Guidelines on How to Read a Physics Textbook and the Assessment of the Readability of Recommended Physics Textbooks in Secondary Schools in Osun State of Nigeria

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Abstract

This study assessed the readability of the four recommended physics textbooks in senior secondary schools in Osun State of Nigeria. A total of 25 physics teachers and 300 senior secondary three (SS3) physics students were randomly selected in the 12 secondary schools used for the study. A survey design was used for the study. Results showed that the four physics textbooks were appropriate for secondary school students in Osun state of Nigeria in terms of age (Fry graph mean age = 17years, students' mean age =15 years) .The books had the highest rating by students on illustrations and clarity of prints while the lowest ratings were on sentence structure and examples. Teachers considered the vocabulary as appropriate while the exercises were considered least appropriate. The study also showed that the four physics textbooks were adjudged readable in term of students' ability to read and understand the contents. However, senior secondary school physics textbooks (69%) was found to be most readable, seconded by ordinary level physics (64%), followed by principle of physics while science teacher association of Nigeria (STAN) physics (15%) was found to be least readable by the students. It is recommended that the readability of textbooks and the reading ability of students should be part of the criteria for selecting textbooks.
Keywords: Readability, Recommended Physics Textbooks, Approved Guidelines, Structure and Objectives

Introduction

Science textbook have a pervasive influence in school science education. One of the goals of science education is to prepare individual for lifelong science learning, then it is important to examine the extent to which textbooks are designed to facilitate this goal. Science textbooks are the ultimate source of science knowledge in many science classroom of the extent that in many ways, they become the embodiment of science for students (Yore, 1991).

The textbooks are very important teaching and learning resources. Thus, great effort must be taken in ensuring that those to be selected and recommended for the schools are of good quality. A good textbook is considered as a major tool in the educational advancement of a nation and consequently national development. Providing explicit instruction on the use of illustrations and analogies can assist students in the effective reading of science textbooks and enhance science learning (Mallow, 1991, Young, 1992). The textbook is relevant to education and can be effective when used as a basis for planning a course according to topics; and in so doing, it is important to use the sections of the book, which have bearing on the course. The textbook therefore fixes the responsibility for knowing a certain amount of information and knowledge on the learners. By using the textbook, the teacher is encouraged to cover a definite score of word. In defect, the textbook helps to check the teacher's performances, his methods and practices are compared with those suggested in the text (Okorie, 1979).

Essentially, the textbook helps a teacher to provide an organization of structure for his course. The textbook also gives a variety of sources for gathering more information and the establishment of clearer concepts. It can also be useful in training children and to develop skill very necessary to science. Another legitimate use to which a class textbook may be put is to meet the problem of children's lack of background knowledge. Good as the textbook is to teaching and learning, based on the roles explained. A case is therefore made for one or more textbooks in teaching physics, provided they are valuable adjunct (Lump & Beck, 1996).

There are certain requirements that guide the selection of learning resources. Ehindero (1994) remarked that, it is the responsibility of the teacher to make sure that learning resources are: in keeping with curriculum objectives and as such can assist in achieving desire goals of the programme; selected and appropriate to the specific classroom learning setting; genuine concrete and foster reliable learning; appropriate to the range of intellectual abilities of learners' such that they encourage and motivate directly or indirectly learners' participation; geared towards motivating and assisting learners to transfer and apply learning appropriately to new situation, and directed to promote group and corporate learning, improved social interaction and encourage problem solving skills and attitudes.

If textbooks are not properly censored, they should not be recommended at all, let alone being read in the school. This is because there are two great dangers in using such a book in the interest of economy and the hope of attracting a wide range of purchasers, publishers tend to cram as much information as possible into their

textbooks.   A noticeable trend away from this pattern has appeared in recent years In Nigeria with publishers tending to concentrate upon only a small number of topics, which the author treats more intensively. However, the type of book in which a large number of topics is treated in outline only is still to be found. The use of textbooks of the latter type may result in children learning a number of facts without really understanding them. The words and sentences may register but their significance is lost; there is no learning beyond the extension of the capacity to repeat verbal symbols when given appropriate   stimulus (Akinwale, 1997).

Readability is an attribute of a text referring to whether or not it is interestingly and attractively written, and easy to understand. Readability relates to the systematic examination of a wide range of factors that in combination have been found to be associated with the interest and difficulty levels of texts. Readability is defined as reading ease, especially as it results from a writing style. Easy-reading text improves reading speed, reading persistence, retention and comprehension. Easy-of –reading is the result of the interaction between the reader and the text. In the reader, those features affecting readability are motivation, interest, reading skill and prior knowledge. In the text, those features are style, structure, design and content (Orstein, 1994).

Readability is the sum total of all those elements within a given piece of printed material that affect or influence effective understanding which an individual or group of readers have. The factors that define the success of any assessment of the readability of any text book are: the attraction and sustenance of the interest and motivations of the reader, the legibility of the print, and the complexity of words and sentences in relation to the reading ability of the reader (Adeyemi, 2006). To this extent, textbooks with poorly printed words and illustrations, complex sentence structures, long words and too much material containing entirely new ideas are not therefore likely to encourage, interest or motivate a reader. Such a text will therefore constitute a poor written textbook with low readability index. Akinwale (1997) states what he called an overall impression of what the characteristic of a readable textbook should be. Akinwale identified that books selected for pupils must have titles that have appeals; books' cover must be good and possess an attractive quality and the size must not be too big in order to sustain their interest for long.

Yoloye (1975) used Longe Readability Technique to analyze the readability of the Nigeria Secondary School Science Programmes (NSSSP) and Ayetoro comprehensive high school social studies materials. Classes one and two students have difficulty in understanding them because the readability indices of the text were much higher than the average reading level. Fawole (1992) also evaluated the readability indices of three selected Mathematics textbooks and the perception of the subjects of the study on the readability of the Mathematics textbooks in Ondo and Oyo States of Nigeria, using Fry readability method. Results obtained from the study showed that the textbooks were appropriate for the age of the class of students' readers for which they were written. The readability indices of the books were also considered to be of varied qualities.

Egbugara and Astill (1989) compared predictions of Fry graph and Close-technique as they are related to Physics students' use of a recommended text material at the secondary school level in Nigeria and investigated the appropriateness of the two readability formulas. The following discoveries were made: Fry graph and Cloze readability technique did not compare in terms of predicting how students would perceive the difficulty of Comparative Education Study and Adaptation Center (CESAC) Physics book 3, while the Cloze scores suggest that students would generally have much difficulty in comprehending the textbooks. Fry's index indicated that it was at an appropriate level. What was found between the two techniques was that texts could exhibit varying degrees of difficulty to a class of learners because the final year secondary Physics students for whom the textbooks was prepared are expected to have a mean age of 17 years. A correction value for use in Nigeria would most probably be 6 years (that is expected mean age minus graph age (17-11) correction value for years). He recommended for a further research to establish the reliability of the reading age corrective value for Nigeria.

Statement of the Problem

The challenges faced by the Nigerian education system, such as increasing class size, decreasing budgets for equipment and supplies, increasing safety concerns and ageing teachers' population, may likely contribute to a continual dependence on textbooks. However, it is doubtful if the readability of textbooks are determined before their being recommended for use in secondary schools. The problem of determining the readability of Physics textbook is particularly acute given the technicality and the abstract nature of the concepts embedded in the writing of Physics textbook. Hence, because of the technical nature, which Physics textbook demands, the determination and their readability remain a problem. This study attempts to assess four of the selected senior secondary schools physics textbooks used in Osun State of Nigeria in terms of the context, legibility, sentence structure, illustration and colour, examples, organization and application.

Purpose of the Study

The purpose of the study is to assess the readability of recommended Physics textbooks in senior secondary schools in Osun State of Nigeria. The study is specifically designed to achieve the following objectives.
    1   To compare the structure and objectives of the textbooks with the approved guidelines for the

secondary school physics programmes.

2   To determine the readability level of each of the textbooks with respect to students' ability to read and understand the contents of the book.

Research Questions

For the purpose of the objectives stated above, the following research questions were raised:

1.   Do the structure and objectives of the four selected recommended Physics textbooks conform with the approved guidelines for secondary school Physics curriculum in Nigeria?
2.   Is the readability of the four selected recommended Physics textbooks within the comprehension level of senior secondary school year three Physics students in Osun State in Nigeria?

Research Method

The research design used for the study was a survey design. The population consisted of all the 38 Physics teachers that taught senior secondary three (SS3) in all the 30 secondary schools in Ife East Local Government Area of Osun State, Nigeria and their students numbering 925 during the 2008/2009 academic session. A simple random sampling technique was used to select 12 secondary schools from the population. Twenty five (25) students were randomly selected in each school. A total of 300 students took part in the study. All the 25 Physics teachers in the selected secondary schools were used for the study.

Two researchers – made instruments: Physics Teachers' Questionnaire on Readability of Recommended Physics Textbooks (PTQRRPT) and Physics Students' Questionnaire on Readability of Recommended Physics Textbooks (PSQRRPT) were used to gather data for the study. The instruments were designed to seek information on the content in terms of facts, illustrations and language of presentations, format and styles of writing, examples, organizational structure of topics, complexity of words and sentences and contents in line with national Physics curriculum in determining the readability of the four textbooks selected for the study. The PTQRRPT consisted of 16 items while PSQRRPT consisted of 13 items. The two instruments consisted of 5-rating scale responses format of superior, good, fair, poor and unsatisfactory.

Two Physics educators and two secondary school Physics teachers validated the initial drafts of these instruments. Some items were deleted while some were modified to the final items of the two instruments based on their suggestions. The reliability of the two instruments were ascertained by conducting a trial test on a group of 40 students and five (5) teachers using test- retest approach and the reliability index of 0.79 was obtained for PTQRRPT and 0.81 was obtained for PSQRRPT.

The senior secondary three (SS3) Physics teachers in each school served as research assistants. They were all briefed about the objectives of the study and the procedure for the administration of the research instruments. The instruments (PTQRRPT and PSQRRPT) were administered in all the twelve schools selected for the study with the help of the research assistants. All the copies of the instruments given out were duly completed and returned.

The Fry (1977) graph readability method as noted in Dale and Chall (1989) was employed. The Fry graph is two-factor instrument for predicting the difficulty and readability level of reading materials. The rationales for using Fry graph readability technique in Physics textbooks materials are the types, which are difficult to analyze using a conventional readability formula. The materials are disjointed prose in "fractured English". They are a mixture of headings, brief instructions and less continuous prose. Fry readability technique is neither a formula nor a Cloze-text but a graphical form which gives visual information when numerical results might give a spurious impression of accuracy and enables the users to tell, at a glance, if a passage is, in comparative terms, more difficult than average in vocabulary or sentence length. The graph when validated by Fry himself correlated 0.94, 0.96 and 0.78 as noted in Dale and Chall (1989). The procedure for Fry's graph method is as follows:

•   Randomly select three sample passages and count out exactly 100 words each, beginning with the beginning of a sentence.
•   Count the number of sentence in the 100 words; calculating the length of the fraction of the last sentence to the nearest one-tenth.
•   Count the total number of syllables in the 100-words-passages.
•   Enter the graph with the average number of sentences and syllables; plot a dot where the two lines intersect.
•   When counting syllables for numerals and abbreviations, count one syllable for each symbol.

For the graph, the area where the dot is plotted gives the approximate United State grade level. The study adapted Egbugara and Astill (1989) corrective value by subtracting the expected age from the graph age for each Physics textbook and taking the average as the corrective value for Nigeria. The following are the descriptions of the analysis according to the research questions raised:

•   The topics of the contents of each of the four textbooks were itemized and then compared with

topics in the approved guidelines for secondary school Physics programme. Two things were examined, the number of topics that are found in the two documents and the order of the existence.

- Responses of the students and teachers on items that relate to students; ability to read and understand the contents of the textbooks were examined. Frequency counts of the ratings of superior, good, fair, poor and unsatisfactory were taken and compared across the textbooks.

The recommended Physics textbooks, authors and the year of publications are as shown in Table 1.

Table 1: Recommended Physics textbooks, authors and year of publications

S/N	Title	Code/Author(s)	Year of Publications
1	Senior Secondary School Physics	T1 P.N. Okeke and M.W. Anyakoha	1989(Revised Edition)
2	Principles of Physics	T2 M.N. Nelkon	1977 (7th Edition)
3	Ordinary Level Physics	T3 A.F. Abbott	1999 (5th Edition, Petroleum Trust Fund (PTF) Low Price Edition)
4	Science Teachers Association of Nigeria (STAN) Physics	T4 STAN	1999 (Reprinted PTF) Low Price Edition

Results

Research Question One

Do the structures and objectives of the four recommended Physics textbooks conform with the approved guidelines for secondary school Physics curriculum in Nigeria?

In answering this research question, a breakdown of the contents of each of the four selected textbooks was done and the summary was compared with the summary of the approved guidelines for secondary school Physics curriculum as shown in Table 2.

Table 2: Comparison of approved guidelines for secondary school Physics curriculum and the contents of the selected recommended textbooks

Content of Physics Textbooks	Abbott Physics	Okeke and Anyakoha	STAN	Nelkon
1st Year	Chapters	Chapters	Chapters	Chapters
Space, time and motion .	3	19	7,8	1,2,3
Conservation Principles. Waves.	7,15,17,32	7,15,23	13,14,26	3,14,24
	3,30,31,32,33,35	40	19	22,23
Quanta.	2,13,46	2,37	3,4,5	8,34
2nd Year				
Space, time and motion.	3,5,6	19,21,22	8,9,10	1,2,3,4,5
Conservation Principles.	4,7,8,14,16,18,19	20,25,26,27	9,13,14,15	3,5,9,11,12
Waves	21,22,23,24, 25,26,27,28,29	8,9,10,11,12,13,14,31, 32,	20,21,22	15,16,17,18,19, 20,22,23,
Quanta.	13	2	5	8
3rd Year				
Waves	26,33,35,36	34	24,34	29,30,31
Fields	33,34,36,38,43, 44,45	15,16,17,34,35,36,37,40	26,27,28, 29	25,28,32
Quanta	46,47	15,39	31,32,35, 36, 37	34

The contents of Table 2 show the curriculum topics in secondary school Physics are categorized into four major content areas. These are: space, time and motion; conservation principles; waves and quanta. The table also shows that in the first year of the senior secondary (SS I), Physics textbooks by Nelkon, STAN, Okeke and Anyakoha and Abbott contain contents of space, time and motion, conservation principles, waves and quanta in similar proportions. In the second year (SS II), Physics textbooks by Nelkon, STAN, Okeke and Anyakoha, and Abbott contains of space, time and motion, conservation principles, waves and quanta. In the third year (SSS III), the three topics prescribed in the approved guidelines are waves, fields and quanta. These three topics are

treated by the four textbooks which conform to the approved guidelines for Physics curriculum of the senior secondary schools in Nigeria.

Research Question Two
Is the readability of recommended Physics textbooks within the comprehension level of senior secondary school year three physics student in Osun State of Nigeria?

The research question is generated to find out how the students rate each of the four textbooks in terms of how easy the books were for them to read and understand. The items that relate to this research question were identified and students' responses to them were analyzed. Summary of the analysis of the responses is as shown in Table 3 and 4.

Table 3: Readability of textbooks in terms of reading and understanding

| S/N | Items | Textbook | Percentage responses of the students | | | | |
			Unsatisfactory %	Poor %	Fair %	Good %	Superior %
1	The unfamiliar scientific terms are clearly identified and for special treatment	T1	0	0	16	72	12
		T2	0	0	12	80	8
		T3	0	0	6	66	28
		T4	0	0	20	63	7
2	The diagrams are well illustrated	T1	0	0	15	82	3
		T2	0	0	20	71	9
		T3	0	0	11	82	7
		T4	0	0	44	51	5
3	The size of the type makes for easy reading	T1	4	28	20	40	8
		T2	0	2	15	77	6
		T3	16	32	32	20	6
		T4	0	0	22	67	11
4	The exercises and activities are well arranged from simple to the more difficult ones	T1	21	16	39	20	7
		T2	16	143	49	13	8
		T3	0	17	36	40	7
		T4	0	21	59	17	3

Table 3 shows the analysis in terms of percentages of the responses of the students on their ability to read and understand the contents of each of the textbooks. A look at the summary of the average percentages of the responses of the students show that very few students (between 3 and 12%) agreed that the four textbooks give them unsatisfactory and poor ability to read and understand, few of them still agreed that their ability to read and understand the textbooks is fair (between 21 and 34%), majority (between 48 and 60%) agreed that their ability to read and understand the textbooks is good while few students (between 6 and 12%) agreed that their ability to read and understand textbooks is superior. If the responses of the good and superior students are merged together, we have the 68% of students agreed that T1 is good, 60% of students agreed that T2 is good, 64% of students agreed that T3 is good and 54% of students agreed that T4 is good. This indicated that the textbook T1 is the most accepted textbook among the four recommended Physics textbooks.

Table 4: Readability data for the four Physics textbooks using Fry graph

Textbooks	Mean Sentence	Mean Syllable	Average Sentence Difficulty	Average Vocabulary Difficulty	Graph Age	Age relative to Nigeria is Graph Age of +6	Observed Readers Age	Remarks
T1	6.3	1.65	Normal	Higher	11	17	15	Match the intended age
T2	6.3	1.65	Normal	Higher	11	17	15	Match the intended age
T3	6.7	1.65	Normal	Higher	11	17	15	Match the intended age
T4	7.7	1.66	Normal	Higher	12	18	15	Match the intended age

Age relative to Nigeria = Expected mean age of the reader minus graph age (Egbugara & Astill, 1989).

As shown in Table 4, the average difficulty of the sentence structure in the four Physics textbooks was found to be normal for the targeted school class. Their average vocabulary difficulty was found to be higher. The predicted (graph) age for the textbooks match the expected mean age of the targeted school class. Using the Fry graph readability method, therefore, the Physics textbooks were appropriate, age-wise for the targeted school class.

Discussion

The study indicated that the selected textbooks conform with the approved guidelines for senior secondary school Physics programmes in Nigeria in terms of the contents of the textbooks. The study also showed that the four textbooks adjudged readable in terms of students' ability to read and understand the contents of the books. The items in which the textbooks are rated good in terms of readability are: the unfamiliar scientific terms are clearly identified, the diagrams are well illustrated and the size of the type makes for easy reading.

The findings of the study is in line with Fawole (1992) who found that the textbooks used in secondary school Mathematics in Oyo State of Nigeria are appropriate in terms of readability to the level of the students. However, the study pointed out that some textbooks are more readable than the other. This is reflected in the order in which the students rated their ability to read and understand the textbooks. Senior secondary school Physics by Okeke and Anyakoha is rated as the most acceptable (68%). This is followed by Ordinary level Physics by Abbott (64%), Principles of Physics by Nelkon (60%) and Science Teachers Association of Nigeria (STAN) Physics (54%) follow in that order.

Further, the four textbooks are all rated equally for their smooth progressiveness by the students. The materials in the books are considered to be so well organized that each topic allows for continuity. Success in one learning task reinforced a progress to the other, while exercises are arranged from simple to the more complex. Ehindero (1994) buttressed this that learning must proceed from simple to complex. Also, the students have equally rated the covers of the textbooks at the same level of readability. It is of the opinion of Ojedokun (2000) that any book targeted at any particular level of education especially primary and secondary schools must possess an attractive quality. To him, often times, this quality determines the decision of the reader or buyer to open it and possibly go ahead to make purchase of it. In addition, three other qualities must be satisfied by a good cover. They are durability, rough handling and sometimes pass-on factor.

Meanwhile, the teachers' evaluation of the textbooks presents in the first instance a variation in their levels of legibility which may be as a result of varied expertise and of machines and tools of different characters. There is also a variation in the evaluation of the extent to which the books stimulates teachers' interest in the discipline, Physics. The teachers, unlike students have not rated all the books as very attractive and appealing.

Conclusion

The study has found out that the four selected Physics textbooks that are being used the senior secondary schools in Osun State of Nigeria conform to the approved guidelines for senior secondary schools Physics programmes in Nigeria terms of structure, objectives and contents of the textbooks. The study also showed that the four Physics textbooks are adjudged readable in terms of students' ability to read and understand the contents of the textbooks. However, the study pointed out that some textbooks are more readable than the others. This is reflected in the order in which the students rated their ability to read and understand the textbooks. Teachers need to give adequate explanations and illustrations of very difficult aspects of physics topics. Also, it would be more helpful if the government agencies responsible for recommending school textbooks take due cognizance of the different factors of the readability of such textbooks. This research has considered readability study as a way of enhancing students' motivation to learn. This is because information provided at the end of the evaluation will provide the quality textbooks to be recommended for schools, which will in turn enhance achievement and success in school and out of school.

Guidelines on How to Read a Physics Textbook

The way you read a physics textbook is quite different from the conventional way students are taught to read textbooks in secondary school and colleges. Students are taught to skim over the materials or to read quickly and if they do not understand a word, they suppose to keep on reading until they under understand it. This implies that the teacher want the students to continue to read so that they can pick up the unknown words and their meanings from context. This approach to reading may work with other subject, but using it in Physics will be confusing because of the nature of the subject that deals with symbols, formulas and signs. Hence, by skipping some major concepts words, formulas, symbols, and signs, the learner may not understand the physics textbook or be able to do assignment and home work.

The suggested approaches in reading a physics textbook include:
- Start by reading the chapter introduction and each section summary.
- Skim over the reading material in order to get the general idea about the major concepts in the topic and

relate the concept with what you have already know.
- As you skim through the main chapter, underline the new words, concepts, symbols, or formulas that you do not understand. Then, ask your teacher for help concerning the new words, concepts, symbols or formulas. The initial skimming should not be more than 10 minutes after reading the assignment.
- Concentrate fully on reading the textbook and highlight the materials or concepts that is important to you. The highlight should not be more than 20 percent of a page. The purpose of highlighting is to lay emphasis on the important materials or concepts for future study. It might take about 15 minutes to read and understand a page in a physics textbook.
- Insert any missing step when going through examples. By filling in the extra steps, you are starting to over learn the concept for better recall on future study.
- Erase the concepts, symbols, or formulas you have marked and you now understand after skimining. Mark only concepts, symbols or formulas that you do not know and reread the page or look for the meaning at of the glossary. Do not read further until you understand all the concepts, symbols, words or formulas.
- Write down the concepts, words, formulas or symbols that you do not understand at the back of your notebook as your own glossary, if you find it difficult to understand then ask your teacher for better explanation.
- If you do not understand the concepts, words, formulas or symbols, follow the procedure below until you understand them.
  i. Reread the material and go back to the previous page for more information
  ii. Move to the next page and skim through whether you will get more information.
  iii. Check illustrations, rules, examples, figures and diagrams that explain the misunderstood concepts, words, formulas or symbols.
  iv. Read the misunderstood paragraph(s) several times. Silent reading must precede vocal reading.
  v. Make reference to your Physics note for better understanding
  vi. Read another physics textbook that gives more explanation of the misunderstood concepts, words, formulas or symbols.
  vii. State and define exactly what you do not understand and ask for help from your fellow students.
  viii. Contact your Physic teacher for help in understanding the concepts, words, symbols or formulas.
- Link up the new knowledge or information with the one you have already know.

Recommendations

The following recommendations were made based on the findings of this study. Firstly, it is recommended that readability of textbooks and the reading ability of students should be part of the criteria for selecting textbooks. In making a choice of textbooks, a teacher has to consider the following factors: the materials must fit well into the programme; the book must be well organized; the content of the book must possess several examples for the students to practice from and the teacher must ensure that the subject concepts are correctly presented with good instructional strategy.

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