

## READABILITY OF RECOMMENDED BIOLOGY TEXTBOOKS AS CORRELATE OF SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN ENUGU STATE

<sup>1</sup>Dr. Regina Ijeamasi Enebechi.

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### Abstract

The study examined the readability of biology textbooks as correlate of secondary school students' academic achievement in biology in Enugu State. Two research questions and one null hypothesis guided the study. The study adopted correlation survey research design. The population consisted of six recommended biology textbooks used in Enugu state and 12,500 senior secondary school II students offering biology in 292 public secondary schools in the state. The sample consist of four commonly used biology textbooks and 370 (127 males and 243 females) biology students selected from 30 senior secondary schools used for the study. The instruments for data collection were Cloze test of readability of Biology textbook (CTRBT), and 2022 Biology Mock examination result for senior secondary II (SS II) which were collected from the sampled school to measure students' academic achievement. The instruments were validated and trial tested on 20 SS2 biology students. The data collected were used to calculate the reliability of the instrument using Kuder-Richardson 20 Formula. It yielded a reliability of 0.85. The mock are standardized and therefore assumed to be reliable. Mean and Pearson Product correlation were used to answer the research questions while t-test for correlation was used to test the hypotheses at 0.05 level of significance. The findings revealed that the readability level of the biology textbooks was easy for the male students and fairly difficult for the female students. The results equally revealed that a positive relationship exists between the readability of biology textbooks and students' academic achievement. It was therefore, recommended that teachers should provide feedbacks on the readability of Biology textbooks to the authors and publishers who in turn should revise the recommended Biology textbooks in the light of comment raised.

### Introduction

Reading was invented around the second and third Century CE, the first "Books" known as Codex was first created by the Romans. A Codex was an ancient book in which individual sheets of papyrus, parchment, or

<sup>1</sup> Department of Science Education, Nnamdi Azikiwe University, Awka.

Email: [ri.enebechi@unizik.edu.ng](mailto:ri.enebechi@unizik.edu.ng); Phone: 08036723893

paper went folded in half and sewn together at the fold. The reader would open the pages to reveal two columns of text that shared a page. ‘Reading is the process of looking at a series of written symbols and getting meaning from them. According to Anderson in Burns (2013) reading is a process of understanding the meaning implied in a text and looking at the ideas contained in the written word. Reading is an active process of constructing meanings of words. Reading serves so many purposes to literate people. Reading with a purpose helps the reader to direct information towards a goal and focuses their attention. A person may read in order to gain information or verify existing knowing or to enhance knowledge. A person may also read for pleasure/enjoyment, to pass examination or interview. Reading is the basis for learning different subjects in schools. (Cahyani & Perdana 2019).

According to Perekeme (2015) no matter the aspect of life one is considering, one discovers that the ability to read efficiently enhances individual ability to function in an effective manner. Burns (2013) reiterated that reading requires that we identify the words in print-a process called word recognition, construct an understanding from them-a process called comprehension, coordinate identifying words and making meaning so that reading is automatic and accurate- an achievement called fluency.

In sciences, such as biology, there are so many textbooks recommended by the government for the study of the subject. Students read such textbooks for information, to pass exam, discussion, criticism, presentation to mention but a few. Reading is a form of individualized learning. Textbooks recommended must be readable so as to give students the opportunity to gain a better knowledge of how and why things function. Reading the textbooks should also create curiosity that helps students understand and formulate questions on the information they have accumulated. If the books are not readable, the students can get lost and fail to understand or comprehend content. It is desirable in education to measure the readability/ difficult level of a particular text in relation to the students for which it is assigned.

A lot of biology textbooks are published in Nigeria for Secondary Schools. Most of these textbooks are published and pushed into the market without proper evaluation by specialists for its readability Perekeme & Agbo (2012). Textbooks therefore need to be critically and periodically evaluated to see how readable they are so as to meet the expected goals of the National Policy on Education (FGN, 2004) and at the same time to see whether the recommended biology textbooks are in conformity with the new Nigerian Educational Development and Research Centers (NEDRC) curriculum. The importance of textbooks in biology classroom cannot be over emphasized. Textbook is often considered the main source of information and the most common tool for teaching and learning. It is therefore important for periodic evaluation to determine their readability. Assessing a text’s readability is one way teachers can determine if a text is appropriate for their students. From the researchers point of view readability is the degree to which a given class of people find certain reading material compelling and comprehensive. It is a measure of how easy a piece of text is to read. Readability, according to Chavkein & Odinga (2013) refers to the general difficulty level of written material which can affect reader’s comprehension. It is one of the factors that determine the understanding of a subject by the students. According to El-Haddad *et al* (2016) readability means “how easily written materials can be read and understood. This depends on several factors including the average length of sentences, the number of new words contained, and the grammatical complexity of the language used in a passage”, its presentation (such as typographic aspects that affect legibility, like font size, line height, character spacing and line length. Readers factor such as prior knowledge, text coherence and cohesion, reading ability, motivation, interest, and vocabulary-difficulty.

The Federal Government of Nigeria with a statutory mandate of recommending textbooks for both primary and tertiary education established the Nigerian Educational Research and Development Council (NERDC).

Examination bodies such as West African Examination Council (WAEC), National Examination council (NECO) and the joint Admission and Matriculation Board (JAMB) also recommend textbook for candidates preparing for their respective examination.

Unfortunately, most of these bodies without due consultation with relevant stakeholders like Nigerian union of teachers (NUT), Science Teachers Association of Nigeria (STAN) recommend textbooks for use in school without due consultation of these relevant stakeholders. One of such textbooks being recommended for use by students in secondary schools is biology textbook.

Biology is the Science of life; biology is the study of living things. There are so many varieties of shapes and forms of living things, and biologists study life in many different ways. Biology is a fascinating and important subject, because it dramatically affects our daily lives and our futures. Biology is one of the most successful of the “natural Sciences, explaining what our world is like (Nwuba, Egwu and Osuafor 2020). To understand biology, you must first understand the nature of science and how scientists think. Scientist use specific observations to build general models and then test the models to see how well they work. Science is a way of viewing the world that focuses on objective information, putting that information to work to build understanding.

Biology has been identified as a fulcrum on which all other sciences and technology hinged for national development. As a result Enebechi (2021) stressed that a sound knowledge of biology is needed in our everyday lives as it occupies a central position among the sciences due to its remarkable contribution in microbiology, zoology, medicine, dentistry, physiology, molecular biology, pharmacy, nursing, agriculture to mention but a few. Biology as a subject is taken by science students at senior secondary level. Secondary education is a crucial tier in the hierarchy of education in Nigeria. It is the midway between primary and tertiary schools. It is the form of education that students receive after their primary education and or before their tertiary education.

Despite the importance of biology in National development, it has been plagued with gross underachievement by students over the years. Researchers over the years have identified several factors contributing to underachievement such as decline in reading culture, lack of instructional materials, poor method of teaching, over loaded biology syllabus, lack of qualified biology teacher, inability to answer questions that required application of knowledge. (Enebechi, 2021, Uzoma & Okoli, 2019, Ufommadu & Okoli, 2019, WAEC 2022 chief examiner’s report). Thus the poor performance has made it difficult to realize the national goals for scientific and technological development.

Akpan (2012) defined academic achievement as the degree of success or level of attainment by a student in the scholastic or the curricular subject prescribed from learning in the classroom. In societies like Nigeria where standardized test of different kinds exist, the academic achievement of the students is represented by the individual’s response to standardized scholastic aptitude tests, and the level of response given to such scholastic tests can help in determining success. The aptitude test should embrace the students’ general school achievement in various school subjects. For example, in West African School Certificate Examination (WASCE) and National Examination Council (NECO) students are tested on the subjects offered in the Examination.

In support of the above, Walker in Egun (2013) explains that academic achievement is the general school performance of students in the various school subjects and can be affected by so many factors. The issue of readability of biology textbooks as they influence the academic achievement of biology students had received very little attention. Therefore the fundamental question of what makes a book readable for a particular set of readers needs to be addressed. The question is imperative when one recognizes the strong relationship between

understanding of biology and the reading level of the textbooks/materials recommended (Lenzer 2014). There are so many types of computer applications that have been developed for determining/testing readability of any textbook. Some of these methods are: simplified measure of Gobbledygook (SMOG), Flesch- Kincaid Reading Ease score developed in (1964), Fog index developed by Gunning (2003), automated readability index, the Fry's scale developed by Fry (2002) and the Cloze Procedure developed by Taylor (1956). Flesch Readability score monitors average sentence length and average syllables per word to conclude how easy a text is. A higher score means the text is easier to read and understand. The Flesch Reading Ease gives a text a score between 1 and 100, with 100 being the highest reading ability score. Cloze test involves the ability of students to select appropriate words if occasional gaps occur in a passage based on their abilities to infer meaning from context. The use of cloze procedure as a reliable measure of readability has been validated by Kane (1970) and Harrison (1980). In that procedure, some words of the text are deleted and replaced by blank; readers are expected to supply the missing words. Thus the cloze procedure measures the interaction between the reader and the text. A reader who finds the text easy and interesting will be able to supply more of the missing words than one who does not understand the passage.

This study adopted the Flesch mean Cloze formula. Some advantages offered by the cloze procedure over other readability tests are: it appears to reflect the sum total of all influences which interact to affect readability, the performance of the reader is being measured on the samples of the text to be read, when the Cloze text is applied, both the reader and the book are assessed simultaneously by the use of one measure. This therefore has greater face validity.

Readability scores and notes adopted from Flesch are shown below: 90-100 (very easy to read, easily understood) 80-89 (easy to read) 70-79 (fairly easy to read) 60-69 (standard) 50-59 (fairly difficult to read) 30-49 (difficult to read) 30-29 (confusing to read) 0-19 (very confusing).

The readability levels of the following recommended biology textbooks for senior secondary schools using Flesch formula were evaluated: Text 1: Modern Biology for Senior Secondary Schools by, Sarojini T.R.(2016) revised edition (4<sup>th</sup> edition), Singapore: FEP International, textbook 2: Essential Biology for senior secondary schools by M. C. Michael (2012) (5<sup>th</sup> edition) Tonad publishers limited, Textbook 3: Simplified Biology for senior secondary schools (new edition) by Ezemoka J. A.(2010) Lagos: Rabboni Publishers International. Textbook 4: College Biology, by Idodo U. (1996) Edo: Idodo Umeh Publishers. The reason for the choice of these textbooks primarily was that they are the most widely used biology textbooks among schools in Enugu state. To cater for their academic achievements, selected students score in Mock/2022 senior secondary school certificate examination were used. Mock/SSCE is a standardized test for all schools within each state written by SS2 students in preparation for the external West African Senior School Certificate Examination (WASSCE) and National Examinations Council (NECO exams).

#### **Statement of the problem**

The role of biology in National development cannot be over emphasized, this is probably why it is one of the science subjects that both the arts and science students mostly prefer to enroll on. For this reason, biology has a very high enrolment of students in the external examination when compared to other science subjects. Notwithstanding its importance and popularity, available statistics over the years showed that students' performance in biology in external examination has remained unsatisfactory and inconsistent. Teachers as well as parents have expressed concern about the poor performance of students in biology. This has created an educational gap of students not continuing their studies in biology or biology related courses at tertiary institution. Many researchers till today have attributed this unsatisfactory performance to several factors such as decline in reading culture, attitude of students towards the subject, poor method of teaching, lack of

instructional materials, inability to answer questions that required application of knowledge, inadequate exposure of learners to the use of appropriate textbooks. This gap can be filled by devising a more effective approach for improving the situation in order to meet the needs of the students and the society at large. It is worthy to note that little attention has been paid to the issue of readability of recommended biology textbooks as they relate to the achievement of students in biology.

There are several reasons why people read books, including bold font, appealing images, simple language etc. this is very crucial for textbooks so that students will desire to read them. The question then becomes, are the textbooks we suggest for our science students' in Nigeria and Enugu state in particular simple enough for them to read?. Is there a connection between students' performance in biology and how easily they can read the textbooks?. These are the areas of interest in this study.

In Nigeria today, there are many biology textbooks written by different authors, published and pushed into the market and schools. Some of these textbooks were never properly assessed by specialists before recommending them for use in schools. Consequently, the students may find them counterproductive with the devastating consequences of loss of interest and mass failure in biology examinations. There is therefore an urgent need to assess the content adequacy and readability of biology textbooks in use in our senior secondary schools to determine their appropriateness so as to provide the basis and guides for their revision.

### **Purpose of the Study**

The main purpose of this study is to investigate the readability of recommended Biology textbooks as correlate of secondary school students' academic achievement in Enugu state. Specifically, the study will find out;

1. The readability scores of recommended Biology textbooks for senior secondary (SS II) students in Enugu State.
2. The relationship between readability of Biology textbooks and students' achievement

### **Research Questions**

The study was guided by the following questions;

1. What are the readability scores of recommended Biology textbooks for senior secondary (SS II) students in Enugu State?
2. What is the relationship between the readability scores of recommended Biology textbooks and students' academic achievement scores of SS II students in Biology?

### **Research Hypothesis**

H<sub>01</sub>: There is no significant difference between readability scores of recommended Biology textbooks and achievement of male and female students SS II students in biology

### **Methodology**

#### **Research design**

Descriptive survey research design was used for the study. Descriptive survey systematically described characteristics of a given population or areas of interest. The choice of the descriptive survey method; is therefore justified since the researcher is interested in collecting data from a representative sample of the target population; on an existing condition which is readability level of the most recommended Biology textbooks in Enugu State.

#### **Area of the Study**

The study was carried out in all the public senior secondary schools in Enugu state. Enugu State is a state in the South-East geopolitical zone of Nigeria, bordered to the north by the states of Benue and Kogi, Ebonyi State to the east and southeast, Abia State to the south, and Anambra State to the west. The state takes its name from its capital and largest city, Enugu. The state has a good number of secondary schools comprising of public, private

and missionary schools. The schools in Enugu State are made up of six education zones namely: Agbani, Awgu, Enugu, Nsukka, Obollo-Afor and Udi zones.

### **Population of the study**

The population of the study was 12,500 SS II biology students from 292 public senior secondary schools in the state. There are (43) secondary schools in Agbani zone, fifty five (55) in Awgu zone, thirty one (31) in Enugu zone, sixty (60) in Nsukka zone, forty five (45) in Obollo-Afor zone and fifty four (54) in Udi zone. (Statistic and Record Department of PPSMB, Enugu, 2021/2022 academic session). The population equally consists of eight (8) recommended biology textbooks used in Enugu State that were approved by the Nigerian Educational Research and Development Council (NERDC).

### **Sample and sampling techniques**

Stratified sampling technique was used to select 5 schools from each of the six education zones. This gave a total of 30 schools. Random sampling technique was used to select 13 students from 20 schools based on their population and 11 students from 10 schools equally based on population. This gave a sample size of 370 students. The researcher used simple random techniques to select 127 males and 243 females from 30 schools sampled for the study.

### **Instrument for Data Collection**

The researcher adopted Cloze test of readability of Biology textbooks (CTRBT) because Cloze measures the interaction between the reader and the textbook. According to Taylor (1959), the cloze test involves the ability of students to select appropriate words if occasional gaps occur in a passage based on their abilities to infer meaning from context. New passages of about 450 words which have not been taught by the teachers were selected in each of the Biology textbooks. The CTRBT was constructed by deleting every 5<sup>th</sup> word from the passage; to ensure fair representation of all the text, the passages from each textbook was randomly drawn from the beginning, middle and end of the text respectively. The first and the last sentences from the passages were left intact. The students were asked to insert the appropriate substitute or correct words for the 50 blank spaces in the passage. The tests will be administered to students in SS II during the normal class. To score the cloze passage, only the exact replacement was counted as correct answer. Spelling errors were not penalized. The raw score was the number of words that are correct; the correct numbers were double to find percentage, that is, if there were 50 correct replacements, it would be  $50 \times 2 = 100\%$ . The percentage of answers the reader gets correct is the measure of how readable the text is. The higher the percentage, the more readable the text.

To cater for their academic achievements, students' score in biology Mock/ SSCE examination were used. Mock/SSCE is a standardized test for all schools within each state written by SS 2 students in preparation for the external West African Senior School Certificate Examination (WASSCE) and National Examinations Council (NECO exams). Data were collected by obtaining from the school principals, the 2022 Mock/Senior Secondary School Certificate Examination (SSCE) results in biology for the students selected for analysis.

### **Validation of the Instruments**

The instrument was face validated by presenting it to three experts, two from the Department of Science Education, Nnamdi Azikiwe University, Awka and one from Measurement and Evaluation from the Faculty of Education of the same University. The experts were required to go through the instrument for proper wording, clarity and fair representation of the various section of each of the text. Their suggestions and corrections were used by the researcher in making the final draft of the instrument.

### Reliability of the Instrument.

The reliability of the cloze test was established using Kuder-Richardson formula 20, (K-R 20). The choice of the K-R formula was because the instrument was dichotomously scored. Moreover, Nworgu (2016) stated that K-R 20 is applicable to items of different level that are dichotomously scored. The instrument was administered to 20 senior secondary SS II biology students of Command Secondary School Abakiliki in Ebonyi state. The reliability coefficient of 0.83 was obtained from the trial testing. The Mock/Senior Secondary School Certificate Examination (SSCE) are standardized and therefore assumed to be reliable.

### Method of Data Collection

The researcher went to the sampled schools each with the help of three research assistants and administered 370 copies of Cloze test of biology textbooks (CTRBT). This was collected back on the spot on the same day. The Mock/Senior Secondary School Certificate Examination (SSCE) results were collected from the school principals of the various schools.

### Method of Data Analysis

The mean readability scores of the students was collected and interpreted based on guideline provided by Flesch readability formula which are shown below: 90-100 (very easy to read, easily understood) 80-89 (easy to read) 70-79 (fairly easy to read) 60-69 (standard) 50-59 (fairly difficult to read) 30-49 (difficult to read) 30-29 (confusing to read) 0-19 (very confusing). For the purpose of this work, the scores will be categorized as: 60% and above, text is predicted to be quite easy. 35% -59%, text is predicted to be appropriate difficulty level and 20%-34%, text is predicted to be very difficult.

### Results

1. **Research Question 1:** What are the readability scores of recommended Biology textbooks for senior secondary (SS II) students in Enugu State?

**Table I:** Mean readability scores of students on each of the biology textbook for males and Females

Group		Modern biology	Essential biology	Simplified biology	College biology
	Number	Mean	Mean	Mean	Mean
Males	127	60.71	61.74	63.56	60.64
Females	243	53.49	57.43	58.25	50.18

Table I shows the mean readability scores of students on each biology textbooks sampled for males and females. The result shows that male have mean scores of 60.71, 61.74, 63.56 and 60.64 for Modern biology, essential biology, simplified biology and college biology respectively. These are interpreted to be quite easy for the male students. On the other hand, the females have mean scores of 53.49, 57.43, 58.25 and 50.18 for Modern biology, essential biology, simplified biology and college biology respectively. These are interpreted to be difficult for the female students

**Research Question 2:** What is the relationship between the readability scores of recommended Biology textbooks and students' academic achievement scores of SS II students in Biology?

**Table 2:** Relationship between readability scores of the students and academic achievement scores of students in biology

		Modern Biology	Essential Biology	Simplified Biology	College Biology
Academic score of the participants	Pearson correlation	.181**	.200**	-.002	-.004
	Sig.(2-tailed)	.000	.000	.970	.972
	N	3700	370	370	

The Pearson correlation coefficient in Table 2 shows a positive but weak correlation between readability and academic achievement of students in biology. The correlation coefficient .181 shows a weak positive significant relationship between students' academic achievement and Modern Biology score. The study further shows a weak but positive significant relationship between students' academic achievement and Essential Biology ( $r=.200$ ). Furthermore, the study also revealed a weak negative relationship between students' academic achievement in both Simplified Biology and College Biology. (-.002 and -.004 respectively)

### Hypothesis One

**H<sub>01</sub>:** There is no significant difference between readability scores of recommended Biology textbooks and academic achievement of students in biology

**Table 3:** t-test correlation on the relationship between readability scores and academic Achievement of SS II students in Biology

Variables	N	R	Df	tcal	tcrit	Remark
Modern biology	370	0.16	371	19.57	1.94	Significant
Essential biology	370	0.18	371	19.64	1.94	Significant
Simplified biology	370	0.20	371	19.38	1.94	Significant
College biology	370	-0.002	371	19.27	1.94	Significant

The t-test of correlation in Table 3 shows that the t-calculated value of 19.57, 19.64, 19.38 and 19.27 for modern biology, essential biology, simplified biology and college biology is more than tcrit value of 1.94 at 0.05 level of significant. Therefore there is significant difference between readability scores of recommended Biology textbooks and academic achievement of students in biology. The null hypothesis is therefore rejected.

### Discussion of Findings

Findings from the study indicate that there is a significant positive relationship between the readability level of biology textbooks and academic achievement of senior secondary II students in Biology. This implies that as the readability level of the textbooks increases, the academic achievement of students in biology increases and vice versa. A number of studies have identified that there is relationship between readability and academic achievement. (Ekwe, 2020, Fatoba, 2015, Umoke and Nwafor, 2015, Toba, 2015, Yong, 2014). From these studies it was revealed that there is a significant relationship between readability level of textbooks and academic achievement. Although, all these researchers' carried out their study outside Enugu State and their

study were mainly on chemistry, basic science only Fatoba and Toba carried out their research in biology but it was outside Enugu State. That is the reason why the present study was carried out in Enugu state and in biology. The findings also revealed that the male students read at standard level while the females read at fairly difficult level according to the Flesch mean cloze scores. This equally indicates that the biology textbooks used were appropriate for the males since they can easily read and understand the textbooks without the assistance of the teacher. Consequently, the male students possess better academic achievement in biology than the female students. This is in agreement with the findings of (Petty, 2014, Tunji, 2014, Uzoagulu, 2013) who found that boys performed better than girls in science subjects. The findings are also in agreement with Ekwe (2020) who found out that achievement of students in science especially chemistry depended greatly on the readability of textbooks in use. Therefore the findings of this study are in tandem with the findings of the previous studies with respect to relationship being significant.

### **Conclusion**

Based on the findings of the study, it has been empirically established that the level of understanding and academic achievement of students' in biology, to a large extent are determined by the readability of the textbooks in use.

### **Recommendations**

Based on these findings of the study, the following recommendations were made:

1. For the Biology textbooks to be more helpful to the students, the said textbooks need to be revised as soon as possible and the difficult words be replaced with much simpler words to facilitate reading comprehension for their readers. In making this recommendation, our position is in agreement with Yong (2010) who argued that textbooks should not challenge and frustrate students', rather, textbooks should motivate students to read by its simplicity, attractiveness and accessibility.
2. Teachers should provide feedbacks on the readability of Biology textbooks to the authors and publishers who in turns should revise the recommended Biology textbooks in the light of comment raised.
3. Authors of Biology textbooks should select the appropriate language, diagrams, pictures dictions that will make their published textbooks highly readable to the target class of readers.
4. Book publishers in conjunction with universities and other tertiary institution should liaise among themselves to periodically mount workshops for Biology authors and prospective authors on how to write high quality and standard textbooks. Such workshops are directly needed so as to update and upgrade the writing skills of the authors and prospective authors.

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