or more ranges from 12 for unit 3 up to 16 for unit 6.

An investigation of the column “average reading level” in Table 4.4 reveals that:

- 2(25%) of the units present in the textbook are standard for grade 10 level students
- 3(37.5%) of the units present in the textbook are standard for grade 11 level students
- 2(25%) of the units present in the textbook are standard for grade 12 level students
- 1(12.5%) of the units present in the textbook is standard for college level students
- 0(0%) of the units is found to be standard for grade 8 level students.

According to the FOG formula, all the units present in the textbook are found to be difficult for grade 8 students.

From the data in Table 4.4, the textbook has an average sentence length of 15.2 and average words of three or more syllable count 13.9. Based on this data, the reading level of the prescribed textbook is grade 11. This implies that the textbook is difficult for grade 8 but standard for grade 11 students.

4.2.1.3 Fry readability formula

Table 4.5 shows the distribution of the grade levels of the 24 sample passages used in the study applying the Fry readability formula (see Appendix D).

Table 4.5 Readability data for the sample passages using Fry formula

Grade level	Number of passages from the text							
	Units							
	1	2	3	4	5	6	7	8
6								
7			1	3				
8			2		3	1	1	
9	3	1				2		1
10		2					2	2
11								
12								

As can be seen from the table, in unit 1, the three sample passages are found to be difficult for grade 8 but standard for grade 9 students. In unit 2, the three sample passages are found to be difficult for grade 8 but 1 of the sample passages is standard for grade 9 and 2 of the sample passages are standard for grade 10 students. In unit 3, 1 sample passage is easy for grade 8 but standard for grade 7 students and 2 sample passages are standard for grade 8 students. In unit 4, all three sample passages are easy for grade 8 but standard for grade 7 students. In unit 5, all three sample passages are standard for grade 8 students. In unit 6, 1 of the sample passages is standard for grade 8 and 2 of the sample passages are standard for grade 9 students. Unit 7 consists of 1 sample passage standard for grade 8 and 2 sample passages difficult for grade 8 but standard for grade 10 students. In unit 8, all the sample passages are difficult for grade 8, in other words, 1 sample passage is standard for grade 9 and 2 sample passages are standard for grade 10 students.

A close examination of Table 4.5 reveals that:

- 4(16.7%) of the sample passages are easy for grade 8 but standard for grade 7 students
- 7(29.2%) of the sample passages are standard for grade 8 students
- 7(29.2%) of the sample passages are difficult for grade 8 but standard for grade 9 students
- 6(25%) of the sample passages are difficult for grade 8 but standard for grade 10 students.

Using the Fry formula, it can be deduced that 4(16.7%) of the sample passages are easy for grade 8 but standard for grade 7 students, 7(29.2%) of the sample passages are found to be standard for grade 8 students, and 13(54.2%) of the sample passages are difficult for grade 8 but standard for higher grade level. Thus, a large portion of the sample passages is found to be inappropriate for grade 8 but appropriate for higher grade students.

Table 4.6 depicts the data obtained using the Fry formula for the 8 units in the Eritrean grade 8 biology textbook.

Table 4.6 Fry readability data for the 8 units in textbook

Unit	Average number of sentences (ANS)	Average syllable counts (ASC)	Grade level	Description
1	6.4	154.7	9	Difficult for grade 8 but standard for grade 9
2	5.6	153.3	10	Difficult for grade 8 but standard for grade 10
3	7.7	155.8	8	Standard for grade 8
4	7.9	160	7	Easy for grade 8 but standard for grade 7
5	7.2	159.3	8	Standard for grade 8
6	6.3	161	9	Difficult for grade 8 but standard for grade 9
7	5.4	155.3	10	Difficult for grade 8 but standard for grade 10
8	5.4	151.5	10	Difficult for grade 8 but standard for grade 10
The text	6.3	156.4	9	Difficult for grade 8 but standard for grade 9

The data in Table 4.6 reveals that the average number of sentences ranges from 5.4 for unit 7 and unit 8 up to 7.9 for unit 7. The average number of syllable counts ranges from 151.5 for unit 8 up to 161 for unit 6. The grade level of the units distributed from grade 7 for unit 4 up to grade 10 for units 2, 7 and 8.

A closer examination of Table 4.6 highlights the following points. Only one unit (unit 4) is easy for grade 8. Two units (units 3 and 5) are standard for grade 8 students. Two units (units 1 and 6) are difficult for grade 8 but standard for grade 9 students. Three units (units 2, 7 and 8) are very difficult for grade 8 but standard for grade 10 students.

From the 8 units presented in the prescribed textbook,

- 1 of the units is easy for grade 8 but standard for grade 7 students
- 2 of the units are standard for grade 8 students and
- 5 of the units are difficult for grade 8 but standard for higher grade level students.

From the result, one can conclude that in the textbook, a larger number of the units that is 5 out of 8 units are difficult for grade 8 students.

Finally, according to the data at hand from the Fry readability formula, the average number of sentences in the textbook is 6.3 and the average syllable count in the textbook is 155.7. Applying the Fry readability formula to interpret the data, the Eritrean biology textbook for grade 8 is difficult for grade 8 but standard for grade 9 students.

The following Table 4.7 gives the overall interpretations of the three readability formulas.

Table 4.7 Summary of grade level distribution of the units using Flesch, FOG and Fry readability formulas

Unit	Grade level		
	Flesch formula	FOG formula	Fry formula
1	8-9	11	9
2	10-12	12	10
3	8-9	10	8
4	10-12	10	7
5	10-12	11	8
6	10-12	12	9
7	10-12	13	10
8	8-9	11	10
The text	10-12	11	9

In my study, the same sample passages were used. An interpretation of Table 4.7 allows making the following conclusions about the readability of the textbook. Though variations occurred between the readability measurements of the readability formulas in determining the readability of each unit, all three readability formulas without basic variation indicate that the Eritrean biology textbook for grade 8 is difficult for grade 8 students but standard for higher grade level students. Thus based on the Flesch readability formula, the prescribed biology textbook is standard for grades 10-12 students. Based on the FOG readability formula, the textbook is standard for grade 11 students. Based on the Fry readability formula, the textbook is standard for grade 9 students.

4.2.2 Cloze test

In the current study, the modified cloze test was administered to 229 students in the selected four senior secondary schools.

In analyzing the cloze test results, I adopted Bormuth's (1967 and 1968) criterion-referenced scores frame of reference for multiple choice comprehension tests. According to the criterion-referenced score frame of reference, readers are categorized into three reading levels:

- independent level (when a reader scores between 90% - 100%) implying that the reader can both read and understand without any help
- instructional level (when a reader scores between 75% - 89%) implying that the reader can read and understand with little help from a teacher
- frustration level (when a reader scores below 75%) implying that the reader can not make any satisfactory progress in reading and understanding even with the help of a teacher.

Based on the above categorization of readers, in the following section the results of the cloze test will be presented and analyzed.

Table 4.8 shows the overall performance of the students on the cloze test in the four selected schools.

Table 4.8 Cloze test data of the students in the four schools

Scores in %	Schools				Total	Grand total	Description
	A	B	C	D			
90-100	1			1	2(0.87%)	2(0.87%)	Independent level
80-89	5	2		6	16(6.99%)	29(12.67%)	Instructional level
75-79	3	1	4	5	13(5.68%)		
60-74	20	16	23	25	84(36.68%)	198(86.46%)	Frustration level
50-59	16	20	16	10	62(27.07%)		
40-49	8	11	3	4	26(11.35%)		
16-39	16	6		2	26(11.35%)		
0-15							
Total	71	56	49	53		229 (100%)	

NB. Total number (N) of students is 229.
 Figures on the side of bracket indicate number of students.
 Figures inside bracket indicate percentages.

The table indicates that the score of the students obtained from the cloze test ranges from 16-100%. Applying the Bormuth (1967 and 1968) interpretation, a close examination of Table 4.8 reveals that only 2(0.87%) students fall within the independent level, 29(12.67%) fall within the instructional level and 198(86.45%) fall within the frustration level.

Applying the Bormuth (1967 and 1968) interpretation a very small minority of the students (0.87%) could read and understand the prescribed textbook independently and consequently learn meaningfully from the textbook. 12.67% of the students can read and understand the textbook with some help from a teacher. The majority of the students (86.46%) cannot read and understand the prescribed textbook even with the help from a teacher. From this point of view, it could be deduced that a minority of the students could read and understand the content and concepts of the prescribed textbook, while a large number of the students could not read and understand the content and concept of the prescribed biology textbook. The result of the cloze test indicates that a large number of the students face difficulties in comprehending the textbook.

In the following presentations, the results of the cloze test with respect to the age, sex, and localities of the students will be analyzed. These are significant variables since they will enable me to see whether there could be similarity or dissimilarity in performance of the students who share the same textbook.

Cloze test data with respect to age of the students

As indicated in Chapter Three in Table 3.1, the age of the grade 8 students who participated in the study ranges from 12-23 years, with the exception that no student with the age of 21 years was found registered. Table 4.9 depicts the performance of the students in the cloze test with respect to age.

Table 4.9 Cloze test data with respect to age of the students

Scores in %	Age in years													
	12	13	14	15	16	17	18	19	20	22	23			
90-100			1(3.7%)				1(2.9%)							
80-89		1(16.7%)	4(14.8%)	6(13.6%)	3(7.3%)		1(2.9%)	1(3.9%)						
75-79		1(16.7%)	2(7.4%)	4(9.1%)	2(4.9%)	1(2.9%)	1(2.9%)	2(7.8%)						
60-74	1 (-)	4(66.6%)	15(55.6%)	14(31.8%)	19(46.3%)	11(32.4%)	11(31.4%)	3(11.7%)	5(41.7%)					
50-59			4(14.8%)	16(36.4%)	9(22%)	14(41.2%)	10(28.6%)	6(23%)	2(16.7%)	1(50%)				
40-49				2(4.6%)	5(12.2%)	5(14.7%)	5(14.3%)	5(19.2%)	4(33.3%)		1 (-)			
16-39			1(3.7%)	2(4.6%)	3(7.3%)	3(8.8%)	6(17.2%)	9(34.6%)	1(8.3%)	1(50%)				
0-15														
Total	1	6	27	44	41	34	35	26	12	2	1			

NB. Figures on the side of bracket indicate number of students
 Figures inside bracket indicate percentage

A close investigation of the results of the cloze test depicted in Table 4.9 with respect to the age of the students in a decreasing frequency indicates that:

- 3.7% of the 14 years old and 2.9% of the 18 years old fall within the independent level
- 33.34% of the 13 years old, 22.6% of the 15 years old, 22.2% of the 14 years old, 12.2% of the 16 years old, 11.7% of the 19 years old, 5.6% of the 18 years old, and 2.9% of the 17 years old fall within the instructional level
- All the students whose ages are 12, 20, 22 and 23 years, 98.3% of the 19 years old, 97.1% of the 17 years old, 91.3% of the 18 years old, 87.8% of the 16 years old, 77.4% of the 15 years old, 74.1% of the 14 years old, and 66.66% of the 13 years old fall within the frustration level.

As can be seen from the data in Table 4.9, the largest proportion of the students with respect to age falls within the frustration level. From the results of the cloze test with respect to the age of the students, a greater percentage of the students with the ages of 13, 15 and 16 years fall within the instructional level. From this result one can deduce that the textbook seems to be readable and comprehensible for the students whose age ranges between 13-16 years. All the students below 13 years and above 19 years fall within the frustration level. One explanation for this might be that the children below 13 years old are not cognitively ready to cope with the content and concept presented in the prescribed textbook. The poor performance of those above 19 years old could be due to frustration as they are learning with students who are much younger than them.

Cloze test data with respect to sex of the students

Table 4.10 shows the performance of the students in the cloze test with respect to sex.

Table 4.10 Cloze test results with respect to sex of the students

Scores in %	Sex		Description
	M	F	
90-100	1(0.75%)	1(1.1%)	Independent level
80-89	14(10.45%)	2(2.1%)	Instructional level
75-79	9(6.72%)	4(4.2%)	
60-74	46(34.33%)	38(40%)	Frustration level
50-59	34(25.37%)	28(29.5%)	
40-49	17(12.69%)	9(9.5%)	
16-39	13(9.7%)	13(13.7%)	
0-15			
Total	134	95	

NB. Figures on the side of bracket indicate number of students.

Figures inside of bracket indicate percentages.

A close examination of Table 4.10 discloses the following points. From all the male students who participated in the cloze test, only 0.75% of them fall within the independent level. Of the female students who participated in the cloze test only 1.05% of them fall within the independent level. From all the male students who participated in the cloze test, only 17.17% of them and from all the female students who participated in the cloze test only 6.3% of them fall within the instructional level. However, it is surprising, the majority 82.09% of the male and 92.62% of the female students fall within the frustration level.

A closer observation of the percentage performance between the two sexes of the students reveals a very little difference favouring female students who fall within the independent level. The percentage of the male students who fall within the instructional level is almost three times larger than their female counterparts and the percentage of female students who fall within the frustration level is larger than that of the male student population. Generally, the percentage of male students who fall within the independent and instructional levels are twice that of the percentage of the female students who fall within the independent and instructional levels. The percentage of the female students who fall within the frustration level is larger than that of their male counterparts. From this result, it can be deduced that male students outperformed their female counterparts in the cloze test.

Cloze test data with respect to locality of the students

As mentioned in Chapter Three (3.3), two of the schools (school A and B) were situated in the semi-urban setting and two of the schools (school C and D) were situated in the urban setting. The selection of the schools from the two settings was made to examine the similarities or differences in the comprehension level between the urban and semi-urban students. However, it is not the scope of the thesis to analyze the school factors which could contribute to differences in the comprehension level of the students.

Table 4.11 shows a general picture of the performance of the students in the cloze test with respect to their locality.

Table 4.11 Cloze test data with respect to locality of the students

Scores in %	Schools		Description
	Semi-urban	urban	
90-100	1(0.79%)	1(1.98%)	Independent level
80-89	7(5.51%)	9(8.82%)	Instructional level
75-79	4(3.15%)	9(8.82%)	
60-74	36(28.35%)	48(47.06%)	Frustration level
50-59	36(28.35%)	26(25.49%)	
40-49	19(14.96%)	7(6.68%)	
16-39	24(18.89%)	2(1.96%)	
0-15			
Total	127	102	

NB. Figures on the side of bracket indicate number of students.

Figures inside of bracket indicate percentages.

The cloze test result in Table 4.11 indicates that 0.98% of the urban students and 0.79% of the semi-urban students fall within the independent level, 17.65% of the urban students and 8.66% of the semi-urban students fall within the instructional level, while 81.37% of the urban students and 90.55% of the semi-urban students fall within the frustration level.

An examination of the performance between the urban and semi-urban students in the cloze test highlights the following points. Although not considerable, the percentage of urban students who fall within the independent level is a bit higher than that of the

semi-urban students. The percentage of urban students who fall within the instructional level is almost twice that of the semi-urban students. The percentage of the urban students who fall within the frustration level is smaller than the percentage of the semi-urban students who fall within the frustration level. Hence, in the cloze test, the performance of the urban students, even if not satisfactory, seems a little higher than the performance of the semi-urban students.

4.2.3 Word Difficult Index (WDI) data

As expounded in Chapter Three, the word difficult index test is set out to measure the extent to which the students understand or fail to understand both the technical (biological) terms and non-technical words. Understanding of both the technical (biological) terms and non-technical words is assumed to help the students to understand a text. In addition, the WDI test examines the ability of the students to comprehend and to explain in clear language the meaning of fundamental concepts of a given text/passage. For the WDI test a passage was extracted from the prescribed textbook (see Appendix G). The students were requested to underline any word/words that they did not understand in the passage, and then to write a sentence in their own words, which they thought best describes the passage. In the following section the performance of the students in the WDI test will be presented and analyzed.

Words not understood by the students in the WDI test

Table 4.12 shows the percentage of students in the four schools who did not understand some of the words in the passage.

Table 4.12 Words not understood by the students in the WDI test

Words	Schools				Mean
	A	B	C	D	
Plug	44%	57%	84%	76%	79%
Double	66%	55%	59%	76%	64%
Gate	58%	63%	59%	60%	59%
Separate	52%	55%	78%	45%	57%
Membrane	52%	65%	65%	53%	56%
Acts	56%	64%	57%	47%	56%
Attached	28%	43%	90%	53%	53%
Molecules	48%	54%	57%	51%	52%
Cytoplasm	45%	43%	67%	61%	52%
Fluids	38%	61%	51%	53%	51%
Allows	39%	48%	57%	47%	48%
Unwanted	32%	39%	43%	60%	44%
Soon	32%	30%	55%	25%	36%
However	21%	23%	37%	21%	25%
Flow	10%	13%	45%	23%	22%

The words that the students claimed they did not understand are listed in Table 4.12 in a descending order of frequency. As can be seen from the Table, 79%, 64%, 59% and 57% of the students did not understand the common (non-technical) English words 'plug', 'double', 'gate' and 'separate' respectively. Also 56% and 52% of the students did not understand the biological (technical) terms, 'cell membrane', and 'cytoplasm' respectively.

An examination of Table 4.12 reveals that the students experience problems in understanding the non-technical and technical words used in the textbook.

Description of the passage in the WDI test by the students

In the following section, the performance of the students in describing the passage in their own words will be presented and analyzed. Table 4.13 shows the performance of the students in this regard.

Table 4.13 Performance of the students in describing the passage in the WDI test

No	Sentences assumed best describe the passage	Sex		Mean	Description
		M	F		
1	The passage is about the function of the cell membrane	22(16.4%)	13(13.6%)	35(15%)	Understand the passage
2	The passage describes about cell membrane functions				
3	The passage describes about the function of cell membrane				
4	The passage describes the cell membrane is double layered and its function				
5	The passage is about the processes in the cell membrane				
6	The passage studies about cell membrane and about activities of cell membrane				
7	The passage is about the cell membrane and functions of cell membrane				
8	The passage is about cell membrane	112(83.6%)	82(86.3%)	194(85%)	Don't understand the passage
9	The passage is about the cell function				
10	It describes about the cell				
11	The passage is about living things				
12	The passage is about function of nucleus				
13	It defines about the cell and cytoplasm				
14	The biology for grade 8 is very hard				

NB. Figures on the side of bracket indicate number of students

Figures inside of bracket indicate percentages

As can be seen from the table, only a very small percentage (15%) of the students were in a position to understand and describe the passage in their own words. While a great percentage (85%) of the students failed to understand and describe the passage in their own words.

Of the male students 16.4% understood and described the passage in their own words, while only 13.6% of the females did. In this regard, although the deference is not considerable, male students performed better than the female students.

Table 4.14 Performance of the students in the WDI test with respect to locality

No	Sentences assumed best describe the passage	Schools		Description
		Semi urban	Urban	
1	The passage is about the function of the cell membrane	14(11%)	21(21%)	Understand the passage
2	The passage describes about cell membrane functions			
3	The passage describes about the function of cell membrane			
4	The passage describes about cell membrane is double layered and its function			
5	The passage is about the processes in the cell membrane			
6	The passage studies about cell membrane and about activities of cell membrane			
7	The passage is the cell membrane about and functions of cell membrane			
8	The passage is about cell membrane	113(89%)	81(79%)	Do not understand the passage
9	The passage is about the cell function			
10	It describes about the cell			
11	The passage is about living things			
12	The passage is about the function of the nucleus			
13	It defines about the cell and cytoplasm			
14	The biology for grade 8 is very hard			

NB. Figures on the side of bracket indicate number of students

Figures inside of bracket indicate percentages

Table 4.14 shows the disparity or otherwise in the performances between the semi-urban and urban students in understanding and describing the passage in their own words. As can be seen from Table 4.14, 21% of the urban students understood and described the passage, while 11% of the semi-urban students understood and described the passage. Thus, the students in the urban schools outperformed the students in the semi-urban schools. Likewise, 79% of the urban students and 89% of the semi-urban students failed to understand and describe the passage in their own words. Therefore a smaller percentage of the urban students could not understand and describe the passage given in the WDI test when compared with the semi-urban students.

4.2.4 Students' questionnaire

As discussed in Chapter Three, a questionnaire was used as an instrument to collect data regarding the readability of the textbook. All the students (134 male and 95 female students) completed and returned the questionnaire items.

From the questionnaire particular trends emerged regarding possession of the Eritrean biology textbook for grade 8. The questionnaire data indicated that 90.8% and 9.2% of the students possess and do not possess the prescribed biology textbook respectively. In other words, 208 of the students possess the textbook, while 21 of them do not.

In response to the questionnaire item, "how much of what you read on your own do you understand from the textbook", 7% of the students responded that they understand 'all that they read', 39.7% responded that they understand 'most of what they read', 48.1% responded that they understand 'some of what they read' and 5.2% responded that they do not understand 'any of what they read'. From this data it seems that only 53.3% of the students have difficulties in understanding of the concepts in the prescribed biology textbook.

To the questionnaire item, "how do you evaluate the English language used in the textbook", 7% of the students responded 'very easy', 20.9% of them responded 'average', 47.2% of them responded 'some are difficult', 19.7% of them responded 'mostly difficult' and 5.2% of them responded 'all difficult'.

By combining the students who responded that the language used in the textbook is 'easy' and those who responded that the language used in the textbook is 'average' only 27.9% them seem to have not difficulty with the language used in the textbook, while the rest 72.1% of them seem to have difficulty with the language used in the textbook

The responses given by the students in evaluating the language used in the textbook indicate that only a minor number (almost one-quarter) of the students do not have difficulties with the language used in the textbook whereas the majority of the

students (almost three-quarters) have difficulties with the language used in the textbook. The responses given by the students coincide with the actual performances of the students in the cloze test and Word Difficult Index (WDI) test. In the cloze test, Table 4.8 indicates that a large percentage (99.13%) of the students were not able to read and understand the textbook independently. In the WDI test, Table 4.13 reveals that majority (85%) of the cohorts were not in a position to understand and express their ideas in their own words in writing. From this, it can be concluded that majority of the students have difficulties with the language used in the textbook.

4.2.5 Interviews

In my study, to obtain firsthand information from the subjects of the study (students, teachers and a biology curriculum designer), interviews were conducted. Procedures of the interviews have already been expounded in Chapter Three. In the section that follows the interviews conducted with students, teachers and the biology curriculum designer will be presented and analyzed.

4.2.5.1 Students' interview

To obtain relevant information, interviews were conducted with 8 grade 8 students. The students interviewed were those who scored low marks in the cloze test. The responses of the students recorded on the tape recorder, were analyzed in terms of how often they read their textbook, their opinion of their ability to understand the text, their perceptions of the level of English language in the textbook in relation to their own reading level and the problems they faced while reading the textbook. For anonymity students are coded as S₁ student one, S₂ student two...S₈.

When the students were asked how often they read the textbook, half of them responded that they read the textbook before a teacher explains a new topic and half of them responded that they read it after the teacher explains a topic. Those who read before a teacher explains a new topic claim that this prior reading helps them to understand easily when a teacher explains a new topic. Those who responded that

they read the textbook after a teacher explains a new topic reasoned that this helps them to revise what was explained to them in class.

When they were asked to evaluate their ability to understand what they read on their own from the textbook, the majority of the students responded that they hardly understood what they read on their own from the textbook. They expressed their concern that the language used in the textbook is difficult for them. However, a few of them responded that they understood what they read on their own from the textbook, indicating that the textbook is prepared in a simple way that is understandable for them.

When they were asked to evaluate the language used in the textbook in relation to their English ability level, majority of the students (S₁, S₂, S₄, S₅, S₆ and S₇) responded that the English language used in the textbook is beyond their English ability level. The following excerpt made by S₄ represents their similar view:

If I am to explain about the English usage in the textbook, it is by far large beyond my capacity. To mention, especially the biological words present in the textbook are very difficult for me.

While some of the students responded that the English language used in the textbook is in line with their English ability level. S₃ and S₈ gave similar responses. The following statement given by S₃ reflects their response:

Actually the English language used in the textbook is almost in line with my English ability level, because if I read repeatedly I can grasp the main points I want to understand.

When they were asked about the problems facing them while reading the textbook, almost all of them reflected the same problem, in that they faced problems with the technical words present in the textbook. The response given by S₁ reflects their common view:

The problem I faced while reading the textbook is the shortage of English language. I could not understand any idea from the textbook. Also I faced problems not to understand the biological terms used in it, for example, words like hormone ...etc.

When they were asked about their performance in the cloze test, most of them gave similar responses indicating that they performed well. The statement made by S₄ reflects these responses:

Any one who usually reads and studies can usually do well in any test. As I have been usually reading and studying my biology textbook and the note given by my teacher, I found the test to be nice and I really did very fine.

From the responses given by the students, most of them did not seem to understand what they read on their own from the textbook. Most of them claimed that the language used in the textbook is beyond their ability. Moreover, their responses indicated that the biological terms used in the textbook were difficult for them. The interview responses confirmed the quantitative data analyzed in the cloze and WDI tests that the textbook is difficult for grade 8 students.

From the cloze test, it is evident that only a very small number of the students fall within the independent level and can read and understand the textbook independently. Indeed, the majority of the students fall within the frustration level and could not make any satisfactory progress in reading and understanding the textbook even with the help from a teacher. The results obtained from the WDI test indicated that the students did not only have problems in understanding the technical words used in the textbook but also in the common English language word. Consequently, only a minor number of the students were in a position to understand and express their understanding of the given passage in writing whereas majority of them did not. Thus, the data obtained from the cloze test, WDI test and interviews support each other. All indicate that the students need help to understand the whole text.

4.2.5.2 Teachers' interview

Interviews were conducted with four biology grade 8 teachers in the four schools selected for study-that is one teacher from each school. The responses of the teachers' interview were analyzed with regard to appropriateness of the language used in the textbook in relation to the students English ability, problems students faced while

reading the textbook, helping of students to understand what they read on their own from the textbook, differences in readability of the textbook between the two sexes of the students, ability of the author to consider students' English ability level, and changes to be done on the language usage in the textbook so as to fit the students' English ability level.

In the subsequent interview responses, for anonymity, the teachers are coded as T₁ teacher one, T₂ teacher two...T₄

When the teachers were asked about the appropriateness of the English language usage in the textbook in relation to the students' English ability level, except T₁, the others responded that it is not appropriate. The response given by T₃ reflects their similar views:

The level of English language usage in the textbook is not appropriate in relation to the students' English ability level. This happens as most of our students join grade 8 with very low English ability from junior school.

However, T₁ argued that the language used in the textbook is appropriate with the students' ability level and stated that:

If I see the level of English language used in the textbook in relation to the students' English ability, it is appropriate, as the textbook is prepared in simple English.

When the teachers were asked about the problems facing students while reading the textbook, the teachers had a common view. T₃ explained:

The students have a weak English ability while joining grade 8 from junior school. As a result they face problems while using the textbook be it the common English words or the biological words used in the textbook.

T₄ tried to respond widely to the same question as follows:

Some of the problems that the students face while reading the textbook are related with the biological terms used in the textbook. This happens because the students join grade 8 with general science knowledge from junior school. In grade 8, they start to learn biology as an independent subject enriched with biological terms, which they did not encounter before.

When the teachers were asked how they help students to understand what they read on their own from the textbook, all the teachers gave a similar answer. The response given by T₁ reflects their common view:

I usually give them homework to answer referring from the textbook. In order to answer the questions necessarily they will read the textbook. Also I give them reading assignment from the textbook on some topics and that I will ask them questions from what they read in the next class session. All this will help them to develop reading interest and thereby to understand what they read on their own from the textbook.

To the same question T₃ responded as follows:

I give the definitions of the biological terms used in the text. Moreover, I encourage them to use a dictionary in finding the meanings of common English words. All these efforts will help them to understand what they read on their own from the textbook.

When the teachers were asked if there is a difference in readability of the textbook between the two sexes of the students, all agreed that there is a difference in readability of the textbook between the two sexes of the students. Half of them responded that male students outperform than their female counterparts and half of them the other way round. T₂ and T₄ reflected the two different responses respectively in the following way:

There is a difference in readability of the textbook between male and female students. This can be justified by the results they get in tests and examinations. Usually male students score better than female students do. This is because they have got good readability skill, which help them to read and easily understand than the female students.

As to my experience female students actively participate in a class discussion than the male students. In my class the prize winners are female students. This is attributed to their better readability than their male counterparts.

When the teachers were asked about the ability of the author of the textbook to consider students' English ability level, T₂, T₃, and T₄ had the opinion that the author did not take the English ability of the students into account. The response given by T₃ represents their common understanding:

Given the fact that our students are weak in their English ability, there is a mismatch between the students' English ability and the author's way of preparing the textbook. It is filled with technical words and heavy common English words.

In contrast, T₁ responded that the author took into consideration the students' English ability. T₁ tried to justify his answer as follows:

Yes, the author has taken the students' English background ability level. When I give homework, projects to the students to be answered from the textbook, usually most of them give the right answer. Had it been beyond their ability level, they would not have answered correctly.

When they were asked what changes should be made in terms of English language usage to fit the students' ability level, majority of the teachers suggested that the textbook should be prepared in a simplified manner to fit the students' English ability level. T₃ suggested the following points:

Since most of our students join grade 8 with a weak English ability from junior school, they have got difficulties in understanding the contents of the textbook. So to solve this problem, it should be prepared in a simple English language.

Similarly T₄ responded that:

Grade 8 is a starting point for the students to learn biology as a separate subject from the general sciences in the junior school. Hence the textbook should not be inflated with heavy biological terms rather with few introductory biological terms.

However, to the same question T₁ responded that:

I do not expect any change in the English usage of the textbook. It is quite okay for grade 8 students. Instead, we teachers should be able to motivate our students to develop reading interest by giving lots of assignments to be answered from the textbook. This will definitely help them to develop reading interest, ability and synthesize their comprehension ability.

Majority of the teachers interviewed were of the view that the author of the Eritrean biology textbook for grade 8 did not take the English ability of the students into consideration when preparing the textbook. This suggests that the English language used in the textbook is difficult for the intended grade 8 students. Moreover, the

results of the students in the cloze test (Table 4.8) and WDI test (Table 4.13) indicate the low performance of the students. The responses of the majority of the teachers and the above mentioned test results agree that the language used in the textbook is difficult for grade 8 students.

4.2.5.3 Biology curriculum designer's interview

As previously indicated in Chapter Three, in Eritrea there is only one person in the biology curriculum office responsible for designing all the biology courses given in the senior secondary school from grade 8 up to grade 11. To obtain information relevant to the study, an interview was conducted with the biology curriculum designer. The interview conducted with the biology curriculum designer is analyzed below and discussed in terms of appropriateness of the language used in the textbook in relation to the students' level of English ability, the ability of the author to take into consideration the students' English language ability, and changes that need to be done in terms of language usage in the textbook to fit the students English ability.

When the Biology curriculum designer was asked about appropriateness of the language used in the textbook, considering that English is a second language for the students, his response was as follows:

I would agree that the language used in the textbook is appropriate to the given grade eight level. It has used standardized sentences, phrases, and paragraphs. However, in reality, most of the grade 8 students are weak in their English ability. They cannot even write one short paragraph about themselves. They cannot read and understand a short and simple story. They cannot communicate in English about their routine daily activities. So putting all these into consideration, the very long sentences, complex sentence structure, the very difficult words, the long paragraphs used in the textbook are not appropriate for the students.

When he was asked about the ability of the author to take into consideration the students' English language ability while preparing the textbook, he was of the opinion it is not only the responsibility of the author to write a textbook appropriate to the English level of the students. There are other stakeholders who should play a great role in preparing students with English of a standard appropriate to their schooling level. He noted the discrepancy between the language the students use in science

subjects and the English language they learn in their English subject. The level of English used in the English period is much more elementary than the English used in science subjects in the same grade level. He suggested that:

Though I can say that the English used in the textbook is difficult, it is mainly because the English level of the students is much less than the level they are in. So I would say, instead of preparing the textbook in a very much simpler way, in our education system, the English panel should make great effort to equip the students with standardized English ability to the grade level where they are in.

When he was asked about what changes should be done in terms of language usage to fit the students' ability, he responded that:

Most of the contents in the textbook, for instance, in the plant kingdom, they are prepared for the pursuit of higher education rather than meeting the learners' general educational needs and priorities. This leads to the use of highly technical terminology. So if we simplify the presentation of such concepts using as much as possible simple and appropriate language, it could help the students to understand the subject matter without problem.

From the interview responses provided by the biology curriculum designer, it can be deduced that he was of the view of that the prescribed biology textbook for grade 8 is written in a language beyond the ability of the grade 8 students.

Generally, analysis of the data from the quantitative and qualitative instruments used in the study concurred that the prescribed biology textbook is difficult for its intended audience. The data from the quantitative source indicated that the textbook is unreadable for its intended grade 8 students. Also analysis of the interview data indicated that the prescribed biology textbook is written beyond the language ability of its intended audience.

In the succeeding section, the data presented and analysed in the preceding section will be discussed by interrogating with the literature reviewed.

4.3 Discussion

A study of the literature on research into readability reveals that textbooks should be prepared in such a way as to suite the grade level of their intended audiences. According to Jones *et al* (1995:28), readability is the matching of a text with the reading and understanding level of the readers. Furthermore, according to Flanagan (1995:7), an independent reader is one who can learn from reading and learn about reading every time, reads for purpose, makes sense from a text, identifies main ideas in a text, reads critically and applies what is being read to certain situation in live time. According to Koch and Eckstein (1995:613), the development of reading comprehension skills is particularly important today in a period of accelerating technological changes and to keep up with the changes students have to continue their studies through independent reading. Therefore, selecting textbooks that have appropriate reading levels can motivate students' interest in reading and thereby the learning of the students.

It is from this point of view that the study on readability of the Eritrean biology textbook for grade 8 was made. In the subsequent section, the results of the Flesch, the Frequency of Gobbledgook (FOG) and the Fry readability formulas, cloze test, and Word Difficult Index (WDI) test will be discussed by interrogating them with the relevant literature review.

4.3.1 Readability formulas

Although the recommendations vary, depending on the readability indices, the findings of my study from the readability formulas indicate a mismatch between the textbook and its intended grade 8 level learners. From the readability results summed up in Table 4.7, in terms of the Flesch formula the textbook is standard for grades 10-12 students, in terms of the FOG formula the textbook is standard for grade 11 students, and in terms of the Fry formula the textbook is standard for grade 9 students. In view of this, it is reasonable to assert that the textbook is not likely to be easily understood by grade 8 students. The findings of my study agree with an earlier study made by Soyibo (1996) of three Caribbean high school biology textbooks. As to the

study made by Soyibo, three of the biology textbooks were not considered readable, as the target group of grade 9-11 students could not comprehend them. Likewise, the Eritrean biology textbook for grade 8 is unreadable and incomprehensible to its target group of grade 8 students. The findings of my study corroborate with Chiappetta *et al* (1991) and Soyibo (1996). To them, a textbook is a major source of transmitting scientific information to both teachers and students. They contend that despite the importance of textbooks to both teachers and students, not all authors seem to be aware that their textbooks often vary from the reading ability of the intended audience. Likewise, the author of the prescribed biology textbook did not take the advice of Vachon and Haney (1991) to heart, that textbooks should be designed with consideration of language ability of the students for whom they are intended.

4.3.2 Cloze test

From the results of the cloze test (see Table 4.8), it can be deduced that only a very small minority of the students (0.87%), those who fall within the independent level, can read and understand the prescribed textbook independently. While the majority of the students (86.46%), those who fall within the frustration level could not make any satisfactory progress in reading and understanding of the textbook even with the help from a teacher. This is an indication that the prescribed textbook is difficult for grade 8 students and hence grade 8 students encounter problems in comprehending the textbook. The finding of this study agrees with a study made by Okpala (1982) to determine the readability of five physics textbooks. From his study, Okpala identified that three out of the five physics textbooks were difficult for their intended third year secondary school students.

Textbooks are vital written materials for school purposes (Potter & Rosser, 1992:669). Then, if a textbook is to be of value for the teaching-learning purpose, it should be meaningful to the students. The students should be able to read, understand, learn and develop new ideas from it. According to Smith *et al* (1993:111), meaningful learning of science involves coming to understand scientific ideas as they are used for their intended purposes, including description, prediction, and explanation of phenomena in the natural world. To learn meaningfully the language used in the

textbook should be also taken into consideration in relation to the students' language ability. Thus, the language used in a textbook either facilitates or impedes students' understanding and academic achievement. Viewed from this perspective, language becomes an important determinant of what can be learnt meaningfully, because it determines the extent to which the students can extract meaning from the textbook. Therefore, the appropriateness of reading level (readability) of a textbook has a major influence in enabling the student to be engaged in active dialogue with the reading material (Clark, 1993).

The Education Policy of Eritrea grants equal access to all students without discrimination in terms of age, sex, race, ...etc. (Department of Education, 1998:7). Bearing in mind the equity of access for all students, whether the students perform equally or not in the cloze test and word difficult index test, a comparison between the performances of the students in terms of sex and locality was also made.

The cloze test (see Table 4.10) and word difficult index test (see Table 4.13) results show that male students performed better than female students. Catsambis (1995:254) note that a significant body of research exists which documents gender differences in science and mathematics and shows that men outperform women in science and mathematics achievement tests. Furthermore, Catsambis states that females are socialized in ways that do not allow them to develop personal characteristics and interest in the successful pursuit of scientific career. Therefore, although female students receive equal access, or even better, to science courses, they show less interest in science subjects than male students. Moreover, Hill and King (1993) and Chamdimba (1994) point out that factors contributing to girls' low performance in science may not be unrelated to socio-cultural factors: marriage, child bearing, influence of teachers' attitudes to both girls and boys, career aspiration, and home language. In my study, I would suggest that marriage, child bearing and workload at home are contributing to the girls' low performance in the cloze test and word difficult index test. In Eritrea, most of the work done at home is left to females, hence the female students may not get enough time to read and study the textbook at home.

Considering the performance of the students in the cloze test (see Table 4.11) and word difficult index test (see Table.4.14) with respect to locality, urban students

appeared to perform better than the semi-urban students. The better performance of the urban students than the semi-urban students might be attributed to the availability of additional reading materials like magazines, newspapers, and better library accommodation when compared to the semi-urban situation. Such access could help the urban students broaden their reading and understanding capacity.

4.3.3 Word Difficult index (WDI) test

Cassels and Johnstone (1980) assert that in learning-teaching science, the difficulties students face are not just the technical language used in science, but also how common daily language is used in science. According to Koch and Eckstein (1995:625), reading comprehension of both non-technical and technical texts is an essential skill for the students who need to keep abreast of new developments in their future studies. DiGisi and Willette (1995:133) contend that being able to understand and explain fundamental concepts in clear language is central to scientific literacy. It was from this point of view that the WDI test was administered.

Regarding the WDI test, Table 4.12 reveals that many students did not understand many of the common English words and some of the technical (biological) terms used in the passage. Table 4.13 indicates that only a very small number of the students (that is only (15%) understood and described the passage in their own words, while the larger majority of the students (85%) did not make any sense of the passage. However, understanding the given passage, certainly, would require understanding of those words not understood by the students. If the students could not understand such a number of words from the given passage, then, it is not surprising that they failed to understand the passage and were unable to write one sentence in their own words to describe the passage. Williams (1985) and Harrison (1980) assert that the language and grammar of a textbook affect the ability of the students to learn from a textbook. They agree that difficulties associated with vocabulary choice and sentence length and complexity are the main factors affecting the readability of a textbook.

Most of the students, the teachers interviewed and the biology curriculum designer expressed their concern that the language used in the textbook is beyond the students'

English ability. The need for preparing textbooks in line with the language ability of the students is vital to promote comprehension for the students. Clark (1997:390) clarifies the impact of textbooks prepared beyond the reading level of students. According to Clark, the failure on the part of the textbook to communicate basic concepts due to a too advanced level of writing could lead to students' frustration, which in turn interferes with the development of science as a favourite interest on the part of the students.

The problems that the students faced, and which consequently culminated in a low performance in understanding and describing the passage, possibly might be attributed to the mismatch between the textbook and the level of its intended users. From this, one can deduce that students need to be provided with a textbook appropriate to their grade level.

4.4 Conclusion

The underlying assumption of this study was that the grade 8 students would experience difficulties in understanding the prescribed biology textbook due to the level of language used in the textbook. This assumption was confirmed by the results obtained through the different research instruments used to collect data for the study.

The readability formulas used to analyze the readability of the prescribed biology textbook indicated that the textbook is difficult to read and understand (for the target students-grade 8 students). In addition, the poor performance of the students on the cloze and WDI tests indicated that the grade 8 students face difficulties in comprehending and understanding the textbook. The questionnaire items completed by the students showed that most of the students had difficulties in the language used in the prescribed biology textbook and consequently have difficulties in understanding the textbook. The interview responses indicated that the language used in the prescribed biology textbook is beyond the language ability level of the grade 8 students. Analysis of both the quantitative and qualitative data sources indicated that the prescribed biology textbook is difficult for grade 8 students. With this finding in

mind, it is reasonable to suggest that students need to be provided with a textbook more appropriate to their reading level.

This chapter has dealt with presentation, analysis and discussion of the data, in relation to the appropriateness of the textbook for its intended grade level students. The next chapter will focus on a summary, recommendations and conclusion based on the empirical findings of the study.

CHAPTER FIVE

SUMMARY, RECOMMENDATIONS AND CONCLUSION

5.1 Introduction

The data of this study has been presented, analyzed and discussed in Chapter Four. The central concern of Chapter Five is to summarize the salient findings of the study. In this chapter, recommendations that emanated from the study are highlighted. Finally, the chapter is concluded by signalling the need for preparing appropriate textbooks for their intended grade level audience.

5.2 Summary of the study

The central focus of this study was to determine the readability of the Eritrean biology textbook for grade eight. According to Jones *et al* (1995:28), readability is "the matching of a textbook with reading and understanding level of the reader." It was from this point of view, in that to determine whether there is a match or mismatch between the Eritrean biology textbook for grade eight and its intended grade 8 level learners that I conducted the study. In pursuance of this concern, the main research question was "**How readable is the Eritrean biology textbook for grade 8 students**"? The subsidiary questions posited were, how much do students understand what they read on their own from the textbook? What are the students', the teachers' and the biology curriculum designer's perceptions of the appropriateness of the language used in the textbook for its intended grade eight students?

To implement the purpose of my study, I employed different methods of data collection namely readability formulas, cloze test, Word Difficult Index (WDI) test, questionnaire and interview.

The data obtained from the three readability formulas (the Flesch, the Frequency of

Gobbledgook (FOG), and the Fry) unanimously indicated that the prescribed textbook is difficult for grade eight students, but appropriate for higher grade level students. The result from the cloze test indicated that the prescribed textbook is not readable for the grade 8 students. The results of the readability formulas and of the cloze test agreed with the ideas of Chiappetta *et al* (1991) and Soyibo (1996). They argue that despite the importance of textbooks to both teachers and students, not all authors seem to be aware that their textbooks often vary from the reading ability of their intended audience.

The result obtained from the WDI test indicated that most of the students did not understand the common (non-technical) English words and consequently, that most of them were not able to understand and describe the passage in their own words. The poor performance of the students in the cloze test and WDI test is not unrelated to the over sophistication of the presentation of the textbook to its intended audience. Viewed from this angle, the prescribed textbook author does not seem to take into consideration that language as a communication strategy in textbooks determines whether or not a textbook is comprehensible to the students. If students are provided with a textbook that is difficult to read, they may be frustrated with it and may stop reading or the comprehension of the text will be poor. This may be the reason that the students do not read the textbook. Although 90.8% of them possess the textbook, many performed poorly in the cloze test, and WDI test. The data from the questionnaires showed that most of the students have difficulties in comprehending the prescribed textbook. The data from the interviews revealed that the prescribed textbook is prepared with a language that is beyond the language ability of the grade eight students.

Based on the data obtained from the different instruments, I am confident to conclude that the Eritrean biology textbook for grade eight is unreadable for Eritrean grade eight learners.

However, the literature review indicates that textbooks being the focal point in the teaching-learning process, they should be appropriate to their intended grade level students. In line with this, Fry cited in Okpala (1982:102) contends that selecting the right reading material for the students is the most important job in the schooling

system. This shows that textbooks should be prepared to suite the grade level of their intended audience. Okpala (1982) adds that if students are provided with material to be read that is too difficult for them, they may be bored with it, stop reading, or the comprehension of the material will be poor. Likewise, while in Eritrea there is only one prescribed biology textbook for grade 8 students, the author of the prescribed textbook did not appear to take into consideration the level of the students' language ability while preparing the textbook, and this resulted in the mismatch between the comprehension level of the students and the readability level of the textbook.

In conclusion, my study has found that the Eritrean biology textbook for grade 8 is difficult for Eritrean grade 8 students. Considering the importance of textbooks in the teaching-learning process, Jones *et al* (1995:31) affirm that careful preparation and selection of textbooks appropriate for their intended grade level is crucial. In particular, in Eritrea, where the medium of instruction, English, is a second language for the learners, and there is only one prescribed textbook for each grade level, preparing appropriate textbooks in line with the language ability of the students is vital to promote comprehension for the students of their textbook. In this regard, for instructional purposes, students need to be provided with "a just right textbook". According to Rog and Burton (2001/2002:348), "A just right textbook is in one where the student can read 9 out of 10 words and comprehend the meaning of the passage with little difficult."

5.3 Recommendations

Given the significant role that textbooks play in learning and teaching process of science (Ogunniyi, 1982; Yager, 1983; Lynch, 1984; Chiappetta *et al*, 1991), findings regarding the poor readability of the Eritrean biology textbook for grade eight is significant for making recommendations to the curriculum developers, textbook writers, teachers and for future study to improve the textbook.

Hence, to improve the quality of the textbook so as to enhance comprehension and thereby learning, of the students the following recommendations are forwarded.

Recommendation for curriculum developers

Given that this study has provided conclusive evidence that the Eritrean biology textbook for grade eight is not readable for Eritrean grade eight students, it is recommended that provision of appropriate and readable textbooks for students is crucial in education. In this regard, Denning and Read (1990) argue that textbooks are the key ingredients in learning, as the intended curriculum cannot be implemented without them. They add that it is self-evident that the provision of an appropriate textbook is an essential condition for effective learning in schools. The curriculum planners who are responsible for preparation of the textbook should not easily ignore Denning and Read's (1990) admonition. Then, it is expedient for the curriculum planners to make a spirited effort to support the development of appropriate textbooks, in this case, an appropriate biology textbook for grade 8 students.

Recommendation for textbook writers

The issue of appropriate language level cannot be ignored as it has an impact on the teaching-learning process. Hence, in writing a textbook, particularly for second language learners, textbook writers need to exercise greater care with the language complexity such as semantics and syntax. They need to find ways of attaining substantial clarity in their textbooks—for instance, by involving teachers to try out their textbook before preparing the final draft for publication.

Recommendation for teachers

Although readability is affected by textbook factors, it is also known that a reader factor is important. It is important to equip students with the necessary skills required for effective reading. Teachers should encourage their students to read their textbooks, and develop the skills of their students so that the students can read effectively and critically. A system of teacher in-service training programmes could be developed to assist teachers in this regard.

Recommendations for further study

The findings of this research indicate a need for a more appropriately readable biology textbook for grade eight. It is suggested that the development of this textbook is the product of interrelated roles of the curriculum developers, textbook writers and teachers in ongoing research.

In the present study, the performances of the students in the cloze and WDI tests with respect to age, sex and locality of the students were highlighted. Despite that the Education policy of Eritrea grants equal access irrespective of age, sex, race...etc, differences are seen between the age groups, sex, and locality of the students. Thus, the factors which contribute to the differences in the performances of the students between the two sexes, between the different age groups and between the different localities of the students, warrant further study.

5.4 Conclusion

This chapter provided a synopsis of the research project. It summarized the main findings of the study. Based on the research findings, it is apposite to conclude that textbooks need to be appropriate for their intended audiences.

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Appendix A

Instructions for using Flesch (1948) reading ease formula

Systematically select 100 word samples from a text.

Determine the average number of words per sentence (ASL) that is sentence length

Determine the number of syllables per 100 words (ASC) that is word length

The values are substituted in the following equation

$$R. E. = 206.835 - (1.015 \times ASL) - (0.846 \times ASC)$$

Where R.E = Reading ease on a scale from 100 (very easy to read to zero (very difficult to read).

The value of R.E. will be used to estimate the suitable reading grade level of the sample text.

Example:

From a sample of a textbook, ASL= 17, and ASC= 147

$$\begin{aligned} R. E. &= 206.835 - (1.05 \times ASL) - (0.846 \times ASC) \\ &= 206.835 - (1.05 \times 15) - (0.846 \times 135) \\ &= 206.835 - 129.435 \\ &= 77.4 \end{aligned}$$

R.E. falls between 70 & 80. Therefore the sample textbook is suitable for grade 7.

Appendix B

Interpretation table for Flesch's reading ease scores

Description of style	Average sentence length (ASL)	Average syllable counts(ASC)	Reading ease scores	Estimated school grade completed	Estimated reading grade
very easy	8	123	90-100	4th grade	5th grade
Easy	11	131	80-90	5th grade	6th grade
Fairly easy	14	139	70-80	6th grade	7th grade
Standard	17	147	60-70	7 th & 8th grade	8th and 9th grade
Fairly difficult	21	155	50-60	Some high school	10th to 12th grade
Difficult	25	167	30-50	High school or college	13 th to 16 th grade (college)
Very difficult	29 or more	192 or more	0-30	College	Graduate

Appendix C

Instructions for using Frequency of Gobbledgook index

Select systematically samples of 100 words.

Determine the average number of sentences: number of words divided by number of sentences (ASL).

Determine the percentage of polysyllabic words, that is, the number of words of three or more syllable (PW).

The values are substituted in the following equation

$$\text{FOG index} = (\text{ASL} + \text{PW}) 0.4$$

The values obtained in the FOG index will be used to estimate the average reading level suitable for a given text.

Example:

In a sampled textbook ASL = 8.2, and PW = 12.5

$$\begin{aligned}\text{FOG index} &= (\text{ASL} + \text{PW}) 0.4 \\ &= (8.2 + 12.5) 0.4 \\ &= (20.8) 0.4 \\ &= 8.28\end{aligned}$$

The FOG index value is approximately 8. Therefore, the sample is suitable for grade eight level students.

Appendix D

Fry graph for estimating readability

Instructions:

Select three 100 word passages from the beginning, middle and end of the book or document.

Count number of sentences in each passage

1 _____
 2 _____
 3 _____
 Add _____

Divide by 3 to get average x

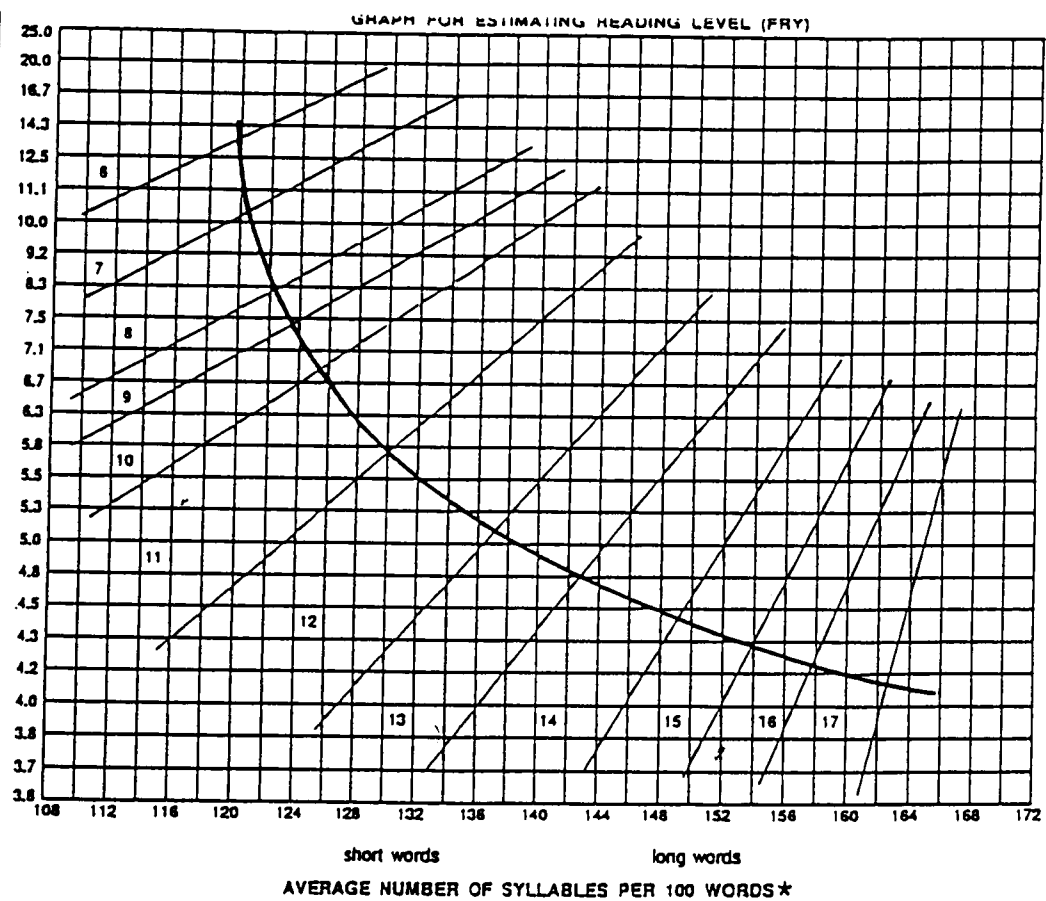
Count number of syllables in each passage

1 _____
 2 _____
 3 _____
 Add _____

Divide by 3 to get average *

Plot x against *

1) Points above the line or towards the top right quadrant will represent higher than average vocabulary difficulty.
 2) Points below the curve, towards bottom left quadrant, will suggest greater than average sentence length.



Appendix E

Cloze test passage

A. What is biology?

Biology is the science of living things. A biologist is a scientist who...1...about living organisms such as plants and...2.... Biology is one the oldest ...3..... In the past we learned a...4...about our selves and the living things....5... past knowledge helps us to collect...6... knowledge and make biology richer. At ...7... biology is developing quickly and it...8...continue to do so in the...9.... Biology helps us to understand how...10...living conditions depend upon the environment,...11...how the environment itself changes.

Biology...12... the relationships and differences between living things....13... studies the internal and external structures...14...livingthings, how each structure is...15... to its function, which organisms cause ...16... and how to control them. It...17... how to improve agriculture, that is, how to...18... more crops by breeding different varieties...19...crops. It studies how to control...20...of the environment. Most of all...21... studies the origins of life, and...22...basic chemical substances which make it.

B. What is life?

All the things, which we see, touch, feel and smell around us are made up of matter. The things around us are made...23...of two different forms, that is, living things...24...non living things. What is meant...25...life then? It is not simple...26... define what life is at...27...stage. There is a good way to...28...what life is: that is we...29...try to list those properties that...30...a living thing from a non- living thing.

C. What is a cell?

The body of some organisms is made up of a single cell. The body of more complex organisms...31...be made up of thousands, millions...32...even billions of cells. Your body...33... example, is made up of about ...34...billion cells. However, an organism's size...35...on the number of its cells...36...not their size. In general,

elephant's...37...are no larger than ant's cells. ...38...is simple because it has more...39....

D. The nucleus

The nucleus is the inner most part of the cell. It is bounded by a nuclear...40.... It also consists of a dense...41..., called the nucleolus together with small...42... granules. These chromatin granules produce chromosomes. ...43...are special proteins like Deoxyribonucleic (DNA)...44...Ribonucleic (RNA). These chromosomes carry hereditary...45.... They determine the organism's characteristics. They...46...traits to subsequent generations. In general,...47...nucleus is the control center for...48...cell activity. This includes reproduction and...49.... Without its nucleus, a cell will...50....

Appendix F

Answer sheet for close test

School _____
 Sex Female Male
 Age _____
 Roll number _____

Write the letter of your answer on the space given.

- | | | | |
|--------------------------|---------------|-----------------|-----------------|
| _____ 1. A. studies | B. studied | C. was studied | D. have studied |
| _____ 2. A. stones | B. animals | C. stars | D. astronomy |
| _____ 3. A. superstition | B. religion | C. science | D. mathematics |
| _____ 4. A. some | B. much | C. many | D. lot |
| _____ 5. A. These | B. This | C. Those | D. There |
| _____ 6. A. more | B. the | C. is | D. an |
| _____ 7. A. now | B. the | C. past | D. present |
| _____ 8. A. have | B. was | C. will | D. is |
| _____ 9. A. back | B. long ago | C. past | D. future |
| _____ 10. A. we | B. ours | C. our | D. they |
| _____ 11. A. to | B. and | C. is | D. in |
| _____ 12. A. studies | B. studied | C. is studied | D. study |
| _____ 13. A. We | B. You | C. It | D. They |
| _____ 14. A. of | B. to | C. for | D. from |
| _____ 15. A. relate | B. related | C. relation | D. has related |
| _____ 16. A. health | B. prevention | C. prevent | D. diseases |
| _____ 17. A. studies | B. is studied | C. have studied | D. studying |
| _____ 18. A. produced | B. produce | C. produces | D. is produce |
| _____ 19. A. to | B. for | C. of | D. an |
| _____ 20. A. pollute | B. polluted | C. is polluted | D. pollution |
| _____ 21. A. chemistry | B. physics | C. mathematics | D. biology |
| _____ 22. A. the | B. a | C. an | D. for |
| _____ 23. A. the | B. for | C. up | D. in |
| _____ 24. A. to | B. and | C. for | D. in |
| _____ 25. A. for | B. and | C. by | D. in |

- ____ 26. A. to B. of C. for D. and
 ____ 27. A. an B. a C. the D. this
 ____ 28. A. understood B. understand C. have understood D. understanding
 ____ 29. A. will B. is C. was D. were
 ____ 30. A. is distinguished B. distinguish C. distinguishes D. distinguishing
 ____ 31. A. was B. were C. may D. is
 ____ 32. A. and B. the C. of D. or
 ____ 33. A. of B. for C. to D. and
 ____ 34. A. 1.5 B. 5 C. 50 D. 10
 ____ 35. A. dependent B. have depended C. is depended D. depends
 ____ 36. A. and B. for C. to D. in
 ____ 37. A. cell B. celled C. are celled D. cells
 ____ 38. A. This B. Those C. These D. There
 ____ 39. A. cellular B. cells C. celled D. cell
 ____ 40. A. protoplasm B. cytoplasm C. membrane D. nucleolus
 ____ 41. A. bodies B. body C. parts D. is body
 ____ 42. A. chromosomes B. genes C. chromatin D. materials
 ____ 43. A. chromosomes B. chromatin C. chromosome D. gene
 ____ 44. A. to B. for C. in D. and
 ____ 45. A. is matter B. has material C. materials D. was material
 ____ 46. A. transmitter B. transmits C. transmitting D. transmit
 ____ 47. A. the B. to C. for D. in
 ____ 48. A. an B. all C. and D. to
 ____ 49. A. cell division B. cell C. cell pollution D. cell control
 ____ 50. A. died B. die C. death D. is died

Appendix G

Word difficult index test passage

Name of school _____

Sex: Female Male

Age _____

Roll Number _____

Directions

1. Read the following passage and underline any word you do not understand in the passage.
2. Write one sentence in your own words, which you think, best describes the passage in the space given below the passage.

The cell membrane

It is made up of a double layer of fat molecules. It also has protein molecules attached to it. This membrane,

- a) separates the cell from other cells, and from surrounding fluids.
- b) acts like a “gate”, that is, it allows needed molecules to pass in and keeps others out.

The same membrane also lets the unwanted molecules out of the cell, but keeps the needed ones. If this membrane is cut, cytoplasm may flow out through this cut for a short time; other molecules, however will soon organize to plug the flow of cytoplasm.

Appendix H

Students' questionnaire

This questionnaire attempts to find out information about the "Readability of Eritrean biology textbook for grade eight." The information will be used only for the purpose of this study. Your honest answers will have a valuable input in the study. Please answer all the items in the questionnaire. All your answers will be kept confidential.

Please take a bit of your time to answer the following questions.

Zone/zoba _____

Name of school _____

Grade and section _____

Age _____

Sex _____

Roll number _____

Please mark x your answer in the box.

1. Do you have your own biology textbook for grade eight?

- a) Yes b) No

2. How much of what you read on your own do you understand from the textbook?

- a) All what I read b) Most of what I read
 c) Some of what I read d) Nothing what I read

3. How was the cloze procedure test?

- a) Easy b) Average
 c) Difficult d) Very difficult

4. Generally how do you evaluate the English language used in the textbook?

- a) Easy b) Average
 c) Some are difficult d) Most are difficult
 e) All difficult

Thank you for your cooperation.

Appendix I

Students' interview

This interview attempts to find out information about the "Readability of the Eritrean biology textbook for grade eight." The information will be used only for the purpose of this study. Your honest answers will have a valuable input in the study. All your answers will be kept confidential.

Please take a bit of your time to answer the following questions.

Zone /zoba _____

Name of school _____

Grade and section _____

Age _____

Sex _____

1. Do you have your own biology textbook for grade eight?
2. How often do you read? Explain your answer.
3. How far can you understand what you read on your own with out some one explaining it for you?
4. How do you evaluate the English language used in the textbook in relation with your English level of knowledge? Explain your answer.
5. What problems do you face while reading the prescribed textbook?
6. How did you work in the cloze test? Explain your answer.
7. I need your opinion how to improve the textbook in relation with the English language usage?

Thank you for your cooperation

Appendix J

Teachers' interview

This interview attempts to find out information about the "Readability of the Eritrea biology textbook for grade eight." The information will be used only for the purpose of this study.

Your honest answer will have a valuable input in the study. All your answers will be confidential.

Please take a bit of your time to answer the following questions.

1. Do you think the level of English language used in the textbook is appropriate with the students' English ability level?
2. What problems do you think students face while reading the textbook?
3. What do you do to help students to understand what they read on their own from the textbook?
4. Do you notice any difference in readability of the textbook in relation with sex of the students? Explain your answer.
5. How far do you think that the author of the prescribed textbook has taken into consideration the students' English background ability while preparing the textbook?
6. What changes do you want to be done on the textbook in terms of English language to fit the student's English ability level?
7. Any other suggestion you want to add about the textbook.

Thank you for your cooperation and sharing your experience.

Appendix K

Interview for biology curriculum designer

This interview attempts to find out information about the "Readability of the Eritrea biology textbook for grade eight." The information will be used only for the purpose of this study.

Your honest answer will have a valuable input in the study. All your answers will be confidential.

Please take a bit of your time to answer these questions.

1. Considering English as a second language for the students in Eritrea, how do you see the appropriateness of the language used in biology textbook for grade eight?
2. Do you think that the author of this textbook has taken into consideration the students' English language ability while preparing the textbook? Explain your answer.
3. What changes do you want to be done on the prescribed textbook in terms of language usage to fit the students' ability?

Thank you for your cooperation and sharing your experience.