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Evaluation of basic science textbooks used at universal basic education (UBE) schools in Benue state, Nigeria

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Article Info

Abstract

This study evaluated the Basic Science textbooks used at Universal Basic Education Schools in Benue State, Nigeria using naturalistic evaluation design. The purpose of the study was to ascertain if the content coverage, learning activities, chapter summaries and study questions are consistent the prescribed core curriculum for teaching Basic Science. Four research questions guided the study. The seven approved Basic Science textbooks were use d for the study. 81 Basic Science teachers from one Local Government each representing two Education Zones in Benue State were purposively sampled for the study. The instrument used for data collection was the 8-point evaluation model, an update of Quantitative Approach to Content Evaluation of Science Textbooks (QACEST). The 8-point model was used to answer research questions. The results of the findings showed that: on topical coverage, Effective Basic Science textbook had the highest topical coverage index of 0.90 while Basic Science textbook had the lowest topical coverage index of 0.79. In terms of learning activities, Basic Science textbook had the highest learning activity index of 0.70 while Fundamentals of Basic Science had the lowest learning activity index of 0.52. On chapter summaries, Fundamentals of Basic Science had the highest chapter summary index of 0.88 while Effective Basic Science had the lowest chapter summary index of 0.60. On study questions, Classical Basic Science had the highest study question index of 0.69 while Fundamentals of Basic Science had the lowest study question index of 0.61. Based on the findings, it was recommended among others that there should be periodic evaluation Basic Science textbooks to ensure that the best textbooks are approved and used for teaching and learning of the subject considering the fact Basic Science is the foundational science subject that determines the success or failure of future scientific studies in Nigeria.

Keywords: Evaluation, Basic Science, Textbooks and UBE Schools

Introduction

Science has been conceived variously by different people. It is a discipline that discovers new knowledge through observation, measurement, experimentation and drawing of inferences based on empirical data (Ode, Akpoghol, & Aondover, 2020) [13, 14]. Science therefore is the scientific process of discovering knowledge through a systematic process that is experimental, verifiable and confirmable. That suggests science has a logical step-wise process to be followed and it is experimental in nature. Developed nations today based their strength on scientific and technological advancement as seen in the demonstration of computer skills, security, innovations in manufacturing, use of nuclear weapons and advance agricultural practices as the list is endless. It is also noteworthy that advancement in knowledge of science has led to improved health, housing, agriculture, energy, environment, urbanization and global climate change.

The benefits of scientific literacy account for why nations all over the world accord science teaching and learning at all levels of education (Ode & Eriba, 2020) [15]. The pressure from Nigerian nationals who had opportunity to study abroad persuaded the

Colonial masters to establish post-secondary institutions marking the beginning of modern science teaching as science teachers were then trained. Further curricular reforms led to the change of general science to integrated science and after the National Council on Education (NCE) curricular review and restructuring from September 2007, Basic Science and Technology curriculum replaced that of Integrated Science.

The 2011 review of the National Council on Education (NCE) directed by the Nigerian Educational Research and Development Council (NERDC) discovered that the scientific, vocational and technological aspects of education were not effectively implemented in the school system. This led to the decision by the federal government of Nigeria to introduce the 9-year of basic education so as to attain the Millennium Development Goals (MDGs) by the year 2015 along with the need to meet the critical target for the National Economic Empowerment and Development Strategies (Arokoyu, 2013) [4]. In addition, it became necessary for the existing curriculum for the upper basic level to be reviewed, restructured and realigned to fit into the 9-year basic education programme (Chukwuneke & Chinkwenze 2012 as cited in Agbidye 2015) [1]. A major outcome of that review is the change in nomenclature and content of the subject from Basic Science without elements of technology to Basic Science and Technology (Ukor, 2019) [21]. The objectives of the subject were to help students: observe and explore the environment; develop basic science process skills including observing, classifying, experimenting and manipulating as well as acquiring scientific attitudes like curiosity, honesty, perseverance, willingness to change, opinion and critical reflection, self - confidence and self-reliance through problem - solving activities in science. It is also geared towards laying a good foundation for the learning of science in the future, and the ability to apply the knowledge and skills gained in science to solving everyday problems (FME, 2014). In Nigeria, Basic Science and Technology is the foremost science subject that furnishes the child with the scientific and technological knowledge and skills that serve as veritable ingredients for developing students' scientific literacy and providing solid ground for subsequent scientific and technological studies related to fields such as engineering, medical and allied science as well as other science-based disciplines. Basic Science and Technology is a science subject that presents science in a unified or holistic form with the intent of building scientifically literate and technologically skillful citizens that can rationalize and engage scientific skills and attitudes in solving everyday life problems (Ode & Eriba, 2020) [15]. Basic Science and Technology occupies a significant position in Nigeria education system at the basic level since it is the first science subject a child is exposed to. Consequently, the need for effective teaching of the subject using appropriate curriculum to ensure a sound foundation in science for the achievement of expected scientific and technological advancement becomes pertinent.

The nature of the curriculum prescribed for the teaching of science at the upper basic level according to the National Policy on Education (FGN, 2014) should be Basic Science and Technology encompassing the following subjects; Basic Science, Basic Technology, Information Technology and Physical Health Education. This was expected to meet the needs of the Nigerian child through the relevance and functionality of its contents, method, processes and application. (Ukor & Agbidye, 2015) [20] maintained that the overall objectives of the curriculum re-alignment and restructuring in line with the UBE general objectives were to enable the learners to: develop interest in science and technology, acquire basic knowledge and skills in science and technology, apply their scientific and technological knowledge and skills to meet societal needs, take advantage of the numerous career opportunities offered by Basic Science and Technology, including being prepared for further studies in science and technology. To achieve these objectives, the use of the model for evaluation of science textbooks with the following indices: Topical Coverage Index (TCI), Learning Activity Index (LAI), Study Question Index (SQl) and Chapter Summary Index (CSI) becomes necessary as the approved Basic Science and Technology textbooks are written by varied authors.

Basic Science textbooks are vital instructional materials that provide a holistic presentation of science and technology contents as well as science process skills to learners. These skills include scientific enquiry, identification of questions, carrying out assignments and carrying out experiments among others. Despite the importance of Basic Science and Technology to national socio-economic development, Basic Education Certificate Examination (BECE) Chief Examiners' report 2016 reported students' poor achievements in Basic Science and Technology and inconsistency in students' performance in science subjects. Though Basic Science and Technology has been of great value both to individuals and society globally, students have been performing poorly in the subject especially in Benue State (Ode & Akpoghol, 2020) [13, 14]. This poor performance might be because of defectiveness associated with the textbooks, adequacy of study questions and learning activities, readability level of textbooks, illustration index and teacher's perception of the textbooks in use in teaching Basic Science and Technology as these books are written by different authors and may not be evaluated before approval.

Evaluation is a matter of judging the fitness of something for a particular purpose. It is used to connote the process of making value judgments or taking decisions on events, objects or their characteristics. Evaluation can simply be a systematic process of determining to what extent instructional objectives has been achieved. Evaluation helps in preparing instructional objectives, assessing learner's needs, providing feedback to students, preparing programmed materials, curriculum development, reporting learners to parents and effective school administration. Evaluation of textbooks is also considered to function as a kind of educational judgment. Evaluation of textbooks can be carried out to help publisher, students, parents or an institution to make decisions in developing and selecting the right textbooks (Nworgu, 2015) [11].

Appropriateness of text book is the selection of the right textual material which must align with the curriculum aims and objectives and the age of the learners. Adequacy of study questions and learning activities is the quality of being good enough or great enough in the amount to be acceptable (Ani, 2016). Devetak and Vogrine (2015) [6] opined that the criteria for selecting an appropriate text has to do with the typical layouts including photographs, table, textboxes, flowcharts, drawings and myriad of other visual representations, study questions along with comprehensive scope and sequence for a particular course or set of courses, easily divisible into smaller sections with text that is not overly self-referential in order to enable modularity as much as possible. It should

have content accuracy without factual errors and content must be up-to-date to avoid presenting information that will make the text obsolete quickly, taking into account the subject being addressed. Should contain a variety of instructional materials including reflective questions, learning activities and other features which promote learner engagement and active learning, also the relationship between the use of the textbook and fulfilling particular learning outcomes is clearly explained and readable.

Textbooks are study aids that may or may not consist of workbook and teacher's handbook. In other words, a textbook is a book of instruction. Its primary aim is not just to impart information about a specific subject but to enable one to develop proper understanding of the subject. Textbook presentation is extremely important and it is prepared to serve a particular level of learning. It should not be comprehensive, and its presentation should be colorful and accompanied with diagrams. A good textbook takes into consideration the method of teaching and level of learning. It is revised in line with new innovations in the curriculum. Although, textbook may differ in content and presentation according to various countries terms of pictures and examples and are written by different authors (Okolo, 2018) [16]. Basic Science and Technology textbooks are instructional aids that usually consist of a number of chapters with texts of different lengths and deals with various topics. There are different themes and activities or exercises. Textbooks and their contents stand as tools for attainment of curricular objectives and for impacting knowledge and skills in learners; hence, it becomes imperative to evaluate them (Ani, 2016). Nwafor and Umoke (2016) [10] clearly states that a good text book should be readable, with adequate learning activities and study questions, good illustration and chapter summary; the content should align with the prescribed curriculum and be acceptable by teachers and the society.

Available evidence from literature shows that there is no uniformity in textbooks used by teachers in teaching Basic Science and Technology. Based on literature evidence, there is scarcity of empirical studies on evaluation of Basic Science textbooks in use in Benue State. Therefore, it becomes imperative to properly examine the approved textbooks used by teachers in teaching Basic Science and Technology in Benue State so as to determine the adequacy in content coverage, learning, chapter summary and study questions in the textbooks vis-avis the prescription of the core curriculum for the teaching of the subject. This is because; there is every tendency that some of the Basic Science and Technology textbooks in use may lack the basic qualities of a good science and technology textbook which may be in themes, topics and activity. Therefore against the backdrop of scarcity of empirical studies that have evaluated Basic Science textbooks in use in Benue State, this study evaluated Basic Science textbooks used by teachers at Universal Basic Education schools in Benue State, Nigeria.

Statement of the Problem
There is a declining trend and inconsistency in students' performance in science subjects. These may not be unconnected to the nature of Basic Science textual materials. Basic Science textbooks in use are written by varied authors with different qualities in terms of content. This poor performance might be because of defectiveness associated with the textbooks, adequacy of topical coverage, study questions, learning activities and chapter summaries of the

textbooks in use in teaching Basic Science. These attributes are capable of affecting the quality of teaching and learning Basic Science by teachers and students which could in turn affect students' performance. Despite the important place occupied by Basic Science textbooks in effective teaching and learning of the subject, there is still scarcity of literature evidence on the quality of Basic Science textbooks in Benue State. It is against this background that this study evaluated the Basic Science textbooks used at the Universal Basic Schools in Benue State.

Purpose of the Study
The general purpose of this study was to evaluate Basic Science textbooks used at the Upper Basic School level in Benue State of Nigeria. Specifically, the study sought to:
1. Determine if the contents of Basic Science textbooks in use at upper basic school level reflect the contents specified in the curriculum for Basic Science.
2. Ascertain the adequacy of the learning activities of each of the Basic Science textbooks used at upper basic school.
3. Find out the appropriateness of each of the textbooks chapter summaries.
4. Determine the adequacy of the study questions in each of the textbooks.

Research Questions
The following research questions were raised to guide the study.
1. How do the contents of Basic Science textbooks used at the Upper Basic Education schools in Benue State reflect the contents specified in the core- curriculum?
2. How adequate are the learning activities in the Basic Science textbooks used at the Upper Basic Education schools in Benue State of Nigeria?
3. How appropriate are the chapter summaries of the Basic Science textbooks used at the Upper Basic Education schools in Benue State of Nigeria?
4. How adequate are the study questions of Basic Science textbooks used at the Upper Basic Education schools in Benue State of Nigeria?

Methodology
The research design for this study was descriptive survey. The study was aimed at evaluating the Basic Science textbooks used by teachers in teaching the subject at upper basic level in Benue State of Nigeria. Specifically, this study employed the naturalistic evaluation design which according to (Wolf, 1991 as cited in Nwafor, 2014) is the act of gathering the strengths and weaknesses, merits or worth of an education innovation, materials, programmes or products. The design is vital to the study because the study involves making value judgment about Basic Science textbooks used in teaching the subject at upper basic level in Benue State. The target population for this study consists of all the seven upper Basic Science textbooks approved by the Benue State Ministry of Education (2023) and 1,307 Basic Science teachers of public schools in Benue State (State Universal Basic Education Board, 2023). All the seven approved Basic Science textbooks and 81 Basic Science teachers purposively drawn from Tarka in Zone B and Obi in Zone C schools in Benue State were used for the study.

The 8-point point Quantitative Approach for Content Evaluation of Science Textbooks (QACEST) was used for

the study. The model for evaluation of science textbooks has the following indices: Topical Coverage Index (TCI), Learning Activity Index (LAI), Study Question Index (SQl), Chapter Summary Index (CSI). The Topical Coverage Index (TCI) provides an estimate of how far the content of the Basic Science textbooks covered the prescribed syllabus. Learning Activity Index (LAI) is an estimate of the degree to which the Basic Science textbook provides activities that will ensure optimal participation of the learner. Study Question Index (SQI) estimates the extent to which the study question in Basic Science textbooks challenges the learners of Basic Science textbooks meaningfully. Chapter Summary Index (CSI) provides an estimate of the extent to which the chapter summaries promote a more permanent understanding of the content of the Basic Science book. Data were collected using the 8-point Quantitative Approach for Content Evaluation of Science Textbooks (QACEST) using Basic Science textbooks. 81 Basic Science and Technology teachers of upper basic schools were trained on how to use the 8-point quantitative approach for the evaluation of Basic Science textbooks to determine the indices of topical-coverage,

learning-activities, chapter-summaries and study-questions index. The quantitative formulae of 8-point evaluation model was used to answer the research questions.

Results
Research Question One
How do the contents of Basic Science textbooks used at the upper basic schools in Benue State reflect the contents specified in the core- curriculum?

This was obtained using $\textbf{T}.\text{C}.\text{I} = \left(\frac{T_t - S_t}{T_s - S_s}\right) \frac{1}{2}$

Where

T_t = Number of topics sufficiently covered in the curriculum/syllabus covered by the text.
T_s = Number of topics in the curriculum / syllabus.
S_t = Number of sub-topics in the curriculum / syllabus covered by the text.
S_s = Number of sub-topics in the curriculum / syllabus.

Table 1: Topical Coverage Index of Basic Science Textbooks

S/N	Textbooks	Tt	Ts	St	Ss	Index
1	Basic Science for JSS by Agbebi *et al.* (2020).	8	8	145	95	0.79
2	Basic Science for JSS by Bajah *et al.* (2015).	8	8	195	95	0.80
3	Basic Science for JSS by Opoku *et al.* (2014).	8	8	153	95	0.83
4	Classical Basic Science by Akintelure *et al.* (2020).	8	8	195	95	0.80
5	Effective Basic Science by Adewale *et al.* (2015).	8	8	164	95	0.90
6	Functional Basic Science by Onyirioha *et al.* (2015).	8	8	163	95	0.89
7	Fundamentals of Basic Science by Adebesin *et al.* (2020).	8	8	157	95	0.86

Acceptance range = 0.75 to 1.00

The result presented in Table 1 shows topical coverage index of basic science textbooks. The topical coverage index of the textbooks ranges from 0.75 to 1.00. Textbook 5 (Effective Basic Science for JSS by Adewale *et al.* (2015)) has the highest topical coverage index of 0.90 while textbook 1 (Basic Science for JSS by Agbebi *et al.* (2020)) has the lowest topical coverage index of 0.79. In ascending order, the topical coverage index of textbooks is 0.79, 0.83, 0.86, 0.80, 0.89, and 0.90. Based on the result, all textbooks are within the acceptance range.

Research Question Two
How adequate are the learning activities in the Basic Science textbooks used at the upper basic schools in Benue State of Nigeria?
This was obtained using $\text{L}.\text{A}.\text{I} = \frac{A - P}{A + P}$
Where,
A = Number of sentences requiring the learner to perform some kind of activities.
P = Number of sentences which do not require any form of activity on the part of the learners.

Table 2: Learning Activity Index of Basic Science Textbooks

S/N	Textbooks	A	P	Index
1.	Basic Science for JSS by Agbebi *et al.* (2020).	157	31	0.67
2.	Basic Science for JSS by Bajah *et al.* (2015).	141	41	0.55
3.	Basic Science for JSS by Opoku *et al.* (2014)	169	30	0.70
4.	Classical Basic Science for JSS by Akintelure *et al.* (2020).	214	39	0.69
5.	Effective Basic Science by Adewale *et al.* (2015).	212	42	0.67
6.	Functional Basic Science for JSS by Onyirioha *et al.* (2015).	159	48	0.54
7.	Fundamentals of Basic Science by Adebesin *et al.* (2020).	113	36	0.52

Acceptance Range = 0.50 to 1.00

The result presented in Table 2 shows learning activity index of Basic Science textbooks. The learning activity index of the textbooks ranges from 0.50 to 1.00. Basic Science for JSS by Opoku *et al.* (2014) has the highest learning activity index of 0.70 while Fundamentals of Basic Science has the lowest learning activity index of 0.52. In ascending order, the learning activity index of the textbooks is 0.52, 0.54, 0.55, 0.67, and 0.70. Based on the result, all seven textbooks are

within the acceptance range, implying that their learning activities cover the specification of the core- Basic Science curriculum.

Research Question Three
How appropriate are the chapter summaries of the Basic Science textbooks used at the upper basic schools in Benue State of Nigeria?

This was obtained with C.S.I. $(I_S/I_C + N_S/N_C)^{1/2}$
Where:
I_s = Number of Statements in the summary which represent major points covered in the chapter.

I_c = Number of major points covered in the chapter.
N_s = Number of Statements in the summary which represented minor points covered in the chapter.
N_c = The number of minor points covered in the chapter.

Table 3: Chapter Summaries Index (CSI) of Basic Science Textbooks.

S/N	Textbooks	I_S	I_C	N_S	N_C	Index
1.	Basic Science for JSS by Agbebi *et al.* (2020).	118	83	34	40	0.62
2.	Basic Science for JSS by Bajah *et al.* (2015).	119	81	36	41	0.64
3.	Basic Science for JSS by Opoku *et al.* (2014).	76	50	26	28	0.65
4.	Classical Basic Science by Akintelure *et al.* (2020)	82	47	15	30	0.63
5.	Effective Basic Science by Adewale *et al.* (2015).	81	46	24	42	0.60
6.	Functional Basic Science by Onyirioha *et al.* (2015).	75	41	34	41	0.66
7.	Fundamentals of Basic Science by Adebesin *et al.* (2020)	79	37	32	15	0.88

Acceptance Range =0.60 to 1.00

The result presented in Table 3 shows chapter summaries Index of Basic Science textbooks. The chapter summary index of the textbooks ranges from 0.60 to 1.00. Fundamentals of Basic Science by Adebesin *et al.* (2020) have the highest chapter summary index of 0.88 while Effective Basic Science has the lowest chapter summary index of 0.60. In ascending order, the chapter summary index of the textbooks is 0.60, 0.62, 0.63, 0.64, 0.65, 0.66 and 0.88. Based on the result, all textbooks are within the acceptance range, implying that their learning activities cover the specification of the core- Basic Science curriculum.

Research Question Four
How adequate are the study questions of Basic Science textbooks used at the upper basic schools in Benue State of Nigeria?
This was obtained with S.Q.I = (T-R)/(T+R)
Where;
T = Total number of questions requiring students to engage in real thinking.
R = Total number of questions requiring students to merely regurgitate what had been learned from the textbook.

Table 4: Study Question Index (SQI) of Basic Science Textbooks

S/N	Textbooks	T	R	Index
1.	Basic Science for JSS by Agbebi *et al.* (2020).	80	17	0.65
2.	Basic Science for JSS by Bajah *et al.* (2015).	91	20	0.64
3.	Basic Science for JSS by Opoku *et al.* (2014).	83	18	0.64
4.	Classical Basic Science for JSS by Akintelure *et al.* (2020).	86	16	0.69
5.	Effective Basic Science by Adewale *et al.* (2015).	90	19	0.65
6.	Functional Basic Science for JSS by Onyirioha *et al.* (2015).	79	16	0.66
7.	Fundamentals of Basic Science by Adebesin *et al.* (2020).	94	23	0.6

Acceptance Range = 0.25 to 1.00

The result presented in Table 4 shows study question Index of Basic Science textbooks. The study question index of the textbooks ranges from 0.25 to 1.00. Classical Basic for JSS by Akintelure *et al.* (2020) has the highest study question index of 0.69 while Fundamentals of Basic Science by Adebesin *et al.* (2020) has the lowest study question index of 0.61. In ascending order, the study question index of the textbooks is 0.61, 0.64, 0.65, 0.66, and 0.69. Based on the result, all textbooks are within the acceptance range, implying that their learning activities cover the specification of the core- Basic Science curriculum.

Discussion of Findings
The index of topical coverage of the seven Basic Science textbooks is highly in line with the core curriculum which could be that the authors consulted the core-curriculum before the textbooks were written. This is in conformity with the studies conducted by Nwafor and Umoke, (2016) [10] who evaluated Basic Science and Technology textbooks and reported that index of topical coverage (ITC) were high. However, the finding varies from that of Omebe and Nnachi (2014) [17] who evaluated topical coverage and chapter summary of 12 Basic Science and Technology textbooks and found nine out of the 12 textbooks had inadequate topical coverage. The variation in the findings could be as a result

the different textbooks used for the study.
The result also shows that learning activity indices of the seven Basic Science textbooks are very adequate. This result of the finding is in agreement with the study carried out by Nwafor (2014) [9] who evaluated the content and adequacy of primary science textbooks in public primary schools in Ebonyi State revealed that the learning activities where adequate. Uchechukwu (2022) [18] on the other hand determines the adequacy of the content and readability of recommended Agriculture textbooks for upper basic education in Enugu State and the textbooks were discovered to be inadequate in learning activities, illustration, chapter summary and study questions.
The findings of this study also reveals that all seven textbook evaluated have high indices of chapter summaries. The finding agrees with that of of Ugama, Nnachi, Anugwo and Okpara (2020) [19] who evaluated the content coverage, chapter summaries and readability index of twelve approved mathematics textbooks in Ebonyi State Junior Secondary Schools and reported that eight out of the twelve mathematics textbooks evaluated had chapter summaries. However, the finding disagrees with that of Uchechukwu (2022) [18] who found the recommended Agriculture textbooks for upper basic education in Enugu State to be inadequate in chapter summary. The disagreement of the findings could be because

the studies were carried out on textbooks in subjects.

Another finding in this study indicate that all seven Basic Science textbooks used in this study contained adequate study questions. This is in agreement with Chukwuneye, Ihekwaba and Akani (2018) [8] who found that the Physics textbooks had adequate study questions in Imo State. However, the finding is inconsistent with that of Ebere (2018) [7] who found none of the books provided a balance of higher and lower order questions in River State.

Conclusion

Based the results of the study, the contents of all seven Basic Science textbooks evaluated appropriately reflected the specified content in the core-curriculum. The learning activities, chapter summaries and were appropriate. The Basic Science textbooks also reflect adequate study questions.

Recommendations

Based on the findings, it is recommended that:

1. There should be periodic evaluation Basic Science textbooks to ensure that the best textbooks are approved and used for teaching and learning of the subject considering the fact the Basic Science is the foundational science subject that determines the success or failure of future scientific studies

2. The Benue State Ministry of Education should set out a committee of experts including curriculum planners who will oversee and approved the Basic Science textbooks to be used and a monitoring team to check and enforce compliance by schools.

3. The Benue State government should intervene by liaising with the publishers of these approved Basic Science textbooks and subsidize them for the universal basic education schools in the State for uniform curricula instruction.

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