READABILITY OF GRADE 7 BIOLOGY TEXT BOOK OF ADDIS ABABA REGION

BY:
GETACHEW LEMMA

A THESIS SUBMITTED TO THE
SCHOOL OF GRADUATE STUDIES
OF ADDIS ABABA UNIVERSITY

IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE
OF MASTER OF EDUCATION IN
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Approval of the board of examination:

Chairman, Department of graduate committee

Advisor

Examiner-External

Examiner -internal

ACKNOWLEDGEMENTS

I am greatly indebted to my advisor Ato Amare Asgedom, for his generous help and effective guidance through out the study.

I would also like to express my deep gratitude to Ato Anbsu Blazen coordinator of Research and Evaluation panels in ICDR for his encouraging remarks and assistance in giving valuable suggestions and comments.

I am very grateful to Mrs Judith Mortimer (English panel in ICDR), Ato Rahimet Beyene (From unity college), and Miss Kara Janigan (From BESO) for their encouragement and valuable comments, which helped me a great deal in effecting the aim of the study.

I am particularly indebted to ICDR experts Ato Fikre Baileyegn, Ato Yemane Gossaye, Ato Asmare Demlew, Ato Metassebia Demissie and Ato Deresse Mengistu for the great concern and help they rendered during my stay in the graduate program. I would like to thank Addis Ababa University and MOE for their financial support.

I also wish to thank W/t Hyemanot Tekalegn who typed the thesis neatly.

Finally, I would like to extend my heart felt and deep gratitude to my wife Martha Tadesse, who had been a source of constant encouragement, advice, and material support without which the completion of this program could have been difficult.

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ABSTRACT

The purpose of the study was to investigate the readability of grade 7 biology textbook of Addis Ababa region. The sources of data were grade 7-biology textbook, grade 7 biology teachers, and students. Four data collection instruments were used: teachers' questionnaire, students' interview guide, two different comprehension tests, and readability assessment checklists. Accordingly, 20 teachers were made to fill the questionnaire, 50 students were interviewed, two different groups of two hundred students took two types of comprehension tests, and readability assessment checklists, which consist of 52 guide items, were used. The method used to investigate the study was readability assessment based on survey and selection of unit of analysis. Both quantitative and qualitative methods were used.

The result of the study revealed that the grade level estimate of the textbook is grade 10, which is beyond the students' grade level. The reading age of the text and students' average age is almost the same. However, by considering the average age of the students of the sample schools, it was found out that the students' age and grade level is inconsistent.

From the result of comprehension tests, it was found that reading comprehension depends on the readability levels of the passages of the textbook.

An investigation was also made regarding the legibility of the text. It was obtained that inappropriate labels, poor lettering conditions, small size of letters, long length of lines (statements), narrow margin space, less weight

of print, unsuitable reading conditions and unclear and not well visible diagrams were some legibility problems.

The main readability problems of the text were found to be: absence of glossary, availability of unfamiliar words in most parts of the units, absence of color or bold signs for new and unfamiliar words, students less interest and motivation to compute exercises and practical activities, inadequate periods allotment, inappropriateness of the content to the maturity level of the students, students inability of reading the text with the intention of understanding and remembering, availability of long sentences in most units of the text, and teachers unawareness of readability factors.

Regarding adequacy, simplicity and clarity of illustrations it was investigated that: examples are very few, exercises and activities are not adequate, some experiment activities lack clarity and simplicity, in some topics and subtopics; tables, charts, diagrams and pictures lack clarity and simplicity and some of them are not self-explanatory.

It was also examined that the sequence and integration of contents, the color of ink, appropriate size of spaces between paragraphs and lines, availability of chapter summaries and review questions, the relationship of contents and illustration, the relevance of contents to the daily life of students, appropriateness of the brightness ratio between the book and the surrounding table, the presence of related reading materials in each topic and subtopic, variety and quality of exercises and relevance of ideas, coverage and values were obtained to be satisfactory.

Thus, curriculum developers and other pertinent bodies should see to it that the textbook should be revised to be readable by considering the above-mentioned readability factors.

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the Study

The history of readability of textbooks goes back to early 1940's. It had very much to do with newspaper; persons who were trying their best to communicate messages to ordinary people (Guthrie, 1972).

Good textbooks are indispensable in an effective educational system. This is supported by Marshall (1962) that "one of the students important aid to learning and to the teacher, textbook is a great time and labor saving device." Hence, it is necessary that textbooks should be readable to the target class of users.

In the education and training policy with regard to textbooks, it is stated that... textbooks prepared at central and regional levels, are based on sound pedagogical and psychological principles and are up to international standard, giving due attention to concrete local conditions and gender issues (1994, p. 13).

One of the main determinant factors, which should be seen into account before preparing test books, is readability. If the textbooks are readable and interesting, the fore mentioned points in the training and education policy could be fulfilled effectively.

In relation to this point Amare (2001, p. 108) stated that textbooks are prepared with the assumption that they will be read and understood by students. This assumption, however, is seldom true. Students often found their texts hard and less interesting to read Similarly in the summative evaluation study (ICDR, 2000), it is mentioned that in the primary schools of Ethiopia where there are libraries, the quality of reference materials are not investigated whether they are readable and fulfill the interest and need of the students or not.

Thus, it was considered to be very essential to study and uncover the readability of grade 7 biology textbook of Addis Ababa region.

1.2. Statement of the Problem

It is generally accepted that the independent pursuit of knowledge entails the ability to use the written text. At the same time, the necessity to provide opportunities for all students to progress their own level despite wide variations among them depends on written instructions and the use of written materials; (Lunzer and Gardner, 1979, p. 4).

Hence, the very attempt to provide comprehensive primary education for all has made it more apparent that many students, perhaps most, need help and tuition to use written language, not just as writers, but also as readers and learners. Education in the USA has long been less elitist than in Britain and it is no accident that a long tradition of teaching "study skills" including especially the use of reading for learning exists there. The teaching of reading in order to learn through reading is an essential consequence of the democratization of education. It is also significant that as we move towards a greater interest in "teaching readers to read" in this country, ideas which were hitherto confined to a small body of specialists are gaining ground rapidly, chiefly through the work of poly techniques and the open university (Ibid).

According to most dictionaries readable means easy or interesting to read. The evaluative study of the general education system (ERGESE) carried out in 1986 strongly suggests that the quality of curricular materials should be improved. One of the indicators of a quality of textbook is its readability.

Department of curriculum development and research of Addis Ababa region education bureau has been very active in preparing textbooks of primary schools. Despite the fact that there have been evaluative studies on curricular materials, very little effort has been made along readability. Thus, textbooks have to be prepared for the reading and comprehension level of pupils of a particular grade level; good textbooks are indispensable aids for teaching and learning.

Therefore, the study aimed to investigate to what extent grade 7 biology textbook of Addis Ababa region is readable. The specific objectives of the study were to:

1. find out the suitability of the readability level of grade 7 biology textbook to the comprehension level of the student users.
2. identify the mechanisms/methods/ applied by teachers to know the readability level of the text.
3. examine the dependence of reading comprehension on the readability levels of the passages of the text.
4. assess the readability of the text.
5. assess the adequacy, simplicity and clarity of illustrations.
6. identify the relationship of the readability of the text with its sequence and integration of the content.

Based on these specific objectives the study tried to provide answers for the following research questions:

1. To what extent is the readability level of grade 7 biology textbook suitable for the grade level of the student users?
2. Does reading comprehension depend on the readability levels of the passages of the textbook's?
3. Are there any methods applied by teachers to know the readability level of grade 7 Biology textbook?
4. How does grade 7 Biology textbook reflect the readability of the book?
5. Are there adequacy and clarity of illustrations? (That is, adequacy and clarity of tables, charts, diagrams, examples, pictures, activities, exercises and experiments).
6. How is the relationship of the readability level of the text with its organization and integration of the content?

1.3. Significance of the Study

In primary schools of Ethiopia grade 7, biology textbooks are locally prepared and written in mother tongues except Addis Ababa and some regions in which the textbook is written in English. The language of instruction is also English beginning from grade 7 in the region. Hence, the need to assay the readability level of the textbook written in English cannot be over-emphasized.

The federal government in general and the regions in particular spend too much money for the preparation of textbooks. These responsible bodies should have a means of ascertaining that these books (if they are to serve their purpose) are suitable to the comprehension level of the target class of users. A close check at the readability level of grade 7 Biology textbook will help a lot for teachers, curriculum developers, and other scholars in the field of Addis Ababa region. Thus, this study can also indicate some preconditions of awareness of balancing the students' capacity of understanding a written material during revision and preparation of a textbook.

1.4. Delimitation of the Study

In order to make the study manageable the study is delimited to one grade level, subject, and region, i.e., grade 7, biology in Addis Ababa region. It is also delimited to consider readability in terms of the factors: a) legibility of the print (and of any illustrations), b) interest and motivation of the students, c) complexity of words and sentences in relation to the reading ability of the students, d) readability level of the written materials in the text, e) the appropriateness of the reading materials to the students' grade level, f) testing the readability level of the reading materials in relation to the students reading capacity, and g) the relationship of the readability level of the text with its organization and integration of the content. Hence, the result of the study could not be generalized to other grade levels, subjects, readability, and regions.

1.5. Limitation of the Study

The following points are found to be the main limitations of the study:

- Due to time and financial constraints, it was not possible to use larger sample size for comprehension tests and questionnaire. Therefore, the attempt to use adequate sample size i.e. all biology teachers found in the two sub cities of primary schools necessitated to administer questionnaire with two different rating scales.
- Since the study is confined to investigate only aspects of readability, generalizing the results of the study to other aspects of the textbook and implementation is curtailed.

1.6. Definition of Terms

Legibility: means written or printed words, which are clear enough to be read easily.

Complexity of words and sentences: mean unfamiliar long and scientific words and sentences.

Color of ink: color used for printing. Black type on white paper (or a white screen) is more legible than any other color combination.

Polysyllabic: is a word of several syllables or more than three syllables.

Infrequent: rare; not common; infrequently used words are words, which are not commonly used.

Glossary: is a list of technical or special words, especially those securing in a particular text, explaining their meanings.

Logical sequence: is some sort of order to succession, it deals with the question "what is to follow what"

Psychological Sequence: is that learning experiences can be sequenced using certain organizing principles such as proceeding from simple to complex, concrete to abstract, immediate to remote and from whole to part.

Comprehension test: is an exercise aimed at testing what one understands of a written language.

Readability score of the passage: is the reading ease score of the passage interpreted in terms of Flesch readability formula.

Students' score: is the result of the students who took the two comprehension tests.

Coverage: is the comprehensiveness of the content consisting of all knowledge, attitude and skills.

Metaphor: is the imaginative use of a word or phrase to describe some body or something as another object in order to show that they have the same qualities and to make the description more forceful.

Values: are contents with a reflective thinking of culture, gender, and stereotype issues.

Syllable: any of the units into which a word may be divided, usually consisting of a vowel sound, with a consonant before and /or after it.

Average sentence length: when the number of words counted in the written material and divided by the number of sentences counted in the same material gives average sentence length.

Reading ease score: it is a score of a written material, which is calculated by using a formula to estimate the readability of the material.

Readability assessment: is the method of investigating the readability of the material (the text), in terms of its legibility, condition of words, sentences, illustrations, clarity and simplicity of activities, laboratory works and its quality of being interesting and motivating as well as appropriateness for a particular grade level.

Reading age: is a term, which indicates the chronological age of a reader who could just understand the text.

Labels: are words or phrases, which describe about the part or whole of something.

Length of line: line means here the line of the written statements from the initial margin to the final (from left margin to right margin).

Cognitive development: in this aspect (paper) means both maturation and environmental experiences of the child which contribute for the child's learning.

1.7. Organization of the Study

The content of the study has been organized into five chapters. Chapter one introduces the background of the study and also contains the statement of the problem, significance of the study, delimitation of the study, limitation of the study and definition of terms. Chapter two presents review of relevant selected literature and research findings that are related to the problems under investigation. Chapter three and four deal with the method and procedures of the study and the report of the result and interpretation of the findings respectively. Chapter five summarizes the work of the investigation and presents conclusion drawn from the results of the investigation. Recommendations are also provided based on the findings of the study.

CHAPTER TWO

2. *REVIEW OF RELATED LITERATURE*

This chapter deals with review of the relevant literature and research findings that are thought to be related to the research problems under investigation. Accordingly, first, the concept of readability of textbooks and comprehension, second readability of tests and formula, third reading ages of school science textbooks, fourth the development of concept based curriculum via readability and finally some research studies of readability are presented as follows:

2.1. The Concept of Readability, Readability of Science Textbooks and Comprehension

The concept or theoretical considerations of readability, readability of science textbooks and comprehension including the subtopics, kinds of reading materials, factors that influence to use language more effectively, guide lines in reading science materials, strategies of selecting textbooks as well as factors that influence comprehension are presented in detail.

2.1.1. Readability

Readable, according to most dictionaries, means "easy or interesting to read."Dale, And Chall; (1948, p. 27) defined readability as "the sum total (including interactions) of all those elements within a given piece of printed material that affects the success which a group of readers have with it." the success is the extent to which they understand it, read it at optimum speed and find it interesting. Similarly, Chris and Johnson (2001) in the website information wrote that the term readability refers to all the factors that affect success in reading and understanding a text.

These factors include:

- The interest and motivation of the reader
- The legibility of the print; (and of any illustrations), and
- The complexity of words and sentences in relation to the reading ability of the reader.

These factors are discussed in turn, followed by the results of research into school science textbooks as follows (http: // www.)

I. Interest and Motivation

This aspect of readability is probably the most important, but unfortunately, it is also the least tractable. A young electronics enthusiast may read and persevere with a complex electronics magazine, but quickly abandon the simplest history book. This internal motivation is very powerful, but not easily modified by a teacher. There are other, externally factors which affect motivation and which can be adjusted to advantage. These include approval by the teacher, the use of merit marks, and success in tests and other tasks.

'Nothing succeeds like success; generally, motivation for reading schoolbooks is likely to blow. Indeed, a textbook has been defined as 'a book that no one would read unless they had to? In practice, this means that the prose in a schoolbook usually should be much simpler than the readers are capable of reading.

This is particularly necessary when pupils are given instruction to perform a specific task... not only may the motivation below, but the learning experience is likely to be spoiled unless the instructions are followed accurately.

II. Legibility of Print

According to Gilliland (1972, P.75), and Watts, and Nisbet, (1974, P.53), the following points were stated regarding legibility of print:

> *"If a student is a fluent reader, reading at a rate of 250-300 words per minute, his/her eyes moving in a series of rapid jerks and pausing 8-10 times along the length of a typical line. These pauses consume about 90 percent of reading time, each pause lasting for about 0.2 second. When there is difficulty in reading the text, his/her eyes are likely to make a backward movement, a 'regression'. Reading then becomes less efficient in terms of speed, but more efficient in terms of comprehension. The factors affecting speed and comprehension have been extensively researched. However, due to the large number of variables, the conclusions are sometimes ambiguous."*

Nevertheless, Legibility of print can be recognized in terms of: (a) the type: (b) the lay out and (c) the reading conditions (Tinker, 1963, Buckingham,., 1931). According to these authors, the factors of legibility of print are discussed in detail as follows:

a) The Type / Lettering condition/

More than a hundred typefaces are in use in the UK, some much more legible than the others. Lowercase print is preferred by most readers, and is read about 10 percent faster than words in CAPITAL letters.

However, for single letters (e.g. Labels on diagrams), capital letters are more easily differentiated. There seems to be no significant difference in legibility between serif and sans-serif type faces, whether on paper or on VDU screens (Mobley, 1986)

Some designers prefer sans- serif for sub-heads and serif for the body text. A fluent reader relies up on the upper coastline of the print for most of his information. In addition, the right-hand sides of letters give more information than the left. Where emphasis is required, bold type is read more quickly than italic or CAPITALS, (Ibid).

b) The Layout

There are 4 inter-related factors here:

- The size of type,
- The length of line,
- The spacing between the lines (the 'leading'), and
- The weight of print.

If the size of type or length of line is changed, then the leading should be altered to maintain efficient eye movements. 10 point, 11 point, and 12-point type seem to be the best sizes for fluent readers. At the normal reading distance of 35 cm, 10-point type brings 4 letters within the for veal area and 20 letters within a 5-degree field of view.

Most word- processors set the leading at 120 percent. i.e., for a 10 point type face, the leading is 12 point. (72 points =1 inch; 12 point = 4.2 mm). Klare (1985).

Lines, which are too short or too long cause inefficient eye movements. When considering the speed of reading, researchers have recommended line lengths in the range 6-9 cm (depending on the size of type and leading). The width of VDU screen is often about 25 cm and an A4 work sheet may have lines of 18cm. (Tinker, 1963). According to him the standard spacing between lines, words, and paragraphs is 0.5cm, 0.2cm,and 1cm respectively.

The author advocates a series of safety zones within which type size; line length and leading may be varied with out loss of legibility. Some schoolbooks appear to lie outside these

safety zones. However, the correlation between speed of reading and comprehension of information seems to be poor.

According to Bucking, (1931), in one study, a text in 18 point typeset in 10cm line length on a 21-point leading was ranked fourteenth in speed, but second in comprehension scores.

Overall, line lengths of 7-12 average words seem to be optimum. Unjustified lines (i.e. where the right-hand edge of the text is not straight) are better, because they help the reader's eye to scan the lines more accurately; white space (between paragraphs) and sub-heads help for the same reason, (Ibid).

c) The Reading Conditions

According to Lunzer and Gardner (1979, P. 85) serious effects on legibility arise when vibration occurs with a hand-held book and when the line of vision is not at right angles to the plane of the page. Books with thick spines may cause difficulty due to the curvature of the page, particularly where the inner (gutter) margin is narrow strong illumination may help here, by causing the pupil of the eye to contract, reducing spherical aberration and giving a greater depth of focus. Standard margin size of left and right is 3.17 cm, each and top and bottom is 2.54cm, each.

Harrison, and Gardner (1977, P.19) state that the brightness ratio between a book and the surrounding table surface should be 1:1 ideally, but a value of 3:1 is acceptable. Beyond 5:1 there is some impairment. Light meter readings on a brown laboratory table indicate 30:1. The size of margin does not seem to affect the speed of reading, but may cause increased eye fatigue if it is too narrow.

Matt paper causes less eye fatigue than glossy paper. The paper should be thick enough to prevent print on the reverse side showing through. Black type on white paper (or a white screen) is more legible than any other color combination. Blue, red, and green on white are often acceptable. The worst combination is black type on a purple background. (p. 24).

III. The Complexity of Words and Sentences

The other factor, which affects readability, is concerned with the words and sentences chosen by an author. For estimating or predicting vocabulary difficulty, most of the formulae

use a measure of word length, such as the average number of syllables per word, or the average number of polysyllabic words per sentence, (lunzer and Gardner, 1979, p. 78).

Similarly Flesch (1948), Chall, (1958), and Klare, (1963) state that the choice of one variable rather than another is partly determined by the type of reading material from which the formula was originally derived. For example in infant-school primers, the proportion of monosyllabic words might correlate most highly with the scores of passage difficulty based on what the children could read and understand. With adult prose, however, this variable could be less crucial, and the proportion of three-syllable words might be a more useful variable to include.

As Zipf's (1935) law demonstrates, word length is inversely correlated with word frequency, and a measure of word length is thus an indirect measure of frequency. The Dale-Chall formula is an example of one, which measures this variable more directly. The idea is that the greater the proportion of infrequently used words, the more difficult the reader is likely to find the passage.

2.1.1.1. Kinds of Reading Materials

According to Barbara (1977, P.5), kinds of reading materials are:

I) Recreational reading,

II) Magazines and short stories,

III) Specialized magazines and trade journals,

IV) News paper reading, and

V) Work-study materials

The author discusses these reading materials in detail as follows: (pp. 5-15).

I. Recreational Reading

Recreational reading could similarly be called relaxation reading. Actually many terms like reading for pleasure, reading for fun and leisure reading define the same thing. As stated by Barbara (1977, P.6), the primary purpose of recreational reading is to enjoy one self. What is important is that recreational reading should be different from work-or study-type reading. As ones skills grow, expand, and develop through recreational reading, he/she becomes a better more flexible reader.

The good things that recreational reading does can be summarized in the following ways (p. 7).

- Recreational reading helps the reader to relax and escape reality for a short time.
- Recreational reading helps the reader develop mentally by increasing ideas, interests, and knowledge.
- Recreational reading helps the reader understand him/her and others better.

II. Magazines and Short Stories

Good readers choose magazines and short stories for many of the same reasons they choose other recreational readings. They usually select material that is suited to their interests and satisfies their curiosity. Such reading can provide relation and deeper understanding about new ideas and adventures. The readers can learn to understand more about human nature through the experiences of the people and characters they read. (P.10)

What is the best way to read magazines and short stories? To answer this question we must make several decisions regarding the article or story we wish to read in order to plan the best way to read it. As Barbara states it (1977, P.12) the points to be considered for the best way to read magazines and short stories are-

- The difficulty of the material, he/she will attack it differently if it is easy, average, or difficult to read. To do this one should know the readability test of interpretation.
- It is essential to recognize what he/she wants to get out of the material. For example if some one is looking for the answer to a specific question, seeking new concepts, or reviewing material in which he/she once were quite familiar with.
- Better to recognize the knowledge he/she already have about the topic. He/she may have a strong background in a subject and therefore breeze through the article easily, or they may decide to look up wards first.

  After they have made these decisions, they are ready to read.

III. Specialized Magazines and Trade Journals

Specialized magazines and journals are published for people interested in a particular profession like academic, business, engineering science streams and so on. Generally people who read such things have advanced training in a particular field or feel a need to learn more about the field through research (p. 14).

The examples given by the above-mentioned author are teachers and students of psychology counselors, and many others interested in understanding and working well with others after they read psychology today. Virtually every special interest group that requires training or education in an academic area or a profession has a journal or magazine, no matter what area they would like to know more about.

Normally, the Magazines and Trade journals range from average to very difficult. Each article must be judged for ease or difficulty in order to decide how it should be read. It makes a difference whether or not some one:

- has education or training in the field.
- has practical experience in the work area discussed.
- knows the technical vocabulary required and
- is deeply interested (P.15)

Determining the difficulty of the material will help some one to decide which reading techniques to use.

IV. News Paper Reading

Newspaper reading is easy reading, understood by nearly every one with an elementary school education. Newspapers are easy to read because reporters have learned to use words descriptively and economically. Some of the writing factors that contribute to readability are:

a) Short sentences,
b) Concise paragraphs,
c) Familiar words, and
d) Straightforward style; (Ibid).

In one respect newspaper reading may become somewhat difficult, if the reader is not familiar with the vocabulary and concepts of particular area, he/she may have some blocks to rapid comprehension in that area. For instance, a youngster reading the sports pages for the first time may encounter words or references to rules that are beyond his or her understanding. A person glancing at the financial pages may realize that he or she must learn some terms in order to understand adequately what is there; he or she must also learn what system is used to report stock transactions.

According to Barbara, (p. 21), when we read newspaper many techniques can be practiced: these are pre reading, skimming, graph-and chart reading, critical evaluation, interpretation, phrase reading, and so on.

V. Work-Study Materials

In the work-study materials, before beginning any type of study reading it is better to consider: (a) the purpose (b) ones background knowledge (c) their interest; and (d) the difficulty of the material; (Ibid).

Each of these affects the way they read. For example if they take:

(a) Purpose: what specifically do they wish to learn from the material?" When they have finished reading this section, what should they know"?

It is preferable not to start reading thoroughly unless the reader can answer this question.

(b) Background knowledge: how much do they already know about the subject? Do they know the basics well enough to dive right in? On the other hand, do they have to look up some words, check an easier reference; or get help from some one? If they do not know the fundamentals, they will of course be unable to understand advanced ideas. How much they know influences their rote.

(c) Interest: Do the readers really want to find out about the topic? If the answer is yes, reading will be easier for them. If the answer is no, they should try to work up an interest. Ask what they can get that will benefit them. In other words, good study reading involves motivation.

(d) Difficulty of the material: what style and what level of vocabulary do the author use. To increase their understanding, they had better try to spot the organization and methodology. Even for very difficult material, understanding the patterns aids comprehension.

These four factors can be viewed from positive to negative as follows: (Ibid)

+ Specific purpose adequate knowledge	- No purpose in sufficient knowledge
• High interest understanding of difficulty	• Little interest no concept of difficulty

Thus, Reading becomes easier and therefore faster as the readers increases the positive and eliminates the negative. In general, though try to raise their work-study speed so their slowest speed for the most difficult material is no lower than 250 words per minute. This is an average rate, allowing for some time spent memorizing balanced by time spent skimming.

Overall, work-study speeds should begin at 250 words per minute and move upward. Some guidelines to help speed study reading are: (p. 25).

- The readers should always evaluate the four-study factors, which are purpose; background knowledge: interest; and material difficulty. They should be definite, specific and try for the positive aspects of each factor:
- The readers should avoid distractions; work is an area that contributes to good study. Before they begin, check physical factors such as lights, heat, and noise. Make sure they have all the equipment and supplies needed.
- Clear their mind of other things. If worries and problems are bothering they, decide on a plan for handling them. They should not try to read for improvement and worry at the same time; it simply does not work. Instead, they plan a program that allows them to attach their studies and problems.
- They Read the material once; with the intention of understanding and remembering it. Going over material is merely boring. Instead, they set their purpose for reading; read to achieve that purpose; then review to check themselves. Look over material that they cannot recall, but do not waste valuable time in re-reading everything.
- The readers believe in their ability to comprehend accurately and quickly. Push them a head, confident that their mental processes are at work. They can understand work-study materials more rapidly than they now do. They do have lots of ability they have not yet put to use.

2.1.1.2. Factors that Influence to use Language More Effectively

James W. Gibson, et.al, (1992, p. 85) states that some factors that influence to use language more effectively are:

a) Choice of expanding the vocabulary
b) Usage of the language
c) Choice of specific language
d) Choice of action language
e) Choice to illustrate abstract ideas
f) Employ comparison and contrast

The above-mentioned author discussed the factors in detail as follows (pp. 85-87).

a) Choice of Expanding the Vocabulary

Fluency and Credibility are closely tied to the number of words that the readers know how to use some of the arguments are:

- The longer their vocabulary, the greater their control of imagery and the better their ability to manage the impressions they leave with others.
- The more words they know, the better able they are to manage their relationships.
- The greater the number of the readers feeling words the richer their emotional range.
- The more words they know, the greater their ability to perceive the world accurately.
- The more words they know, the better their ability to express their attitudes and opinions.

Thus, they can choose to expand their vocabulary. That is the first and most important step in learning to use language more effectively.

b) Usage of the Language

Use simple words, simple phrases, and simple sentences. The advice to use simple language does not keep the readers from creating vivid images or using language powerfully or persuasively. Rather it implies that they match their level of language usage to the least skillful of their listeners. They never have to sell out an idea to say it simply and clearly. For instance, official writing does not demand big words or fancy phrases write naturally using the words with which they speak. Those words are usually small. The essence of English is in its small (often one-syllable) words. They save typing and reading time, and they make writing livelier and ideas clearer.

c) Choose Specific Language

If the readers want some one to form an image, then they must give that person the materials needed to do it. Generalizations and abstractions do not conjure such images. Instead of using the General (abstract), they can use specific (concrete). For example instead of labor, they can use chopping wood, digging, weaving etc. and instead of Tall, they can use 6 feet, seven inches etc.

d) Choose Action Language

Receivers do better, whether reading or listening. When, the sender uses the active voice, that is, the subject of the sentences do the action of the verbs. If some one follows this general

suggestion about language usage, his/her receivers are more likely to draw accurate conclusions and vivid images.

Action language includes the active voice, but also short sentences, time words, and interrupted rhythms.

e) Choose to Illustrate Abstract Ideas

People think about concepts in very predictable way. First, they visualize a concrete image that makes sense to them. After that, they can handle concepts that are more abstract. Therefore, examples and illustrations help receivers to visualize ideas.

To verify the usefulness of illustrations, examine their own experiences. When they read a textbook or listen to a lecture, how do they respond to the examples? If their experience is like most other people's experiences, then they like those examples. They help them to understand abstract ideas because they are more vivid and clear.

f) Employ Comparison and Contrast

Comparison and contrast (i.e. analogy and antithesis) add vividness and accuracy to language. Place one idea against another to show similarities and differences. The readers use comparison and contrast for three purposes:

- to make things clear and vivid,
- to support or prove things, and
- to make something abstract (justice, equality, goodness) more concrete.

To make a thing clear and vivid compare it to something that is well known to the receiver. For example, they might explain the size of a newly developed electronic "micrometer" by comparing it to the thickness of a single human hair.

To use comparison and contrast to build concreteness, they compare something that exists in the real world to the abstraction you want to strengthen and clarify.

2.1.1.3. Content Analysis

A workshop was carried out for content analysis by ICDR Researchers, Anbesu, et.al. (1994).

As the researchers stated the objectives of the workshop were to:

- familiarize the analysts with the concept of readability.
- give guide lines for carrying out content analysis with regard to readability.

- review and improve the items generated for the content analysis.

Based on the above objectives the researchers had prepared content analysis items in which the teachers would be directed to analyze the textbooks.

However, according to Amare (2001), content analysis methods were stated as follows:

- Content analysis can be taken as research technique for the objective systematic and quantitative description of the manifest content of communication or media.
- It is the coverage on what we observe as readers, listeners, etc.
- What used to be casual observation /careful documentation/ people's impressions?
- Paradigm for communication research is who says what to whom with what effects.

As Amare the procedures of content analysis are:

1. Selection of unit of analysis
   - Words, statements, sentences, or entire articles.
   - Readability of textbooks, coverage of ideas, gender stereotypes, etc. can be studied using content analysis.
2. Category construction
   - The category must be pertinent
   - The category should be functional
   - The category must be manageable
3. Sampling of content
   - In studying the content of radio, books, TV, etc. proper sampling procedures must be followed.
4. Reliability of coding
   - Training of coders
   - inter coder agreement
   - definition of categories and creation of common frame of reference.

2.1.2. Readability of Science Textbooks

Regarding readability Lunzer and Gardner (1979,P.72) stated as follows:

> *'The effect of modern approaches in many subjects is to print a higher premium than ever on the ability to read. There is increasing use of assignment cards and worksheets. All too often these and the tasks they prescribe make no allowance for individual differences in reading ability and the advice given to subject departments (by a suitably qualified members of staff) should include a concern for readability levels in the material being used"*

On the other hand George and Paul (1955, p. 184) stated that,*" The reading materials of science text books will stress on main ideas, details and conclusions or influences."*

In addition to these the authors also elaborate, that reading can be seen as intensive, critical, and rapid reading.

Thus, the readability of science textbooks will be considered in terms of their difficulty and style.

For instance, George and Paul put it as follows:

Table 1: Readability of science textbooks in terms of difficulty, style and rates.

Difficulty	Style	Rate
Very difficult	Formal, textbook style	Slowly and carefully rate below
Average difficulty	Informal, literary style	At an average rate probably 250-350 words/ minute
Fairly easy	Mixed style	Quickly between 350-500 words

Source: - the Art of efficient reading by Geogrge D. Spache and Paul C. Berg (1955, p.184).

The authors wrote the methods of performing for the table by using the following direction:

- The readers write down the time they begin to read when they have finished reading, write that time below. Then put the result in the formal shown below.

Began	Finished	Rate of words per minute
_____ minutes	_____ minutes	

As. Brandenwein (1962, P. 122) notes, we regard science "not merely as a body of information about the world but also as a way of learning more about the world; "i.e. as a body of knowledge and as a way of thinking and investigating.

Thus, in science, text books some illustrations and laboratory works are included. However, the readability of the instructions to perform the experiment and the statements and words written to elaborate the diagrams should be readable.

2.1.2.1. Assessing the Readability of School Texts

If a teacher is to plan individual instruction to meet specific needs, her/his first task is to assess the attainment level of every child and provide each with reading material of the right level of readability (DES, 1975, p. 19).

DES also pointed out; the potential value of a book or worksheet in the classroom is determined by a least three groups of factors, these are: (a) the ability of the children to read and understand, (b) how the teacher presents the text within a lesson and (c) factors associated with the text it self, notably the extent to which it is legibly and attractively produced and clearly or simply written.

Lunzer (1978), stated that the problem for the teacher is how to determine the right level of readability for each child. Even if the teacher has a reasonable knowledge of the reading ability of a child, there remains the difficulty of deciding which factors need to be taken into account in deciding whether a text is suitable or not, and which once are most important.

According to Harrison (1974, P. 32) to assess text difficulty the following points should be measured:

a) Legibility, b) linguistic variables, c) vocabulary difficulty, and

d) Illustrations within a book

How do we measure these points? To answer this question it is preferable to see the following points in detail

a) Legibility

Watts and Nisbet (1974) conclude that the usefulness of many results is diminished because of a failure to control the many variables, which can affect legibility. Among those, for example, are font type (i.e. the particular style of type used by the printer), type size (e.g. 8-

point, 12 point), the size of spaces between words, lines or paragraphs, the width of margins, the nature of the ink used for printing, and the texture, color and reflective qualities of the paper.

b) Linguistic Variables

If a layman is asked what tends to produce readable prose, he might suggest 'Simple English' or not too many long words.' This common sense view has a good deal to commend it, and it has been established regularly that vocabulary and sentence are the two most crucial determinants of text difficulty. Klare, in his authoritative reviews of readability research (1963, 1974) gives an account of the historical development of formulae.

Harrison (1974) used the Flesch formula, which first appeared in 1948 and wrote that the Flesch formula takes the form of a reading ease score (RE).

RE = 206.835- (0.846) x NSYLL – (1.015xW/S) where NSYLL is the average number of syllables per 100 words and W/S is the average number of words per sentence.

The RE score is in fact a notional comprehension scores out of 100. The above formula is typical of most of those used widely to day (Lunzer, 1978). Bormuth (1966), for example found a correlation of .99 between a count of words per sentence and an extremely complex syntactic variable. The author also states that there are certain readability formulas that measure grammatical complexity using some syntactic variable, such as clauses structure, number of T-units per sentence, or percentage of propositional phrases.

However, partly because not all teachers are reliable in terms of their knowledge of English grammar, and partly because such variables present the computer programmer with massive difficulties, the formula included in the present study only use sentence length as a variable to estimate grammatical complexity.

(c)Vocabulary Difficulty

For estimating or predicting vocabulary difficulty, most of the formulae use a measure of word length, such as the average number of syllables per word or the average number of polysyllabic words per sentence (Klare, 1963 and Chall, 1958).

For example, in infant school textbooks, the proportion of monosyllabic words might correlate most highly with the scores of passage difficulty based on what the children could read and understand.

As Zipf's (1935) law demonstrates word length is inversely correlated with word frequency, and a measure of word length is thus an indirect measure of frequency. The Dale-chall formula is an example of one, which measures this variable more directly. The idea is that the greater the proportion of infrequently used words, the more difficult the reader is likely to find the passage.

(d). Illustrations within a Book

Pictures, diagrams, charts, figures, examples must be shown clearly, precisely, meaningfully related to the topic.

The size, length of line, the spacing between the lines, and the weight of print will be taken into account.

2.1.2.2. Guide Lines in Reading Science Materials

According to Barbara (1977, P. 63), the following guidelines can help the readers read mathematical and scientific materials with greater ease and accuracy:

- Conscientiously learn the special vocabulary. Words in technical fields often have very specific applications. It is helpful to keep a notebook or a set of index cards for terms that they need to know and use in their reading.
- Find the plan of the text. Most textbooks have a careful organizational pattern, each chapter following a similar out line. For instance a book may begin with the statement of a theory, in this case they give examples of its application; provide sample problems; and finally summarize the material knowledge how each part of a text is arranged enables them to locate idea and data more rapidly.
- Begin each technical reading with pre reading. This shows the author's out line and provides a framework for more organized thinking. Seeing things from the author's viewpoint leads to better understanding, to a somewhat more rapid speed in reading and to longer firmer retention. The readers avail themselves of summaries or self-cheek questions at the end of textbook chapters. These tell them what the author thinks it important and help them to understand his writing.
- Begin every technical reading by evaluating the four study factors: purpose, interest, background, and material difficulty. It is essential to be specific and positive about each of these.

- Look first for the main ideas. Then they try to see relationships between the various main points. They go on to locating and relating to small comprehension factors. At the end, they should be able to state the main concepts in their own words and identify the sub point under each one.
- Review after a thorough reading: whether they have accomplished their purpose; whether they can ask and answer questions; whether they can apply formulas and whether they can solve the problems.
- While reading and reviewing; they try to visualize the cases and problems the author presents, conjure mental pictures, draw or sketch figures representative of the material they are studying, rephrase ideas in their own words and then this makes more meaningful to them
- If there are sample problems, they compute them as assigned or suggested. Check their answers to be sure they understand the work.
- Use the index to cross check terminology formulas, definitions, and similar material. To use an index the readers turn to the back of the book, find the page numbers on which a certain term is discussed, and the turn to those pages to obtain fuller knowledge.
- Know and use the basic references for the field they are studying. Refreshing their memory of the basics and checking on concepts is a valuable way to learn their ideas are reinforced when they refer to other sources.

The author finally concluded that one should use these guides for better reading and better grade in such courses as Mathematics, Physics, Chemistry, Biology, and Geology.

2.1.2.3. Strategies of Selecting Textbooks

The following strategies are useful for choosing textbooks: (Fry, 2001) (http: // www.). The readers:

- Gather as many books from which to choose as possible. Some sources might be from textbook companies, who are more than happy to send their desk copies for examination, fellow teachers, who have books they have chosen for various reasons, or local bookstores, who might have books that are applicable as well.

- Make a list of content criteria that they have for their course text. What are the areas of content that are necessary for their course? What are areas that they could easily supplement if necessary?
- Next, go through the books only looking at the content. Immediately eliminate all of the books that do not cover their minimum content needs. The rewashing books should cover the material necessary for their course.
- With the remaining books, select the one that is the most reader-friendly for their students. They might consider the following:
  a) What is the readability level of the text?
     - How difficult or easy is it for their students to read? In general, how complex are the sentences and how difficult are the vocabulary words?
  b) How "reader friendly" is the text? What is the over all organization of the text (chronological, categorical, etc)? Are the sections and chapters organized logically? What is the overall organization of the chapters? Does the author use headings and subheadings that clearly reflect the information presented?

     What are the learning features in the text? Are there chapter previews, summaries, review questions, etc? Does the book have a glossary, Index, appendix, maps, etc? How does the text look visually? Are there engaging photographs, charts, comics, etc.?

     Is there space in the margins in which students can annotate or it is too dense for note taking?

     How is vocabulary handled in the text? Are new words written in bold or color noted in the margins? Is there a glossary? Are new words listed at the end of each chapter? How does the book represent diverse cultures, races, ethnicities, languages, abilities, genders, etc.? This might be reflected in the content or visuals.
  c) Extra features: Does the book come packaged with a dictionary or Internet website for the students?
  d) Cost: If they are still debating between texts that seem equal, they consider choosing the one that is the lower-priced.

2.1.3. Comprehension

Lunzer, et.al (1976, P.38), defined comprehension: "to penetrate beyond the verbal forms of text to the underlying ideas, to compare these with what one already knows and also with one another, to pick out what is essential and new, to revise one's previous conceptions". However, according to the author none of these events is observable.

On the other hand, Skinner (1938, 1959), Carroll (1971), Gagne (1971), and especially Bloom, Hastings, and Madaus (1971) defined comprehensions in terms of observable behavioral objectives.

According to the authors mentioned above to establish whether a given pupil has indeed understood a given material, it is essential to raise the following questions. Can he/she tell the meaning of the words in the passage? If a word is ambiguous taken by it self, can he/she derive a particular meaning from its appearance in context?

Can he/she separate out the main themes in a paragraph from subsidiary points or examples? Can he/she translate into direct terms ideas that may have been presented by metaphor? Can he/she make such inferences as are essential to an intelligent reading?

Each of these last questions and others like them, enable us to construct one or more "comprehension items" based on the reading of a suitable material.

2.1.3.1. Comprehension Tests and Reading Skills

Comprehension involves a multiplicity of sub skills. Davis (1968) conducts a study in this area. He constructed a 96-item test each comprising eight subtests designed to measure distinct sub skills. There were therefore twelve items in each form for each skill. Combination of the two forms produced twenty-four items per subtest and 192 in all. The subjects were 988 college students.

Davis's own analysis of his data led him to conclude that he could reliably distinguish four skills, and these he identified as:

a) identifying word meanings,
b) drawing inferences,
c) identifying the writer's technique and reorganizing the mood of a passage and
d) finding answers to questions.

A subsequent analysis of Davis data by Thorndike (1971) produced only three factors, of which the first accounted for much the greater portion of the covariance while the other two did not admit of any clear-cut psychological interpretation.

However, Spearritt (1972) re-analyzed the same set of data using procedures that are more sophisticated and again found four correlated factors. These were similar to those originally described by Davis, except for the last, which was identified as:
"The ability to follow the structure of a passage." this being quite different from "answering questions." correlations between factors were high, ranging from .75- .93, but generally lower than the reliabilities of the original tests. Davis's study is the largest and most careful, but there have been several others.

Lennon (1962) gives a summary of twelve of these, and Farr (1969) further discusses his work. Six of these twelve studies produced only a single general factor.

The New York City Board of Education (1964) suggests several reading sub skills in a publication. These can be shown under the title reading skills in the subject areas, Grades 7-8-9 in the table below:

Table 2 : Reading Skills in the Subject Areas, Grades 7-8-9

No	Reading Skills	Subject Areas				
		Language Arts	Social Studies	Science	Maths	Industrial
1. 1.1.	Word recognition Recognize basic sight words	X				
1.2	Use phonetic analysis	X				
1.3	Use structural analysis	X				
1.4	use contextual clues for word meaning	X	X	X	X	
1.5	Use dictionary to check meaning	X	X	X	X	
2.1	Comprehension Understand word and sentence meaning	X	X	X	X	X
2.2	Find main idea and related details	X	X	X	X	X
2.3	Organize and classify facts	X	X	X	X	X
2.4	Perceive sequence of ideas	X	X	X	X	X
2.5	Draw inferences and conclusion	X	X	X	X	
2.6	Understand problems	X	X	X	X	X
2.7	Form judgments	X	X	X	X	
2.8	Predict customs	X		X	X	
2.9	Read critically distinguishing fact from opinion	X	X	X		
2.10	Read for appreciation	X				
2.11	Understand relationships	X	X	X	X	X
2.12	Follow directions	X	X	X	X	X
3 3.1	Work study Understand parts of a book	X	X	X	X	
3.2	Understand the index of a text	X	X	X	X	
3.3	Use of the dictionary	X	X	X	X	
3.4	Use of the encyclopedia	X	X	X		
3.5	Understand library techniques	X	X	X		
3.6	Interpret maps	X	X	X	X	
3.7	Understand charts	X	X	X	X	
3.8	Interpret graphs	X	X	X	X	
3.9	Understand diagrams	X	X	X	X	X
3.10	Adjust reading rate skimming	X	X	X	X	X
3.11	Select and evaluate information	X	X	X	X	X
3.12	Use techniques of retention and results	X	X	X	X	X

Source: Ericlunzer and Keith Gardner (1979, pp. 42, 43), The Effective use of Reading

As you could see from the table, the "X" under each subject area indicates that the reading skill is relevant to the particular subject.

To evaluate the above-mentioned reading skills, the comprehension test will be set based on the following eight points lunzer and Gardner (1981, P. 44).

- Word meaning (w)
- Words in context (WIC): Deriving the appropriate meaning of an ambiguous word from the context in which it appears.
- Literal comprehension (L): Finding the answers to questions when these can be obtained directly by reference to phrase or a sentence in the text.
- Drawing inferences from single strings (ISS).: A string is an uninterrupted sequence of words, usually a phrase or a short sentence. Questions in this category require the reader to draw an inference from such a sequence as opposed to deriving its literal meaning.
- Drawing inferences from multiple strings (IMS).:These tasks are similar to ISS, save that the necessary information for making the inference cannot found by reference to one phrase but must be deduced from a comparison of two or more facts appearing in different parts of the text.
- Interpretation of metaphor (M): These questions require the readers to show an understanding or application of meanings that are given indirectly by use of metaphor.
- Finding salient or main ideas (S) Self-explanatory.
- Forming judgments (J): The items clearly require the reader to go beyond the text, he/she is not asked to make a value judgment about the worthwhile ness of the material or of its presentation. Rather to offer an intelligent interpretation of ideas contained in the text or implied by it in the light of his own knowledge or related matters.

There are a number of techniques, which might help to determine whether all of the tests in a battery are measuring the same thing or whether they indicate more than one ability, aptitude, or skill. Factor analysis will generally be the first choice, since this techniques was devised with this specific end in view. (ibid)

2.1.3.2. Factors that Influence Comprehension

Understanding the factors of comprehension is frequently vital for some dealing with the science or mathematics, organization and procedures, or evidence and proof.

According to Barbara (1977, p. 53) comprehension factors that influence particularly in written material may be expressed in several ways depending upon purpose; these are:

a) Descriptive words, phrases, or sentences which clarify or illustrate a key word or an idea.
b) Explanatory items: which define or elucidate another word, phrase, or concept.
c) Reasons given for a particular belief or conclusion.
d) Steps indicating a method to be followed, (Watch for numbers) or a set of directions.
e) Chronological or logical sequences (This... then this, etc.).
f) Examples, providing, explaining, or describing a point.
g) Numbers, figures, and statistics
h) Typographical changes, such as capital letters, italics, underlining, or bold face type.

Finally, the author states that readers should not find some factors, but rather, proceeds in this way:

- Obtain and understand main ideas through pre reading or within their previous knowledge. Knowing the main points gives meaning and sensitivity to the small comprehension factors.
- Set a purpose, what precisely do they want to find or learn.
- Use skimming skills (Key word and rapid eye pattern) to locate the items desired.
- Evaluate the small comprehension factors. Is there what they really want to know? Are they relevant? Do they answer their questions and satisfy their purpose? Do they need to read further? By following the above-mentioned procedures, they are able to see the significance and importance of small factors in comprehension.

2.2. Readability of Tests and Formula

The main function of readability tests is to give students a quick assessment about the density of their writing. Readability tests alone cannot tell how easily a reader can understand the information in the text.

McCormick Colkins, et.al (2002), (http: // www.) states that some one can perform readability tests manually by counting and doing a mathematical calculation, or by using word-processing software. There are several popular readability indices and formula, for example:

- Gunning Fog Index

- Flesch Reading Ease Scale
- Flesch- Kincaid Grade Index
- The Fry Testing Readability Formula

Fog Index

To calculate the Fog Index of a passage, it is essential to do the following: (Ibid)

1) Count the number of words in the paragraph, W.
2) Count the number of sentences in the paragraph; S.
3) Count the number of words of three syllables or more, HW.
4) Apply the following formula:

   (W/S+ HW/Wx (100) x 0.4)

The Fog Index gives the number of years of education that the reader needs to understand the paragraph. Typically, in technical documentation, aim for a Fog Index between 10 and 15. The Fog Index formula implies that short sentences written in plain English achieve a better score than long sentences written in complicated language.

Table 3: Flesch Reading Ease Scale

The Flesch Reading Ease Scale measures readability as follows:

Readability score	Style	Description
100	Very easy to read	Average sentence length is 12 words or less. No words of more than two syllables
65	Plain English	Average sentence length is 15 to 20 words. Average word has two syllables
0	Extremely difficult to read	Average sentence length is 37 words. Average word has more than two syllables

Source:- McCormick Calkins, Kate Mont Gomery and Donnasantman (2002) A Teachers Guide to Standardized Reading Tests,(http :// www.).

As it could be observed from the table the higher the score, the easier the text is to understand. Aim to maximize the score is to minimize difficulty level. The approach to calculating the Flesch score is as follows: McCormick, et.al, (2002).

1. Calculate the average sentence length, L.
2. Calculate the average number of syllables per word, N.
3. Calculate score (between 0-100percent).

Flesch-Kincaid Index

This index computes readability based on the average number of syllables per word and the average number of words per sentence. The score in this case indicates a grade-school level. For example, a score of 8.0 means that an eighth grader would understand the document. Standard writing approximately equates to the seventh-to eighth-grade level.

The Fry Testing Readability Formula

To use the fry formula some one considers the following points Fry, (2003), (http: // www.)

1. Select three 100- word passages from the material, then. Count out exactly 100 words for each passage, starting with the first word of a sentence (omit heading). If some one is testing a very short pamphlet that may have only a few hundred words, he selects a single 100-word sample to test. Readability levels may vary considerably from one section to another. Therefore, it is better to select the 3 samples from different content topics, if possible. Additional information:
    - Count proper nouns. Hyphenated words count as one word.
    - A word is defined as a group of symbols with a space on either side (i.e. "IRA." "1994," AND "&" are each one word)
2. Count the number of sentences in each 100 words, estimating the fractional length of the fast sentence to the nearest 1/10. For example, if the 100- word occurs 5 words into a 15- word sentence, the fraction of the sentence is 5/15 or 1/3 or 0.3.
3. Count the total number of syllables in each 100- word passage. He/she can count by making a small check mark over each syllable. For initializations (e.g., IRA) and numerals (e.g., 1994), count 1 syllable for each symbol, so, "IRA" = 3 syllables and "1994" = 4 syllables.
4. Calculate the average number of sentences and the average number of syllables from the 3 passages. This is done by dividing the total obtained from the 3 samples as shown in table below:

Table 4: Number of words, average number of sentences and syllables derived from the 3 Passages of Biology texts.

Number of words	Number of sentences	Number of syllables
1st 100 words	5.9	124
2nd 100 words	4.8	141
3rd 100 words	6.1	158
Total	**16.8**	**423**
Divide totals by 3	**5.6 average**	**141 average**

Source: Fry Edward B. (2003), Books on language skills: reading, Phonics, Spelling, Writing, Key boarding. (http ://www.).

This information can be referred to the fry graph on page 39. From the graph on the horizontal axis, find the line for the average number of syllables. On the vertical axis, find the line for the average number of sentences, the readability level of the material is found at the point where the 2 lines intersect. In this example, the readability level is 8th grade.

Example:

No of words	Number of sentences	Number of syllables
1st 100 words	5.3	141
2nd 100 words	5.6	140
3rd 100 words	7.5	130
Totals	**18.4**	**411**
Divide totals by	3 6.1 average	137 average
Readability level: 7th grade		

2.2.1. Test Selections of Reading Assessment

When we select Cloze procedure for readability assessment deleting the nth word of the sentence where n= 5 or n=7 is said to be reliable and valid (Ginitie, 1961 and Fillenbaum etal, 1963) as cited by Lunzer (1979, P.89).

How ever, the system of applying the technique can be seen in detail as follows: (ibid).

In a cloze test, the reader's task is to work out from the surrounding context which word has been omitted, and to insert the one, which seems most appropriate in each blank space. The proportion of correctly guessed words gives an indication of the extent to which the reader has understood the passage.

The scores a reader obtains on a number of passages will vary according to how difficult each one is to comprehend, and they enable the reader to rank the passages in order of difficulty. Similarly, Graham (1978) and Mobley (1986) have given details of cloze tests, which can be applied to science texts. Particularly for students who are not native speakers of the language the following method of using the cloze procedures is preferable.

1. The nth word of the sentence will be deleted (n= 7, n=9 or 10^{th} word).
2. Where n =7, next to the deleted word one word will not be counted. That is for the 1^{st} nth word one word will be skipped (will be left uncounted). For the second nth word, two words will be left uncounted and so on.

2.3. Reading Ages of School Science Textbooks

We use the term 'reading age' to indicate the chronological age of a reader who could just understand the text. The term is also useful when applied to the text it self: a text which a reading age of 14 years is one that could be read and just understood by a 14- year-old pupil having average reading ability.(Chris and Johnson (2003) (http: // www.). In Europe and North America the students' age, the reading age of the text, and the students' grade level is almost appropriate. In these countries the statistical distribution of reading ability in a population of given age is roughly normal. (Graham, 1975, P.26)

The expectation is that the range of reading achievement is likely to be two-thirds of the median chronological age of the group i.e. in a mixed-ability class of 12- year olds, the reading ages would vary from 8 to 16. In a science 'set', selected based on ability in science, the range of reading ability can still be large.

Regarding ages Piaget's theory states that the maturational theory comes out of the work of Arnold Gesell and associates at Yale University in the 1940s and 50s. For a maturationist changes in behavior are primarily due to physical maturation of the nervous system. Which is controller by the genes through in heritance, (Cited by Temechegn, 2003).

Piaget also described four basic stages of contrive development which were age- related but not age- dependent, and the kinds of thinking typical of each stage. In contrast to maturationists and behaviorists, cognitive develop mentalists believe that both maturation and environmental experiences play a part in the child's' learning, (ibid).

In considering the suitability of a book or a work sheet for a class, it is desirable to determine the reading age of the text, to see how well it matches the reading ages of your pupils.

Kathleen Weidner Zoehfeld (2003) states in the website information, science books should have a reading age at least 2 years below the reading age of the students, because:

- science books are usually used as 'unsupported' texts, for homework or revision, with out direct teacher support, and,
- reading age tests are based on a comprehension level of only 50 percent or less. Fifty if a book has a reading level of 14 years; an average 14 year old would score only 50 percent on a test of comprehension of that text. Fifty percent is a long way from full comprehension.

The '4F' reading age tests that were Fry, Fog Gunning, Flesch-Kincaid, and Forcast are used. The introductions to 10 topics were also used in each book that is 40 tests per book. Because the introductions to topics were used, this probably means that the results are minimum values. The table below shows the reading ages of British Biology books currently available for pupils.

Table 5: The reading ages of British Biology books, currently available for pupils in key stage 4 of the National Curriculum. (For ages 14-16 years)

Reading age (in year)	Author, Title of book, publisher
17	
16	James Torrance, S. Grade Biology (Hodder and Stoughton) Gareth Price and Jane Taylor, GCSE Biology (Collins)
15	D.G. Mackean, GCSE Biology (John Murray) David Applin, Key Sc; Biology (Stanley Thomes)
14	R. Fosbery and J.Mclean, Biology Higher (Heinemann) Mary Jones and Geoff Jones, Biology (Cambridge) Terry Parkin and John Simpkins, Biology (Longman) Mary Jones and Geoff Jones, Biology (Coord) (Cambridge) David Baylis, GCSE Biology (Letts)
13	J. Sears and S. Taylor, Life and Living (Hodder and Staughton) Jane Vellacott, Life and Living (Hodder and Stoughton) S. Gater and V. Wood Robinson, Biology (John Murray) M.B.V. Roberts, Bilogy for life (Nelson)
12	Michael Roberts, Bilogy (Nelson) Michael Roberts, The living world (Nelson) A. Stuart and S. Webster, Biology (Foundation) (Heinemann) Brian Beckett and Rose Marie Gallagher, Biology (Oxford) Gareth Williams, Biology for you (Welson Thomes)

Source: Kathleen Weidner Zochfeld (2003) Reading ages of School Science Textbooks Internet Website Information.

2.3.1. Methods of Assessing Reading Age

Subjective assessment has been shown to be inaccurate, with teachers (perhaps because of their reading competence and familiarity with the subject) usually under-estimating the difficulty of the text (by up to 8 years). D. Jeffery Higginbotham and Jennifer L. Cornish (2001). Similarly, Chris and Johnson (2003) in the website information state that there are four main methods of objective assessment:

a) Question and answer technique:

Pupils of different ages are given the text to read. They are then questioned to gauge the level of comprehension and hence determine the reading age. This is usually unrealistic for practicing teachers.

b) Sentence Completion (the 'cloze' technique)

Sentences are taken from the text and every n^{th} word is deleted. Often, n =5 and n=7. These sentence completion exercises are then given to the pupils to test comprehension and gave the reading age. Graham (1978) and Mobley (1986) have given details of how cloze tests can be applied to science texts.

c) Comparison of Text with a Standard Word List

The percentage of words not included in the Dale word list is determined and the reading age calculated from this. Well-known examples are the Dale- Chall (1948) and Spache (1955) tests. Again, this method is tedious.

d) Calculations Involving the Sentence Length and Number of Syllables

Objective measures of readability are now widely used. They are formula (or graphs), which are based on an enormous amount of research evidence.

A readability formula predicts the reading level of the text. This is expressed as a chronological age and is accurate to about one year.

The reading level (reading age) predicted indicates that an average reader of that age could just cope with the text. The reading level predicted by a readability tests is the 'break-off' point for a reader of that reading age. i.e. a reading level measured as 14 years predicts that an average 14- year old would be at the limit of his/her reading comprehension ability with that book.

This is because most readability formulae are based on a 50 percent correct- answer score in a comprehension test.

Therefore, if a book has reading level of 14 years, an average 14- year-old pupil would score only 50 percent on a test of comprehension of that text! and 50 percent is a long way from full comprehension.

Harrison (1980) and Klare (1985) point out that some of the tests were used to find the reading ages of current UK textbooks and these values are given in a table of science textbooks. These tests are concerned simply with the length of sentences and the number of syllables. They do not take into account the order of words in a sentence, although some interesting work by Yngve, H.V. (1960) show a method of calculating the complexity of the structure of a sentence.

Much of the work on reading ages has been done in America. The formulae give a numerical value, which is the American grade level.When counting syllables for these tests, it helps to say the words aloud. As McLaughlin (2002) (http: //www.); some examples of syllables count are another (3), area (3), passed (1), surface (2), surfaces (3), particle (3), enable (3). When counting numbers, symbols, initials, etc, count one syllable for each number or letter. For example:

1998 = 4 syllables (1-9-9-8),

4.2 = 3 syllables (4-point –2),

H_2O = 3 syllables (H-2-O),

USA = 3 syllables (U.S.A), and

Fig.2 = 2 syllables (Fig-two).

But for abbreviations (cm, mm, km, kg, e.g., i.e.), the usual rule is to count each as just one syllable since headings and sub-heading are usually not sentences they are best ignored. It is not known how to deal with a formula or a numerical calculation, so for the results below they were just ignored (but they probably increase reading age).

Table 6: Mean estimates of teachers of age at which "the average child" could read two passages with understanding: Flesch Formula readability scores given for comparison.

	Passage A				Passage B			
	Mean	Lowest	Highest	S.d	Mean	Lowest	Highest	S.d
Group 1 (n= 17)	13.24	10	19	2.4	12.70	9	17	2.5
Group 2 (n= 22)	12.38	9	15	1.6	11.95	8	14.5	1.5
Group 3 (n = 22)	13.90	11	18	1.7	12.70	9	16	2.1
Group 4 (n = 12)	13.50	10	17	1.8	12.40	11	14.5	0.9
Average Teachers' Score (n = 73)	13.22				12.42			
Reading level obtained from Flesch formula	13.95				12.32			

Source: Erich lunzer and Keith Gardner ;(1979), P. 74) the Effective use of Reading.

The above table shows, the pooled scores of different groups. As indicated in the table all four groups assessed passage A as the more difficult. When we compare the results with the best-known readability formula, which devised by Rudolf Flesch in 1948: The formula yields a reading age level of 13.95 for passage A and 12.32 for passage B. These figures are remarkably close to the over all mean score of teachers' groups. Which were 13.22 and 12.42 respectively.

Table 7: Flesch formula grade-scores for readability survey passages (reading level= grade score +5)

Texts	1st- year passages			4th year passages		
	Number of texts	Reading level	Standard deviation	No of texts	Reading level	Standard deviation
English	17	12.4	1.2	23	12.9	1.4
Mathematics	5	11.3	0.6	15	12.7	1.7
Science	9	13.5	2.3	12	14.0	1.8
Social studies	22	13.0	2.3	22	14.1	2.2
Population means	53	12.73		72	13.60	

Source: The Effective use of Reading by Eric Lunzer and Keith Gardner (1979, P.82)

Table 7 shows the number of text samples collected from each subject and age group, and the average reading level of the texts in each group as derived from the flesh formula together with the associated standard deviation for each group, which is a measure of how much variation in difficulty there was in the group. The term 'reading level' is used in preference to the more usual, 'reading age'. Because the latter is sometimes interpreted in unfortunate ways. A

child who has a chronological age of eight and a 'reading age' (as derived from a standardized test) of ten is a very different reader from a fifteen-year old with a 'reading age' of ten.

Colin Harrison (1977, P.110) states that the term 'reading level' should be taken to suggest the age at which those children whose reading competence is about average for their age should be able to cope with the passage.

The results are given in terms of the Flesch formula grade scores since the formula is quite widely known and used.

2.3.1.1. Readability Tests and Formula, which will be used for Reading Age

The following Readability tests and formula are widely considered to know the reading age: Graham, W. (2003), (http: // www.).

a) Gunning 'FoG' Readability Test,

Gunning R. (1952), states the following: select samples of 10 words, normally three such samples.

i. Calculate L, the average sentence length (number of words ÷ number of sentences). Estimate the number of sentences to the nearest tenth, where necessary.
ii. In each sample, count the number of words with 3 or more syllables.

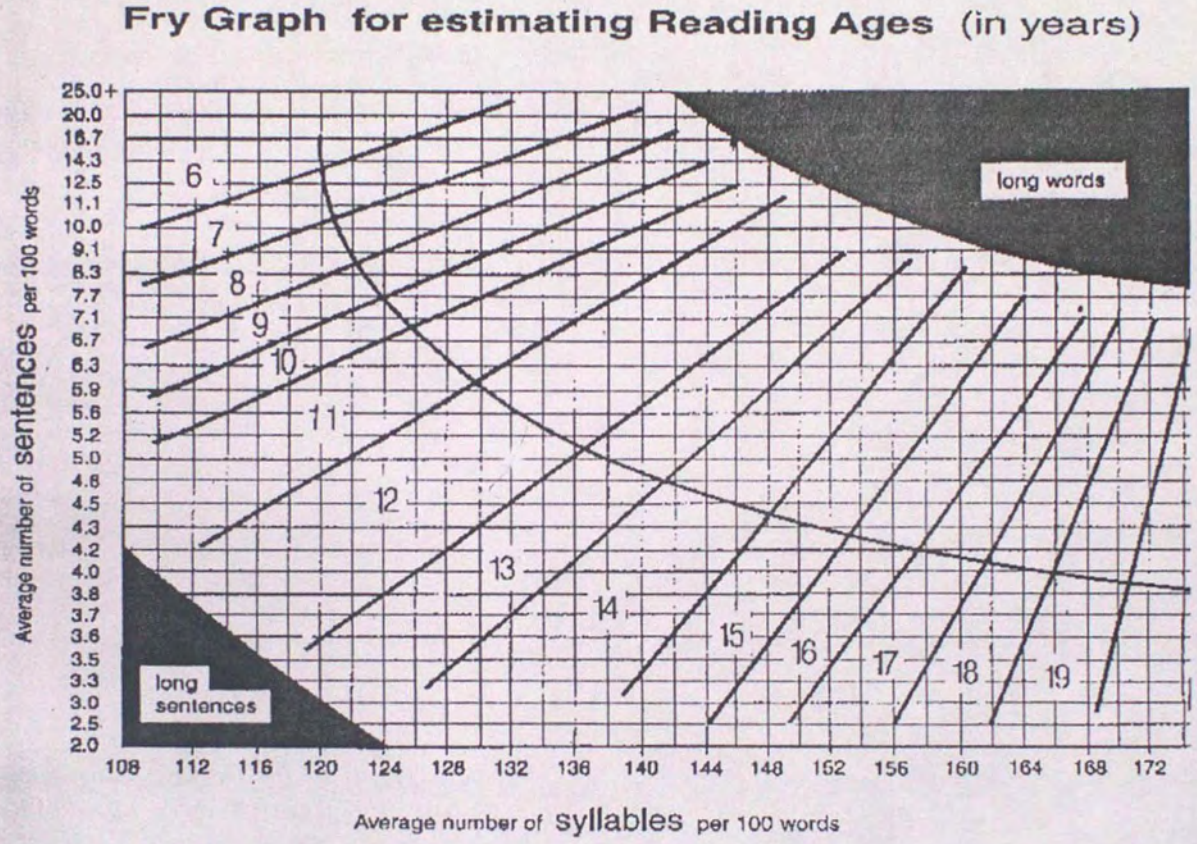
Find N, the average number of these words per sample. Then the grade level needed to understand the material = (L+N) x 0.4 so the Reading Age = [(L+N) x0.4] + 5years. This 'FoG' measure is suitable for secondary and old primary age groups.

b) Fry Readability Graph

Edward Fry (2003), (http: // www.), stated that: select samples of 100 words.

i. Find Y, the average number of sentences per 100-word passage (calculating to the nearest tenth).
ii. Find X, the average number of syllables per 100- word sample. Then use the Fry graph (below) to determine the reading age, in years. The test is suitable for all ages, from infant to upper secondary. The curve represents normal texts. Points below the curve imply longer than average sentence lengths. Points above the curve represent text with a more difficult vocabulary (as in school science texts).

Fry readability Graph



Flesch- Kincaid Formula

This is a US Government Department of Defense standard test, Chris and Johnson (2003), (http: www.). The formula will be shown as follows:

i. Calculate L, the average sentence length (number of words÷ number of sentences). Estimate the number of sentences to the nearest tenth, where necessary.

ii. Calculate N, the average number of syllables per word (number of syllables ÷ number of words).

Then grad level = (Lx 0.39) + (N x 11.8) – 15.59

So Reading Age = (L x 0.39) + (N x 11.8) – 10.59 years.

d) Powers- Sumner- Kearl Formula

This is the only one of the formula suitable for primary age books, powers, R.D., et.al. ;(2003), (http: // www.).

Select samples of 100 words, then:

i. Calculate L, the average sentence length (number of words ÷ number of sentences). Estimate the number of sentences to the nearest tenth, where necessary.

ii. Count N, the number of syllables per 100 words.

Then grade level = (L x 0.0778) + (N x 0.0455) – 2.2029.

So Reading Age = (L x 0.0778) + (N x 0.0455) +2.7971 years

e) McLaughlin 'SMoG' Formula

McLaughlin, H. (1969) Stated as follows; select samples of 30 consecutive sentences. In each sample, count the number of words with 3 or more syllables.

Find the average number, N.

The grade level = (square root of N) + 8 years. This test tends to give higher values than the other formulae, because McLaughlin intended it to predict the level necessary for 100% comprehension of the text (what ever that means), where as other tests were validated against lower comprehension levels.

f) Forcast Formula

Sticht, (1973) stated that this was devised for assessing US army technical manuals. It is not suitable for primary age materials. Because it is the only formula that does not need whole sentences, it is suitable for assessing notes and multiple- choice questions select samples of 150 words. Count N, the number of single-syllable words.

Then grade level = 20 – (N ÷ 10).

Reading age = 25 – (N ÷ 10) years.

If you use samples of only 100 words,

Reading age = 25 – (N ÷ 6.67) years.

This formula was validated at only a 35% score on comprehension tests.

2.3.2. Results of Applying the Tests

In an attempt to calibrate some fixed points on the scale of readability, the averages of four tests (Fry, Gunning, Flesch- Kincaid, forcast) are applied for some science textbooks. Chris and Johnson (2003), (http: // www.).

For example, in order to allow a reasonable comparison of the reading ages needed for the various science textbooks that are available, four of the tests were applied to passages on the same eight topics. The tests were Fry, Gunning, Flesch- Kincaid, and forcast.

The topics that were chosen were eight that are in the UK national curriculum and were expected to be found in any recent physics text. These topics were all among the less mathematical sections of work, because it was not known how to find the reading ages of numerical sections.

The eight sections were of work that is commonly taught in years 10 and 11 of UK secondary schools (pupils' ages 14-16): Introductions to: (i) electric circuits; (ii) electromagnetic induction; (iii) Hooke's law; (iv) refraction of light; (v) sound; (vi) solar system; (vii) thermal conduction; (viii) alpha, beta, gamma rays.

Where a topic appeared more than once in a book, the passage used was the one that appeared earliest, i.e. introduction to the topic (at this level). The four tests were applied to each of the eight sections for each text that, 32 tests per text. Biology textbooks results are shown in the table 5.

2.4. The Development of Concept Based Curriculum via Readability

Every content-based discipline has a core of conceptual, essential understandings. In this age of knowledge overload, students need a mental schema to pattern and sort information. As they progress through the grades, students build conceptual structures in the brain as they relate new examples to past learning's, Erickson (1998, P. 51).

According to Erickson, this means that teachers, in writing curricula, need to identify conceptual ideas often stated as essential understandings, which are developmentally appropriate for the age level of their students. Conceptual understandings become more sophisticated from elementary through secondary and post secondary schools.

Erickson (P.54) stated that identifying and writing essential understandings is not an easy task. It requires learning new skill thinking beyond the topic and facts to the important, transferable ideas. A first step is to understand how knowledge is structured.

Traditional objectives asked students to "list", "define", "identify", and "explain" important fact based information. But this model of linking arbitrary verbs to topics is limiting and antiquated for the information age, where knowledge is expanding exponentially and the ability to process a large amount of information at abstract levels of thinking becomes more critical each year.

For Erickson if we are to develop the thinking abilities of students systematically, then we need to move from a solely topic-centered to an idea-centered model of curriculum design. The reasons mentioned by the author are that topic centered curricula focus heavily on the memorization of facts and assume the development of deeper ideas. On the contrary, Idea-centered, logically, and psychologically sequenced curricula focus on deeper, conceptual ideas and use facts to support the understandings.

Facts are viewed not only as critical for building content knowledge but also as tools for gaining insight into the conceptual ideas that transfer across time and cultures.

Erickson (P.55), points out the next step, a major task of curriculum design and instruction is to address clearly the key concepts, and generalizations (essential understandings) related to the critical content of our discipliners. Principles and generalizations are written in identical form. They are both statements of important conceptual relationship. The differences lie in their link to truth and their significance to the foundations of the discipline.

Erickson in his book concept based curriculum and instruction on p. 56 put the following points to be considered as in developing concept-based curriculum:

- It contains an organized idea that categorizes a variety of examples. Although the examples may differ in context, they have common attributes, symmetry, for example is a concept that is exemplified by many different examples, but all examples display the attribute of "balance".
- Concepts also meet timeless, universal, abstract, and broad, and examples share common attributes.
- The quality of timelessness is one reason that concepts make excellent organizers for a content base that is continually shifting expanding, and growing in complexity. We can

remain grounded to the conceptual structure of knowledge yet have some flexibility with the specific topics.

- Concepts are the same across the world. The specific examples may differ from culture to culture, but the concepts are universal. In an increasingly multicultural society, the ability to draw cross-cultural examples to understand concepts is a helpful tool.
- By nature, concepts are abstract and broad in order to provide for a variety of examples. We have been trained in education to believe that abstract is "Fuzzy," and specific is better, because it is more clearly tested. However, what are we testing? Memorization of facts as our goal, or the ability to use facts to support the expression of conceptual understanding?

2.4.1. Reviewing the Standards of Science Textbooks In terms of Readability

To review the national science standards of textbooks the following set of questions and points will be considered; (National Research Council, (1996), as cited by Erickson (1998, pp. 9, 10, 13).

1. Do the standards clearly identify and highlight "integrating concepts" to facilitate integrated thinking within and across disciplines?
    - A set of "unifying concepts" provide a conceptual lens to facilitate "integrated thinking" as students draw from the fact base and see the patterns and connections of science at a danger level of conceptual understanding. Students begin to understand specific topics, such as "weather," or "the human body" not simply as a set of facts to be memorized, but as representative examples of a bigger, and more abstract conceptual ideas" systems". What lessons can be learned about the interdependence and importance of systems with the study of each new example from whether systems to human body systems? Students build conceptual sophistication through out the grades, and new information finds a home.
2. Do the standards provide a systematic schema for building conceptual understanding over time?
    - The national science standards systematically and purposefully build a conceptual mental schema for understanding science and our world. Concepts spiral through the grades, and the related content topics become more sophisticated. Consequently, the

conceptual understandings stated as "supporting ideas" in the document also become more sophisticated.

3-4. Is the critical content clearly identified by grade bands? Is the critical content correlated to disciplinary concepts and conceptual ideas (essential understandings, generalizations, principles)?

- The critical content of fact-based material is clearly listed by grade bands, but the topics are not the endpoint for study. They serve us a tool for understanding the "supporting ideas" that are the deeper, essential understandings of study. The supporting ideas are generalizations that transfer. Students can use these generalizations to build greater conceptual understanding as they meet new examples. Notice how the supporting ideas grow in sophistication through the grade bands.

5-7. Are processes (complex performances) and key skills clearly identified? Do the processes and skills reflect the professional performances and skills of the discipline? Are processes and key skills clearly differentiated from content understandings?

- The focus on "inquiry" and other key processes of science allow students to be thinkers and learners. Inquiry facilitates understanding of the conceptually based supporting ideas. The processes and skills defined in the science standards reflect the work of the professional scientist and are clearly differentiated from the content standards.

8. Do the standards suggest performances that demonstrate conceptual understanding?

- The science standards suggest activities requiring inquiry and the use of process with content.

9. Do the standards provide background information for the teacher on key concepts and critical content?

- Each standard has developmentally appropriate background information to guide the teacher. The guide to the content standard states clearly the fundamental concepts, principles, and generalizations that support the standard. Teachers should teach to these ideas using the specific topics as their instructional tool.

2.4.1.1. Readability of Biology Textbooks in View of Laboratory Work

It is discussed on page one that readability is the sum total (including interactions) of all those elements within a given piece of printed material that affects the success which a group of

readers have with it. The success is the extent to which they understand it, read it at optimum speed and find it interesting Dale and Chall (1948). In relation to this Hegarty (1990: 4) states that laboratory work is a form of practical work taking place in purposefully assigned environment (called laboratory) where students engage in planned learning experiences (manual), and interact with the materials to observe and understand phenomena.

From the above two concepts one can deduce that, practical work (laboratory) work is the best pre condition for the perception of basic practical skills, which paves an ease way for the readability of Biology textbooks.

Though laboratory work is taken an integral part of the Ethiopian school Biology curriculum starting from grade 7, its nature is mainly restricted to demonstration of theoretical concepts (Akalewold, 2003, P. 67).

In his research work, the above-mentioned author also states that practical biology should focus on helping students to learn basic practical skills and bridge the gap between theory and practice. Hence, one cannot find a science course without a laboratory session. Lots of arguments have been raised in the past to give the justification or rationale for its use.

Even though laboratory sessions were generally taken as necessary and important, very little justification was given for their inclusion (Boud et.al. 1989; Matiru et.al, 1995; Lazarowitz and Tamir 1994; Tamir 1991; Akalewold 2001).

Boud et.al. (1989); also stated that any discussion of aims and objectives should be conducted within the umbrella of the overall purpose of the program. In biology instructions, one should be clear of making sharp distinctions between outcomes expected from the biology laboratory and out-comes from non-laboratory classroom work.

Similarly, a number of authorities suggested taxonomy of aims and objectives for practical work (Anderson 1976; Hofstein and Lunetta 1982; Boud et.al. 1989; Hegarty 1990; Tamir 1991; Lazarowitz and Tamir 1994; Gott and Duggan 1995; Matiru et.al. 1995).

Woolnough (1991) also classified the practical work into four major types exercises, experiences, demonstrations and investigations. As cited by Akalewold; (2003, P. 73).

Each of these types of practical has its' own place in science teaching. Thus Readability of Biology textbooks can be facilitated by practical works or theoretical experiments accompanied by laboratory works.

2.4.2. Developing Concept Based Curriculum through Coherence Essential Understandings and Integration

A systems design for curriculum raises the standard for what students will be able to do in their performances. The traditional design of curriculum, at its peak during the behaviorist era, defined what students should be able to do by listening discrete skills for process categories such as reading, writing, listening, and speaking.

Erickson (1998, P. 57) states that today, we see multiple curriculum models developing for language arts that range from very specific skill delineations to elusive descriptions of performance. The question is what kind of curriculum model will provide a balance in the delineation of skills?

Skills can be written with different degrees of specificity. This can be seen through nested hierarchy as follows: (Ibid).

Descriptions of performances	Skills
• Complex process (performance)	• Reads a variety of literary materials with fluency and comprehension
• Performance indicators	• Applies reading skills and strategies appropriate for the type of material. • Constructs meaning by connecting ideas within text and to prior knowledge
• Discrete skills	• Decodes un known words, and blends sounds left to right • Uses context to aid word recognition and comprehension. • Identifies the main ideas in text material

Concept based curriculum depends on the coherence, essential understanding and integration of the systems design which can be seen as follows:

2.4.2.1. A Systems Design for Coherence

Beane (1995, p. 3) stated, "A 'coherent' curriculum is one that holds together, that makes sense as a whole; and its parts, what ever they are, unified and connected by that sense of the whole"

The authority attributes a sense of purpose, unity, relevance and pertinence (p.4) to the idea of a coherent curriculum. He proposes that a curriculum cannot be coherent if students do not realize the relevance of the study to their every day lives.

A systems design for curriculum is coherent, balanced, and systematically develops sophistication in knowledge, understanding, and the ability to perform. A systems design, addresses four critical components: (Erickson, 1998, P. 45). (a) The students out comes (what students should know, understand, and be able to do based on the identified knowledge, skills and abilities they will need as "educated" and successful citizens in the 21st century); (b) the critical content, key concepts, and essential understandings that frame that knowledge base of different areas of study; (c) the major process and skill abilities that ensure quality performance; and (d) quality assessments for measuring standards- driven performance.

2.4.2.2. Deep and Essential Understandings

Caine, R.N, and Caine, G. (1997), in Education on the Edge of possibility, stated, "Meaningful learning includes both 'deep' and 'felt' meanings."

They define deep meaning as "what ever drives us and governs our sense of purpose. Deep meaning is an intrinsic source of energy that spurs inquiry (pp. 111-112).

Felt meaning, according to the caines.

> *"is an almost visceral sense of relationship, an un articulated sense of connectedness that utilimately culminates in sight. An insight, anaha!" is a gestalt. It is the coming together of thoughts and ideas and senses and impressions and emotions... Genuine understanding leaks thought and felling, mind and body". (P. 113).*

David Perkins (1992) quotes Jerome Bruner's Statement (1973) that the person who understands some thing is capable of "going beyond the information given "Perkins provides a sample of understanding performances" that could demonstrate both knowledge and the ability to use that knowledge in the spirit of going beyond:

(a) Explanation, (b) Exemplification, (c) Application, (d) Justification,

(e) Comparison, and contrast (f) Contextualization, and (g) Generalization (Perkins, 1992, p. 77).

2.4.2.3. Designing Integrated, Interdisciplinary Units

Erickson (1998: 79) states that if we cannot maintain the integrity of disciplines (i.e, conceptual integrity), then we should not design inter disciplinary units. Disregarding the conceptual base of the different disciplines leads to the "handmaiden" phenomenon. In a

handmaiden design, all of the essential understandings from the unit of study relate to the unit theme, which is usually based in the social or physical world (social studies or science). In a concept-based model, the essential understandings for each discipline show a balance... some understandings relate to the unit theme, and some understandings express the essential understandings of the specific discipline as demonstrated through the unit theme.

According to Erickson (p. 74) the following points are considered to be the steps for integrated unit design:

- Decide on a unit theme that will allow all team members to enter the integration process.
- Identify a major concept to serve as a suitable integrating lens for the study.
- Web the topics for study, by subject or area, around the concept and theme.
- Brainstorm some of the essential understandings (generalizations) that they would expect students to derive from the study.
- Brainstorm "essential questions" to facilitate the students' study toward the essential understandings.
- List processes (complex performances) and bullet key skills to be emphasized in unit instruction and activities.
- For each week and discipline in the unit, write instructional activities to engage students with essential questions and processes. The instructional activities and questions should help Students Bridge to essential understandings.
- Write the culminating performance to show the depth of learning. The culminating performance answers the question, "What do I want students to know and be able to do as a result of this integrated unit of study".
- Design the scoring guide (criteria and standard) to assess the performance task. Decide on additional types of assessments to measure progress through out the unit.

2.5. Some Research Studies on Readability

One quite influential body of research is a group of reading models, which have been labeled information transfer theories. These theories (e.g. Laberge and Samuels, 1985; Gough 1985) have been strongly influenced by cognitive psychology and are largely responsible for the widely held view that reading is a process of information transfer.

Theorists who have supported this view of reading suggest that it is a letter- by letter and word-by-word process. They believe that readers extract meaning from print by processing the text in a linear way, permitting them to transfer meaning from the page of print to their minds. To do this, it is assumed that readers require specific skills, which enables the transfer to take place.

During the late 1960s and the 1970s a number of theories (for instance Goodman, 1984, and Smith, 1988) challenged the assumptions of transfer-dominated theories of reading, and developed interactive theories, which placed for greater importance upon the role of the reader (and the knowledge he or she possesses) in the reading process.

Researchers have suggested that a text is simply a blue print, which has the potential to generate many meanings (Bleich, 1978), and other researchers have increasingly recognized the reading is an active thinking process (Smith, 1978; Cairney, 1988b, Goodman, 1984). This has been reflected in research, which has frequently assumed an active role for the reader and examined higher-level cognitive processing (Rowe, 1984). However, at the same time, reading instruction in schools has emphasized, shallow and superficial opinions at the expense of reasons and disciplined thought (National Assessment of Educational progress committee, 1981, Sizer, 1984, Harste, 1985, Mullis et.al. 1986) have called for increased attention to be paid to problem solving, reasoning and critical thinking in schools.

Durkin (1978) found that United States teachers spent very little time teaching children to comprehend texts. In fact, the limited time devoted to what was labeled comprehension, was virtually all used for the testing of comprehension through work sheets and work cards. It is difficult to assess whether the situation elsewhere is similar with out a thorough study of classroom practices.

Thomson (1987) found out that teenagers identified with reading difficulties shared one thing; they had all been taught using reading materials with a heavy phonic control of vocabulary. For many children, reading appears to have been a boring school subject characterized by round-robin reading and an emphasis upon word recognition skills (p.21).

Short (1986) found that even when teachers planned lessons that focused on meanings, for the most part the lessons failed to provide or encourage children to engage in what pierce (1966) calls adductive logic. This is they failed to encourage (or provide methods which would encourage) children to see anomalies in what they read.

Research into the role that questioning; plays in the development of spoken language have indicated that adults constantly use questions to facilitate meaning making; (Bruner; 1983, Painter; 1986, Snow; 1983, and Wells; 1986). In addition, recent research in reading comprehension has shown that questions have great potential as facilitators of comprehension (Tierney and Cunningham, 1984).

A major concern of readability research has been the development of taxonomies of questions (Barrett, 1976; Pearson and Johnson, 1985), influenced directly by Bloom's (1956) Taxonomy of educational objectives.

Anderson and Biddle (1975) found that post-questions had a facilitative effect in 37 out of 40 studies when the students were tested on the same post-questions. However, when new questions were introduced, the effects were only moderate, and appeared in only 26 of the studies.

Rickards and Hatcher (1976) found that questions based on a text content of high structural importance facilitated learning from texts largely than those based on a content of low structural importance. Similarly Denner (1982), cited in Tierney and Cunningham, 1984) found that 'higher level' questions produced a greater effect upon learning than "lower-level" questions.

Studies conducted using a wide range of readers, texts and instructional contexts (Rothkopf, 1966, 1972, Graves and Clark, 1981), have shown that students who have been given the opportunity to respond to inserted factual questions as they read, perform for better on the same questions given a post-test. Nevertheless, there is a lack of evidence concerning the effectiveness of questions used within a variety of text types and in a range of "real-life" learning contexts.

(Corcoran and Evans, 1987, P. 45) identify four basic types of mental activity involved in aesthetic reading:

(a) Picturing and imaging (b) Anticipating and retrospection (c) Engagement and construction and (d) Valuing and evaluating.

It seems highly likely that readers at all levels of reading maturity engage in these mental activities (Cairney, 1989), as Cairney points out (p. 69), all readers engage in picturing and imaging, but the extent to which this mental activity is used will vary depending upon the reader's:

- Engagement with the text;
- Breadth of related inter textual experiences;
- Relevant prior experiences;
- Reading purpose;
- Immediate context within which the text is read, and
- Ability to decode the print.

Readers may often use a number of these activities in a single act of reading.

Teachers face many great challenges in the 1990s one of the most significant must surely be the need to reshape reading curriculum in such a way that more students discover they can use reading for purposes which they see as significant for them selves (Cairney, 1990, p. 119).

The author also justifies the use of any reading strategy as follows:

1. Is the reader a better-meaning maker because of his or her involvement in this learning experience?
2. Does the learning experience lead to a more enthusiastic desire to read for a range of purposes?
3. Are students using reading for purposes other than those defined by the school? Are they reading outside schools?
4. Is reading becoming a significant part of the student's worlds?

Various scholars had also developed readability formula after scientific investigation on readability. Some of these are: a) Flesch (1951), (b) Lorge (1959), (c) Dole-Chall (1948), and Fry (1964) similarly major and Collette (1961) used Flesch's formula to establish the readability of the preferred and must frequently used college Biology textbooks in America and found out that the books were written beyond the reading comprehension level of the freshman students.

Similarly Daugs R.D and Daugs F. (1974) used close procedure to estimate the readability of high school Biology materials and found out that (a) the style of science writers appear to be the most critical factors in consideration of what produces reading difficulty in the materials. The length of the sentences seems to be a function of the writer's style.

(b) Science vocabularies are not a major contributor to sentence difficulty.

(c) The high school Biology materials were suitable for a higher grade than they were being used.

In Nigeria the formula for estimating the difficulty level of reading materials was used by Yoloye (1978) to estimate the readability indices of 37 African primary science program (APSP) materials. Among the results subsequently found are:

(a) The reading abilities of the average primary school teachers are high enough for them to comprehend the majority of APSP units' teachers' guide.

(b) The reading abilities of the average primary school child are such that he may have difficulties with the children's background readers.

In the same country Uche (1979) estimated the readability of fourteen secondary school biology textbooks and produced evidence that seriously challenge the suitability of at least three of these textbooks for secondary school Biology and Wahome (1979), used Flesch's formula to estimate the readability indices of eight recommended chemistry books. The findings of the study were that:

(a) The commonly used chemistry textbooks are not selected because they are easy to read (b) most of the commonly used and recommended chemistry textbooks in Nigerian secondary schools are not suitable for the student users.

In Ethiopian situation the readability of Amharic, English, Mathematics, and Science, Agriculture, and Home Economics primary school textbooks had been surveyed by Anbesu et.al. (1994).

The major findings of the study were the following:

a) The legibility of the Amharic textbooks is satisfactory. They are found interest stimulating to read. However, there difficulty level needs to be improved.

b) The overall legibility quality of the English textbooks appears to be good. There appear some weaknesses regarding textual content and pictorial content affecting the readability of the textbooks.

c) The mathematics textbooks have also some weaknesses of legibility and interest initiating qualities. The pupils test score was also unsatisfactory.

d) There are no serious problems regarding the legibility of science textbooks. Weaknesses are observed in the gradation of length and type of sentences. The fact that the compression test results have been found to be poor could be taken as an indicator of the difficulty of the textbooks.

e) The findings regarding the legibility and interest indicating variables of agriculture textbooks indicate no serious weaknesses. Nevertheless, the difficulty level of the textbooks needs to be improved by paying attention to the length and type of sentences used in the texts.

f) The legibility and appropriateness of the content of home-economic textbooks need to be improved. The poor performance level of the pupils in the comprehension tests administered should also be points of consideration for the improvement of the textbooks.

Thus the above-mentioned points are some research study works on readability. There can be more research works the main point to be considered here is that readability can be investigated in any subject or discipline in which the subjects of textbooks are found to be difficult, unattractive, uninitiated, and uninterested to read among the students of the particular grade level.

To analyze and synthesize the above-mentioned theories and findings, it is significant to consider the following tables, which are organized through research studies.

Table 8: Correlation of linguistic variables and readability formulae with criteria of pooled teacher-judgments of passage difficulty (based on 39 passages assessed by 24 judges).

Logistical variables and readability formulae	Correlation
Percentage words on Dale's 3000 list	.68**
Average number of syllables per word	.68**
Average number of letters per word	.53**
Average number of letter per sentence	.50**
Average number of words per sentence	.35**
Dale-Chall	.77**
Flesch- Reading Ease	.74**
Power- Sumner- Kearl	.73**
Smog (McLaughlin)	.71**
Smog (using exact squate root)	.71**
Flesch- Grade	.69**
Fog (Gunning)	.69**
Farr-Jenkins- Patterson	.68**
Mugford	.68**
Forcasr (sticht)	.60**

* Significant at .05 levels

** All correlations significant at .01 levels

Source: The effective use of reading by Eric Lunzer and Keith Gardne; (1979, P.91).

Table 8 shows the results of the cross-validation study, which was investigated by Colin Harrison (1977).

If we take the data in Table 8 as determining which formula is most appropriate for widespread use, then the Dale-Chall formula would seem to be the one since it correlates most highly comparing with others. But according to Harrison (1977), there are other factors to be taken into account. First, the Dale-Chall formula is not widely available in the UK and more importantly neither is the Dale 3000 word list. Second, the formula takes a great deal of time to compute for more than a small number of passages, since it involves the rater in establishing whether each separate word is or is not on the list. Third, Dale and Chall give thirty rules for exceptions on determining whether a word is to be regarded as familiar for computing the formula score. Thus these is a danger that these rules may be applied unreliably or even not applied at all, making Dale-formula scores much less reliable as predictors of difficulty. Other formulae have also their own benefits and side effects.

However, mostly the Flesch Readability ease score is preferable. For instance, the researcher has also investigated through cross-validation study, which can be seen from the table below:

Table 9: Means of Readability Scores Over 40 Passages

Variables and readability formulae	1st year passage (n= 24)	4th year passage (n= 16)
Pooled teacher-assessments	11.30	13.14
Flesch-Reading Ease	78.31	66.78
Powers-Sumner- Kearl	5.09	5.76
Smog	8.23	10.12
Flesch- Grade	7.23	9.21
Farr-Jenkins- Patterson	68.89	59.43
Mugford	11.50	13.59
Fog	8.95	11.37
Forcast	8.75	9.46
Dale-chall	6.88	8.04

Source:- The Effective use of Reading by Ericlunzer and Keith Gardner (1979: 92).

According to the researcher table 9 shows, the reading levels similar to those from which the sample passages were actually taken second, the scores are derived directly from the Flesch RE Formula, which was the second best overall, and the lower correlation is essentially related to a rounding effect in the transformation formula. Third many teachers do have access to the fry Readability Graph, and in a pilot study, (Harrison (1974) showed that Fry graph scores correlated extremely highly with Flesch RE scores. In other words, the non-arithmetic aid can be said to give scores, which would be as valid as those obtained from the Flesch formula would.

CHAPTER THREE

3. METHOD AND PROCEDURES OF THE STUDY

This chapter deals with the research method, source of data, sampling procedures, instruments of data collection, procedures of data collection, assessment methods and procedures on the readability of the textbook, tests and procedures and questionnaire and interview administrations.

3.1. Research Method

The research method applied to examine the readability of grade 7 Biology textbook is mainly readability assessment study, based on survey and selection of unit of analysis. Both quantitative and qualitative methods were used

3.2. Source of Data

A number of sources of data were taken in line with the research questions. Hence, grade 7 Biology student textbook of Addis Ababa region, all grade 7 Biology teachers of Addis Ababa government primary schools found in two sub-cities and selected grade 7 students served as source of data.

3.3. Sampling Procedures

The study involved the government schools only assuming that the other non-government schools may not provide the realistic information concerning the readability of grade 7 Biology textbook. Preferably government schools were appropriate for my data

There are ten sub cities, 58 government primary schools and 122 grade seven Biology teachers (see appendix A) in Addis Ababa region. Since the geographic distribution of the primary schools is widely scattered, it was preferred to select two sub cities namely; Akaki-Kaliti, and Nefas Silk- Lafto and all government primary schools in the two sub- cities, in order to make the study manageable within the given limit of time and financial support. The criteria for selecting the two sub-cities were the relative abundance of primary schools and proximity of their location to each other in the two sub cities as compared with that of the other sub cities. In order to get adequate and realistic information about the readability of grade 7 Biology text, the

instruments used in the primary schools of two sub-cities were tests of reading comprehension, questionnaire, and interview guide.

Two different groups of grade 7 students were selected for test II and I. The selection of sample students who took the test was made as follows:

First, in schools where the number of sections was less than or equal to ten all the sections were included and the top 5, average 10 and the least 5 students were selected based on their 1st semester Biology result. Second, in schools where the number of sections was greater than ten, ¾ of the whole sections were selected randomly and the top 5, average 10 and the least 5 students were selected based on their 1st semester Biology result. In both cases 20 students took test I and II. Fifty randomly selected students were interviewed and recorded and field note was used. All grade 7 Biology teachers in the ten schools were included to fill the questionnaire.

3.4. Instruments of Data Collection

The instruments used to investigate the readability of grade 7 Biology student texts were assessment study check lists on the readability of the text, two reading comprehension tests, questionnaire and interview guide.

3.5. Procedures of Data Collection

Before discussing the data collection procedures, it would be informative to explain how the data collecting instruments were developed.

The data collecting instruments were developed based on the objectives of the study and the research questions. Hence, in order to meet the objectives of the study the data needed were:

- Syllables per 100 words of the text
- Average sentence length written in the text.
- Readability score of the text
- The reading age of the text
- Legibility of the textbook
- Clarity and visibility of illustrations
- Organization of the text
- Interest and motivation of the students to read the text.

- The complexity of words and sentences written in the text in relation to the reading ability of the students.
- Coverage of the text
- Values of the text
- Clarity and sequence of contents, relevance of ideas, and up to datedness of contents of the text.

Based on the above-mentioned needed data how the instruments were developed and the procedures used for data collection for each instrument are presented as follows:

3.5.1. Tests and Procedures

Two separate tests were constructed from two different passages. The passages were directly copied from the text in a similar style of font size, space of words, lines, and paragraphs based on Flesch readability test. The readability score of the passages were 72 and 57.8, which are appropriate to the grade and fairly difficult respectively.

These tests were developed with a view to fulfilling the following two main aims of this inquiry.

1) To find out the suitability of the difficulty level of grade 7 Biology textbook to the comprehension level of the student users.
2) To examine the dependence of reading comprehension on the readability levels of the passages of the textbook.

Each of the tests has two distinctive features:

- One of the tests consists of a passage followed by 15 questions and the questions were divided into sub groups corresponding to certain hypothesized sub skills.
- The other test was constructed by using the cloze technique.

Comprehension part I questions consisted of the following sub skills which helped to examine the difficulty level (see appendix B).

1) Literal comprehension (L), finding the answers to questions when these can be obtained directly by reference to a phrase or a sentence in the passage (Items 1,7,11,15).
2) Drawing inferences from single strings (ISS), (A string is an un interrupted sequence of words, usually a phrase or a short sentence) questions in this category require the reader

to draw an inference from such a sequence as opposed to deriving its scientific meaning (Items 3,4,10).

3) Interpretation of metaphor (M). These questions require the reader to show an understanding (Items 8, 12, 13).
4) Finding salient or main ideas (S), (Items 2, 9).
5) Forming judgments, (Items 5, 6, 14).

Comprehension part II questions were set by using the cloze technique; (see appendix C).

Rankin and Culhane (1969) stated that cloze techniques might best be used to assess readability. Cloze procedure scores are not much more commonly used as a correlate of the readers' comprehension.

In comparative terms cloze tests, involving the deletion of every n^{th} word (usually 5^{th} and 7^{th}) in a passage are much quicker to prepare, and offer the researchers none of the problems item construction and development associated with a normal comprehension test (Lunzer and Gardner,(1979,P. 88).

According to the above-mentioned authors in a cloze test, the reader's task is to work out from the surrounding context which word has been omitted and to insert the one, which seems most appropriate in each blank space. The proportion of correctly guessed words gives an indication of the extent to which the reader has understood the passage.

For the comprehension test, part II the passage "Habitats" was selected from page 37 of the text based on flesh readability score, which is found to be difficult. In this passage, a cloze test 7^{th} word deletion was used, in which one version might begin at the 1^{st} word, and every 7^{th} after that the next version would begin with the 2^{nd} word in the passage and so on.

The main reason for the selection of 7^{th} word deletion is that it is recommended to apply for students whose mother tongue is not English.

In order to establish the reliability of the text items, tryout was conducted in two primary schools, namely Entoto Amba and Kechene Debereselam. After the try-out Kuder-Richardson formula 20 (KR-20) procedures was applied to test the reliability of the items. (See appendix-L). The result showed that r_{20} for test I was 0.52 and test II was 0.56 and some improvements and minor errors were corrected for test I and test II

During the try out, the best thing, that the writer observed was that some students did not write their sex, ages, and schools. It became a caution to take care for the main data collection.

3.5.2. Readability Assessment Procedures

Checklists were prepared based on the study objectives and research questions to assess the readability of the text. The checklists consist of 10 main assessment-guiding items and 47 sub-items.

In order to establish reliable assessment checklists constructive comments were forwarded from some ICDR experts and my advisor. After collecting and analyzing, the comments the writer made some improvements, finalized, and applied the instrument (see appendix D).

3.5.3. Questionnaire and Procedures

The third data-gathering instrument was a 15 main item and 56 sub-items questionnaire involving structured items except one unstructured item. The items constructed were composed of mainly from issues addressed in the checklists for assessing the readability. The questionnaire was designed to get realistic and additional information about the readability level, teachers' mechanism of knowing the difficulty level, legibility, length of sentence, sentence structures, difficult vocabularies, illustrations, organization, coverage, clarity, sequence, and values of the materials written in the text.Before the teachers filled the questionnaire orientation was made concerning how they fill the questionnaire and the points whether teachers know about readability, readability level and methods of knowing readability. the responses of teachers were recorded.

In the questionnaire, two different rating scales were used depending on the issue being addressed; (A five and four point rating scales). These are very good, good, satisfactory, poor, and very poor with values 5,4,3,2 and 1 for the 5-point rating scale and High, medium, low and not at all with values 3,2,1,0 for the four point rating scale. The questionnaire was tried out on five grade 7 Biology teachers in two government primary schools of Gulelie sub-city.

Based on information obtained from these teachers during the try-out, the questionnaire was revised and finalized; (see appendix - E for the finalized copy).

The finalized questionnaire was administered in ten government primary schools in two sub cities and filled by all Biology teachers of these schools.

3.5.4. Interview and Procedures

The fourth data-gathering instrument was a 15 items -interview guide consisting of both structured and unstructured items. The stems constructed were composed of mainly from the checklists prepared for assessing the readability of the text. The interview guide was designed to get appropriate information about the student's interest and motivation of reading the text, difficult terminologies, illustrations, legibility of the text and comparison of the difficulty of the reading passages with other texts and the student's general comments on the text.

The try-out was held in two government schools, and the interview items guide were revised and finalized. (See appendix F).

The Interview guide was administered in 10 government primary schools of two sub-cities. Adequate numbers of students were interviewed; recording field note was used in each primary school.

CHAPTER FOUR

4. DATA PRESENTATION, INTERPRETATION, AND DISCUSSION

This chapter deals with the presentation, organization, analysis, and discussion of the data based on the data obtained through questionnaire, Tests, interview, and readability assessment.

4.1. Data Obtained Through Questionnaire

Questionnaire was administered to all grades 7 biology teachers found in the two sub-cities (Akaki-Kaliti and Nefassilk Lafto) and ten government primary schools.

The data gathered through questionnaire was organized, tabulated, entered, and processed in the computer and analysis was made in terms of the respondents' background, difficult /ease/ condition, legibility, and readability of the text as follows.

4.1.1. Respondents Background Information

The background information comprises teachers' sex, age, level of education, qualification, years of service in teaching Biology in any grade, years of service in teaching biology in grade 7, average number of students in one class and total teaching load per week. These are organized as follows.

As could be seen from the table in appendix -G.

- Most of the respondents (55%) were male and the rest (45%) were female
- Minimum, maximum, and average age of the teachers is 21, 44, and 26.80 years respectively.
- All of the sample schoolteachers' level of education is college diploma, most of them (90%) are biology majors, and the rest (10%) are physical education major and Biology minor.
- Majority of the teachers (60%) taught biology in any grade for 1-5 years.
- Many of them (85%) taught biology in grade 7 for 1-5 years.
- The minimum, maximum, and average load of teachers is 6, 27, and 15.6 periods respectively.
- The minimum, maximum, and average number of students in one class is 61, 85, and 74.80 respectively.

From the above-mentioned teachers' background information, some of the background information of teachers' experiences, qualification, level of education and teaching load may influence the readability of the text indirectly. However, among these background information data, teachers experience has an influence on the readability of the text. Because this was investigated that most of the teachers included in the study were found to have little experience (not experienced). Hence, they may face some difficulties of presenting the lesson in clear, simplified, and attractive way. In this case, the students may not be interested and motivated to read the text. In fact, some may try with their own efforts, but they will come across with readability problems.

4.1.2. Difficult/Ease/ Condition of the Text

Teachers were asked to respond whether the textbook is difficult or not, but all of them (100%) answered that the textbook is difficult (see appendix -H).

According to the teachers' response the main factors for the difficulty of the textbook are:

- The materials written in the text are beyond the students' grade level/ standard.
- Examples and exercises are not adequate.
- Some of the topics and subtopics are not sequenced logically and psychologically.
- Some diagrams, pictures, tables, charts and experiments have shortage of clarity and simplicity.
- Unfamiliar and difficult scientific terminologies as well as very long sentence are available in most parts of the units.

4.1.3. Legibility of the Text

Teachers were asked to rate the legibility of the textbook in five point rating scale (i.e., V. good = 5, Good = 4, Satisfactory = 3, Poor = 2, and V. poor = 1).

Teachers rated the legibility of the text in terms of eleven legibility variables and the result is shown in the table below as follows and appendix- I

Table 10: Legibility rate of the textbook

No	Legibility Variables	Rating index		
		Mean	S	S^2
1	Indication of labels on diagrams in capital letters	1.75	0.72	0.51
2	Visibility and clarity of diagrams	2.60	.50	.25
3	Standard size of letters (font size)	2.50	.61	.37
4	Appropriateness of length of lines	2.25	.55	.30
5	Appropriateness of spacing between the lines	2.65	.93	.87
6	Standard size of margin	2.45	.60	.37
7	Suitability of the line of vision at right angles to the plane of the page	3.55	.69	.47
8	Quality of the paper	3.85	.99	.98
9	Color of ink	4.10	.97	.94
10	Appropriate size of spaces between words	2.70	.57	.33
11	Standard size of spaces between paragraphs	3.50	.89	.79
	Aggregate	**2.90**	**0.73**	**0.56**

Table 10 shows that, the means of indication of labels on diagrams in capital letters (1.75), appropriateness of length of lines (2.25), and standard size of margin (2.45) are below average. This implies that there is a legibility problem, particularly on the above-mentioned variables. However, the total (aggregate mean) of legibility rate of the text assessed by the teachers is 2.90, which also indicates that the text has some legibility problems. S indicates the standard deviation and S^2 is the variance. The least standard deviation and variance is indicated for visibility and clarity of diagrams. This implies that teachers' assessment for this variable is almost similar rating point nearer to satisfactory (average).

4.1.4 Readability of the Text

The readability of the text was assessed by teachers with a 3 point rating scale (High = 3, Medium = 2, Low = 1) and not at all. The variables used for assessing the readability and the results of the assessment are presented in the table below as follows and appendix – J.

Table 11:- The readability index of the text

No	Readability Variables	Rating index		
		Mean	S	S^2
1	Availability of polysyllabic words in most parts of the pages	2.45	.51	0.26
2	The spread of average number of syllables per words in most parts of the passage being greater than 3	2.25	.72	0.51
3	Availability of unfamiliar /difficult scientific terms	2.25	.64	0.41
4	Availability of difficult statements in most parts of the page	2.20	0.52	0.27
5	Availability of difficult illustrations	2.00	.56	0.32
6	Availability of very long sentences in the text	2.75	.44	0.20
7	The ability of the students to read and understand the passage	1.10	.55	0.31
8	The proportion of infrequently used words in the passage of the text	1.85	.37	0.13
9	The quality of the written materials to help the students develop mentally by increasing their interest and motivation	2.00	.65	0.42
10	The comprehensiveness of the paragraphs	1.65	0.49	0.24
11	Availability of familiar words	1.30	.66	0.43
12	Background knowledge of the students about the subject matter	1.50	.61	0.37
13	The students interest and motivation to read the text	1.15	0.49	0.24
14	The students ability of reading the material with the intention of understanding and remembering	1.05	.51	0.26
15	The clarity and simplicity of examples	1.50	.61	0.37
16	The relevance, clarity and simplicity of illustrations to help the students visualize ideas and understand unfamiliar scientific students	1.35	0.59	0.34
17	Availability of comparison and contrast in the text to make ideas clear and vivid to support or prove some experiments	1.60	0.50	0.25
18	The emphasis of reading materials on main ideas, related details, inferences, and conclusions.	1.85	0.81	0.66
19	The presence of examples to simplify the scientific statements for the application of experiments	1.65	0.75	0.56
20	Presence of self-cheek questions at the end of topics/ chapters	1.65	0.93	0.87
21	The ability of the students to compute exercises and practical activities	0.90	0.31	0.10
22	Availability of chapter summaries in the text	2.25	0.72	0.51
23	Availability of review questions	2.30	0.73	0.54
24	The presence of glossary	0.45	0.76	0.58
25	Adequacy of diagrams, charts, pictures and tables	1.70	0.47	0.22
26	The presence of bold or color noted to stress on new words	0.40	.60	.36
27	The representation of different abilities culture and gender in the content	1.25	0.72	0.51
28	The motivating and interest arousing of the text to enable the students to tell the meaning of terms, sentences, phrases, and concepts	1.35	0.59	0.34
29	The organization and classification of facts	1.65	0.49	0.24
30	Availability of sequence of ideas	1.55	0.60	0.37
31	The motivating and interest arousing of the text to enable the students to read critically by distinguishing fact from opinion	1.25	0.64	0.41
32	The capacity of the text to enable the students interpret charts, diagrams and pictures	1.50	0.76	0.58
33	The quality of contents to enable the students to form judgments	1.35	0.59	0.34
34	The appropriateness of the content to the maturity level of students	1.15	0.59	0.34
35	The logical sequence of the content	1.45	0.60	0.37
36	The psychological sequence of the content	1.40	0.60	0.36

No	Readability Variables	Rating index		
		Mean	S	S^2
37	The continuing opportunity of the desired concepts and skills in the text	1.85	0.37	0.13
38	The relation of contents and illustrations of the text to other subjects	2.20	0.52	0.27
39	Adequacy of the period allotted to cover the units	0.70	0.80	0.64
40	The quality of exercises to promote problem solving skills	1.40	0.50	0.25
41	Adequacy of exercises and activities	1.25	0.72	0.51
42	The up-to datedness of the content	1.55	0.51	0.26
43	Clarity and simplicity of the language used in the text	1.35	0.59	0.34
44	The relevance of contents to the daily life of students	2.30	0.57	0.33
	Aggregate	**1.58**	**0.60**	**0.37**

As it could be seen from the table, the readability variables, which, were rated below average mean (1.50) by teachers, were as follows:

- The ability of the students' to read and understand the passages (1.10).
- Availability of familiar words (1.30).
- The students' interest and motivation to read the text (1.15).
- The students' ability of reading the material with the intention of understanding and remembering (1.05).
- The relevance, clarity, and simplicity of illustrations to help the students visualize ideas, and understand unfamiliar scientific statements (1.35).
- The ability of the students to compute exercises and practical activities (0.90), which is very low and the standard deviation (0.3) is the least of all, and nearer to zero this implies that almost all of the teachers assessment is concerning this variable is low and not at all. This also shows that students are not actively participating to compute exercises and practical activities except few of them.
- The presence of glossary; (0.45). At the end of the text, only some words are listed without giving their meanings. Nevertheless, glossary here means the full meanings of scientific and unfamiliar words, not list of vocabularies. In fact, some of the teachers thought these lists of words as glossary and rated; (0.45).
- The presence of bold or color noted to stress on new words (0.40). This indicates almost not present.
- The representation of different abilities culture and gender in the content; (1.25)
- The motivating and interest arousing of the text to enable the students to tell the meaning of terms, sentences, phrases, and concepts; (1.35).

- The motivating and interest arousing of the text to enable the students to read critically by distinguishing fact from opinion; (1.25).
- The quality of contents to enable the students to form judgments; (1.35).
- The appropriateness of the content to the maturity level of students; (1.15).
- The logical sequence of the content; (1.45).
- The psychological sequence of the content; (1.40).
- Adequacy of the period allotted to cover the units (0.70). This implied that the period allotted is not appropriate to the amount of contents to be covered.
- The quality of exercises to promote problem-solving skills; (1.40).
- Adequacy of exercises and activities; (1.25). This implies that exercises and activities are not sufficient.
- Clarity and simplicity of the language used in the text (1.35).

However, the aggregate assessment mean of the readability index as rated by teachers is 1.58. This also shows that the text has considerable readability problems. Teachers' were also asked to tell whether they have methods of knowing the readability of the text or not. However, all of them responded that they do not have methods of knowing the readability of the text.

4.2. Data Obtained Through Comprehension Tests

Two separated tests with different readability scores were given for two selected different groups of students in the ten sample primary schools to assess the readability of the text.

The students' test papers were checked and their marks entered into the mark list corresponding to their names and school. Finally, the score of these two separate tests entered into the computer and data analysis was made to correlate readability score, average sentence length, and syllables per 100 words of the passage with the students' score. The result is shown in the table below as follows:

Table 12: Correlation of Students' Score with the Readability Score, Average Sentence Length, and Syllables per 100 Words of the Passages.

Variables	Type of correlation	Syllables per 100 words	Students' score
The readability score of the passages	Pearson Sig. (2- tailed) Spearman's rho Sig. (2-tailed) N	-1.000*** .000 -1.000*** .000 200	.557** .000 .571** .000 200
Syllables per 100 words of the passages	Pearson Sig. (2-tailed) Spearman's rho Sig. (2-tailed) N	1.000 1.000 200	-.557** .000 -.571** .000 200
Average sentence length of the passages	Spearman's rho Sig. (2-tailed) N	1.000** .000 200	-.571** .000 200

***. Correlation is significant at the .01 level (2-tailed).*

See appendix - K for detail correlation.

As it could be seen from the table the students' score and syllables per 100 words, average sentence length of the passages are negatively correlated in both person's and spearman's rho coefficient correlations. This indicates that when syllables per 100 words of the passages are greater, the students' score will be smaller and vice versa. Similar ways happen to students' score and average sentence length of the passages.

The readability scores of the two passages were different. The readability score of the two passages are positively correlated in both coefficients of correlation, which indicates that in a passage, which has high readability score, students' score will be expected to be high, and in a passage with low readability score, the students' score will be expected to be low. Thus, in table 3 this occasion has become true. The passages selected for the test were adapted from biology students' textbook in a similar way; hence, it indicates that the amount of average sentence lengths and syllables per 100 words available in the text are high.

This implies that students at this grade level will be in trouble to understand and recognize the reading materials written in the textbook.

4.3. Data Obtained Through Interview

A considerable number of students were interviewed randomly in the ten primary schools, the data was recorded, and field note was used. From the students response the following information was organized as follows:-

4.3.1. Background Information

The background information comprises the students' sex and age as shown below the table:

Table 13: Interviewed Students by Sex and Age

Age	Frequency	Percent	Sex	Frequency	Percent
12	2	4.0			
13	16	32.0	Male	23	46.0
14	21	42.0			
15	11	22.0	Female	27	54.0
Total	**50**	**100.00**	**Total**	**50**	**100.0**

As it could be seen from the table balanced number in sex and different age groups of students were interviewed.

4.3.2. Students Opinion about the Readability of the Text

The variables used to gather information about the readability of the text were the following:

- How far the students understand when they read the text
- The reasons for the students' fail to understand during reading.
- Students' satisfaction in their first semester result and the reasons for not satisfied.
- Problems they faced in the language when they read the text.
- The difficulty level of the textbook compared to other texts. And,
- Students' out look about the readability of the text.

Based on the above-mentioned points of reference, most of the students (54%) responded that they could not understand the most parts of the written materials when they read it alone. The main reasons forwarded by them were:

1. Unfamiliar scientific words are more.

2. Contents are not appropriate to the period allotment.
3. Printing problems like small font size of letters, terminologies labeled to identify parts of diagrams are written in small letters, some are not visible, and some are excessively written in one diagram.
4. The contents of some units are beyond their grade level, for instance the units "Habitats", "Human biology and Health were suggested as difficult units.
5. In most parts of the text, the sentences are long.
6. Examples, reading parts, and exercises are not adequate and some activity questions are difficult to solve.

Some students (30%) witnessed that they were not satisfied with their 1st semester result. The main reasons for warded by them were:

- The textbook is difficult.
- Some of them (20%) said that they do have problem of understanding the language, due to that they did not learn English effectively in the lower grades. Nevertheless, some (10%) said that they learn English in the lower grade, but it could not enable them to learn subjects effectively in the language.
- Most of the students ((52%) said that Biology textbook is more difficult than texts of other science subjects due to some unfamiliar vocabularies and absence of glossary.

Some students (35%) suggested about the readability condition of the textbook as follows:

- Examples and exercises should be adequate and there ought to be more examples to simplify the methods of solving difficult activities.
- There must be a glossary at the end to introduce the meaning of unfamiliar words.
- Some experiments, which would be performed practically in the laboratory work, could not be implemented, due to shortage of laboratory materials and some teachers were not willing to demonstrate experiments.
- Diagrams had to be presented and demonstrated in model form.
- Some teachers are new for teaching and they do not present the contents in a clear, simple, and understandable way.

4.4. Data Obtained Through Readability Assessment

To gather the data through the readability assessment, checklists for assessing the readability of the text were prepared.

The checklists comprise 10 main items and 46 sub items, which are under the lists of the main items (see appendix - D.

The data gathered through the readability assessment is presented as follows:

4.4.1. Readability Score (Reading Ease Score) of the Text

According to Flesch (1951, p. 2), the steps for the readability test to find the reading case score of the text will be as follows:

1 Take sample of the whole pages of the text that can either be even or odd pages.

2 Find out syllables per 100 words, average sentence length (average number of words per sentence of the selected sample page.

3. Count as a word all letters, numbers, or symbols, or groups or letters, numbers, or symbols that are surrounded by white space. Count contracted and hyphenated words as one word. For example, count each of the following as one word: 1948, $ 19,892, e.g., C.O.D, wouldn't, weekend.

4. In counting sentences, count as a sentence each unit of thought that is grammatically independent of another sentence or clause, if its end is marked by a period, question mark, exclamation point, semi colon or colon. Incomplete sentences or sentences fragments are also to be counted as sentences. And

5. Count syllables the way you pronounce the word: example asked has one syllable, George's two, determined three, and pronunciation five. Count the number of syllables in symbols and figures according to the way they are normally read about.

To do this first count words, syllables and sentence. Then to find the reading ease score, apply the formula.

Based on the above-mentioned steps the writer selected completely odd pages of the text as a sample and found the reading ease score of the text by using the following obtained data.

- Total syllables counted for 83 odd pages were 37, 993.
- Total sentences counted for 83 odd pages were 1, 286. And
- Total words counted for 83 odd pages were 25, 702.

Then the formula was applied as follows

R.E. = 206.835-0.846 NSYLL- (1.015x W/S); (Lunzer and Gardner; 1979, p. 77).

Where R.E = Reading ease score

NSYLL = the average number of syllables per 100 words.

W/S = the average number of words per sentence.

Hence, NSYLL $= \frac{\text{Total number of syllables}}{\text{Number of words}}$

$= \frac{37,993}{25,702}$

$= 1.4782 \times 100$

$= 147.8$

The average number of syllables per 100 words is approximately 148

W/S $= \frac{\text{Number of words}}{\text{Number of sentences}}$

$= \frac{25,702}{1286}$

$= 19.99$

$= 20$

∴ The average number of words per sentence of the text is approximately 20.

Thus, R.E $= 206.835 - (0.846 \times 148) - (1.015 \times 20)$

$= 206.835 - (125.2) - (20.3)$

$= 206.835 - (125.2+20.3)$

$= 206.835 - 145.5$

$= 61.335$

The reading ease score of the text is 61, syllables per 100 words of the text are 148, and average sentence length is 20.

To interpret the above-obtained result, it is essential to observe the following table: -

Table 14: Flesch Readability Table

Readability score (Reading ease score)	Syllables per 100 words	Average sentence length	Description Of style	Grade level estimate
90-100	123 or less	8 or more	Very easy	5th grade
80-90	131 or less	11 or more	Easy	6th grade
70-80	139 or less	14 or more	Fairly easy	7th grade
60-70	147 or less	17 or more	Standard	8th and 9th grade
50-60	155 or less	21 or more	Fairly difficult	10th – 12th grade (high school)
30-50	167 or less	25 or more	Difficult	15th – 16th grade (college level)
0-30	192 or less	29 or more	Very difficult	College graduate

Source: - Rudolf Flesch (1951, pp. 6, 43).

From the table and literature it is interpreted as follows:

Description of style for the score will be between standard and fairly difficult and the grade level estimate is to the nearest 10th grade. However, this can be interpreted also by using Flesch- Kincaid recent formula as follows: (see literature review P. 39)

Grade level = (L x 0.39) + (N x 11.8) – 15.59.

Reading age = (L x 0.39) + (N x 11.8) – 10.59 years.

According to this formula, the grade level estimate of the textbook is 10th grade and the reading age of the textbook is 15 years. (See the detail on pages 86-90)

4.4.2. Reading Age of the Text

The term "reading age" is to indicate the chronological age of a reader who could just understand the text. For instance, a text with a reading age of 14 years is one that could be read and just understood by a 14- year old student having average ability; (see literature on page 33).

Similarly, piaget described four basic stages of development which were age- related, but not age- dependent, and the kinds of thinking typical of each stage. In the same way cognitive develop mentalists believe that both maturation and environmental experiences play a part in the child's learning (Temechegn, 2001).

Thus, it is found to be significant to investigate the reading age of the text. Hence, according to the fry graph for estimating the reading ages (in years) the reading age of the textbook is approximately 15. (See the fry graph on page 42) and using Flesch Kincaid formula the reading age of the text is the same. But when we observe age of sample school students of grade 7, their average age is 14.5 (see appendix - M).

Thus, the reading age of the text and the students' average age is almost the same. In this case, it is difficult to analyze students' age in terms of the reading age of the textbook.

4.4.3. Legibility of the Textbook

The legibility of the text was assessed in terms of labels, visibility and clarity of diagrams, size of letters, length of sentences, spacing, plane of the page, lay out and the reading condition as follows.

4.4.3.1. Labels, Visibility, and Clarity of Diagrams

Almost, in all parts of topics and sub-topics labels on diagrams are not written in bold and capital letters except diagrams on pages 24, 38 and 62, which have written in bold, and on page 63 food web diagrams are the only labels indicated in capital letters. Teachers rated this point below very poor (0.72), which does almost not exist at all.

Visibility of diagrams was examined in terms of the thickness of lines, the color used to draw, and magnifying size of the diagrams. Hence, the following diagrams were found to have visibility problems.

- Page 10 under the sub-topics single celled plants fig 1/7 and spirogyra (fig 1/8).
- Page 30 under the sub topics plant cells and tissues the parts of diagram companion cell and sieve tube cell.
- On page 39 under the sub-topic using a quadrant figure 3.2, a quadrant samples of a known area, and
- On page 129 structures of the digestive system.

4.4.3.2. The Type/ Lettering Condition

Concerning the legibility, particularly 'the type' the following points are indicated (see the literature review on page 9).

- Lower case print is preferred by most readers, and is read about 10 percent faster than words in CAPITAL letters.
- For single letters (for instance labels on diagrams) capital letters are more easily differentiated.
- A fluent reader relies up on the upper, coastline of the print for most of his information.

- The right- hand sides of letters give more information than the left. In addition, where emphasis is required, bold type is read more quickly than italics or CAPITALS.

Based on the above information the writer tried to assess the legibility of the text as follows:

- In the text almost all letters are written in lower case print (small letters). However, the size of the letters is below standard (small).
- The upper coastline of the print particularly for topics and sub-topics are not written in capital letters or upper cases in all pages of the text. This has an impact on the legibility of the text.

In most pages of the text where emphasis is required bold types, capital letters and italics are not used. For instance on page 37 under the topic Habitats and sub-topics different types of habitats and studying a habitat, there are some scientific terms which require emphasis, they are neither written in bold, italics, and nor in capital letters. Similarly, on page 41 under the topic "Aquarium and terrarium", on page 59, under the sub topic "community and succession", on page 61 under the sub topic" food relationships, on page 81 under the sub topic "Moses", on page 88 under the topic "Insects", on page 107 under the sub topic "Honey making by the honey bees", on page 113 under the sub topic "types and structures of bones", on page 118 under the sub topic "taking care of muscles and the skeleton", on page 130 under the subtopic. "Ingestion and Digestion", on page 140 under the sub topic" relationship between structure and function of lungs", on page 141 under the sub-topic "Disease and Health of breathing organs", on page 147 under the sub topic "Circulation in Amphibians", on page 155 under the sub topic" circulation and health", and on page 162 under the sub topic "health and excretory organs". There are some unfamiliar and scientific terminologies, which need emphasis for the readers and better be written in bold, capital letters or italics.

4.4.3.3. The Layout

There are four inter-related factors here, (see literature review on pages 9-11) these are:

- The size of letters,
- The length of line, and
- the spacing between the lines, words, paragraphs, margin, and the weight of print.

The layout of the text was examined based on the above-mentioned points as follows.

4.4.3.3.1. The Size of Letters

In all pages of the text, the size of letters is below 12 point (4.2 mm). Particularly in some pages and sub-topics the size of letters are below the standard font size. For instance on page 37 the reading parts under the topic "Different types of habitats", on page 39 under the sub-topic" studying a habitat" on page 75 under the sub topic "Fungi" on page 99, below the subtopic "Malaria" on page 113 under the subtopic "Types and structures of bones" on page 117 under the subtopic "Interaction of muscle skeleton system" on page 130 under the sub topic "Ingestion and Digestion" on page 140 under the subtopic "Relationship between structure and function of lungs" and on page 155 under the subtopic" circulation and health" the size of letters are below standard. It is also to some extent supported by teachers rating that the standard size of letters was rated as satisfactory (2.50).

4.4.3.3.2. The Length of Lines (Sentences)

It has already discussed in the literature review on page 9 that line means the line of the written statements from the initial margin to the final (or length of line of statements from left margin to right margin). Lines, which are too short or too long cause in efficient eye movements, when considering the speed of reading. Researchers have recommended line lengths in the range 6 cm-9 cm (depending on the size of type and leading). For instance, the width of a VDU screen is often about 25 cm and an A4 sheet may have lines 18 cm. Tinker (1963) advocates a series of safety zones within which type size, line length, and leading may be varied with out loss of legibility. Some schoolbooks appear to lay out side these safety zones. How ever, the correlation between speed of reading and comprehension of information seems to be poor.

In one study, a text in 18-point type set in 10c m line length on a 21-point leading was ranked fourteenth in speed, but second in comprehension scores. Overall, line lengths of 7-12 average words seem to be optimum.

Based on these information the average measurement of length of line of the textbook for even pages is 15.57 cm and for odd pages is 15.54cm which is measured by using scheduled ruler. This implies that the size of letters is below standard, because when the length of line is small the size of letters will be big. For appropriate size of letters, the length of lines should be 6-9 centimeters.

4.4.3.3.3. The Spacing between the Lines, words, Paragraphs, Margin Space and the Weight of Print

Unjustified lines (i.e., when the right hand edge of the text is not straight) are better, because they help the reader's eye to scan the lines more accurately. White space between paragraphs and sub-heads help for the same reason.

Standard spacing between the lines, words, and paragraphs is 0.5 cm, 0.2 cm, and 1cm respectively, (see literature review page 9).

The size of margin may cause increased eye fatigue if it is too narrow. Standard margin size of left and right is 3.17 cm each and top and bottom is 2.54 cm each; (Literature review, p.9-11).

The weight of the print is the color of ink and the quality of the paper. When one examines the color of ink and the quality of the paper, the following points will be taken into account; (Literature review, p. 10). A) Black type on white paper (or a white screen) is more legible than any other color combination. Blue, red, and green on white are often acceptable. The worst combination is black type on a purple background B) Matt paper (not shiny/dull) has less eye fatigue than glossy paper. The paper should be thick enough to prevent print on the reverse side showing through. Based on the above-mentioned points of reference, the text was examined as follows.

- In most parts of the book, the spacing between the lines is 0.48cm. This is almost at the standard level. Concerning this teachers rating point is 2.65, which is good.
- The spacing between words and paragraph of the text is 0.2cm and 0.8cm respectively. These are almost to the standard level. Teachers rating are also (2.70) for words and (3.50) for paragraphs, which are beyond satisfactory.
- The margin of space to the left for even pages is 3cm and to the right is 0.2cm, for odd pages it is 0.5cm to the left and 2cm to the right. The size of space for the margin is not appropriate particularly for even pages to the right and odd pages to the left. Concerning margin teachers' rating point is 2.45, which is below average this also implies that the margin space of the text needs more improvement.
- The color of ink used is black type on white paper, which is more legible than any other color; however, the paper should be thick enough to prevent print on the reverse side showing through. In general, the weight of print of the text is satisfactory. Teachers rating

point for the color of ink and quality of paper is (4.10) and (3.85) respectively that are good.

4.4.3.4. The Reading Conditions

Books with thick spines may cause difficulty due to the curvature of the page, particularly where the inner (gutter) margin is narrow. Researchers state that the brightness ratio between a book and the surrounding table surface should be 1:1 ideally, but 3:1 is acceptable. Beyond 5:1, there is some impairment. It is measured by light meter readings in the laboratory. Serious effects on legibility arise when vibration occurs with a handheld book and when the line of vision is not at right angles to the plane of the page (see literature review on pages 9-11).

Based on the above information the book was examined as follows.

- Thick spines (pages joined) are observed in some parts of the book due to the cover of the book. For instance on pages 26.34,64,65,66,78,120,121,127,146 and 147 thick spines are observed. This happened due to the small size of space given for left margin of even and odd pages of the text.
- As the writers view the brightness ratio between a book and the surrounding table surface is appropriate.
- The line of vision in all parts of the page is almost at right angles. Vibration could not be observed even in the pages of a little bit slant lines. Concerning this teachers rating point is 3.55, which is beyond satisfactory.

4.4.4. Readability of the Text

The readability of the text was assessed in terms of the following point of references.

- Condition of illustrations (charts, tables, diagrams, pictures, and examples) based on their clarity, relevance, and simplicity.
- The condition of reading materials (the proportion of infrequently used words, polysyllabic, long and unfamiliar words, presence of many scientific terms, long, and complex sentence structures.
- The stress on main ideas, related details and conclusions, scientific statements and phrases with out examples, laboratory works, clarity and simplicity of the language, clarity, relevance and simplicity of reading parts,

- The nature of exercises, activities, self-checks and review questions. (These can also be examined in terms of their adequacy, appropriateness, variety, promotion of students' problem solving skills, quality of assessing pupils' knowledge, attitudinal development and skills and unclear instructions).
- The presence, relevance and clarity of chapter summaries and glossary
- Appropriateness of contents to the cognitive development of the students (i.e., mental, physical growth and social development and
- Presence of related variety materials to be read by the students in each topic and subtopic.

4.4.4.1. Condition of Illustrations (Charts, Tables, Diagrams, Pictures, and Examples)

4.4.4.1.1. C harts and Tables

- The table presented on page 15, which is to be filled by the students lack clarity, to make it clear some parts had to be filled and the others will be left for the students to complete.
- The table on page 16, lack clarity and relevance it is under the sub-topic, "Types of structures" But what is written in the table is kinds and types of shape of Bacteria.
- The chart on page 18 mode of nutrition's (feeding) lack clarity due to the ambiguity of the title of the chart which is not self explanatory.
- Under the subtopic "Harmful bacteria "what is stated on page 19 below the table is that "Examples of pathogenic bacteria", but the title of the table is "Human bacterial diseases", under "Diseases" type of bacterial diseases are written, but it will be difficult for the student to identify pathogenic bacteria from the table. In this case, the table lacks clarity and relevance.
- The food web chart on page 63 is relevant to the topic, but to show the flow from left to right the flow arrows are not showing clear directions.

When the chart is observed the food web can be taken from the chart as follows.

1. Green plant► caterpillar► small bird►Hawk
2. Green plant► caterpillar► Mouse► Fox
3. Green plant► Rabbit► Hawk
4. Green plant►Cater pillar►Mous► snake
5. Green plant► Caterpillar►Mouse► Hawk

From the above food web, the 2nd and 3rd chains are not clearly indicated by arrows in the chart.

The table presented under the topic "Green algae' on page 70 is relevant but it lack clarity and simplicity, because in the table red algae and brown algae are included and the title written under the table is "The different features of algae". Nevertheless, the main heading is "Green algae".

- The life cycle of a fern on page 85 is relevant to the topic, but the flow chart alone is not self-explanatory, because the scientific terminologies sporophite, sporangia, and Gametophyte need more elaboration. Therefore it lack clarity and simplicity
- On page 99, the life cycle of Anopheles mosquito and pages 101 and 102 life cycle of a locust are relevant to the topic and a brief description had been given separately under the life cycles, which made the chart clear and simple.
- On page 121, the chart showing percent of nutrient needed each day lack accuracy. On the statement is it is written that "carbohydrate should make up about 55% of a normal diet" but on the chart it is shown approximately to 60%.
- The flow chart showing the complete metamorphosis of a cabbage butterfly is relevant, however the chart by itself is not explanatory, and it needs brief explanation separately.
- On page 127, the table given for Height /Weight ratio is relevant, but needs further clarity and simplicity. Particularly symbols written for height for instance (5' 6") should be explained in terms of unit of measurement in words.
- On page 142 the table and chart presented under lung cancer are "cigarette smoking and lung cancer" and "cigarettes smoked per capita per year' both of them are relevant but they need clarity and simplicity. For instance under increased risk of lung cancer. The symbols (x8, x13, x25) are written, but they are not specifically elaborated and the lines representing smoking and lung cancer should be differentiated by bold or light color and if possible with other two different colors. In addition, the explanation written below the two charts, that is "Deaths from lung cancer per 100,000 per year" lack clarity.
- On page 153 under the topic Blood Transfusion (donation), the Blood transfusion table is given. This is written as follows.

Table 6/5 Blood Transfusions

	O	A	A	AB
O	-	-	-	-
A	+	-	?	?
B	+	?	?	?
AB	+	?	?	-

N.B, "AB" blood type is a universal acceptor and "O" type is a universal donator. The sign for (-) is meant for no blood agglutination up on mixing and the sign for (+) indicates agglutination when the recipient acts on the donated blood due to having different antigens.

As we could see from the table, the question marks are given to be completed by the students. However, the main problem here is that the difference between types of blood filled in the table in column and row is not clear and at the same time in the row and column the same letter "A" is repeatedly written, which makes confusion. Hence, the table lacks clarity and simplicity.

4.4.4.1.2. Diagrams, Pictures, and Examples

Under the topic "The world of micro organisms and the discovery of microscopes" on page 3 a diagram representing Anton Van Lee Wenhock's (1632-1723) simple microscope is drawn. This is in fact relevant to the topic. The main problem that Anton Van Lee Wenhock made the first microscope and at the same time, Antonvan Lee Wenhock's simple microscope is shown. This lacks clarity and simplicity that students may assume it the old microscope. In actual sense, the picture of microscope can be the same but it may differ in operation and function.

- The diagram representing the parts of microscope on page 5 is relevant and the explanation is given separately. Nevertheless, it seems difficult for a grade 7 student who has never seen microscope parts in its real object.
- The diagram on page 8 entitled "preparation of onionskin for observation" needs explanation for every step. Nothing is written about it.
- Under the topic spirogyra on page 10, the diagram representing spirogyra is given, this is in fact relevant, but the diagram is not magnified and visible and labels should be written in bold.

- On page 38, the picture representing profile of rain forest is relevant, but lines or arrows to indicate the bottom, medium and tip size of trees do not indicate the labels written to the right.
- On page 39 under the topic "Studying a habitat" and sub-topic using a quadrant a diagram representing a quadrant samples of a known lack clarity, visibility and it is not simple for the students to count the number of a particular species inside a quadrant.
- The diagrams and pictures; on page 42 a balanced aquarium, on page 44 a vivarium for ground dwelling animals, on page 45 "A butterfly or moth cage", on page 46 a locust or grass hopper cage, on page 47 Frog vivarium,, on page 49 "The sweep net', on page 50" A butterfly net", on page 51"Insect killing Jar", on page 53 'pitfall trap', on page 54 Tull green funnel , and on page 55 food trap need more clarity and simplicity so as the students can prepare it practically.
- The diagram on page 71 under subtopic "Volvox" needs label of letters to be more clear and self-explanatory.
- Under the topic "Importance of Mosses", on page 82 the diagram given for life cycle of a moss does not show any relevance to the topic and arrows showing the flow of cycle are not indicated.
- On page 90, under the unit "insects" and sub-topic" External body structure of insects and their functions", for two different pictures the title given is the same. That is "External structure of Grass hopper". It was better to mention the external structures in words. First it had to be labeled by using nominal representation method to use the space appropriately. Otherwise, it may lack clarity and simplicity.
- On page, 100 under the sub-topic "Locust" arrows are not properly indicating the labeling of parts.
- One page 119, under the topic lifting and bending, the pictures given for lifting and bending is relevant and self explanatory but the title given for the picture is "safe lifting' only the un safe part should be also mentioned for more clarity and simplicity.
- On page 129, the diagram representing "structures of the digestive system" is relevant but lack clarity and simplicity. It will be simpler and clearer if it is enlarged, magnified, and labeled to the appropriate terminologies indicating the parts.

- On page 140 under the sub-topic "Exchange of gases", the diagram representing' Gaseous exchange" lack clarity, simplicity and visibility, at least it should be enlarged and lines should be bold and needs more explanation about the labeled parts.
- On page 147, under the topic circulation in Amphibians and circulation in reptiles, the diagrams of Amphibian, reptile's heart labels are not written in bold and capital letters and the diagrams should be enlarged and visible.
- On page 149 under structure and function of the heart, the diagram of external structure of the heart is drawn after the exercises are given. In fact it is relevant, but labels on diagrams should be written in capitals and bold and preferable to draw the diagram after the explanation, not after the exercises.
- On page 158 the diagram "Excretion and Egestion" need enlargement, clarity and visibility. However, arrows are clearly visible. On page 162, under the topic excretion by the skin, a diagram showing the section of the human skin is presented. Even though, the diagram is visible clear and relevant the labels indicating the part of the human skin are not clear and not written in bold and capital letters.
- Only a few examples are given these are the importance's of fungi on page 79, Insects on page 88. However, these examples are relevant and clear. There are some experiments and activities, which need more examples. For instance, experiment 2.1 "Looking at chloroplasts, in the cells of a moss leaf "need related examples. Exercise 3.1," Base your answers on the following diagram" needs at least one example and points labeled on the diagram are not written in capital letters.
- On page 75 under the topic "Mucor/Mould/", the biological statement written here is that "Mucor is a simple mould that grows on jam, damp bread, damaged tomatoes, boiled beet-root and flower paste." Concerning this statement, Experiment 4.2 is given, but no example or table is given to guide the students in order to perform the experiment. For the variable, "The relevance, clarity and simplicity of illustrations to help the students visualize ideas and understand unfamiliar scientific statements" teachers' rating points was 1.35, which is below average. This implies that illustrations have some clarity, relevance, and simplicity problems.

4.4.4.2.2. The Condition of Sentences, Ideas, Details, and the Language

Long and complex sentence structures, stressing on main ideas, related details, and conclusions, scientific statements with out specific examples, clarity, and simplicity of the language and experiments determine the readability of the text either positively or negatively (see literature review pp 11, 16, 45).

Based on the above-mentioned points the following topics and subtopics were examined as follows.

- Topics and sub-topics that have long sentences beyond the standard level (see literature pp. 9-11) are: unit 1 on page 1, topic "single celled organism". On page 2, the world of microorganisms". On page 11, "single celled animals". On page 17, "Habitat, propagation and Nutrition". On page 31, "Animal cells". On page 37, "Habitats". On page 47, 'Methods of collecting organisms". On page 59, "Community and succession". On page 81, "Mosses". On page 94, "complete metamorphosis". On page 99, "Malaria". On page 117, "Interaction of muscle skeleton system". On page 130, "Ingestion and Digestion". And on page 140" Relation ship between structure and function of lungs".

In most parts of the above mentioned pages and topics the writers of the textbook stressed on related details mainly.

There are also some scientific statements with out specific examples. For instance on page 8'. "Activity ½", "To study animals", on page 13 "Assignment", on page 47 "Methods of collecting organisms", on page 55 "Methods of preservation of collected specimens", on page 75 "Mucor/Mould/", on page 75 "Experiment 4.2", and on page 111 "Experiment 6.1" on the title "Animal with a skeleton inside the body".

In most parts of the topics and sub-topics the clarity and simplicity of the language to perform some experiments needs more elaboration. However on the curriculum guide (syllabus) is clearly indicated in the methodology part, how teachers are demonstrating each experiment in the laboratory.

Regarding the condition of sentences, ideas, details, clarity and simplicity of the language used teachers rating point was as follows (see Table 11). For availability of very long sentences, (2.75), for the emphasis of reading materials on main ideas, related details, and inferences (1.85), and for clarity and simplicity of the language, (1.35. From these rating points,

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Based on the above-mentioned points the following topics and subtopics were examined as follows.

- Topics and sub-topics that have long sentences beyond the standard level (see literature pp. 9-11) are: unit 1 on page 1, topic "single celled organism". On page 2, the world of microorganisms". On page 11, "single celled animals". On page 17, "Habitat, propagation and Nutrition". On page 31, "Animal cells". On page 37, "Habitats". On page 47, 'Methods of collecting organisms". On page 59, "Community and succession". On page 81, "Mosses". On page 94, "complete metamorphosis". On page 99, "Malaria". On page 117, "Interaction of muscle skeleton system". On page 130, "Ingestion and Digestion". And on page 140" Relation ship between structure and function of lungs".

In most parts of the above mentioned pages and topics the writers of the textbook stressed on related details mainly.

There are also some scientific statements with out specific examples. For instance on page 8'. "Activity ½", "To study animals", on page 13 "Assignment", on page 47 "Methods of collecting organisms", on page 55 "Methods of preservation of collected specimens", on page 75 "Mucor/Mould/", on page 75 "Experiment 4.2", and on page 111 "Experiment 6.1" on the title "Animal with a skeleton inside the body".

In most parts of the topics and sub-topics the clarity and simplicity of the language to perform some experiments needs more elaboration. However on the curriculum guide (syllabus) is clearly indicated in the methodology part, how teachers are demonstrating each experiment in the laboratory.

Regarding the condition of sentences, ideas, details, clarity and simplicity of the language used teachers rating point was as follows (see Table 11). For availability of very long sentences, (2.75), for the emphasis of reading materials on main ideas, related details, and inferences (1.85), and for clarity and simplicity of the language, (1.35. From these rating points,

it is inferred that very long sentences are available, in the reading materials, much emphasis on main ideas, related details and inferences, was not given, and clarity and simplicity of the language used to write the text was not to the standard level.

4.4.4.2.3. The Nature of Exercises (Activities)

Adequacy, appropriateness, variety, promotion of problem solving skills, quality of assessing pupils knowledge, attitudinal development and skills, clear instructions and simplicity of language used for activities and exercises influence the readability of the exercises and activities. For instance, the exercises in unit one "single celled organisms" are appropriate, but not adequate, only seven review questions are given for the whole unit. However, these review questions lack variety and promotion of problem solving skills. In other units "The cell", "Habitats", "Non-flowering plants", "Insects", and "Human biology and health", the adequacy, appropriateness, variety, promotion of problem solving skills, quality of assessing students knowledge, attitudinal development, simplicity and clarity of language used is satisfactory. Teachers also rated for the quality of exercises to promote problem solving skills and adequacy of exercises and activities with (1.40) and (1.25) points respectively.

From teachers rating point and the text assessment the writer inferred the following points. Appropriateness, variety, and quality of exercises to promote problem solving skills, knowledge, and attitude of the students are satisfactory. Nevertheless, adequacy, clear instruction, and simplicity of language used for exercises and activities are not satisfactory.

4.4.4.2.4. Availability, Relevance, Clarity, and Simplicity of Unit Summaries and Glossary

Unit summaries are available for all units of the text, except unit 1 (single celled organisms). Glossary is not available at all. All unit summaries are relevant to each unit. The clarity and simplicity of each unit is satisfactory. However, the unit summary of unit 6 (Human Biology and Health) seems a little bit vast and has some difficult terms. Teachers have also assessed summaries and glossary by using a 3-point rating scale. Teachers rated for the availability of glossary (0.45) and for availability of chapter summaries (2.25). Teachers rating point supports the assessment made by the writer. However, some teachers misunderstood glossary and list of vocabularies. This happened due to the availability of list of vocabularies at the end with out their meanings.

4.4.4.3. The Appropriateness of Contents to the Cognitive Development of the Students

The fore cognitive developmental theorist is Jean piaget. His ideas fit cognitive theory because they are concerned with the thinking events that are associated with learning; they also fit developmental theory, because they carefully consider occurrences at each stage of growth and maturation as a student's capacity to learn changes (see literature review on page 33).

Similarly on the review of related literature under the subtopic "reading ages of school science textbooks" states that a text, which has a reading age of 14 years, is one that could be read and just understood by a 14-year old pupil having average reading ability.

According to the fry graph for estimating reading ages (in years), the reading age of biology grade 7 textbook is 15.5 (see in page 39) and from the statistics taken from sample. Schools of two sub-cities of Addis Ababa region, the average age of grade 7 students is 14.5 (see appendix - M).

Based on the above information the following topics and subtopics are examined as follows.

The formula used to examine the grade level and reading age of the topics and subtopics is Flesch- Kincaid formula (see literature, p. 39).

Grade level = (L x 0.39) + (N x 11.8) – 15.59

Reading age = (L x 0.39) + (N x 11.8) – 10.59 years where L is the average sentence length and N, the average number of syllables per 100 words.

Hence, the writer took the following subtopics and topics randomly.

1. For the subtopic "The world of Micro organisms and the discovery of microscopes" from pages 2-3 the following words, syllables and sentences were counted and the result is shown as follows:

   - Number of words of the reading material = 201
   - Number of syllables = 330
   - Number of sentences = 13

   Grade level = (L x 0.39) + (N x 11.8) - 15.59

   L = 201 ÷ 13 (Number of words ÷ number of sentences)
   = 15.5

   N = Number of syllables ÷ Number of words
   = 330 ÷ 201 = 1.64

Hence, grade level = (15.5 x 0.39) + (1.64 x 11.8) –15.59
= 9.807

This will be 10 approximately. Hence, the grade level estimate of the subtopic "The world of micro organisms and the discovery of microscopes" is 10^{th} grade.

Reading age = (L x 0.39) + (N x 11.8) – 10.59 years

= (15.5 x 0.39) + (1.64 x 11.8) – 10.59 years

= 6.045+19.352 – 10.59 years.

= 25.397 – 10.59 years

= 14.807 years; hence, the reading age of the sub topic mentioned above is 14.807 years. This is approximately 15 years.

2. Under the unit "Habitats" the topic "different types of habitats" p. 37 has:

- Number of words = 209
- Number of sentences = 11
- Number of syllabus = 320. Hence, L= 209 divided by 11= 19, N= 320 divided by 209=1.53

Grade level = (L x 0.39) + (N x 11.8) – 15.59

= (19 x 0.39) + (1.53 x 11.8) – 15.59

= 7.410 + 18.054 – 15.59

= 25.464 -15.59

= 9.874

Reading age = (Lx 0.39) + (Nx11.8) - 10.59

= (19x 0.39)+ (1.53x11.8) – 10.59

= 7.410+18.054 – 10.59

= 25.464 – 10.59

= 14.874 years

The result implies that the grade level estimate of the topic "Different types of habitats" is grade 10. Moreover, reading age of the topic will be 14.874 this is 15 years approximately. This shows that a 15-year-old student can read and understand the topic.

3. Similarly, under the sub-topic "community and succession" from page 59-60; the number of words, sentences, and syllables counted were 203, 14 and 346 respectively. Therefore, L (average sentence length) = 203 divided by 14= 14.5

N (syllables per 100 words) = 346 divided by 203= 1.7

Grade level = (L x 0.39) + (N x 11.8) – 15.59

= (14.5 x 0.39) + (1.7 x 11.8) – 15.59

= 5.6550 + 20.06 – 15.59

= 25.7115 – 15.59

= 10.1250 this is grade 10 approximately

Reading age = (L x 0.39) + (N x 11.8) – 10.59

= (14.5 x 0.39) + (1.7 x 11.8) - 10.59

= 5.6550 + 20.06 – 10.59

= 25.7150 – 1059

= 15.1250 this is 15 years approximately.

Thus, the grade level estimate will be 10.125 this is approximately 10 and this implies that a grade 10 student can read and understand the subtopic. Moreover, the reading age of the subtopic is 15.125, which is approximately 15, this means that a 15-year-old student can read and understand the sub-topic.

In general, the reading materials of the text were assessed with regard to grade level and reading ages as follows:

The total syllables, sentences, and words were counted by taking sample odd pages (83 pages) of the text (see page 71-73)

- Total syllables = 37,993
- Total sentences = 1,286
- Total words = 25,702

By using the above mentioned total syllables, sentences and words the text's grade level and reading age were tested as follows and Flesch Kincaid formula was selected for testing, which is widely used and a little bit recent.

Grade level = (Lx0.39) + (N x 11.8) – 15.59

Where L (average sentence length) = Number of words ÷ Number of sentences

= 25,702 ÷ 1, 286

= 19.98

≈20

N (average number of syllables) = Number of syllables ÷ Number of words

= 37, 993 ÷ 25, 702

= 1.48

≈1.5

Hence, grade level = (20 x 0.39) + 1.5 x 11.8) – 15.59

= (7.8 + 17.7) – 15.59

= 25.5 – 15.59

= 9.91, this is approximately grade 10

Therefore, the grade level of the text is 10th grade. This implies that a 10th grade student can read and understand the written materials of the textbook.

Reading age = (L x 0.39) + (N x 11.8) – 10.59 years

= (20 x 0.39) + (1.5 x 11.8) – 10.59 years

= (7.8 + 17.7) – 10.59 years

= 25.5 – 10.59 years

= 14.91 years

≈ 15 years

Therefore, the reading age of the textbook is 15 years. This implies that a 15-year-old student can read and understand the textbook.

Concerning the appropriateness of contents to the cognitive development of the students, teachers were asked to rate and teachers' rating for the appropriateness of the content to the maturity level of the students was 1.15 that is below average (low).

From the results of the textbook's grade level and reading age and teachers rating scale, the following points are deduced:

- In Ethiopian situation the grade level and the students' age is not appropriate.
- The result of the formula indicates that in Europe and North America a 15-year-old child's grade level is 10. Nevertheless, in our country a 15 year old child can be a grade 7 student or below that, because age is not a determinant factor for the students grade level. The maximum age of grade, 7 students' in the sample schools was 18.

Hence, it is difficult to conclude that the book is beyond the age of the students, but it is examined exhaustively that the textbook is beyond the students' grade level.

4.4.4.4. Presence of Related Variety Materials to be read by the Students in Each Topic and Sub Topic

In the text, an effort was made to write related variety materials. Still, some related variety reading reference materials are necessary for all units. These additional reading materials would be significant for the students to read by their spare time (out side the classroom).

4.4.5. Contents of the Text

The contents of the text were examined in terms of sequence, integration, relevance of ideas, coverage, and values as follows:

4.4.5.1. Sequence and Integration

Curriculum experience can be sequenced in terms of content and learning experiences. Content is usually sequenced by means of the logic of the subject matter, while the psychological approach is used to determine the sequence of learning experiences; (Derebissa, 1999).

There are two types of sequences logical sequencing and psychological sequencing (see literature on p 46- 51 for detail information).

The logical and psychological sequence of the content, topics, and subtopics were examined as follows:

The arrangement of the main contents would be preferable if unit 2 "The cell" should come first and then unit 1 "single celled organisms follows and the other units take the same arrangement.

The logical and psychological sequence of the unit "Habitats" is arranged as the following sub-topics:

- Different types of habitats
- Studying a habitat
- Community and succession
- Food relationships.

But it would be better if it is arranged as:

- Studying a habitat
- Community and succession

- Different types of habitats
- Food relationships.

The logical and psychological sequence of the other units is satisfactory. However, some units do not have the introduction part. For instance, unit 2 "The cell", unit 3 "Habitats", and unit 6 "Human biology and Health" need to be introduced in brief to facilitate the preconditions and prerequisites of the topics, subtopics, and illustrations of the unit.

There are some topics and subtopics, which were not arranged logically and psychologically. For instance, on page 7 "precautions" on a microscope should come before the topic "Handling the microscope". Some experiments (investigation) are written before exhaustive explanation of the topic. For example on page, 11 investigation-guiding points are written about spirogyra after four sentences of explanation about spirogyra. Similarly on page 13 investigation about ameba and on page 69 the unit entitled "Non- flowering plants"; but the introduction part discusses 1st about flowering plants and then Non- flowering plants. Which part should come 1st? In my opinion, the Non-flowering plants had to be introduced first and flowering plants may be included in examples not in the subtopic. On page 106, Fig 5/25 indicates the various types of bees found in a hive. However, the hive is introduced on page 108. Type of hives had to be introduced before the fig 5/25. Some topics and sub-topics have integration with other subjects; these are: Electron microscope, using a quadrant, aquarium and terrarium, methods of collecting organisms, methods of preservation of collected specimens, community and succession, food relationships, fungi, mucor / mould/, bee- keeping, lifting and bending, deficiency diseases, vitamin and their effect, balanced diet, ingestion and digestion, keeping the digestive system health, breath health, and excretory organs.

Teachers evaluated the sequence and relationship by rating a point for availability of sequence of ideas, logical sequence of the content, and psychological sequence, the relationship of contents and illustrations to other subjects; 1.55, 1.45 and 1.40, and 2.20 respectively.

The logical and psychological sequences of the content rated by teachers are below average. This implies that the contents in the textbook have some problems on sequence.

4.4.5.2. Relevance of Ideas, Coverage, and Values

Relevance of ideas is the salient points written in the book should be relevant to the topic/ subtopic. Coverage comprises in such away that the students acquire and develop

knowledge, attitude, and skills from each unit. Values of the contents would consist of the reflection of cultural and gender sensitivity of the learners.

Based on the information mentioned above, most of the written materials in each topic and subtopic do have relevancy to the topics and subtopics except some. For instance on page 1 under definition of Biology, the topic "Biology is a useful science is written; this does not have much relevancy to the definition.

On page 64, the topic "pyramid of numbers" does not show any relevancy to food web. It is preferable to be "pyramid of consumers" not numbers. On page 81, the term "Nutrition" is not relevant to the content of making food.

In the content coverage, knowledge and skills are the most dominative; of course, these can be significant for the cognitive development of the students. Nevertheless, there could be also development of attitudes and values. The development of attitudes does with feelings, likes, and dislikes. In fact, it seems abstract, but this one is also included indirectly in some contents of the text. For instance on page 7 precautions of microscope are written to be noticed by the students during experiment/laboratory work. In this case, the students' attitudinal change can be observed. However, in the text when the practical works are implemented, attitudinal coverage can be practical, otherwise, attitudinal change may not be observed. It is examined in the text that the coverage of values is satisfactory.

Thus, equality of opportunity for all students is reflected. In some tables and figures, there are some significant cultural issues, for instance on page 124, importance of vitamins and their efforts can help the students to improve /develop their feeding culture. From page 119, the students learn the best way of lifting any furniture or heavy thing; this one is also one style of cultural activity, which would be reflected in the learners' culture.

Concerning these points' teachers commented more on implementation problems that they could not cover the whole units with in the given short periods. According to them, the annual periods allowed to cover the course are not sufficient.

CHAPTER FIVE

5. SUMMARY, CONCLUSION, AND RECOMMENDATIONS

This chapter deals with the summary, conclusion and recommendations part of the study.

5.1. Summary

The main objective of the study was to investigate to what extent grade 7 Biology textbook of Addis Ababa region is readable. In due course of the study, it was intended to get answers for the following questions:

1. To what extent is the readability level of grade 7 biology textbook is suitable for the grade level of the student users?
2. Does reading comprehension depend on the readability levels of the passages of the textbook?
3. Are there any methods applied by teachers to know the readability level of grade 7 biology textbook?
4. How does grade 7 Biology textbook reflect the readability of the book?
5. Are there adequacy and clarity of illustrations? (That is, adequacy and clarity of tables, charts, diagrams, pictures, examples, activities, exercises and experiments).
6. How is the relationship of the readability level of the text with its organization and integration of the content?

In order to get the appropriate data four data gathering instruments were used. These were; Questionnaire, interview guide, comprehension tests, and readability assessment checklist. The sources of data were grade seven-biology textbook, selected grade seven students, and all biology teachers of government primary schools found in the two sub-cities. That is 20 teachers for questionnaire administration, 200 students selected for comprehension tests, and 50 students randomly selected for interview. Accordingly, the following results were obtained in accordance with the research questions.

5.1.1. The grade level estimate of the book was found to be grade 10. This shows that a grade 10 student can read and understand the text. This was investigated by counting the number of words, syllables, and sentences of odd pages (83 pages) of the textbook and using the Flesch Kincaid formula. The result was as follows:

- Total syllables counted were 37,993

- Total words counted were 25,702, and
- Total sentences counted were 1,286

Based on the above information, the average sentence length was found out by dividing the number of words by the number of sentences. That is to the nearest ten 20. And the average number of syllables (number of syllables divided by number of words) to the nearest ten is 1.5. Then by using the Flesch-Kincaid formula the grade level of the textbook was found to be 9.91, which is to the nearest grade 10 and the reading age of the text is 14.9 years, which is to the nearest 15 years. This implies that the textbook is beyond the students' grade level.

This was also supported by teachers' assessment that the appropriateness of the content to the maturity level of the students was rated (1.15) below satisfactory. Nevertheless, according to the statistics taken from sample schools, the average age of the students is 14.5, and the reading age of the textbook was found to be 15 years. In this case, there is no significance difference between the average age of the students and the reading age of the text.

5.1.2. Two passages (comprehension tests) with different readability scores were given for two selected different groups of students the result shows as follows:

The readability score of the passages positively correlated with the students score in both Pearson (.557**) and spearman's rho (.571**) correlation coefficients.

Since the passages were extracted from the text with different readability scores, this implies that when the readability score of the passage is high (easy), then the students reading comprehension result will be high and when the readability score of the passage is low (difficult), the students reading comprehension result will be low.

Syllables per 100 words of the passages negatively correlated with the students' score in both Pearson (-.557**) and spearman's rho (-.571**) correlation coefficients. This means that when the number of syllables per 100 words of the passages is high the students' score will be low when the number of syllables per 100 words is low the students score will be high. Average sentence length of the passages is also negatively correlated with the students' score with a spearman's rho (-.571**) correlation coefficient. This shows that when the average number of sentences is high, the students' score will be low and when the average number of sentences is low; the students' score will be high. In the same way when the average number of sentences is high, the number of sentences will be low and when the average number of sentences is low, the

number of sentences will be high. This implies that when the number of sentences is low. The number of long sentences will be more.

5.1.3. Teachers responded that the main factors for the difficulty of the textbook were: the materials written in the text are beyond the students grade level /standard/; examples and exercises are not adequate; some of the topics and subtopics are not logically and psychologically sequenced; some diagrams; pictures; tables; charts and experiments have shortage of clarity and simplicity and availability of unfamiliar scientific terminologies as well as availability of long sentences in most parts of the content.

The above-mentioned points for warded by teachers were also found to be the main readability problems of the text when investigated through readability assessment checklists. Similarly based on teachers assessment absence of indication of labels on diagrams in capital letters, in appropriateness of length of lines, and size of margin are found to be the main legibility problems of the text. In the same vein through the legibility assessment of the textbook, in most topics and subtopics the main legibility problems of the text were found to be in appropriate labellings, some unclear and not well visible illustrations, poor lettering conditions, small size of letters, long lines (statements), narrow margin space, less weight of print and unsuitable reading conditions.

Regarding the readability factors of the text teachers indicated the following as main readability problems: absence of glossary; less students interest and motivation to compute exercises and practical activities; absence of color or bold signs for new and unfamiliar words; inadequate periods allotment; in appropriateness of the content to the maturity level of the students; availability of many unfamiliar words; students inability of reading the text with the intention of understanding and remembering; students less interest and motivation to ask and tell meanings of terms, phrases, and sentences; inappropriate sequence of the content; inadequacy of exercises and activities; and unclear illustrations and long sentences.

In addition to this, teachers also responded that they did not design the mechanism of knowing the readability of the text.

Some of the above mentioned points were also supported by the students: such as availability of unfamiliar words in most parts of the text, inappropriateness of the periods allotment to cover the contents, printing problems like small font size of letters, visibility

problems particularly on parts of diagrams, the contents of some units were difficult for them, long sentences were available in most parts of the unit, examples and exercises were not adequate, and experiments were not demonstrated in the laboratory.

5.1.4. In the text some readability factors had been treated satisfactorily. These were; appropriateness of the color of ink, standard size of spaces between paragraphs, suitability of the line of vision at right angles to the plane of the page, appropriateness of spacing between lines, availability of chapter summaries and review questions, the relation of contents and illustrations, the relevance of contents to the daily life of students, appropriateness of the brightness ratio between the book and the surrounding table, the presence of reading materials in each topic and subtopic, variety and quality of exercises, relevance of ideas, coverage and values, and organization and integration of the content.

5.1.5. In the text, some tables and charts lack clarity and simplicity (For instance on pages 15, 16, 18, 19, 63, 85, 99, 121, 127, 142 and 153).

Similarly, some diagrams and pictures lack clarity and simplicity. (For instance diagrams on page 8, 10, 38, 39, 42, 44, 46, 47, 49, 50, 51, 53, 54, 55, 82, 90, 100, 119, 129, 140, 147, 149, 158, and 162).

In the text only a few examples are given these are the importance of fungi on page 79, and insects on page 88. Even though the examples are few, they are relevant and clear. Some experiments need more examples, for instance for experiment 4.2 no example or table is given to guide the students.

5.2. Conclusion

Readability is considered to be the success in reading and understanding. It requires the interest and motivation of the reader, the suitability of legibility of the print (and of any illustration), the appropriateness of words and sentences in relation to the reading ability of the reader and simplicity and clarity of language.

When the textbook is readable the students will be engaged in planned, learning experiences and interact with the material with interest, motivation and understanding.

As it is indicated in chapter one the education and training policy (ETP, 1994), stated that... text books prepared at central and regional levels, are based on sound pedagogical and

psychological principles and are up to international standard, giving due attention to concrete local conditions and gender issues.

In line with this the grade 7 biology syllabus which was prepared by ICDR and the students' textbook which was prepared by region 14 education bureau aimed to reflect the material to be readable.

Based on the above-mentioned information the study tried to investigate the extent to which grade 7 biology textbook is readable. Accordingly, it was found that:

5.2.1. The grade level estimate of the textbook is grade 10. This implies that grade 10 students can read and understand the text. Similarly, the reading age of the text is 15 years. This also indicates that a 15-year student can read and understand the text.

From these findings it is concluded that:

- The textbook is beyond the students' grade level and.
- Based on the statistics taken from sample schools the average age of the students' is 14.5 years and the reading age of the text is found to be 15 years, which is almost similar. In this case, it is difficult to deduce about students' age in terms of the reading age of the textbook. However, in the case of the reading age of the text a 15-year student in Europe and North America is expected to be grade 10. Nevertheless, in Ethiopian situation students' age and grade level is inconsistent. Because 18 years students were found to learn at grade seven in the sample schools.

5.2.2. From the comprehension, tests result:

- The readability score of the passages is positively correlated with the students score in both Pearson (.557**) and spearman's rho (.571**) correlation coefficients. This means when the readability score of the passage is high the students' score will be high, and when the readability score of the passages is low, the students' score will be low.
- Syllables per 100 words of the passages are negatively correlated with the students' score in both Pearson (-.557**) and spearman's rho (-.571**) correlation coefficients. This implies that when the number of syllables per 100 words of the passage is high the students' score will be low, and when syllables per 100 words of the passage are low in number the students score will be high. Similarly the average sentence length of the

passage is negatively correlated with the students' score, which is (-.571**) spearman's rho correlation coefficient.

From the above findings, it was found that reading comprehension depends on the readability levels of the passages of the textbook.

5.2.3. According to teachers' response the main factors for the difficulty of the textbook are:

- Examples and exercises are not adequate,
- Some of the topics and subtopics are not logically and psychologically sequenced,
- Some diagrams, pictures, tables, charts and experiments have shortage of clarity and simplicity,
- Unfamiliar and difficult scientific terminologies and,
- Availability of long sentences in most parts of the content.

The above-mentioned points are also found to be the main problems of readability of the text when investigated in detail through readability assessment. In addition to this indication of labels on diagrams in capital letters, in appropriateness of length of lines, and size of margin are indicated to be the main legibility problems by teachers.

In the legibility assessment of the textbook, the main legibility problems of the text were found to be inappropriate label[illegible], some unclear and not well visible illustrations, poor lettering conditions, the small size of letters, long length of lines (statements), and narrow margin space, less weight of print and unsuitable reading conditions.

Thus, based on the above findings the textbook had a considerable amount of legibility problems:

5.2.4. According to teachers' assessment the main problems of the readability of the text were:

- Absence of glossary,
- students less interest and motivation to compute exercises and practical activities,
- absence of color or bold signs for new and unfamiliar words,
- in adequate periods allotment,
- in appropriateness of the content to the maturity level of the students,
- availability of unfamiliar words and students in ability of reading the text with the intention of understanding and remembering,

- students are not interested and motivated to ask and tell meanings of terms, phrases and sentences,
- in appropriate sequence of the content,
- in adequacy of exercises and activities, and
- unclear illustrations and long sentences.

Even though, teachers forwarded the above-mentioned information as readability problems of the text, they responded also that they had not yet designed mechanisms of knowing the readability of the text. In addition to this, the students were also identified the following readability problems: availability of unfamiliar words in most units of the text, inappropriateness of the periods allotment to cover the contents, printing and visibility problems particularly on parts of diagrams, the contents of some units were difficult for them, long sentences were available in most parts of the unit, examples and exercises were not adequate, and experiments were not demonstrated in the laboratory.

The above-mentioned readability variables had been also assessed through readability assessment checklists and it was found out that some readability factors were treated appropriately and some were not. From the teachers' assessment, students' opinion and readability assessment checklist it is deduced that: teachers have not yet designed the mechanism of knowing the readability level of the textbook. In addition, the authors of grade 7-biology textbook tried to make the book readable, but some readability factors were not exhaustively treated.

The main findings regarding adequacy, simplicity and clarity of tables, charts, diagrams, pictures, examples, activities, exercises and experiment works were: examples were very few, exercises and activities were not adequate, some experiment works lack clarity and simplicity and in some topics and sub topics tables, charts, diagrams and pictures lack clarity and simplicity and some were not self-explanatory.

From this it is inferred that illustrations had to be more clear, simple and attractive to motivate the students' reading ability. Nevertheless, in the text the problems observed regarding to illustrations found to reduce students' reading interest and motivation.

The assessment made by teachers concerning sequence and integration of the content was below average. However, it was obtained through the assessment study that except one unit (Habitats) the logical and psychological sequences of the content of other units were well

treated. Similarly, it was found that in some topics and subtopics the integration of the content with other subjects was satisfactory.

5.3. Recommendations

Based on the findings presented in this study, the following recommendations are provided so that the curriculum developers, teachers and other concerned scholars and officials in the field will make the necessary adjustments.

5.3.1. To reduce the grade level estimate of the textbook, it is essential to use plain English particularly in some activities, exercises, and experiment works. To make the students be interested and motivated to compute exercises and activities and to try to perform the laboratory works it is also essential to use the language at the students' standard.

5.3.2. Long sentences, unfamiliar, and polysyllabic words in a particular topics and sub topics of reading parts should be minimized during the revision and improvement of the text to facilitate the reading and understanding ability of the students.

5.3.3. Teachers' assessment on the readability factors was effective. However, teachers' were not aware of this readability factors and no efforts were made to treat some simple readability problems. Hence, it will be significant to make teachers aware of readability factors during short seminars, workshops or in any means of educational meetings.

5.3.4. In the text, some readability factors were found to be treated satisfactorily. Such as; appropriateness of the color of ink, standard size of spaces between paragraphs, suitability of the line of vision at right angles to the plane of the page, appropriateness of spacing between lines, availability of chapter summaries and review questions, the relationship of contents and illustrations, the relevance of contents to the daily life of students, appropriateness of the brightness ratio between the book and the surrounding table, the presence of related reading materials in each topic and subtopic, variety and quality of exercises, relevance of ideas, coverage and values, and the appropriateness of organization and integration of the content. However, the following readability factors need to be observed and treated by the concerned education officers, curriculum developers, and teachers. These are:

- examples and exercises should be adequate and clear,

- some diagrams, pictures, tables, charts and experiments should be more clear and self-explanatory,
- labels indicated to show parts of diagrams and pictures better be written in capital letters,
- standard size of space between margins should be given emphasis,
- the students reading and understanding ability, and background knowledge of the subject matter should be emphasized at the spot of writing the text,
- in the reading materials emphasis should be given on main ideas, comparison and contrast, related details, judgments, inferences and conclusions,
- the presence of glossary is significant to reduce the difficulty of scientific terminologies and unfamiliar words,
- in the reading passages some unfamiliar and scientific words should be written in bold, capital letters or italics to make the students stress on these terms,
- in the text the methods and procedures of interpreting tables, charts, diagrams and pictures should be expressed clearly to the students,
- appropriate periods should be allotted to cover the course in the appropriate time,
- suitable conditions should be created to perform and demonstrate some experiment works in the laboratory,
- the font size of the letters should be at the standard level. Moreover, thick spines (pages joined together should be considered during printing and binding.

The main factor to be considered during text preparation is to make contents appropriate to the cognitive development of the students; it seems in fact difficult to balance the students' environment and learning experiences. Nevertheless, particularly for Addis Ababa region the cognitive development of the students can be taken into account despite the influence of environment and learning experiences.

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APPENDICES

The appendices part of the study consists of the number of government primary schools (1-8); and biology teachers of each sub- city of Addis Ababa region; comprehension tests; the three types of instruments used for the study; back ground characteristics of teachers', and their responses; correlations of students' score with the readability score of the passages; the reliability of the items tested after the try out by using KR – 20 formula; and age of students' who took comprehension tests.

Appendix – A: Number of government primary schools (1-8) and biology teachers of each sub-city of Addis Ababa region.

Name of sub- cities	Number of government Primary schools (1-8)	Number of biology teachers		
		M	F	Total
Arada	6	8	5	13
Addis Ketema	4	6	3	9
Lideta	3	4	2	6
Ker Kos	7	9	6	15
Yeka	8	10	7	17
Bole	5	6	5	11
Akaki- Kaliti	7	7	6	13
Nefas Silk Lafto	3	4	3	7
Kolfe Keranyo	8	10	6	16
Guleli	7	9	6	15
Total	58	73	49	122

Source :- **Addis Ababa Education Bureau Statistics office Schools' data .**

Appendix- B Comprehension test 1

Name of the school ----------

Name of the student _____

Age _____

Sex _____

The following passage is extracted from Biology student text of grade 7 (unit two); for the purpose of data collection on readability. According to Flesch readability formula:

- The readability score of the passage is :72
- Syllables per 100 words of the passage is :141
- Average sentence length of the passage (ASL):13

Direction: Read the passage carefully and answer the questions given below the passage.

Comprehension Part I

THE CELL

Animals and plants are made up of small units of living matter called cells. Cells are the units of life. The plants and animals we see around us are made up of many cells. These are called multi cellular organisms. Yet, there are other plants and animals that are made up of a single-cell (unicellular organisms). We cannot see cells with our naked eyes. They can only be seen with the help of a magnifying lens or a microscope. Thus, our knowledge about cells started with the invention of the microscope.

Cell Theory

In 1839, two German scientists, Matthias Schleiden and Theodore Schwann, formulated the cell theory, which states that all organisms (plants and animals) are made up of cells. Schleiden and Schwann recognized that all cells, no matter what the organism is, are very similar in structure. Then, biologists conclude that cells reproduce to form new cells.

The major ideas of the cell theory can be stated as follows:

1. All living organisms are made of one or more cells.
2. Cells are the basic structural and functional units of life.
3. All cells come from pre-existing cells.

Cell Size

Cells in animals and plants vary in size. Some of the bacterial cells are very small, being only about 0.2 micron in size. (One micron is one thousandth of millimeters). The largest cell is the ostrich egg, about 20cm long. the vast majority of cells are within five to fifteen microns.

Cell Shape

Cells differ widely in their shape. The shape of a celled is related to its function. For example, the muscle cells that contract and relax cause movement, and the nerve cells that carry messages from one part of the body to another have shapes suitable to their functions.

Cell Number

The simplest organisms, such as protozoa and bacteria consist of one cell. Such organisms are called single-celled or unicellular organisms. Multi-cellular organisms are composed of many cells. The bodies of Multicultural plants and animals consist of many million cells.

Cell Structure

Although cells vary in shape and size, they nearly always have the same basic structure, no matter what their function is or what organism they are found in. Each cell has three main parts. These are the cell membrane, cytoplasm and nucleus.

General Structure of a Plant Cell

Many small structures that cannot be seen with the light microscope can be seen with the electron microscope.

A plant cell consists of the following structures:

1.Cell Wall

Are plants cells are surrounded by a cell wall? The cell wall is made of cellulose. Cellulose belongs to a group of carbohydrates called polysaccharides. Cell wall helps to protect and support the cell; the presence of a cell wall makes plant cells clearly visible as distinct units when viewed under a microscope. The cell wall is fully permeable.

2. Cell Membrane

The cell membrane is also known as plasma membrane. It is made up of proteins covered by two fat layers (proteins sandwiched between fat molecules). The cell membrane gives the cell shape and holds the cytoplasm.

It also controls what moves into and out of cells. The membrane allows some substances to pass through it easily e.g. water, glucose, etc, but does not allow other substances to pass through it e.g. big proteins. So, it is said to be selectively permeable or semi permeable.

3. Nucleus

This is a round or oval structure that controls the activities of a cell. The nucleus is bounded by a double membrane called nuclear membrane. The nucleus contains chromosomes and nucleolus. Chromosomes are thread like structures that determine the characteristics of living things (example, color of skin, eye etc). Nucleolus is a small, spherical body that is darker and denser than the rest of the nucleus. It is chiefly responsible for the formation of ribosome's.

4. Cytoplasm

The portion of protoplasm outside the nucleus is called cytoplasm. Cytoplasm is a jelly-like material containing a large number of substances. These include many different enzymes concerned with metabolism, starch grains, crystals of excretory substances and inorganic substances, etc.

The cytoplasm also contains many small structures called organelles. the following are the chief cytoplasm that is organelles found in plant cells.

These are chloroplasts, vacuoles, mitochondria, Endoplasmic- reticulum, Ribosomes, Golgibodies, Centrosome, and Lysosomes.

Questions, which will be answered after reading the passage

Instruction: select the best answer and write the letters of your choice on the given space at the left (please! try all the questions).

Time allowed: 1hour.

_____1. The plants and animals we see around us are made up of many cells. These cells are called _____.

A. Tissue B. Muscles

C. Multi-cellular organisms D. Unicellular organisms

_____2. Which of the following statement is true of cells?

A. Cells in animals and plants vary in size

B. All living organisms are made up of many cells

C. All cells come from new cells

D. All plants and animals are made up of a single cell.

_____3. When we say cells are the basic structural and functional units of life, it means:

A. Structure of cells are similar

B. When the cells stop their function; life will stop.

C. For once life the function of cells is decisive

D. All of the above

_____4. Which of the following is **not true** about cells?

A. We cannot see cells with our naked eyes.

B. Our knowledge about cells started with the invention of microscope

C. Some of the bacterial cells are very large.

D. The vast majority of cells are within five to fifteen microns.

_____5. Which of the following has the largest cell?.

A. Birds' egg B. Hens' egg

C. Monkeys' egg D. Ostrich's' egg.

_____6. Which of the following organisms consist of one cell ?

A. Protozoa B. Frogs C. Snakes D. Birds

_____7Multi-cellular organisms composed of:

A. One cell B. Two cells C. Many cells D. No cells

_____8. How many main parts have each cell?

A. 1 B. 2 C. 3 D. 4

_____9. The main parts of each cell are:

A. Cell membrane and nucleus.

B. Nucleus and cytoplasm

C. Cell membrane and cytoplasm

D. Cell membrane, cytoplasm and nucleus.

_____10. Many small structures of plant cells that cannot be seen with the light microscope, can be seen with

A. An eye glass B. Pin hole camera

C. Naked eyes D. electron microscope

_____11. All plant cells are surrounded by a _____.

A. Cellulose B. Cell wall

C. Cell membrane D. Nucleus

_____12. A non-living substance that forms the cell wall is called _____.

A. Cellulose B. Protein C. Fat D. Sugar

_____13. The structure of a plant cell that allows water to pass through it is called_____.

A. Cell wall B. Cell membrane

C. Nucleus D. Cytoplasm

_____14. A plant cell, which is a round, or oval structure that controls the structure of a cell is:

A. Nucleus B. Cell membrane

C. Cytoplasm D. Cell wall

_____15. The portion of protoplasm outside the nucleus is called_____.

A. Cell membrane B. Cytoplasm

C. Nucleus D. Cell wall

Appendix- C comprehension test ii

Name of the school ----------

Name of the student _____

Age _____

Sex _____

The following passage has extracted from Biology student text of grade 7 unit 3 for the purpose of data collection on readability.

According to Flesch readability formula:

- The readability score of the passage is: 57.8
- Syllables per 100 words of the passage is: 153
- Average sentence length of the passage: (ASL) = 19

Comprehension Part II

Direction:- Read the following passage carefully and complete the missed words by filling in the blank spaces given on the passage.

HABITATS

A habitat is a place where _____ lives. For a plant a habitat provides _____ to grow on, get water and minerals, animals get _____ and shelter from their habitats.

Plants and animals _____ in a habitat are affected by a variety of factors. There _____ factors include rainfall, temperature, wind, humidity, amount of light and _____ of soil. Solutes and movements of water in the case of aquatic habitats are also important _____ that influence living things.

Different Types of Habitats

1. Terrestrial Habitats: these describe habitats found on land; deserts, forests and _____ are examples of terrestrial habitats.

A desert is a place where the average rainfall is less than 25 _____ a year. Desert survival depends on water conservation by structural, behavioral, or physiological adaptations. Plants _____ to desert conditions reduce water loss with few stomata in the leaves, small leaves, and _____ roots and stems. Plants like cacti are capable of storing much water. Most desert animals _____ in deep and coal burrows. They emerge from these burrows only at night when temperatures

are relatively low. Snakes, lizards, _____ rodents, arachnids, insects and a few small birds are examples of animals that live in a desert habitat. Some animals, like camels, can drink large _____ of water when it is available and can stay for a longer duration of time without drinking water.

Forests: forests _____ wherever there is sufficient rain. Tropical rain forests have a great variety of plants and animals. The rainfall in _____ where tropical rainforest occur is generally above 200 centimeters per year. forest vegetation is arranged in a number of layers. That is from _____ (ground) to its tip. The layers from bottom to top are shrubs, lower layer, middle layer and upper layer.

The upper layer includes _____ the tallest tress that may be up to sixty meter's or more in height. This layer contains the dominant tress. The middle layer contains the medium sized _____, and the third layer the smaller trees. A forest contains many species of birds. A forest also contains different animals like monkeys, elephant, _____, antelope, leopards, frogs and snakes.

Appendix- D

Checklists for Assessing the Readability of Grade 7 Biology Textbooks

1. Take sample of the whole pages (it can be all even or all odd).

   According to Flesch Readability Test:

   a) Find out syllables per 100 words
   b) Find out the average sentence length
   c) Find out the readability score of the text
   d) Identify the description of style
   e) Identify the grade level estimate of the textbook

2. Comment on the legibility of the textbook by:

   2.1. Listing down topics/subtopics and pages in which the labels on diagrams are not indicated in capital letters.

   2.2. Listing down topics/ subtopics and pages in which the diagrams are not visible and clear.

   2.3. Finding out size of letters (font size of the letters in the text)

   2.4. Finding out the length of lines of the written statements

   2.5. Finding out the spacing between the lines

   2.6. Finding out the size of margin (Top and bottom, left and right)

   2.7. Finding out whether the line of vision is at right angles or not to the plane of the page.

   2.8. Examining the quality of the paper

   2.9. Examining the color of ink

   2.10. Finding out the size of spaces between words

   2.11. Finding out the size of spaces between paragraphs

3. Comment on the Readability of the text book by:

3.1. Listing down textual contents, topics/ subtopics and pages, which have complex sentence structures

3.2. Identifying textual contents, which have too much material containing entirely new ideas

3.3. Identifying textual contents and pages, which are poorly printed

3.4. Listing down topics/subtopics, which have difficult vocabularies

3.5. Identifying topics/subtopics and pages which have unclear examples, diagrams and activities

3.6. Listing down topics/subtopics and pages which have poly syllabic-words.

3.7. Identifying topics/subtopics, which have very long sentences

3.8. Identifying topics /subtopics and pages, which have passages that the students could not read and understand easily

3.9. Identifying topics /subtopics and pages in which the proportion of infrequently used words in the passage of the text is greater.

3.10. Identifying textual contents in which the reading materials are not stress on main ideas, related details, and conclusions.

3.11. Listing down topics/ subtopics, which have scientific statements and phrases without specific examples and laboratory works.

3.12. Identifying topics/subtopics, which have no self-check questions at the end

3.13. Listing down topics/ subtopics, which do not have student activity questions

3.14. Identifying textual contents, which do not have chapter summaries at the end

3.15. Listing down topics/subtopics, which do not have review questions.

3.16. Identifying the presence of glossary at the end of the text

3.17. Identifying topics/ subtopics, which do not have adequate illustrations (examples, pictures, charts, and diagram

3.18. Identifying topics/ subtopics and pages in which new words are not written in bold or color noted.

3.19. Listing down topics/ subtopics, which do not have clarity and simplicity of the language

3.20. Identifying the nature of the exercises presented in the textbook according to the following aspects

a) Adequacy
b) Appropriateness
c) Variety and
d) Promotion of problem solving skill

3.21. Investigating the exercises/ activities in the textbook whether it has the quality of assessing pupils' knowledge, attitudinal development, and skills or not

3.22. Identifying the instructions of the exercises that are not clear if any

3.23. Identifying and listing down textual contents that are not appropriate to the developmental level of the pupils in terms of mental physical growth and social development

3.24. Identifying variety of materials to be read by the students in each topic and subtopics.

4. Comment on the sequence of contents by

4.1. Identifying topics/ subtopics which have problems on logical sequence

4.2. Listing down topics/ subtopics and pages, which have psychological sequence

5. Which of the textual contents are not relevant for tackling every day/ future problems?
6. Indicate and comment on the contents/ topics of the textbook that do not show integrated approach. Support your response by citing examples, page numbers, and suggest the way they should be.
7. List the content/ topics of the textbook that do not cover the fundamental or principal aspects of the subject matter.
8. Indicate and comment on the contents that are not presented accurately
9. Are the contents of the textbook promote the use of problem solving approach? Or does it help the pupils to solve their own and environmental problems? Support your response by examples.
10. Examine and point out whether or not gender balance is maintained in the textbook regarding
    a) The topic and sub-topics
    b) The proper names, pronouns and adverbs
    c) Activities
    d) Occupations
    e) Biographies and pictorial content

Appendix- E

Questionnaire to be filled by all Grade 7 Biology Teachers of two Sub- cities of government Primary Schools in Addis Ababa Region

Objective: The purpose of this questionnaire is to collect data (appropriate information) on the readability (i.e., legibility, linguistic variables, vocabulary difficulty, and illustrations within a text as well as the continuity, sequence, scope and integration of the content) of grade 7 biology textbook.

To this effect, this instrument has been developed in the hope that the results could assist to recommend for further improvements of the text based on realistic data.

Direction:

1. Writing name is not significant
2. Please mark a (✓) in the appropriate box that corresponds to your choice or write the information needed in brief when ever necessary.
3. Please read the additional information provided at the bottom of the questions that may help you understand better.

1. Name of your school _____

Sub-city (Kifleketema)_____

Sex: Male ☐ Female ☐

Age_____ Years

Level of Education a) TTI Graduate ☐

b) College diploma ☐

c) B.A / B Sc/ B Ed ☐

2. Qualified in a) Major area_____

b) Minor area_____

3. Years of service in teaching_____
4. Years of service in teaching biology in any grade _____
5. Service years of teaching biology in grade 7_____
6. Total teaching load per week at present _____
7. Average number of students in classes you are teaching at present _____

8. Is biology textbook difficult for grade7 students? a) Yes ☐ b) No ☐

9. In question No. 12, if your answer is yes, what are the factors that make it to be difficult? Give your answer in rank order (i.e., 1, 2, 3----)

   a) contains complex sentence structures _____
   b) too much material containing entirely new ideas_____
   c) poorly printed _____
   d) difficult vocabularies (terminologies) _____
   e) has shortage of clear illustrations (examples, diagrams, practical works) _____
   f) Contents are not organized from simple to complex, concrete to abstract, specific to general etc.
   g) exercises are not adequate and appropriate _____
   h) the materials written in the text are beyond the students level/ standard _____

   If you have any opinion different from the above-mentioned factors please, specify.

   _____

   _____

   _____

14. Evaluate the legibility of the textbook based on the following legibility variables and ratings.

Please! Read the additional information at the bottom of the chart in order to fill this accurately.

S. No	Legibility variables	V. good	Good	Satisfactory	Poor	V. poor
14.1	Indication of labels on diagrams in capital letters					
14.2	Visibility and clarity of diagrams					
14.3	Standard size of letters (font size)					

14.4	Appropriateness of length of lines					
14.5	Appropriateness of spacing between the lines					
14.6	Standard size of margin					
14.7	Suitability of the line of vision at right-angles, to the plane of the page					
14.8	Quality of the paper					
14.9	Color of ink					
14.10	Appropriate size of spaces between words					
14.11	Standard size of spaces between paragraphs					

Additional Information

Visibility and Clarity of Diagrams

Diagrams illustrated to show the parts of something or to simplify the statement should be drawn in visible bold lines and the labels should be written in capital letters.

The Size of Type

The size of type is the size of letters written by using type font for instance 10 point, 11 point and 12-point type font seem to be the best sizes for fluent readers. Particularly for student texts, 12 point is advisable. i.e. 12 point = 4.2 mm.

The Length of Line

Line means here the line of the written statements from the initial margin to the final (or length of line of statements from left margin to right margin).

Line which are too short or too long cause inefficient eye movements. When considering the speed of reading, researchers have recommended line lengths in the range

6 cm-9cm. (depending on the size of type and leading). For instance, the width of a VDU screen is often about 25cm and an A4 work sheet may have lines of 18 cm.

The Spacing between the Lines

White spaces (between lines) help the readers' eye to scan the lines more accurately. Standard spacing is 0.5 cm.

The Size of Margin

It is the size from the initial edge of the paper to the written statements and the size from the final edge of the paper to the ends of the written statements.

The size of margin may cause increased eye fatigue if it is too narrow. Standard margin size of left = 3.17cm and right = 3.17 cm.

Standard margin size of Top = 2.54cm and bottom = 2.54cm.

The line of vision at right angles to the plane of the page

Vibration occurs when the line of vision is not at right angle to the plane of the page. Written statements of the text on the plane page should be at right angle.

The quality of the paper

Matt paper (not shiny/dull) has less eye fatigue than glossy paper. the paper should be thick enough to prevent print on the reverse side showing through.

Color of ink

Black type on white paper (or a white screen) is more legible than any other color combination. Blue, red and green on white are often acceptable. The worst combination is black type on a purple background.

The Size of Spaces between Words

If words are written compactly without sufficient space, the reader will not be interested and motivated to read. Standard space between words is 0.2cm.

The Size of Spaces between Paragraphs

When the space between the paragraphs is narrow, it affects the readability of the material. The standard size of spaces is 1cm.

15. Evaluate the readability of the materials written in the textbook based on the following variables and ratings (please! read additional information at the bottom).

S. No	Variables	If your answer is yes, rate:			Not at all
		High	Medium	Low	
15.1	Are words used in the text polysyllabic in most parts of the pages?				
15.2	Are the average number of syllables per words in most parts of the passages greater than 3				
15.3	Are there difficult scientific terms?				
15.4	Are there difficult statements in most parts of the page?				
15.5.	Are there difficult exercises?				
15.6	Are there difficult illustrations?				
15.7	Are there very long sentences in the text?				
15.8	Could the students read and understand the passages?				
15.9	Are the proportion of in frequently used words in the passage of the text more?				
15.10	Are the materials written in the text help the students to develop mentally by increasing ideas, interests and knowledge				

S. No	Variables	If your answer is yes, rate:			Not at all
		High	Medium	Low	
15.11	Are the paragraphs of the text concise?				
15.12	Are the words used in the text familiar to the students?				
15.13	Do the students have background knowledge of the subject matter?				
15.14	Do the students have interest and motivation to read the text?				
15.15	Do the students read the material with the intention of understanding and remembering?				
15.16	Are the examples more vivid and clear?				
15.17	Do the illustrations help the students to visualize ideas and simplify the complex scientific statements?				
15.18	Is there comparison and contrast in the text in order to make things clear and vivid and to support or prove				
15.19	Are the reading materials stress on main ideas, related details, inferences, and conclusions?				
15.20	Do the scientific statements have examples on the application of experiments?				
15.21	Are there self-check questions at the end of topics/ chapters?				
15.22	Do most of the students compute sample comprehension questions and practical activities?				

S. No	Variables	If your answer is yes, rate:			Not at all
		High	Medium	Low	
15.23	Are there chapter summaries in the text?				
15.24	Are there review questions?				
15.25	Does the text have a glossary				
15.26	Are there sufficient pictures, photographs, charts, and diagrams in the text?				
15.27	Are new words written in bold or color noted?				
15.28	Do the contents of the text represent diverse cultures, abilities, and genders?				
15.29	Does the text enable the students to tell the meaning of terms, sentences, phrases, and concepts?				
15.30	Are facts organized and classified?				
15.31	Are there sequences of ideas?				
15.32	Does the text enable the students to read critically by distinguishing fact from opinion?				
15.33	Does the text comprise interpretation of charts, diagrams, and pictures?				
15.34	Do the contents of the text enable the students to form judgments?				
15.35	Are the contents appropriate to the maturity level of students?				
15.36	Are the contents logically sequenced?				
15.37	Are the contents psychologically sequenced?				

S. No	Variables	If your answer is yes, rate:			Not at all
		High	Medium	Low	
15.38	Is there a continuing opportunity of the desired concepts and skills?				
15.39	Are the contents and illustrations related to other subjects?				
15.40	Is there adequacy of the actual period allotted to cover the textbook?				
15.41	Do the exercises promote problem solving skills				
15.42	Are the exercises adequate?				
15.43	Are the contents up-to date				
15.44	Is there clarity and simplicity of the language used in the textbook				
15.45	Are the contents relevant to the daily life of students?				

Additional Information

Polysyllabic Words:- Polysyllabic words are words which have 3 and more syllables. Syllables are the sound of vowels (a,e,i,o,u,y) created during pronunciation. For instance some examples of syllable count are:

- 'another' has 3 syllables
- 'area' has 3 syllables
- 'practice' has 3 syllables
- 'enable' has 3 syllables
- 'pronunciation' has 5 syllables

Average Number of Syllables Per words

From the above examples the syllables of five words are given. In the example the average number of syllables per words is 17/5 = 3.4 =3 syllables.

Infrequently used words

Infrequent words are different words for example to explain about the subtopic "Habitat" if all the words used in the explanation of "Habitat" are different, the readability of the passage will not be easy and the students can be in trouble to understand the details, main ideas and inferences of the passage.

Logical sequencing

Logical sequencing is some sort of order to succession, it deals with the question "what is to follow what" and by doing so it indicates the when of the curriculum. Consequently... the grade placement of content.

Psychological sequencing

Students are different in many respects, including abilities, interests, aspirations and environmental backgrounds, the activities undertaken, assignments given and expectations of performance should well differ accordingly. Psychological sequencing suggests that learning experiences can be sequenced using certain organizing principles such as proceeding from simple to complex, from concrete to abstract, from immediate to the remote and from the whole to part.

Appendix- F

የተማሪዎች ቃለ መጠይቅ

የዚህ ቃለ መጠይቅ ዋና ዓላማ የ7ኛ ክፍልን የባዮሎጂ የተማሪዎች መጽሐፍን ተነባቢነት ለማወቅ የሚያስችል ከተማሪዎች መረጀ ለማሰሳሰብ ነው::

ከተማሪዎቹም የሚገኘው ጠቃሚ መረጃ መጽሐፉ የሚሻሻልበትን መንገድ ለመጠቆም ይረዳል::

ቃለ መጠይቁ የሚመለከታቸው በዚህ ዓመት /በ1996 ዓ.ም/ በመማር ላይ የሚገኙትን የ7ኛ ክፍል ተማሪዎች ሲሆን በተቻለ መጠን የወንዶችንና የሴቶችን ቁጥር በእኩል ለማካተት ጥረት ይደረጋል:: ለመጠይቁ የሚመረጡ ተማሪዎችም በትምህርታቸው የተሻለ ውጤት ካላቸው፣ መካከለኛ ውጤት ካላቸውና ዝቅተኛ ውጤት ካላቸው መካከል ነው::

1. የትምህርት ቤቱ ስም ----------
2. ክፍለ ከተማ ----------
3. የመላሽ ፆታ ሀ. ወንድ ☐ ለ. ሴት ☐
4. የመላሽ ዕድሜ ---------- ዓመት
5. የ7ኛ ክፍል የባዮሎጂ ትምህርት ምን ያህል ይገባሻል/ይገባሃል?
   ሀ. በከፍተኛ ደረጃ ይገባኛል ☐
   ለ. በመጠኑ ይገባኛል ☐
   ሐ. በፍፁም አይገባኝም ☐
6. በ5ኛ ተራ ቁጥር የሰጠኸው /የሰጠሸው መልስ «ለ» ወይም «ሐ» ከሆነ ምክንያቱ ምንድን ነው?

   ---
7. የ7ኛ ክፍልን የባዮሎጂ መጽሐፍ ስታነቢ/ስታነብ ምን ያህል ይገባሃል/ሻል?
   ሀ. በከፍተኛ ደረጃ ይገባኛል ☐
   ለ. በመጠኑ ይገባኛል ☐
   ሐ. በፍጹም አይገባኝም ☐
8. ለ7ኛ ጥያቄ የሰጠኸው/ሸው መልስ «ለ» ወይም «ሐ» ከሆነ ከሚከተሉት ውስጥ ምክንያት ነው የምትለውን /የምትይውን በደረጃ ተናገር/ተናገሪ /1, 2, 3 ---/.
   ሀ. በመጽሐፍ ውስጥ የተጻፉት ዐ.ነገሮች ውስብስብ ናቸው ----------
   ለ. ይዘቱ አዳዲስ ሐሳቦችን የያዘና የተጨናነቀ ነው::----------

ሐ. የሕትመት ችግር አለው ይኸውም ፊደሎቹ ጥቃቅን ናቸው፣ ጎልተው አይታዩም፣ ዐ.ነገሮችና ቃላቶቹ የተጠጋጉ ናቸው የአንቀጽ ክፍፍሎ የተራራቀ አይደለም ----------

መ. ቃላቶቹ ከባድ ናቸው ----------

ሠ. የተሰጡት ምሳሌዎች፣ ሥዕሎችና የመከራ ሥራዎች፣ ግልጽነት ይጎላቸዋል ---

ረ. የይዘቶቹ አደረጃጀት ከቀላል ወደ ከባድ፣ ከማይታይ ወደሚታይ፣ ከዝርዝር ወደ አጠቃላይ በሆነ መልኩ አይደሉም----------

ሰ. መልመጃዎቹ በቂና ተገቢ አይደሉም----------

ሸ. ከላይ ከተዘረዘሩት ውጪ የተለየ ሐሳብ ካለህ/ካለሽ ተናገር/ተናገሪ----------

---

9. በ7ኛ ክፍል በአንደኛው ሲሚስተር የባዮሎጂ ውጤትህ/ሽ ረክተሃል/ሻል?

ሀ. አዎን በጣም ረክቻለሁ ☐

ለ. አዎን በመጠኑ ረክቻለሁ ☐

ሐ. የለም አልረካሁም ☐

10. ለ9ኛው ጥያቄ የሰጠኸው/ሸው ምላሽ «ለ» ወይም «ሐ» ከሆነ ምክንያቱ ምንድነው?

---

11. በ7ኛ ክፍል እንግሊዝኛ የመማሪያ ማስተማሪያ ቋንቋ በመሆኑ በባዮሎጂ ትምህርት አቀባበልህ/ሽ ችግር ፈጥሮብሃል/ሻል?

ሀ. አዎን በጣም ☐

ለ. አዎን በመጠኑ ☐

ሐ. ምንም ችገር አልፈጠረብኝም ☐

12. ለ11ኛው ጥያቄ የሰጠኸው/ሸው መልስ «ሀ» ወይም «ለ» ከሆነ ምክንያቱን ተናገር/ተናገሪ?

---

13. የባዮሎጂን መጽሐፍ ከሌላው የትምህርት አይነት መጽሐፍ ጋር ስታወዳድር/ሪ የክብደቱ ሁኔታ ምን ይመስላል?

ሀ. ከሌላው የበለጠ ከባድ ነው ☐

ለ. ከሌላው በመጠኑ ይከብዳል ☐

ሐ. ከሌላው ይቀላል ☐

14. ለ13ኛው ጥያቄ የሰጠኸው/ሸው መልስ «ሀ» ወይም «ለ» ከሆነ ምክኒያቱ ምን ይመስልሻል/ሃል?

_____

_____

_____

15. በአንተ/ቺ እምነት የ7ኛ ክፍለ የባዮሎጂ መማሪያ መጽሐፍ የተማሪዎችን የማንበብ ፍላጎት እንዲስብና ተማሪዎቹም ሲያነቡት እንዲገባቸው ለማድረግ ከአሁኑ መጽሐፍ ላይ መሻሻል የሚገባቸው ነገሮች ምንድናቸው?

_____

_____

_____

Frequencies

APPENDIX - G

Statistics

		name of your school	sub- city	sex	age of the tearcher's	level of education	Qualification	Years of service in teaching Biology in any grade
N	Valid	20	20	20	20	20	20	20
	Missing	0	0	0	0	0	0	0

Statistics

		Service year of teaching biology in grade 7	total teaching load per week at present	Average number of students in one class
N	Valid	20	20	20
	Missing	0	0	0

Frequency Table

name of your school

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Beseka	2	10.0	10.0	10.0
	Gelan number 1	2	10.0	10.0	20.0
	Furiber	3	15.0	15.0	35.0
	Kilinto	1	5.0	5.0	40.0
	Akakimengist	3	15.0	15.0	55.0
	Fitawurari Abayneh	1	5.0	5.0	60.0
	Kaliti	1	5.0	5.0	65.0
	Sibistie negasie	2	10.0	10.0	75.0
	Megabit 28	2	10.0	10.0	85.0
	Lafto	3	15.0	15.0	100.0
	Total	20	100.0	100.0	

sub- city

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Akaki- Kaliti	13	65.0	65.0	65.0
	Nefassilk- Lafto	7	35.0	35.0	100.0
	Total	20	100.0	100.0	

sex

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	11	55.0	55.0	55.0
	Female	9	45.0	45.0	100.0
	Total	20	100.0	100.0	

age of the tearcher's

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	21	4	20.0	20.0	20.0
	22	3	15.0	15.0	35.0
	23	1	5.0	5.0	40.0
	24	2	10.0	10.0	50.0
	25	2	10.0	10.0	60.0
	26	1	5.0	5.0	65.0
	27	1	5.0	5.0	70.0
	30	1	5.0	5.0	75.0
	31	1	5.0	5.0	80.0
	32	1	5.0	5.0	85.0
	35	1	5.0	5.0	90.0
	40	1	5.0	5.0	95.0
	44	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

level of education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	College diploma	20	100.0	100.0	100.0

Qualification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Major area= Biology only	5	25.0	25.0	25.0
	Major area= Biology and minor area = Chemistry	13	65.0	65.0	90.0
	Major area =Physical education and minor area = Biology	2	10.0	10.0	100.0
	Total	20	100.0	100.0	

Years of service in teaching Biology in any grade

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	3	15.0	15.0	15.0
	2	5	25.0	25.0	40.0
	3	3	15.0	15.0	55.0
	5	1	5.0	5.0	60.0
	6	2	10.0	10.0	70.0
	8	1	5.0	5.0	75.0
	10	1	5.0	5.0	80.0
	13	2	10.0	10.0	90.0
	18	1	5.0	5.0	95.0
	23	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

Service year of teaching biology in grade 7

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	6	30.0	30.0	30.0
	2	6	30.0	30.0	60.0
	3	1	5.0	5.0	65.0
	4	1	5.0	5.0	70.0
	5	3	15.0	15.0	85.0
	6	1	5.0	5.0	90.0
	7	1	5.0	5.0	95.0
	8	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

total teaching load per week at present

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	6	1	5.0	5.0	5.0
	8	1	5.0	5.0	10.0
	12	4	20.0	20.0	30.0
	13	1	5.0	5.0	35.0
	15	5	25.0	25.0	60.0
	16	1	5.0	5.0	65.0
	17	1	5.0	5.0	70.0
	18	2	10.0	10.0	80.0
	20	1	5.0	5.0	85.0
	21	1	5.0	5.0	90.0
	24	1	5.0	5.0	95.0
	27	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

Average number of students in one class

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	61	1	5.0	5.0	5.0
	62	1	5.0	5.0	10.0
	65	1	5.0	5.0	15.0
	67	1	5.0	5.0	20.0
	70	4	20.0	20.0	40.0
	71	1	5.0	5.0	45.0
	75	1	5.0	5.0	50.0
	78	1	5.0	5.0	55.0
	80	4	20.0	20.0	75.0
	81	1	5.0	5.0	80.0
	82	1	5.0	5.0	85.0
	84	1	5.0	5.0	90.0
	85	2	10.0	10.0	100.0
	Total	20	100.0	100.0	

Frequencies

APPENDIX - H

Statistics

		Is biology text book difficult for grade 7 students ?	What are the factors of difficulty ?
N	Valid	20	20
	Missing	0	0
Mean		1.00	9.00
Sum		20	180

Frequency Table

Is biology text book difficult for grade 7 students ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	20	100.0	100.0	100.0

What are the factors of difficulty ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	all	20	100.0	100.0	100.0

Frequencies

APPENDIX - I

Statistics

		Indication of labels on diagrams in capital letters	Visibility and clarity of diagrams	standard size of letters/ font size	Appropriateness of length of lines	appropriateness of spacing between the lines
N	Valid	20	20	20	20	20
	Missing	0	0	0	0	0
Mean		1.75	2.60	2.50	2.25	2.65
Sum		35	52	50	45	53

Statistics

		standard size of margin	Suitability of the line of vision at right -angles, to the plane of the page	quality of the paper	Color of ink	Appropriate size of spaces between words	Standard size of spaces between paragraphs
N	Valid	20	20	20	20	20	20
	Missing	0	0	0	0	0	0
Mean		2.45	3.55	3.85	4.10	2.70	3.50
Sum		49	71	77	82	54	70

Frequency Table

Indication of labels on diagrams in capital letters

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very poor	8	40.0	40.0	40.0
	Poor	9	45.0	45.0	85.0
	Satisfactory	3	15.0	15.0	100.0
	Total	20	100.0	100.0	

Visibility and clarity of diagrams

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	8	40.0	40.0	40.0
	Satisfactory	12	60.0	60.0	100.0
	Total	20	100.0	100.0	

standard size of letters/ font size

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very poor	1	5.0	5.0	5.0
	Poor	8	40.0	40.0	45.0
	Satisfactory	11	55.0	55.0	100.0
	Total	20	100.0	100.0	

Appropriateness of length of lines

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very poor	1	5.0	5.0	5.0
	Poor	13	65.0	65.0	70.0
	Satisfactory	6	30.0	30.0	100.0
	Total	20	100.0	100.0	

appropriateness of spacing between the lines

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very poor	2	10.0	10.0	10.0
	Poor	6	30.0	30.0	40.0
	Satisfactory	10	50.0	50.0	90.0
	Good	1	5.0	5.0	95.0
	Very good	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

standard size of margin

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very poor	1	5.0	5.0	5.0
	Poor	9	45.0	45.0	50.0
	Satisfactory	10	50.0	50.0	100.0
	Total	20	100.0	100.0	

Suitability of the line of vision at right -angles, to the plane of the page

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Satisfactory	11	55.0	55.0	55.0
	Good	7	35.0	35.0	90.0
	Very good	2	10.0	10.0	100.0
	Total	20	100.0	100.0	

quality of the paper

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very poor	1	5.0	5.0	5.0
	Satisfactory	5	25.0	25.0	30.0
	Good	9	45.0	45.0	75.0
	Very good	5	25.0	25.0	100.0
	Total	20	100.0	100.0	

Color of ink

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	2	10.0	10.0	10.0
	Satisfactory	2	10.0	10.0	20.0
	Good	8	40.0	40.0	60.0
	Very good	8	40.0	40.0	100.0
	Total	20	100.0	100.0	

Appropriate size of spaces between words

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	7	35.0	35.0	35.0
	Satisfactory	12	60.0	60.0	95.0
	Good	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

Standard size of spaces between paragraphs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	2	10.0	10.0	10.0
	Satisfactory	9	45.0	45.0	55.0
	Good	6	30.0	30.0	85.0
	Very good	3	15.0	15.0	100.0
	Total	20	100.0	100.0	

Frequencies

APPENDIX- J

Statistics

		Are words used in the text polysyllabic?	Are the average number of syllables in most parts of the passages greater than 3	Are there difficult scientific terms ?	Are there difficult statements in most parts of the page ?	Are there difficult exercises ?	Are there difficult illustrations ?
N	Valid	20	20	20	20	20	20
	Missing	0	0	0	0	0	0
Mean		2.45	2.25	2.25	2.20	1.80	2.00
Sum		49	45	45	44	36	40

Statistics

		Are there very long sentences in the text ?	Could the students read and understand the passages ?	Are the proportion of infrequently used words in the passage of the text more ?	Are the materials written in the text help the students to develop mentally by increasing ideas, interests and knowledge ?	Are the paragraphs of the text concise ?
N	Valid	20	20	20	20	20
	Missing	0	0	0	0	0
Mean		2.75	1.10	1.85	2.00	1.65
Sum		55	22	37	40	33

Statistics

		Are the words used in the text familiar to the students ?	Do the students have back ground knowledge of the subject matter ?	Do the students have interest and motivation to the text ?	Do the students read the material with the intention of understanding and remembering ?	Are the examples more vivid and clear ?
N	Valid	20	20	20	20	20
	Missing	0	0	0	0	0
Mean		1.30	1.50	1.15	1.05	1.50
Sum		26	30	23	21	30

Statistics

		Do the illustrations help the students to visualize ideas and simplify the complex scientific statements ?	Is there comparison and contrast in the text in order to make things clear and vivid and to support or prove ?	Are the reading materials stress on main ideas, related details, inferences, and conclusions ?	Do the scientific statements have examples on the application of experiments ?	Are there self check questions at the end of topics / chapters?
N	Valid	20	20	20	20	20
	Missing	0	0	0	0	0
Mean		1.35	1.60	1.85	1.65	1.65
Sum		27	32	37	33	33

Statistics

		Do most of the students compute sample comprehensio n questions and practical activities ?	Are there chapter summaries in the text?	Are there review questions ?	Does the text have a glossary ?	Are there sufficient pictures, photographs, charts, and diagrams in the text ?	Are new words written in bold or color noted ?
N	Valid	20	20	20	20	20	20
	Missing	0	0	0	0	0	0
Mean		.90	2.25	2.30	.45	1.70	.40
Sum		18	45	46	9	34	8

Statistics

		Do the contents of the text represent diverse cultures, abilities, and genders ?	Does the text enable the students to tell the meaning of terms, sentences,ph rases, and concepts?	Are facts organized and clssified?	Are there sequences of ideas?	Does the text enable the students to read critically by distiguishing fact from opinion?
N	Valid	20	20	20	20	20
	Missing	0	0	0	0	0
Mean		1.25	1.35	1.65	1.55	1.25
Sum		25	27	33	31	25

Statistics

		Does the text comprise interpretation of charts, diagrams,and pictures?	Do the contents of the text enable the students to form judgments?	Are the contents appropriate to the maturity level of students?	Are the contents logically sequenced?	Are the contents psychologically sequenced?
N	Valid	20	20	20	20	20
	Missing	0	0	0	0	0
Mean		1.50	1.35	1.15	1.45	1.40
Sum		30	27	23	29	28

Statistics

		Is there a continuing opportunity of the desired concepts and skills?	Are the contents and illustrations related to other subjects ?	Is there adequacy of the actual period alloted to cover the text book?	Do the exercises promote problem solving skills?	Are the exercises adequate?
N	Valid	20	20	20	20	20
	Missing	0	0	0	0	0
Mean		1.85	2.20	.70	1.40	1.25
Sum		37	44	14	28	25

Statistics

		Is there clarity and simplicity of the language used in the textbook?	Is there clarity and simplicity of the ~~Charts~~ used in the textbook?	Are the contents relevant to the daily life of the students?
N	Valid	20	20	20
	Missing	0	0	0
Mean		1.55	1.35	2.30
Sum		31	27	46

Frequency Table

Are words used in the text polysyllabic?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Medium	11	55.0	55.0	55.0
	High	9	45.0	45.0	100.0
	Total	20	100.0	100.0	

Are the average number of syllables in most parts of the passages greater than 3

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	3	15.0	15.0	15.0
	Medium	9	45.0	45.0	60.0
	High	8	40.0	40.0	100.0
	Total	20	100.0	100.0	

Are there difficult scientific terms ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	2	10.0	10.0	10.0
	Medium	11	55.0	55.0	65.0
	High	7	35.0	35.0	100.0
	Total	20	100.0	100.0	

Are there difficult statements in most parts of the page ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	1	5.0	5.0	5.0
	Medium	14	70.0	70.0	75.0
	High	5	25.0	25.0	100.0
	Total	20	100.0	100.0	

Are there difficult exercises ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	5	25.0	25.0	25.0
	Medium	14	70.0	70.0	95.0
	High	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

Are there difficult illustrations ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	3	15.0	15.0	15.0
	Medium	14	70.0	70.0	85.0
	High	3	15.0	15.0	100.0
	Total	20	100.0	100.0	

Are there very long sentences in the text ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Medium	5	25.0	25.0	25.0
	High	15	75.0	75.0	100.0
	Total	20	100.0	100.0	

Could the students read and understand the passages ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	2	10.0	10.0	10.0
	Low	14	70.0	70.0	80.0
	Medium	4	20.0	20.0	100.0
	Total	20	100.0	100.0	

Are the proportion of infrequently used words in the passage of the text more ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	3	15.0	15.0	15.0
	Medium	17	85.0	85.0	100.0
	Total	20	100.0	100.0	

Are the materials written in the text help the students to develop mentally by increasing ideas, interests and knowledge ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	4	20.0	20.0	20.0
	Medium	12	60.0	60.0	80.0
	High	4	20.0	20.0	100.0
	Total	20	100.0	100.0	

Are the paragraphs of the text concise ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	7	35.0	35.0	35.0
	Medium	13	65.0	65.0	100.0
	Total	20	100.0	100.0	

Are the words used in the text familiar to the students ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	2	10.0	10.0	10.0
	Low	10	50.0	50.0	60.0
	Medium	8	40.0	40.0	100.0
	Total	20	100.0	100.0	

Do the students have back ground knowledge of the subject matter ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	11	55.0	55.0	55.0
	Medium	8	40.0	40.0	95.0
	High	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

Do the students have interest and motivation to the text ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	1	5.0	5.0	5.0
	Low	15	75.0	75.0	80.0
	Medium	4	20.0	20.0	100.0
	Total	20	100.0	100.0	

Do the students read the material with the intention of understanding and remembering ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	2	10.0	10.0	10.0
	Low	15	75.0	75.0	85.0
	Medium	3	15.0	15.0	100.0
	Total	20	100.0	100.0	

Are the examples more vivid and clear ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	1	5.0	5.0	5.0
	Low	8	40.0	40.0	45.0
	Medium	11	55.0	55.0	100.0
	Total	20	100.0	100.0	

Do the illustrations help the students to visualize ideas and simplify the complex scientific statements ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	1	5.0	5.0	5.0
	Low	11	55.0	55.0	60.0
	Medium	8	40.0	40.0	100.0
	Total	20	100.0	100.0	

Is there comparison and contrast in the text in order to make things clear and vivid and to support or prove ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	8	40.0	40.0	40.0
	Medium	12	60.0	60.0	100.0
	Total	20	100.0	100.0	

Are the reading materials stress on main ideas, related details, inferences, and conclusions ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	1	5.0	5.0	5.0
	Low	5	25.0	25.0	30.0
	Medium	10	50.0	50.0	80.0
	High	4	20.0	20.0	100.0
	Total	20	100.0	100.0	

Do the scientific statements have examples on the application of experiments ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	1	5.0	5.0	5.0
	Low	7	35.0	35.0	40.0
	Medium	10	50.0	50.0	90.0
	High	2	10.0	10.0	100.0
	Total	20	100.0	100.0	

Are there self check questions at the end of topics / chapters?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	2	10.0	10.0	10.0
	Low	7	35.0	35.0	45.0
	Medium	7	35.0	35.0	80.0
	High	4	20.0	20.0	100.0
	Total	20	100.0	100.0	

Do most of the students compute sample comprehension questions and practical activities ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	2	10.0	10.0	10.0
	Low	18	90.0	90.0	100.0
	Total	20	100.0	100.0	

Are there chapter summaries in the text?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	3	15.0	15.0	15.0
	Medium	9	45.0	45.0	60.0
	High	8	40.0	40.0	100.0
	Total	20	100.0	100.0	

Are there review questions ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	1	5.0	5.0	5.0
	Medium	11	55.0	55.0	60.0
	High	8	40.0	40.0	100.0
	Total	20	100.0	100.0	

Does the text have a glossary ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	14	70.0	70.0	70.0
	Low	3	15.0	15.0	85.0
	Medium	3	15.0	15.0	100.0
	Total	20	100.0	100.0	

Are there sufficient pictures, photographs, charts, and diagrams in the text ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	6	30.0	30.0	30.0
	Medium	14	70.0	70.0	100.0
	Total	20	100.0	100.0	

Are new words written in bold or color noted ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	13	65.0	65.0	65.0
	Low	6	30.0	30.0	95.0
	Medium	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

Do the contents of the text represent diverse cultures, abilities, and genders ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	3	15.0	15.0	15.0
	Low	9	45.0	45.0	60.0
	Medium	8	40.0	40.0	100.0
	Total	20	100.0	100.0	

Does the text enable the students to tell the meaning of terms, sentences,phrases, and concepts?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	1	5.0	5.0	5.0
	Low	11	55.0	55.0	60.0
	Medium	8	40.0	40.0	100.0
	Total	20	100.0	100.0	

Are facts organized and clssified?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	7	35.0	35.0	35.0
	Medium	13	65.0	65.0	100.0
	Total	20	100.0	100.0	

Are there sequences of ideas?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	10	50.0	50.0	50.0
	Medium	9	45.0	45.0	95.0
	High	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

Does the text enable the students to read critically by distiguishing fact from opinion?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	2	10.0	10.0	10.0
	Low	11	55.0	55.0	65.0
	Medium	7	35.0	35.0	100.0
	Total	20	100.0	100.0	

Does the text comprise interpretation of charts, diagrams,and pictures?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	2	10.0	10.0	10.0
	Low	7	35.0	35.0	45.0
	Medium	10	50.0	50.0	95.0
	High	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

Do the contents of the text enable the students to form judgments?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	1	5.0	5.0	5.0
	Low	11	55.0	55.0	60.0
	Medium	8	40.0	40.0	100.0
	Total	20	100.0	100.0	

Are the contents appropriate to the maturity level of students?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	2	10.0	10.0	10.0
	Low	13	65.0	65.0	75.0
	Medium	5	25.0	25.0	100.0
	Total	20	100.0	100.0	

Are the contents logically sequenced?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	1	5.0	5.0	5.0
	Low	9	45.0	45.0	50.0
	Medium	10	50.0	50.0	100.0
	Total	20	100.0	100.0	

Are the contents psychologically sequenced?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	1	5.0	5.0	5.0
	Low	10	50.0	50.0	55.0
	Medium	9	45.0	45.0	100.0
	Total	20	100.0	100.0	

Is there a continuing opportunity of the desired concepts and skills?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	3	15.0	15.0	15.0
	Medium	17	85.0	85.0	100.0
	Total	20	100.0	100.0	

Are the contents and illustrations related to other subjects ?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	1	5.0	5.0	5.0
	Medium	14	70.0	70.0	75.0
	High	5	25.0	25.0	100.0
	Total	20	100.0	100.0	

Is there adequacy of the actual period alloted to cover the text book?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	9	45.0	45.0	45.0
	Low	9	45.0	45.0	90.0
	Medium	1	5.0	5.0	95.0
	High	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

Do the exercises promote problem solving skills?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	12	60.0	60.0	60.0
	Medium	8	40.0	40.0	100.0
	Total	20	100.0	100.0	

Are the exercises adequate?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	2	10.0	10.0	10.0
	Low	12	60.0	60.0	70.0
	Medium	5	25.0	25.0	95.0
	High	1	5.0	5.0	100.0
	Total	20	100.0	100.0	

Is there clarity and simplicity of the language used in the textbook?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	9	45.0	45.0	45.0
	Medium	11	55.0	55.0	100.0
	Total	20	100.0	100.0	

Is there clarity and simplicity of the Charts used in the textbook?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all	1	5.0	5.0	5.0
	Low	11	55.0	55.0	60.0
	Medium	8	40.0	40.0	100.0
	Total	20	100.0	100.0	

Are the contents relevant to the daily life of the students?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	1	5.0	5.0	5.0
	Medium	12	60.0	60.0	65.0
	High	7	35.0	35.0	100.0
	Total	20	100.0	100.0	

Correlations

APPENDIX - K

Correlations

		Students' score	Students' group	The readability score of passage	Syllables per 100 words
Students' score	Pearson Correlation	1.000	-.557**	.557**	-.557**
	Sig. (2-tailed)	.	.000	.000	.000
	N	200	200	200	200
Students' group	Pearson Correlation	-.557**	1.000	-1.000**	1.000**
	Sig. (2-tailed)	.000	.	.000	.000
	N	200	200	200	200
The readability score of passage	Pearson Correlation	.557**	-1.000**	1.000	-1.000**
	Sig. (2-tailed)	.000	.000	.	.000
	N	200	200	200	200
Syllables per 100 words	Pearson Correlation	-.557**	1.000**	-1.000**	1.000
	Sig. (2-tailed)	.000	.000	.000	.
	N	200	200	200	200

**. Correlation is significant at the 0.01 level (2-tailed).

Nonparametric Correlations

Correlations

			Students' score	Students' group
Spearman's rho	Students' score	Correlation Coefficient	1.000	-.571**
		Sig. (2-tailed)	.	.000
		N	200	200
	Students' group	Correlation Coefficient	-.571**	1.000
		Sig. (2-tailed)	.000	.
		N	200	200
	The readability score of passage	Correlation Coefficient	.571**	-1.000**
		Sig. (2-tailed)	.000	.000
		N	200	200
	Syllables per 100 words	Correlation Coefficient	-.571**	1.000**
		Sig. (2-tailed)	.000	.
		N	200	200

Correlations

			The readability score of passage	Syllables per 100 words
Spearman's rho	Students' score	Correlation Coefficient	.571**	-.571**
		Sig. (2-tailed)	.000	.000
		N	200	200
	Students' group	Correlation Coefficient	-1.000**	1.000**
		Sig. (2-tailed)	.000	.
		N	200	200
	The readability score of passage	Correlation Coefficient	1.000	-1.000**
		Sig. (2-tailed)	.	.000
		N	200	200
	Syllables per 100 words	Correlation Coefficient	-1.000**	1.000
		Sig. (2-tailed)	.000	.
		N	200	200

**. Correlation is significant at the .01 level (2-tailed).

Appendix –L: The reliability of the items tested after the try out by using KR- 20 formula.

Kuder Richard son formula 20 (KR-20) Procedure gives an estimate of internal consistency reliability (r_{20}), which, in essence, is the mean of all possible split-half coefficients. It is a short cut formula, which was developed by Kuder and Richard son (1973).

$$r_{20} = \frac{n}{n-1}\left(1-\frac{\sum PQ}{S^2}\right).$$

Where n = number of items

p = proportion passing an item

q = Proportion falling an item; and

S^2 = variance of the total test.

Source:- Desalegn chalchisa(2000, p.55) Material prepared for the course Testing and assessment skill.

Thus, according to Kuder Richard son formula 20(KR-20) the reliability of test I and II will be as follows:

a) Test I:

n = 15

$\sum pq = 3.10$

S^2 = 6.04

$$r_{20} = \frac{n}{n-1}\left(1-\frac{\sum pq}{S^2}\right)$$

$$r_{20} = \frac{15}{15-1}\left(1-\frac{3.10}{6.04}\right)$$

$$= \frac{15}{14}(1-0.513)$$

$$= \frac{15}{14}(0.487)$$

$$= \frac{7.305}{14}$$

$$= 0.522$$

$$\approx 0.52$$

Therefore, the reliability of test I is 0.52

b) Test II:

$n = 20$

$\sum pq = 4.05$

$S^2 = 8.73$

$$r_{20} = \frac{n}{n-1}\left(1-\frac{\sum pq}{S^2}\right)$$

$$= \frac{20}{19}\left(1-\frac{4.05}{8.73}\right)$$

$$= \frac{20}{19}(0.536)$$

$$= \frac{10.72}{19}$$

$$\approx 0.56$$

Therefore, the reliability of test II is 0.56.

Appendix-M: Age of students' who took comprehension tests'

Years	Frequency	Percent	Cumulative percent
11	1	.5	.5
12	6	3.0	3.5
13	28	14.0	17.5
14	67	33.5	51.0
15	60	30.0	81.0
16	30	15.0	96.0
17	6	3.0	99.0
18	2	1.0	100.0
Total	200	100.0	

Mean= the summation of frequency times years divided by total number of students is equal to 2903 divided by 200 =14.515.

Therefore, the average age of sample students is 14.5 years.

Appendix- N: Students' Test Result

Statistics	Students' age	Group of students' who took passage 1	Group 1 students' score	Group of students' who took passage2	Group 2 students' score	Students' aggregate score
N	200	100	-	100	-	200
Mean	14.52	-	55.36	-	34.60	44.98
Std. Deviation	1.17	-	23.02	-	15.86	18.70
Variance	1.38	-	529.92	-	251.62	349.59
Sum	2903	-	5536	-	3460	8996

The two groups' students' score

Valid	Frequency	percent	Valid percent	Cumulative percent
10	8	4.0	4.0	4.0
15	8	4.0	4.0	8.0
20	6	3.0	3.0	11.0
25	12	6.0	6.0	17.0
27	2	1.0	1.0	18.0
30	12	6.0	6.0	24.0
33	7	3.5	3.5	27.5
35	23	11.5	11.5	39.0
37	2	1.0	1.0	40.0
40	16	8.0	8.0	48.0
43	1	.5	.5	48.5
45	6	3.0	3.0	51.5
47	9	4.5	4.5	56.0
50	12	6.0	6.0	62.0
52	2	1.0	1.0	63.0
53	13	6.5	6.5	69.5
54	1	.5	.5	70.0
55	3	1.5	1.5	71.5
57	5	2.5	2.5	74.0
58	1	.5	.5	74.5
59	1	.5	.5	75.0
60	14	7.0	7.0	82.0
63	4	2.0	2.0	84.0
65	2	1.0	1.0	85.0
66	1	.5	.5	85.5
67	7	3.5	3.5	89.0
70	5	2.5	2.5	91.5
73	7	3.5	3.5	95.0
75	3	1.5	1.5	96.5
80	3	1.5	1.5	98.0
86	1	.5	.5	98.5
93	1	.5	.5	99.0
100	2	1.0	1.0	100.0
Total	200	100.0	100.0	-

Appendix- O

The four uses of cloze procedure

Cloze procedure has been developed in four general directions, and although our central focus is on readability work, it is worth outlining briefly all four developing the readability aspect; (Taylor, 1963).

These are:

(a) readability measurement

(b) standardized comprehension testing

(c) diagnosis of individual readers' abilities or deficiencies

(d) reading development.

At the instructional level (75% correct on multiple choices), the children's cloze scores obtained by Bormuth, Rankin and Culhane were 44% and 41% respectively. This can be interpreted cautiously by saying that cloze score of 40%-45% seems to indicate an acceptable level of comprehension, provided that a teacher's help is readily available.

In an interesting short study, Judith Cohen, an American researcher, investigated the cloze scores of a group of 60 above average 12 and 13 year--old readers (Cohen, 1975). The children were all in seventh grade, and the passages chosen for the cloze tests were from narrative fiction (literature). The texts all had comparable scores on the Dale-Chall readability formula. Cohen's main finding was that there were statistically significant differences between cloze scores on passages from different subject areas. The mean scores were 30.5 % for literature, 39.67 for social studies and 37.0% for science. All these scores are below the instructional level.