

READABILITY OF SOME TOPICS IN SELECT CURRENT ORDINARY LEVEL CHEMISTRY TEXTBOOKS AND NIGERIAN STUDENTS' PERCEPTION ABOUT DIFFICULTY OF THE TOPICS

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ABSTRACT

The purpose of the study was to determine the readability of some topics in chemistry and to find out the perception of students about the topics. One hundred and forty-five year 3 senior secondary chemistry students in a university demonstration school who have just concluded their SSCE for 2014/2015 constituted the study sample. These students have also read the five commonly used chemistry textbooks investigated in the study. Flesch readability formula was used to assess the readability of the chemistry topics while a perception rating scale was used to determine the students' perception of the chemistry topics. Overall findings of the study revealed that readability indices ranging between 51.2 and 87.0 indicated that the topics were readable by 7th to 12th grade students in the selected chemistry books. It was also observed in the study that over 50% of the students perceived rates of chemical reaction and acids, bases and salts difficult to learn. In all there was no significant relationship between the readability score and the difficult indices of the topics chosen from the commonly read textbooks in the schools. These findings and their implications were discussed in the study. [*African Journal of Chemical Education—AJCE* 8(2), July 2018]

INTRODUCTION

Despite all the attempts made by good chemistry teachers to improve the performance of their students, chemical educators keep reporting that students' performance in chemistry is dwindling [1][2][3]. According to the Chief Examiners' Report [4] for November/December 2013 chemistry examination, the raw mean score of 29 and standard deviation of 12.69 poorer than that of November/December, 2012 results with a raw mean score of 34 and standard deviation of 17.29 was obtained. Till date students' results in both internal and external examinations in chemistry have followed the same trend.

Chief Examiners [4] have continuously complained about students' non-adherence to instructions, poor expression and presentation of facts, poor mathematical skills, inability to use appropriate technical terms in definition and explanation of concepts and inability to interpret the demands of the questions to mention a few.

Blames have gone to chemistry teachers' methods and strategies as regards the poor performance of the students. It is believed that the students have problems with the learning of chemical concepts, theories and principles. Of recent, attention has shifted to the chemistry textbooks recommended by Ministry of Education for use in the secondary schools [5][6]. Some students have reported that some of the chemistry books used in Nigerian Secondary Schools are at the frustration level, difficult to understand for the students.

For example, [7] evaluated the readability by students of five chemistry textbooks, namely (i) New school chemistry for senior secondary schools' students by Osei Yaw Ababio (ii) Senior Secondary Chemistry BK3 by S.T. Bajah & Onwu, G.O.M (iii) Chemistry for senior secondary school certificate by V.I. Oyeyiola (iv) Pure chemistry for West African Schools by B.C. Oluba and (v) A New certificate chemistry by Holderness, A and Lambert, J. The findings of the study

revealed among others that out of the five chemistry textbooks only two (New school chemistry for senior secondary schools students by Osei Yaw Ababio and A new certificate chemistry 7th edition by Holderness and Lambert) attained up to 50% readability score.

One other important observation that was made in the study of [7] was that concerning the perception of the teachers about the chemistry textbooks. It was found that the teachers agreed that the textbooks were helpful to the students and therefore within the acceptance range for use as recommended by Ministry of Education. However, the teachers failed to score the books high. Having considered the teachers' perceptions about the textbooks, it would have been necessary to also probe the students' perception, not only the textbooks but the topics they learn in the textbooks. How readable are some of the chemistry topics in the textbooks? Readability of chemistry topics and students' perception about the difficulty they encounter in learning are central to the present study.

According to [9], readability is

“The sum total (including all the interactions) of all those elements within a given piece of printed material that affect the success of a group of readers..... The success is the extent to which they understand it, read it at an optimal speed, and find it interesting”

Rahma and Gunadi [6] have noted that textbooks are important resources for teachers in assisting students to learn subjects, including chemistry at school. A good reading material should be in the right level of the students' competence. If it is too difficult, the students will be easily discouraged and if it is too easy, it will make them simply bored [10].

In the past [11][12][13] studies have shown that students' perception about difficulty of topics in chemistry helped teachers' lesson delivery. Teachers applied caution in very difficult to

learn topics. Teachers have re-strategized by way of teaching and re-teaching to ensure mastery of such topics.

One question that need to be addressed is that having to do with the reconciliation between students' readability of chemistry topics and their perception about the topics. This is of interest in this study.

RESEARCH QUESTIONS AND HYPOTHESIS

The following research questions guided the study, namely,

1. What is the readability of topics in select chemistry books commonly used in Rivers State Secondary Schools?
2. What is the difficulty perceived by the students in learning the chemistry topics in the select textbooks?
3. What is the relationship between the readability indices and the difficulty indices of the chemistry topics in the select chemistry textbooks?

The following null hypothesis was stated and tested at 5% level of significance, namely, H₀₁: There is no significant relationship between the readability indices and the difficulty indices of the chemistry topics in select chemistry textbooks.

METHODOLOGY

The population of the study is all the year three SS3 Senior Secondary Students in Rivers State that use select chemistry textbooks in teaching and learning chemistry.

One hundred and forty-five (145) year 3 chemistry Senior Secondary Students in a University Demonstration School who have just concluded their SSCE for 2014/2015 session made up the

study sample. The age range of the students was 14years to 18years with mean of 15.8years and standard deviation of 2.9years. These students were conversant with chemistry topics of interest in five select chemistry textbooks commonly used by Senior Secondary Students in Rivers State. These textbooks are (1)Ababio, O.Y. (2005) New School Chemistry for Senior Secondary Schools, 3rd Ed. Nigeria, Ontisha; Africana First Publishers (2)Odesina, T.A. (2015) Essential Chemistry for Senior Secondary Schools, Tonad Publishers Ltd (3)Ezechukwu, J. (2005) Comprehensive Chemistry for Senior Secondary Schools, A. Johnson Publisher Ltd (4)Bajah, S.T. & Teibo, R.O. (2000). Senior Secondary Chemistry Book 3 Africa Plc (5) Holderness, A and Lambert, J. (1987) New Certificate Chemistry. Heinemann Educational Books.

Instruments

Two instruments were used for the study, namely,

- 1) Students' perception rating scale (SPRS), and
- 2) Readability test

SPRS was used to find out how the students perceived "how difficult" or "how easy" they learnt such topics as air pollution, chemical combination, nature of matter, energy and chemical changes, acids, bases and salts, hydrogen and its compounds, rates of chemical reaction, kinetic theory of matter and gas laws, carbon and its compounds and types of reaction.

For each topic the students were provided with a rating scale ranging from very difficult (5), difficult (4), moderate (3), easy (2), to very easy (1). In addition, students were requested to support their choice of the rating of a topic with a reason.

The readability test involved the use of a readability formula, namely Flesch in [14]

Scoring techniques of the Instruments

Students' perception rating scale (SPRS) was scored by carrying out a frequency distribution of the response labels. Each response label was scored 1 point.

Difficulty index (DI) for each topic investigated was calculated using the formula:

$$DI = \frac{\sum(VD_f + D_f)}{T_f}$$

Where VD_f = frequency distribution of "very Difficult" responses, D_f = frequency distribution of "difficult" responses, $T_f = \sum [(VD_f + D_f + M_f + E_f + VE_f)]$, M_f = frequency distribution of "moderate" responses, E_f = frequency distribution of "Easy" responses, VE_f = frequency distribution of "Very Easy" responses.

Flesch readability formula was applied in estimating the readability of the chemistry topics in the select textbooks. The Flesch Reading Ease formula:

$(RE) = 206.835 - (1.015 \times ASL) - (84.6 \times ASW)$,
 where RE = Readability ease, ASL = Average Sentence Length (ie the number of words divided by the number of sentences), ASW = Average number of syllables per word (ie the number of syllables divided by the number of words) [14].

Mean Score Ranges and Readability Interpretations

<u>%</u>	<u>Interpretation</u>
90 – 100	Very easy
80 – 89	Easy
70 – 79	Fairly easy
60 – 69	Standard
50 – 59	Fairly difficult
30 – 49	Difficult
20 – 29	Very confusing

Flesch Readability Scale

<u>Readability</u>	<u>Grade Level</u>	<u>Nigeria Context</u>
80 – 7	7 th – 8 th	JSS 1
70 – 60	9 th – 10 th	JSS 2
60 – 50	11 th – 12 th	JSS 3
50 – 40	College freshmen to juniors	SSS 1
40 – 30	College seniors	SSS 2
30 – 20	College graduates	SSS 3

Key: JSS = Junior Secondary Students, SSS = Senior Secondary Students

DATA ANALYSIS AND RESULTS

Data were analyzed and presented according to the research questions and hypothesis set in the study. Thus, the study first addressed the readability of topics in select chemistry books commonly used in Rivers State, followed by the difficulty perceived by the students in learning the topics. Finally, the relationship between the readability indices and the difficulty indices of the chemistry topics were calculated using the Pearson's product moment correlation coefficient formula (r). Results are presented in Tables 1, 2 and 3.

Table 1: Calculated Readability Indices of Five Textbooks used by Senior Secondary Students in Nigeria

S/N	Topics	Readability index of books (%)				
		1	2	3	4	5
1.	Air pollution	53.5	50.6	45.6	52.0	66.2
2.	Chemical combination	58.5	87.0	66.1	61.3	62.9
3.	Nature of matter	53.6	51.5	52.2	56.1	45.5
4.	Energy and chemical changes	58.9	54.7	53.8	56.2	53.6
5.	Acids, bases and salts	52.6	53.0	53.9	51.2	54.7
6.	Hydrogen and its compounds	52.3	56.5	51.8	53.2	55.3
7.	Rates of chemical reaction	51.2	38.1	50.0	47.1	49.4
8.	Kinetic theory of matter and gas laws	43.4	44.5	47.6	43.0	50.7
9.	Carbon and its compounds	51.8	41.8	49.3	56.4	47.0
10.	Types of reactions	42.0	46.1	48.3	40.3	45.3

Textbook CHS 1 – Ababio, O.Y. (1990) New school chemistry for senior secondary schools, 3rd Ed. Onitsha; Africana – first publishers; CHS 2 – Odesina, I. A. (2015) – Essential chemistry for senior secondary schools. Tonad Publishers Ltd; CHS 3 – Ezechukwu, J (2005) – Comprehensive chemistry for senior secondary schools, A. Johnson Publishers Ltd; CHS 4 – Bajah, S.T., & Teibo, B.O (2000) – Senior Secondary Chemistry Book 3 Africa Plc; CHS 5 – Holderness, A and Lamberts, J (1987) – New Certificate Chemistry, Heinemann Educational Books.

Table 1 revealed that the mean score, ranges of readability indices of the topics 2, 4, 5, 6 chemistry (CHS) Books 1, 2, 3, 4, and 5 were between 51.2 and 87.0 indicating that they were readable by 7th to 12th grade students.

A readability score of less than 48.3% was estimated for Topic 10 – types of reactions for all the chemistry textbooks. This shows that senior secondary students encountered difficulty in reading and understanding the content in all the textbooks.

Table 2: Difficulty Indices (DI) of the Topics in Chemistry

S/N	<u>Chemistry Topics</u>	<u>Difficulty indices (%)</u>
1.	Air pollution	27.7
2.	Chemical combination	22.5
3.	Nature of matter	35.0
4.	Energy and chemical changes	49.6
5.	Acids, bases and salts	54.4
6.	Hydrogen and its compounds	26.4
7.	Rates of chemical reaction	50.0
8.	Kinetic theory of matter and gas laws	44.5
9.	Carbon and its compounds	40.3
10.	Types of reactions	29.4

Table 2 revealed that over 50% of the students perceived topic 7 (rates of chemical reaction) and topic 5 (acids, bases and salts) difficult to learn. Less than 50% of the students perceived the remaining topics difficult to learn.

Table 3: Calculated r for readability of Books' Topics and Difficulty Indices

Readability/Difficulty of topics	r	Level of significance
CHS Book 1 x DI	- 0.083	ns
CHS Book 2 x DI	+0. 16	ns
CHS Book 3 x DI	-0.22	ns
CHS Book 4 x DI	+0.06	ns
CHS Book 5 x DI	+0.003	ns

CHS = Chemistry; ns = not significant

The relationship between the readability scores of chemistry books 1, 3 and the difficult indices as perceived by the students was negative (with $r = -0.083$ and -0.22 respectively). The relationship for books 2, 4 and 5 between readability scores and difficulty indices was positive. In all there is no significant relationship between the readability scores and the difficulty indices of the topics chosen from the commonly read textbooks in the schools.

DISCUSSION OF FINDINGS

Good textbooks are important tools in the hands of the students which to a large extent help the teacher in doing his/her work. A teacher can make the students to learn from the textbooks before, during and after the lesson delivery periods. For this to be effective, student as an independent learner must be able to read and understand what he/she is reading from the textbooks.

Once this is done, the teacher's work is made simple. If the students cannot understand what they read, then there is problem. The investigation carried out in this study in connection with the readability of chemistry topics and students' perception can be done in other disciplines or subjects offered in the schools.

The findings of this study are of general interest in learning and teaching. However, with respect to the chemistry topics and books under investigation, the topics are within the learning range of not difficult to read (Table 1). Chemistry is a science subject that present to the students' conceptual difficulties. There are abstract concepts that require some level of maturity on the part of the students. For example, type of reactions (topic 10) with readability index of less than 50% across the chemistry textbooks present some difficulty to the senior secondary three (SS3) students.

Chemical reactions involve breaking and making of bonds between, atom, molecules and ions. In chemical reactions, there are also acceptance, transfer and sharing of electrons. All these, the learner is unable to see and so difficult to concretize. Even the chemistry teachers do not have the experiences to share with the students. So teachers pass on their ignorance to the students. The textbooks writers are also as ignorant as the teachers. Information they have concerning the conceptual nature of chemical reactions is obtained from foreign or local literature. The students are left with their faith to accept what they read from the chemistry textbooks.

This seems to account for part of the difficulty students have in learning chemistry. After all, chemistry is a study of the interaction between matter. Again, topic 8 kinetic theory of matter is essential in understanding the other topics 1, 2, 3, 4, 5, 6, 7 and 9 (Table 1). They all have link with chemical reactions. We have to understand the nature of the forces between the particles in the gas, liquid and solid so as to understand why chemical reactions occur.

Textbook writers try as much as possible to simplify these chemical ideas in an attempt to help students read and understand. But students' performance in chemistry do not seem to show that students are neither understanding what they read nor benefit from teachers' instructions in the classroom and laboratory. This is further corroborated by the various levels of difficulty chemistry students perceive of the topics (Table 2). It was only in the case of acids, bases and salts (topic 5) with difficulty index of 54.4% that the students do not seem to perceive much difficulty. This could be purely because of the descriptive nature of these concepts in the textbooks at the level of the students used for the study.

One aspect of the findings of the study is the relationship between the readability indices of the chemistry topics in the selected textbooks and the students' perception about the topics. Calculated r for chemistry books 1 and 3 showed negative relationship while that of books 2, 4

and 5 revealed positive relationship. These relationships are found not to be significant at 5% level. This seems to suggest that while the students agree with the readability of the topics in some chemistry textbooks as measured by Flesch indices, they (students) do not agree with readability of the topics in other textbooks.

The implication of this findings is that, the Ministry of Education recommending chemistry textbooks for the students, should go beyond looking at the textbooks, publishers and quality of production and also consider the relevance and explicitness of the topics as related to chemistry curriculum.

In conclusion, chemistry teachers should form part of the committee that recommends textbooks for the students, since they (teachers) teach the students and they know where the “shoe is pinching” them.

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