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Applicability of Flesch's formula in assessing the readability of basic science textbooks

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Abstract

This study investigated the applicability of Flesch's formula in assessing the readability of Basic Science textbooks in selected Junior Secondary Schools in Ekiti State, Nigeria. The study employed an applied research technique and generated data from the pages of each textbook used. The sample consisted of all the Basic Science textbooks used in Ekiti State Junior Secondary Schools. The data collected were analyzed using average sentence length, average syllable count, grade levels and the reading age of the books. The results revealed that STAN Basic Science Book 3 published by Science Teachers Association of Nigeria, Longman Basic Science Book 1 published by Longman Publishers (Nig) Plc, and Evans Basic Science Book 3 published by Evans Brothers (Nig) Ltd. were fairly difficult for the readers with readability grades higher than the target readers. The results also showed that the books contained long sentence length and polysyllabic words that needs to be re-visited. It is therefore recommended that long sentences and polysyllabic words of the books should be split into simpler components for easy comprehension.

Key words : Flesch Reading Ease Formula, Readability, Junior Secondary Schools, Basic Science Textbooks,

Introduction

The most important decision which science teachers can make is to present the best match of materials that are on the appropriate level of difficulty. Students who are given

materials that are too easy are not challenged and growth is hampered[7]. Students who are given materials that are too difficult fail to make progress and are frequently off task, may become behavior problems, and may become so frustrated that they simply give up[3,4,8]. Making the best match requires knowing the readability level of materials. Unfortunately, making the match has never been easier. Abdullahi[1] claims that, a mismatch between students' reading level and readability of the textbook will not only hinder effective learning but that it may also lead to loss of interest in the subject. In view of the mismatch between the reader and the text, it is imperative to assess Basic Science text materials used in Ekiti State Junior Secondary Schools to ascertain whether the books are within the reading levels and ages of the target readers.

The most important way of achieving this is through readability formula. A readability formula is a technique that provides a quantitative estimate of the reading ease or difficulty of a written material[9]. Readability formulae are mathematical expressions that were designed to assess the suitability of books for students at particular grade levels or ages. Zakaluk and Samuels[16] viewed readability as the ease with which a document can be read. In a simpler form, it is the ease or difficulty with which the reader reads a document. It may mean the quality of interaction between the reader and the author. A more reasonable definition of readability, that is in keeping with more recent research and theory, one that defines it as the level of ease or difficulty with which a text material can be understood by a particular reader who is reading that text for a specific purpose[12]. Readability is dependent upon many characteristics of a text and many characteristics of readers. Chall and Dale[5] endorsed an interactive view of readability, concluding that the purpose of readability is to effect a best match between intended readers and texts. Many factors determine the readability of materials, including the syntactic complexity of sentences, density of concepts, abstractness of ideas, text organization, coherence and sequence of ideas, page format, length of typeline, length of paragraphs, intricacy of punctuation and the use of illustrations and color.

Flesch[6] formulated a readability formula that is more accurate for upper elementary texts known as Reading Ease Score Formula. It is considered the easiest formula to use in determining the grade level of texts material and makes adjustment for the higher end of the scale. The formula measures reading from 100 (for easy to read) to 0 (for very difficult to read). The formula takes into account some factors in both the text and the reader; the formula requires that readability of a text be assessed by:

i. Selecting word samples from the passage sample;

ii. Determining the number of syllable per words;

iii. Determining the average number of words per sentence, and

iv. Applying the reading ease formula to get the reading scores and grade level of the materials.

Flesch Reading Ease Score = 206.835 – (1.015 X ASL) - (.846 X ASW) Where: FRE

= Flesch Reading Ease Score, ASL = Average Sentence Length in words or average number of words in sentence (number of words divided by the number of sentences). ASW = Average Syllables per Word (the number of syllables divided by the number of words while the Flesch Grade Level is an index that gives the years of education required to comprehend a document and it can thus be calculated using the following formula: GL = (0.39 x ASL) + (11.8 x ASW) – 15.59. The result is the Flesch Reading Ease Score and the Grade Reading Level (see table 1); and the Reading Age of a given text can be calculated thus: (L x 0.39) + (N x 11.8) – 10.59 years.

Table 1. Flesch Reading Ease Interpretation Table

Flesch Reading Ease Score	Flesch Readability Levels	Grade Level
0 – 29	Very difficult	Post graduate level
30 – 49	Difficult	College level
50 - 59	Fairly difficult	High School level
60 - 69	Standard	8^{th}-9^{th} grade level
70 - 79	Fairly easy	7^{th} grade level
80 - 89	Easy	5^{th}-6^{th} grade level
90- 100	Very easy	4^{th}-5^{th} grade level

Source: (Wyatt, and Schnelbach, 2008).

The obtained Flesch Reading Ease Score is then mapped to its corresponding readability level based on the value scale presented above. This formula predicts the Flesch Reading Ease (FRE) and the Grade Level (GL) required in understanding a piece of text material.

Methodology :

The study employs an applied research method which involves the practical application of science to address a specific problem and the method is suitable for this study because it involves application of Flesch's formula to assess the readability of selected Basic Science textbooks in Ekiti State. The target population consisted of all the Basic Science textbooks used in the Junior Secondary Schools in Ekiti State. The lists of the major Basic Science textbooks were collected from Ekiti State Ministry of Education and Technology, Ado-Ekiti. The title of the textbooks, authors' name, year of publications and the publishers' name of each textbook are tabulated in table 2.

Table 2. Title of Textbooks, Authors, Year of Publications and Publishers

Title of Book	Authors	Year of Publication	Publishers
Nigerian Basic Science Project, Pupils' Textbook **One, Two** and **Three** New Edition	Science Teachers Association of Nigeria	2010	HEBN Publishers Plc.
Basic Science: An Integrated Science Course for Junior Secondary **One, Two** and **Three** UBE Edition	FOC Ndu, L. O. Ndu, A. O. Olarewaju and Femi Somoye	2010	Longman Publishers Nig. Plc.
Evans Basic Science for Junior Secondary School Student's Book **One, Two** and **Three**	J G. Adewale, I. J. Adenuga, I. O. Igwe, T. O. Iroegbu, and C. U. Nwachukwu	2009	Evans Brothers (Nig Publishers) Ltd.

In order to assess the grade reading level of the passage sampled Flesch's measurement of sentence length and syllable count was used.

The readability scores of the books were obtained by selecting three 100-word samples each from the books and count the number of sentences; divide the number of words (100) by the number of sentences and multiply the result by 1.015; and call the result (x). The total numbers of syllables in the sample was also counted and divided by the total number of words (100) and multiply by 0.846; and call the result (y), then x and y were added together and the result was subtracted from 206.835. The final result is the Flesch Reading Ease Score. Similarly, the same data on average sentence length and average syllable per word were also used to analyze the Grade Levels and Reading Age of the selected textbooks. Information on the average age of JSS one, JSS two and JSS three students were obtained from the school's class teachers, the records indicate that JSS one has an average age of 12 years; JSS two has an average age of 13 years while JSS three has an average age of 14 years.

Results

The tables 3-5 illustrate the results of Flesch's formula on STAN Basic Science, Longman Basic Science and Evans Basic Science textbooks.

Table 3 above revealed that, the readability scores of the STAN basic science textbooks are 64.88 for book one, 64.61 for book two and 58.63 for book three with the

Table 3. Readability Levels of STAN Textbooks.

Book	ASL	ASW	Readability Sores	Grade Levels	Reading Age	Remarks
STAN Book One	10.57	155.33	64.88	6.60	11.90	Standard
STAN Book Two	11.94	153.52	64.61	7.00	12.20	Standard
STAN Book Three	15.86	156.45	58.63	8.80	14.10	Fairly Difficult

Table 4. Readability Levels of Longman Textbooks

Book	ASL	ASW	Readability Sores	Grade Levels	Reading Age	Remarks
Longman Book One	13.85	160.67	56.98	8.50	13.80	Fairly Difficult
Longman Book Two	14.50	150.0	65.43	7.50	12.80	Standard
Longman Book Three	13.85	149.0	66.93	7.10	12.40	Standard

Table 5. Readability Levels of the Evans Textbooks

Book	ASL	ASW	Readability Sores	Grade Levels	Reading Age	Remarks
EVANS Book One	7.67	151.67	65.26	7.20	12.50	Standard
EVANS Book Two	16.92	148.67	64.14	8.20	13.60	Standard
EVANS Book Three	16.92	158.67	55.65	9.40	14.70	Fairly Difficult

Average Sentence Length (ASL) per textbook as 10.57 for book one, 11.94 for book two and 15.86 for book three and Average Syllables per Word (ASW) as 155.33 for book one, 153.52 for book two and 156.45 for book three. While the calculated reading age of each book was 11.90 for book one, 12.20 for book two and 14.10 for book three. By implication, books one and two are within the reading levels of the target reader while book three is fairly

difficult for the target user and so not appropriate for year three students of the Junior Secondary School.

Table 4 above revealed that, the readability scores of Longman basic science textbooks are 56.98 for book one, 65.43 for book two and 66.93 for book three with the Average Sentence Length (ASL) per textbook as 13.85 for book one, 14.50 for book two and 13.85 for book three and Average Syllables per Word (ASW) as 160.67 for book one, 150.0 for book two and 149.0 for book three. While the calculated reading age of each book was 13.80 for book one, 12.80 for book two and 12.40 for book three. By implication, books two and three are within the reading levels of the target reader while book one is fairly difficult for the target reader and so not suitable for year one students of the Junior Secondary School[10-13].

Table 5 above revealed that, the readability scores of Evans basic science textbooks are 65.26 for book one, 64.14 for book two and 55.65 for book three with the Average Sentence Length (ASL) per textbook as 7.67 for book one, 16.92 for book two and 16.92 for book three and Average Syllables per Word (ASW) as 151.67 for book one, 148.67 for book two and 158.67 for book three. While the calculated reading age of each book was 12.50 for book one, 13.60 for book two and 14.70 for book three. By implication, books one and two are within the reading levels of the target reader while book three is fairly difficult for the target audience and so not appropriate for year three students of the Junior Secondary School.

Discussion of Findings :

From the findings in tables 3, 4 and 5 the grade level of each book is presented in column 5 as STAN 6.60 for book one, 7.00 for book two and 8.80 for book three, Longman 8.50 for book one, 7.50 for book two and 7.10 for book three and Evans 7.20 for book one, 8.20 for book two and 9.40 for book three. Based on the reports of Yoloye[15] and Osokoya[11], an average Nigerian child is at least a year behind his American counterpart when it comes to reading and comprehension. This is because of the differences in reading ability of those who speak English Language as second Language (ELS) and those who speak English as first Language. The grade levels estimated using the Flesch Grade Level as reported in column 5 of tables 3, 4 and 5 will be adjusted by one (1) for the purpose of discussion and interpretation by the investigator. This means that the grade levels ranging from 6.60 to 8.80 for STAN books will be adjusted to 7.60 to 9.80; the grade levels ranging from 7.10 to 8.50 for Longman books will be adjusted to 8.10 to 9.50 and also grade levels ranging from 7.20 to 9.40 for Evans will be adjusted to 8.20 to 10.40. This means that an average Nigerian Grade 6 student (equivalent of JSS one) will find STAN and Evans textbooks standard for reading, Grade levels 7-8 student (equivalent of JSS two) will find all the textbooks standard for reading. Grade levels 9-10 (equivalent of JSS three) will find Longman textbook standard to read[2,15].

It would be noticed that STAN book three is fairly difficult for JSS three students, Longman book one is fairly difficult for JSS one students also Evans book three is fairly

difficult for JSS Three students. The reason for the difficulty could be as a result of the inherent long sentences and polysyllabic words which are mostly nouns in STAN book three, Longman book one and Evans book three, hence, the three books appears to demand a much higher reading skill than the intended users compared with the remaining books which contains short sentences and monosyllabic words as indicated in column 2 of the tables which is one of the major basic assumptions in determining the suitability of a book for intended users. These findings agreed with the opinion of Flesch[6], Osokoya[11], and Wyatt and Schnelbach[14].

Further assessment of the textbooks revealed that the calculated reading age for each of the textbooks correspond with the observed average age of the students except in Longman book three which has a reading age of 12.40 that is below the observed average age of the target users and Longman book one which has a calculated reading age of 13.80 that is above the observed average age of the target users, no wonder the book seem to be difficult for the intended users.

Conclusion and Recommendation

The findings of this study revealed that STAN book three, Longman book one and Evans books three were fairly difficult for the target readers by having a readability grades substantially higher than the target readers. By implication, these books are not appropriate for the class they were meant for. It is therefore recommended that these books should be revisited or reviewed by the authors and the publishers putting into consideration the long sentence length, reading age and polysyllabic words of the books before recommending such for a particular class.

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