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Qualities of Learning activities and Illustrations Provisions in the Recommended Chemistry Textbooks for Nigerian Secondary School Students

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Abstract - *This study aimed at assessing the qualities of learning activities and illustrations in Nigerian Chemistry textbooks used at the penultimate grades. Five Chemistry textbooks were purposively selected from twenty-two approved and recommended Chemistry textbooks in which evaluation research design was used involving two research questions. The 5 selected Chemistry Textbooks were the instrument for data collection. Data collected were analyzed using QACEST proforma. Results of the study revealed a number of inadequacies in the learning activities and illustrations in these textbooks. It was also observed that none of the Chemistry textbooks emphasized learner centered approach of teaching and the constructivist approach writing.*

Keywords: Learning activities and illustrations, qualities, chemistry Textbooks

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I. INTRODUCTION

Between the year 2000 and 2023 Nigeria has been craving to keep up with development goals. From the Millennium Development Goal (MDG) adopted by the United Nations in year 2000 to 2015, to the Sustainable Development Goal (SDG) adopted in 2015, expected to be actualized in all member nations in 2030.With the goals in mind, Nigeria has laid much emphasis on science, technological, entrepreneurship development and productivity in schools at different levels. The emphasis notwithstanding, little has been achieved in Nigeria in this regard in view of the fact that there is still much poverty and hunger in the country, no good health and good health facilities, no good industries, innovation and infrastructure and most unfortunately, the quality of education appear to be going down. While reporting that the delays in progress and gap is universal due to COVID-19 pandemic, the status of SDG targets for Nigeria (% trend indicators) shows a higher percentage of limited progress and worsening situation and very low percentage on achieved or on track (SDG Implementation Progress Report,2023)

Nigeria cannot achieve the SDG goals without a sound education system. Sound education implies giving the citizens a strong foundation of knowledge and skills that can impart their lives and that of others. This could be possible if Nigeria can invest more in the education sector with more emphasis on science education which is the process of sharing science content with individuals through teaching. Science content is the hall mark of development and the process of achieving the SDG goals. Over the years the teaching and learning of science has been problematic in Nigeria due to poor funding of Science Schools, lack of quality teaching materials and manpower among others. The principal and key teaching materials used in the teaching of science that should be properly funded and maintained is the Science laboratory and the Science textbooks. Textbook powers the laboratory work and imparts the students acknowledge, acquisition of skills and shapes their performances in all disciplines of learning. As an indispensable tool in teaching and learning, textbook is an essential part of Chemistry laboratory activities with regards to the practical guide. Chemistry with all its purported abstractness, is a central science subject that is linked to all the fields of life, science and technology, thus can lead to producing experts in these fields of study required to bring Nigeria to the level of on-the-track in achieving the SDG goals. Its importance in the Nation's Agro-industrial, economic as well as other technological and medical development cannot be overemphasized. Hence it is linked to the understanding of all the science subjects including but not limited to Agricultural science, biological sciences, Physical sciences, Health sciences, Engineering among others. In view of this, the understanding of the basic chemistry contents at the foundational level of education is very vital to a developing nation like Nigeria.

Understanding the concepts of chemistry hinges on the quality of teaching and quality of teaching materials such as textbooks. The usefulness of a textbook as a good teaching material is dependent on the extent to which a textbook provides for such activities that would require the active involvement of the learner or reader in the learning activities. This is important because, it is the primary way to allow the students interact with the materials and experience the contents in concrete terms, enhances the memory level thus making learning more permanent. It also makes the body of knowledge more real and encourages creativity, knowledge construction, retention and skill acquisition (Lemon, 2011). A Chemistry textbook that does not have enough learning activities, is only informational. Hence, the need to make learning activity one of the most important elements in textbook writing.

Research reveals that a number of Chemistry textbooks are informational only dishing out information to the passive learners. Uğur and Fitnat, (2008) asserts that a good number of Chemistry textbooks are still teacher-centered as against learner-centered. Teacher-centered imply that the contents of most of the textbooks contain information which a learner cannot use to discover scientific facts without being taught by a teacher. Students use such textbooks in class, only when they must have been taught by their teacher. Learner-centered implies that the teacher should actually take the role of facilitator or coordinator while the students are at the center of the learning process constructing knowledge from the learning activities and illustrations in the textbook. The restructured Chemistry curriculum of 2009 is prepared and presented in a practical oriented way, which places emphasis on the activity of the pupils and guided discovery approach.

This approach is recommended to ensure that a learner is at the center in the teaching and learning process so that permanency of knowledge and skill acquisition is assured. The practically oriented contents of the curriculum are expected to be reflected as such in every Chemistry textbook. Olufunmilayo, (2018) precisely observed that, most concepts planned in the restructured curriculum are not properly arranged in the textbooks, as such throw the teachers and the students into a frustrating situation while trying to match what is in their textbook with what is in the curriculum. This heightens the difficulty level of the content of such textbooks. The need to ensure the selection and use of textbooks that reflects the content of the curriculum; in terms of learning activities and good illustrations that can get the students involved in knowledge construction necessitates the need for this exposition. The knowledge from the result of the exposition is expected to lead to decisions that will shape the quality of the textbooks based on the areas of good leaning activities and illustrations giving that, many of these textbooks are marketed with claims of comprehensiveness and efficiency by their authors and publishers yet they contain a lot of inadequacies. This study analyzed the qualities of learning activities and illustrations provisions in the recommended chemistry textbooks for Nigerian secondary school students. The study solved the following research questions:

1. What is the learning activity index (LAI) of each of the senior secondary school Chemistry textbooks used?
2. What is the illustration index (ILI) of each of the senior secondary school chemistry textbook used?

II. METHODS

Evaluation research design was employed in this study. The design was most appropriate for the assessment of the quality of learning activities and illustrations in Chemistry

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textbooks since the study involves collecting information used in analyzing the textbooks. The study was carried out in Nigeria. The population for this study consisted of 22 approved Chemistry textbooks for the teaching and learning of Chemistry in Nigeria Secondary Schools. The sample size of 5 out of the 22 approved Chemistry textbooks for the teaching and learning of Chemistry in Nigerian Secondary schools was used for this study. Purposive sampling technique was used to draw 5 most prescribed Chemistry textbooks from the list of approved textbooks for the teaching and learning of Chemistry in Nigerian Secondary Schools. These 5 include; New school chemistry by Osei Yaw Ababio, the 16th edition (Book A), Macmillan Chemistry for Senior Secondary Schools by A. A. Demehin, P.C. Onianwu, P. A. Oshinyemi, et al, New edition (Book B). Understanding Chemistry for Schools and Colleges by Godwin Ojukwu, Second Revised edition (Book C). Senior Secondary Schools Chemistry by S, T. Bajah, B. O. Teibo, G. Onwu, A. Obikwere; 3rd edition (Book D). Comprehensive Certificate Chemistry by G. N. C. Ohia, G. I. Amasiatu, J. O. Ajagbe, G. O. Ojukwu and U. Mohammed, 2nd edition (Book E). The Quantitative Approach to Content Evaluation of Science Textbooks (QACEST) was used to measure the learning activities and illustrations of the sampled textbooks. This was done entirely by the researcher book by book using the prescribed QACEST proformer by Nworgu, (2001).

III. RESULTS

Table 1a presents the percentage of learning activities in each of the textbooks. The figures in the table shows that, the percentage of the learning activities that require the reader to perform some kind of activities in the New school chemistry by Osei Yaw Ababio, the 16th edition, is 19.05% while the Macmillan Chemistry for Senior Secondary Schools by Demehin, et al, New edition is 20.89%. Understanding Chemistry for Schools and Colleges by Godwin Ojukwu, Second Revised edition, is 27.92% and Senior Secondary Schools Chemistry by Bajah, et al; current edition, is 24.04%. Comprehensive Certificate Chemistry by Ohia, et al, 2nd edition,

is 24.16%. Whereas the percentage of activities in the textbooks that do not require the learner to carry out any activity is 80.94%,64.53%,72.07%,75.83% and 75.83% respectively for Ababio, Demehin, Ojukwu, Bajah and Ohia.

Table 1b presents the mean scores of learning activity index of five Chemistry textbooks used in teaching and learning of Chemistry in Enugu State Secondary Schools. The table shows that, the New school chemistry by Osei Yaw Ababio, the 16th edition, has a mean learning activity index of -0.618, Macmillan Chemistry for Senior Secondary Schools by Demehin, et al, New edition has a mean learning activity index of -0.510 while, Understanding Chemistry for Schools and Colleges by Godwin Ojukwu, Second Revised edition, has a mean index of -0.441,whereas the Senior Secondary Schools Chemistry by Bajah, et al, current edition, has a mean learning activity index of -0.630 and the Comprehensive Certificate Chemistry by Ohia, et al, 2nd edition, has a mean learning activity index of -0516 respectively. The interpretation of these figures is that, the current Chemistry textbook written by Bajah has lower mean learning activity index than the others, which means it does not contain as much activities that engage the learners as the others, activities that can make the learner to participate actively in the learning processes. Followed by Ababio (Book A), then Comprehensive Certificate Chemistry written by Ohia & others, then, the Macmillian Chemistry by Demehin. Understanding Chemistry by Ojukwu records the highest mean learning activities, with mean learning activity index of -0.441. Normal range for the Learning Activities is from -1.00 to +1.00. When there is no provision in the text for the learner to perform some kind of activity, the value becomes -1 which is the minimum value of LAI index. But when the text provides opportunity for the learner to perform some kind of activity, the value becomes +1 as the LAI index. The above results indicate inadequate learning activities in all the five textbooks, since none of them measured up to +1.

Table 1a
Percentage of learning activities covered by each textbook

Learning Activity Index (LAI)	Book A ABABIO	Book B MACM	Book C UNDER	Book D BAJAH	Book E COMP
Number of sentences requiring the reader to perform some kind of activity (A)	222 (19.05%)	258 (20.89%)	270 (27.92%)	209 (24.04%)	261 (24.16%)
Number of sentences which do not require the reader to perform any kind of activity (P)	943 (80.94%)	797 (64.53%)	697 (72.07%)	656 (75.83%)	819 (75.83%)
Total	1,165	1,235	967	865	1,080

Table 1b
Mean Score of the Chemistry textbooks as measured by the Learning Activity Index.

Textbooks	Book A ABABIO	Book B MACM	Book C UNDER	Book D BAJAH	Book E COMP

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Learning activity Index	-0.618	-0.510	-0.441	-0.630	-0.516

Table 2a presents the percentage of the illustrations used in each of the textbooks. The figures in the table shows the percentage of illustration requiring the learner to perform some activity other than viewing. The New school chemistry by Osei Yaw Ababio, the 16th edition, records 15.00% while the Macmillan Chemistry for Senior Secondary Schools by Demehin, et al, New edition has 27.77%. Understanding Chemistry for Schools and Colleges by Godwin Ojukwu, Second Revised edition, as 9.83% Senior Secondary Schools Chemistry by Bajah, et al, current edition as 21.11%. Comprehensive Certificate Chemistry by Ohia, et al, 2[nd]edition, has 18.00%. Whereas the percentage of illustrations in the textbooks that do not demand the learner performing any activity other than viewing is 85.00%, 72.22%, 90.16%, 78.88% and 82.00% respectively for Ababio, Demehin, Ojukwu, Bajah and Ohia.

Table 2b presents the mean scores of the illustration index of five Chemistry textbooks used in teaching and learning of Chemistry in Enugu State Secondary Schools. The table shows that, the New school chemistry by Osei Yaw Ababio, the 16th edition, has illustration index of -0.70, while the Macmillan

Chemistry for Senior Secondary Schools by Demehin, et al, New edition has an illustration index of -0.44. Understanding Chemistry for Schools and Colleges by Godwin Ojukwu, Second Revised edition, has an illustration index of -0.80, the Senior Secondary Schools Chemistry by Bajah, et al, current edition, has an illustration index of -0.57 and Comprehensive Certificate Chemistry by Ohia, et al, -0.64 respectively. The interpretation of these figures is that, the Macmillian Chemistry by Demehin and the current Chemistry textbook written by Bajah has better illustrations than the others, followed by Comprehensive Certificate Chemistry written by Ohia, Bajah and Ojukwu in that order. Generally, from this result these textbooks do not have adequate illustrations. Hence when all illustrations in the text are activity oriented, the index has a maximum value of + 1.00, but when none of the illustrations is activity oriented, the activity index has a minimum value of – 1.00. A balance between the two types of illustrations attracts an index value of zero. The above results indicate inadequacy in the illustrations in all the five textbooks, since none of them measured up to +1.

Table 2a
Percentage of Illustrations as covered by each textbook

Illustration Index (ILI)	Book A ABABIO	Book B MACM	Book C UNDER	Book D BAHAH	Book E COMP
Number of illustrations requiring the learner to perform some activity other than viewing (La)	15 (15.00%)	25 (27.77%)	6 (9.83%)	19 (21.11%)	9 (18.00%)
Number of illustrations which do not demand the learner to perform any activity except viewing (Lb)	85 (85.00%)	65 (72.22%)	55 (90.16%)	71 (78.88%)	41 (82.00%)
Total	**100**	**90**	**61**	**90**	**50**

Table 2b
Mean Score of the Chemistry textbooks as measured by the Illustration Index.

Textbooks	Book A ABABIO	Book B MACM	Book C UNDER	Book D BAJAH	Book E COMP
Illustration Index	-0.70	-0.44	-0.80	-0.57	-0.64

IV. DISCUSSION

The findings from this study indicate inadequate learning activities in all the five Chemistry textbooks. None of them contain to a large extent activity that engages the learners to participate actively in the learning processes. The index of the number of sentences requiring the reader to perform some kind of activity in Ababio (Book A) and Bajah, (Book D) is far less than that of Ojukwu (Book C), Macmillan (Book B) and Comprehensive (Book E). The bench mark is that when there is

no provision in the text for the learner to perform some kind of activity; the value becomes -1 which is the minimum value of LAI index. But when the text provides opportunity for the learner to perform some kind of activity, the value becomes +1, as the maximum LAI index. Although none of the five Chemistry textbooks measure up to the bench mark, Understanding Chemistry by Ojukwu (Book C) records minimally, the highest mean learning activity index than all the other four Chemistry textbooks, the text provides opportunity

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for the learner to perform some kind of activity in some of the chapters of the book. The inadequacy in learning activities in all the five textbooks implies that, on this basis they are not fit to be recommended for use. According to Knight (2015), for proper knowledge construction and knowledge transfer, Chemistry textbooks must contain enough learning activities to make it inquiry based. The primary way to allow the students interact with the materials and experience the contents in concrete terms is through providing enough learning activities. It also makes the body of knowledge more real and encourages creativity. A Chemistry textbook that does not have enough learning activities, is only informational. Thus, not in allignment with the new Nigerian chemistry curriculum which provides the learner with continuous experiences in observation and critical thinking, skills acquisition, problem solving abilities, collecting and analyzing data, testing and evaluating situation, manipulating variables, generalizing and applying generalization.

On textbook illustrations, the findings indicate inadequacy in the illustrations in all the five textbooks, since none of them measured up to the bench mark. The findings show that the index of the number of illustrations that does not require the learner to perform some activities other than viewing in all the five textbooks is more than that which require the learner to think and participate in the learning process. The Macmillian Chemistry by Demehin (Book B) and the current Chemistry textbook written by Bajah (Book D) though, has a little better illustration than Comprehensive Certificate Chemistry written by G. N. C. Ohia (Book E), Ababio (Book A) and Ojukwu (Book C) in that order. These textbooks cannot be recommended on the basis of their learning activities because they are inadequate. Greater part of the illustrations in the textbooks does not demand the learner to perform any activity except viewing. Textbook illustration is also one of the most important elements in knowledge construction and retention, therefore, its adequacy is paramount before a Chemistry textbook is selected for use. Thus, Lemon, (2011) affirms that textbook illustrations and learning activities makes the body of knowledge more real and encourages creativity and knowledge construction, maintaining that the primary way to allow the students interact with the materials and experience the contents in concrete terms, is through enough learning activities, which enhances the memory level and makes learning more permanent. The dependence of teachers and students on textbooks suggests that illustrations and learning activities should of major emphasis during textbook construction and writing so that the learner while using them can think, ask questions, discover facts by themselves and draw conclusions.

These Chemistry textbooks still conflict with this notion that students should acquire their own knowledge. In other words, Chemistry textbooks still conflict with constructivists' view of learning which is advocated in the new teaching pedagogy and in the curriculum, in which case, the constructivist learner has a more important role in the learning process. With enough illustrations to embellish the contents of a textbook, the learning process is shifted from teacher-centered to student centered model, so that the teachers should actually take the role of facilitator or coordinator. This could be possible if a Chemistry textbook has adequate illustrations and learning

activities. None of the five sampled Chemistry textbooks used in Nigerian Secondary schools have the constructivist model of textbook as advocated by Uğur and Fitnat,(2008) which takes the form of conceptual change model that enables the students to replace misconceptions with scientifically excepted ideas, historical episodes which enables the students to replace scientific jargon with a narrative structure to guide students in asking questions and analogy which helps to explain abstract concepts with concrete examples to the learners.None of them contain to large extent activities that engages the learners to participate actively in the learning processes. In other words, the amount of activities in all the five chemistry textbooks is below average. Thus, the textbooks are not activity oriented, therefore none of them completely align with the newly restructured Nigerian chemistry curriculum which is inquiry based, practically and activity oriented.

V. CONCLUSIONS

The entire five Chemistry textbook has inadequate illustrations; a greater percentage of the illustrations are merely for viewing which does not encourage active participation of the learner while reading the texts. In order for the learner to construct learning, the illustrations must also be engaging. On the basis of the fact that illustration can hold the attention of the student to the extent that the student can begin to comprehend the content without the help of a teacher, these textbooks are not suitable for use without upgrade, since there are not adequate illustrations. Chemistry textbooks should be accompanied with supporting materials such as; work books. The purpose is to get the students fully engaged while reading the textbooks, or accompanied with CDs and cassettes. This, perhaps will assist the learners in understanding the contents of those textbooks without much learning activities and illustrations.

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