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Readability and Content Coverage Indices of Three Approved Mathematics Textbooks for Senior Secondary School Three in Akwa-Ibom State

Dr. Ijeoma M. Opara and Theresa Edenowo Enang
Department of Educational Psychology, Guidance and Counselling, University of Port Harcourt

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ABSTRACT: *The study investigated the readability and content coverage indices of three approved mathematics textbooks for senior secondary school three in Akwa-Ibom State. Two research questions and two corresponding hypotheses guided the study. The study adopted utilitarian evaluation research design. Three (3) out of the twelve (12) approved mathematics textbooks were drawn using simple random sampling technique. Purposive and non-proportionate stratified random sampling techniques were used to draw sixty (60) senior secondary school three students from population of 340 SSS3 students from three schools in Etim Ekpo Local Government Area of Ikwa-Ibom State. The instruments used for data collection were the three approved mathematic textbooks, syllabus or scheme of work for SSS3 students and Mathematics Textbook Reading Level Evaluation Questionnaire (MTRLEQ). MTRLEQ was validated by three experts in measurement and evaluation for face and content validities. Gunning Fog Index and Topical Coverage index were used to answer the research questions. One-way analysis of variance (one-way ANOVA) and Linear Chi-square were used to test the hypotheses at 0.05 levels of significance. Based on the findings, it was observed that among the three mathematics textbooks, New General mathematics was read successfully by the students. Recommendations were made among others that mathematics textbooks should be written using simple English at the secondary school level.*

KEYWORDS: readability, content coverage, mathematics, textbooks

INTRODUCTION

Education is one of the most important elements responsible for the development of any nation. Education may be seen as the attempt to shape or modify behaviour of an individual with a view of equipping him or her with desirable skills, habits and attitudes to adequately adjust to the communal life and contribute effectively to its growth and preservation (Upadhja & Singh, 2008). The institution which is specifically charged with this responsibility is the school. There are many

subjects taught in a school, and each of these subjects comprises of the information about a particular field taught to the students. For any programme or curriculum to be effective, it should be thoroughly evaluated in order to assess, measure the overall success and identify areas of weakness and make recommendations for changes where possible and necessary.

Mathematics is one of the school subjects that any nation needs for industrial and technological advancement, useful for most vacation and higher specialized courses of learning (Odili, 2006; Sidhu, 2006). According to Nwoke and Nnaji (2011), mathematics is the study of quantity, structures, space and change. It developed through the use of abstraction and logical reasoning, from counting, calculation, measurement and the study of the shapes and motion of physical objects. Mathematics is an excellent vehicle for the development and improvement of a person's intellectual competence in logical reasoning, spatial visualization, analysis and abstract thought (Curriculum Planning and Development Division, of Akwa-Ibom State, 2007). Students who study mathematics, therefore, develop numeracy skill, reasoning, thinking skills and problem solving skills through the learning and application of mathematics.

The inclusion of mathematics as a core subject in the secondary school curriculum is due to the key roles mathematics has to play in the achievement of the objectives of the secondary school education, such as promoting of science and technology, provision of trained manpower in the applied sciences, technology and commerce and the acquisition of appropriate skills abilities and competence both mental and physical, as equipment for the individual to live on and contribute to the development of his society (Federal Republic of Nigeria, 2004).

The Nigerian National Council on Education as reported by Eya (2001) stipulated that the state Ministry of Education should periodically review standard textbooks used in teaching in secondary schools every three years to ensure that books are readable by students. A number of new secondary school mathematics textbooks have been produced and introduced into the secondary school educational system in Nigeria, in the last twenty years in response to new curriculum changes. Also, some of the existing old editions of mathematics textbooks have been reviewed to relate them to the current needs of the curricula and the examination bodies.

Textbook is a very important material in the teaching-learning process. It has the attributes of conveying permanent information unlike other learning materials, which could be transient. It combines durability with portability and can be used where there is no electricity or any other source of power. It serves as a basic source of knowledge and formal learning (Afolabi, 2009). Savery (2001) defined a textbook as teaching-learning material covering a clearly defined subject matter, for the learner of a grade level and reading ability. Eusebio (2000) sees a textbook as a compilation of facts, ideas, concepts, practice and knowledge within a given subject matter area. Therefore, a textbook can be seen as a deliberately arranged and compiled concepts, ideas, facts

and knowledge in a systematic manner within a given subject area to ensure maximum performance of its didactic functions.

Textbook as an instructional tool is unique among all other instructional media due to possession of certain characteristics. It is durable, permanent, portable and independent of electricity or electronic device when in use. It appears to be the oldest of instructional media. Due to its age-long existence and availability, it is common among teachers and learners more than any other medium. Aggarwal (2001) reported that classroom teaching activities depend heavily on textbook especially in the institutions where instructional materials are not available. On the same issue, textbooks are central to schooling and have never been replaced in educational processes. Textbooks play an important role in mathematics education because of their close relationship to classroom instruction (Johansson, 2003). Moreover, textbooks have a prominent position in curriculum reform and are considered the most important tool for the implementation of a new curriculum in many countries (Valverde, Bianchi, Wolfe, Schmidt & Houaug, 2002).

In the teaching and learning of mathematics, both teachers and students depend on the text materials and as such, it is not doubtful then that the equality of textbooks in use will determine, to a large extent the quality of learning and transfer of such learning which will occur (Nworgu, 1991). Hence, the quality of educational materials such as mathematics textbooks is most fundamental where information presented is reliable, valid and authoritative. As a result of the importance of textbooks to school teaching-learning process, the paucity of research on mathematics textual materials and rare analysis of these textbooks themselves, this research work has considered the analysis of some common mathematics textbooks in Nigerian secondary schools.

The students stand the chance of benefiting less from any textbook which contains so many unfamiliar sentence structures and concepts thereby resulting in show pace of reading such a textbook and reading may therefore be meaningless. The reading of mathematical material is different from the reading of other subject materials. The students find it difficult in reading explanations, problems or references of mathematical nature. Difficulties in reading mathematics materials may come from different angles such as general reading inadequacy, use of symbols, formulas, graphs, technical language with which the reader is unfamiliar. In the selection of any textbook, it is important to conduct an evaluation to ensure that it is suitable. Textbook evaluation is an act and process of collecting, quantifying and interpretation of data collected on textbook of interest with the aim of making valid judgement on its quality using agreed criteria. To carryout evaluation one needs information and criteria against which the textbook will be judged. Kelly (1997) opined that the quality of textbooks depends mostly to the degree of its readability and contents coverage.

Readability of textbook is the ability to read and understand with ease within the age level of the students in which the text is meant for. Prins and Ulijn cited in Kasule (2010) defined readability

as the ability of the text to communicate the intention of the writer to the intended reader. It is a measure of how easy a piece of text is to read. Readability is the ease of understanding or comprehension of the text. Richards and Schmidt (2002) define readability as how easily written materials can be read and understood. Pikulski cited in Udu, Gyuse, Samba and Iortin (2016) opined that readability is the level of ease or difficulty with which text material can be understood by a particular reader who is reading that test for a specific purpose. It is believed that high achieving students are those who have good reading ability, while poor achieving students are poor readers (Knoll cited in Udu et al 2016). Also a more motivated reader will obtain easier and faster the comprehension of texts than a reader with little interest. This is obtained through the use of readability formulas (Cherly, 2002). The formulas were designed to assess the readability of the English written in the text and how suitable the textbooks are for a specific level of formal education. In the formulas the measurement includes the word difficulty and the complexity of the text in terms of English writing to determine its appropriate reading level. Omolewa cited in Owhorji (2007) ascertain that the formula approach is a productive device aimed at producing objective quality estimate of the reading difficulty of a textbook.

There are many readability formulas or texts developed over the years. One of such formula or text is the Gunning Fog Index developed by Robert Gunning in 1964. Gunning Fog Index according to Owhorji is a practical readability scale that measures the grade level of a piece of writing. The text is designed to measure the readability of a sample of English writing. The resulting number is an indication of the number of years of a formal education (reading level) that a person requires in order to understand the text on the first reading.

Another area in this study is the content coverage of mathematics textbooks. The content of any textbook shows the way each subject matter and the ideas are expressed in it. Textbook content is always in line with the curriculum content of that class or level in which it is meant for. Hence, content evaluation determines the extent in which the content in the curriculum is in line with the content of the subject matter in the textbook. According to Iwuchukwu (2001) content evaluation could be made on the basis of the extent of topical coverage, provision of relevant study questions, learning activities, illustrations and chapter summary. Topic coverage of a textbook measures the face coverage and the depth coverage. Face coverage is about the number of topics that is covered by the textbook that is in line with the topics in the scheme or syllabus. While the depth coverage compares the number of sub-topics covered in the textbook to the number of sub-topics in the syllabus. Ozoemenem (2002) opined that the index of topic coverage varies between 0 and 1. When none of the topics and sub-topics in the syllabus was covered by the text, the index is “0”. The index is “1” when the textbook covered all the topics and sub-topics in the syllabus.

Researches on evaluation of textbooks have been reported in literature. For example Jeremiah (2015) investigated on the readability of three recommended government textbook for senior secondary school students of Rivers State and found that one of the book New Approach

Government was far above the reading comprehension of the intended audience. Iwuagwu (2019) researched on readability index of secondary school Economics textbooks use in Federal Capital Territory (F.C.T) Abuja. The results revealed that some of the economics textbooks used in teaching senior secondary school students in FCT are not readable. In another study, Iwuchukwu (2001) evaluated the topical content and study questions of English language textbooks and found that one of the textbooks Intensive English textbook has adequate topical coverage of the English language syllabus for JSS 3, but the study questions indices are lower. Also Anugwo (2011) investigated on quality of mathematics textbooks recommended to students in Ebonyi State in terms of content readability and teacher's perception of the text. The results showed that all the textbooks were comprehensible and rated Mathematics Association of Nigeria (MAN) as the best followed by New General Mathematics (NGM) and lastly Sureway Mathematics Text.

The most important instrument used for learning by both the students and the teachers in the Education industry is the textbook. The significance of textbooks in schools has prompted many people to publish different textbooks which include Mathematics textbooks in order to encourage students to learn. Mathematics plays a key role in shaping how individual deal with the various spheres of life, be it private, social or cooperate. A cursory look at the National Curriculum for Mathematics reveals the concept applicability of the Mathematics knowledge in our formal and informal daily activities. Students of the subject matter have challenges to effectively learn Mathematical processes. Mathematics textbooks used in schools in most parts of the country have been criticized by stakeholders in Education to be irrelevant. This is not because they have made analysis or criteria evaluation of these textbooks; it is rather because of the learning outcomes of the students at the end of the programme. Most statements of the critiques were not based on empirical evidence. Yet, most of the critiques have not been able to come up with a better option. The evaluations of each of these textbooks need to be determined, especially since it is the case that the approval of textbooks for schools has also experienced a number of problems. One of such is the approval of textbooks for use in schools without subjecting them to due process of evaluation.

The government of Akwa Ibom State of Nigeria, Curriculum Planning and Development Division (2007) has observed that over the years, many authors have published many books for use in schools in the State. It has also been seen by them that a lot of these books published are of no use to the school system and to the students. Since it is the duty of the government to keep the educational system flourishing, and as such they cannot over look and allow the educational system to be destroyed because of inadequate published materials or textbooks. They in turn decide to streamline the list of the different textbooks used in schools at the junior and senior secondary school levels in Akwa Ibom State.

Observation has shown that over the years many students find it difficult to understand and effectively use their recommended mathematics textbooks for assignments. This results to

ineffective learning and poor academic achievement in mathematics. The above triggered the researchers to investigate the readability and coverage indices of some approved mathematics textbooks for senior secondary school three (SSS3) in Akwa-Ibom State. On the basis of this, the following research questions were raised to guide the study?

1. What are the reading levels of the three approved mathematics textbooks for SSS3 in the Akwa-Ibom State?
2. To what extent do the three approved mathematics textbooks cover the content in the curriculum or scheme of work for the SSS3 in Akwa-Ibom State

The following null hypotheses were tested at 0.05 alpha level.

1. There is no significant difference in the reading level between the three approved mathematics textbooks for SSS 3 in Akwa-Ibom State.
2. The content coverage in the three approved mathematics textbooks for SSS 3 in Akwa-Ibom state do not significantly differ.

METHODS

The study adopted utilitarian evaluation research design. The rational for choosing this design was because it provides information about the worth, value or efficacy of instructional programme or material. The sample size for the study include three (3) approved mathematics textbooks and sixty (60) senior secondary school three (3) mathematics students. The three (3) approved mathematics textbooks were drawn from the twelve (12) approved mathematics textbooks by the Akwa-Ibom Ministry of Education using simple random sampling technique. Purposive and non-proportionate stratified random sampling techniques were used to draw sixty (60) senior secondary school three (SSS3) mathematics students from the population of 340 SSS 3 students from three (3) schools in Etim-Ekpo Local Government Area of Akwa-Ibom State. The instruments used for data collection were the three approved mathematics textbooks, scheme of works for SSS3 students and Mathematics Textbook Reading Level Evaluation Questionnaire (MTRLEQ). Mathematics Textbooks Reading Level Evaluation Questionnaire was structured on the basis of Gunning Fog Formula which asked the respondents to choose six passages of at least 100 words from each passage from the three textbooks, count the number of words, number of sentences and number of hard words in each of the selected passage and record. Hard words are words with more than two syllables. According to Mile (1990), hard words are words of three or more syllables, not including compound words e.g. book-keeping, proper nouns, familiar jargons, or verbs that become polysyllabic by adding common suffixes such as - ed, es, or – ing. A Gunning Fog Index score of 7 or 8 is ideal MTRLEQ was validated by three experts in the field of measurement and evaluation for face and content validities. The reliabilities of the instruments were determined through test-retest method for measurement of stability of the instruments. The reliability coefficients obtained for the three instruments were 0.81, 0.76 and 0.93 for New General Mathematics, Essential Mathematics and Comprehensive Mathematics respectively. Gunning Fog readability index and

topical coverage index were used to answer the research questions while one-way analysis of variance (ANOVA) and linear chi-square were used to test the hypotheses at 0.05 alpha levels.

RESULTS

Research Question 1: What are the reading levels of the three approved mathematics textbooks for SSS3 students in Akwa-Ibom State?
The reading levels of each of the three mathematics textbooks were evaluated using Gunning Fog Index from the approved textbooks. Index obtained were used in answering research question one.

Table 1: The reading level of the approved mathematics textbooks using Gunning Fog Index

Title of Textbook	Percentage of Hard Words	Average Sentence Length	Gunning Fog Index
New General Mathematics (N.G.M)	10%	12.5	9.0
Essential Mathematics (E.M)	20%	12.5	13.0
Comprehensive Mathematics (C.M)	8%	20.0	11.2

Table 1 revealed that New General Mathematics had 10% of hard words, 12.5 average sentence length and 9.0 Gunning Fog Index. The Gunning Fog Index of 9.0 shows that a greater number of students read New General Mathematics successfully. This is based on the ideal index score of Gunning Fog Formula which is 7 to 12. Essential Mathematics shows that the text has 20% of hard words with an index of 13.0. This indicates that the text has some elements of difficulty when reading the text. For Comprehensive Mathematics, the percentage of hard words in the text is 8%. Average sentence length is 20, with the Gunning Fog Index of 11.2. The index scores show that the students read comprehensive mathematics textbook at an ideal level.

Research Question 2: To what extent do the three approved mathematics textbooks cover the content in the scheme of work for the SSS 3 students in Akwa-Ibom State?

Table 2: The Index of Content Coverage of the three Approved Mathematics Textbooks

Title of Textbook	No of topics in the syllabus covered by the text Tt	No of topic in the syllabus Ts	No of subtopics in the syllabus covered by the text St_1	no of subtopics in the syllabus St_2	Topic coverage Index TCI
New General Mathematics	15	22	25	38	0.67
Essential Mathematics	20	22	19	38	0.65
Comprehensive Mathematics	22	22	30	38	0.87

From the formula, when a text has an index of 1 it means the text covers all the topics and subtopics in the syllabus. It has been observed from the table that out of 22 topics that are in the syllabus, New General Mathematics covers 15. The syllabus contains 38 subtopics and the text covers 25, with an index topical coverage of 0.67. This shows that the text covers some topics in the syllabus and not all the topics. For Essential Mathematics, the table shows the number topics and subtopics in the syllabus. The topics in the syllabus are 22, and the text covers 20 topics. The subtopics in the syllabus are 38 and the text covers 19 out of 38. The content coverage index is 0.65. This means that Essential mathematics covers more topics in the syllabus than New General Mathematics, but the subtopics were not well covered. For Comprehensive Mathematics the data presented in the table shows that the topics in the syllabus is 22. The number of topics in the syllabus covered by the textbook is 22. The number of subtopics in the syllabus in 38 and the textbook covers 30 subtopics. The topical coverage index is 0.87. This implies that most of the topics and subtopics in the syllabus were duly covered in the comprehensive mathematics.

Hypothesis 1: There is no significant difference in the reading level between the three approved mathematics textbooks for SSS3 in Akwa-Ibom State.

Table 3: Analysis of Variance (ANOVA) of the reading levels of the three Approved Mathematics Textbooks

Source of Variation	Sum of Squares	Df	Means Squares	F-cal	F-crit
Between group	147.88	2	73.94	6.74	5.01
Within group	625.05	57	10.97		
Total	772.93	59			

Significance at 0.056 alpha level

The result in table 3 shows that there is a significant difference between the three approved mathematics textbooks. The calculated F-value is 6.74 while the critical F-value is 5.01 with degrees of freedom of 2 and 57 respectively. Since, the calculated F-value of 6.74 is greater than the critical F-value of 5.01, the null hypothesis is rejected and the alternate accepted. Since the null hypothesis is rejected, a Scheffe test was carried out to find out the difference in the reading level of the three mathematics textbooks.

Table 4: Summary of Scheffe multiple Comparison of the reading levels of the here approved Mathematics Textbooks

Text Compared	F-Value	Result
N.G.M and Ess. M.	1.2	Not significant
N.G.M and Compr. M.	6.25	Significant
Ess. M and Compr M	5.20	Significant

The values in table 4 revealed the difference in the reading level of the three approved mathematics textbooks when compared with each other. The F-value for N.G.M and Ess M is 1.23, for N.G.M and Compr. M is 6.25 and the value for Ess M. and Compr. M is 5.70. This implies that the readability value for N.G.M and Ess. M is not statistically different from each other while readability value for N.G.M and Compr. M; Ess. M and Compr. M is statistically different from each other.

Hypothesis 2: The content coverage in the three approved mathematics textbooks for SSS3 in Akwa-Ibom State does not significantly differ.

Table 5: Summary of linear chi-square for topic coverage of the approved Mathematics textbooks for SSS 3

	N.G.M	Ess. M	Compr M	Total	Cal X^2	Crit. X^2
Observed scores	15	20	22	57		
Expected scores	19	19	19	57	1.37	5.99

Significant level 0.05

Table 5 shows that the calculated x^2 value is 1.37 while the critical x^2 value is 5.99 with degree of freedom of 2. Since, the calculated x^2 value of 1.37 is less than the critical x^2 value of 5.99, the null hypothesis is retained. This implied that there is no significant difference in the topic coverage between the three approved mathematics textbooks.

DISCUSSION OF FINDINGS

The findings of the three approved mathematics textbooks using Gunning Fog Index indicate that Essential Mathematics is the most difficult to read and understand by the students with an index of 13.0. The reading level for New General Mathematics is the best in terms of reading ease and understanding following by comprehensive mathematics with index of 11.2. These two textbooks have short sentences. That is few words with lesser syllables showing that they are comprehensible. The finding is consistent with Anugwo (2011) who found out that all the mathematics textbooks used for her study were comprehensible, rated Mathematics Association of Nigeria (MAN) as the best followed by New General Mathematics (NGM) and lastly Sureway Mathematics Text.

Also the finding of the study revealed that the three approved mathematic textbooks had enough content coverage. The topical coverage index was 0.67 for New General Mathematics, 0.65 for Essential Mathematics and 0.87 for Comprehensive Mathematics. This indicates that comprehensive mathematics had greater topical coverage than new general and essential mathematics. Topic coverage of any textbook measures both the number of topics and subtopics covered by the textbook in line with the topics in the scheme or syllabus. Iwuchukwu (2001), evaluated the topical content and study questions of English language textbooks and found that one of the textbooks had adequate topical coverage of the English language syllabus for JSS 3.

CONCLUSION

The study investigated the reading level of the three approved mathematics textbooks in Akwa-Ibom State and compares their topical coverage with that of the syllabus. Given the major findings of the study, it was concluded that one of the three textbooks (Essential Mathematics) is more difficult to the students at the secondary school level to read and understand. Which means the text contains more hard words. Also, comprehensive mathematics has the highest topic coverage in the syllabus, except for few additions in New General Mathematics that has more of the subtopics.

Recommendations

Based on the findings of the study, it was recommended that:

1. The approval of textbooks by the Ministry of education should be based on their reading ease and comprehension. Hence any textbook with very high content coverage is useless when it is not readable to the targeted users (Iwuagwu, 2019).
2. The authors of textbooks should always use words that are at the reading level of the students. According to Kelly (1997) the quality of any textbook depends mostly to the degree of its readability and content coverage.

3. The contents of the subject matter in any textbook should be in line with the content in the curriculum or scheme of work.
4. Textbooks should be properly evaluated by experts in measurement and evaluation before being approved for students use.

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