Content Validation of Basic Education Certificate Examination Questions in Basic Science in Adamawa State, Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author MAB designed the study, managed the literature searches, performed the statistical analysis of the study, discussed the findings and wrote the first draft of the manuscript. Authors STK and MAB managed the methodology aspect of the study, conclusion of the study and recommendations. Author STK edited the work. Both authors read and approved the final manuscript.

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ABSTRACT

The study assessed the content validation of Basic Education Certificate Examination (BECE) questions in Basic Science set by Adamawa State Educational Resource Centre (ERC), Yola, Nigeria. This was to determine the representativeness of the topics and their levels of the cognitive domain in the Junior Secondary School Basic Science curriculum in the Basic Education Certificate Examination in Basic Science question papers from 2013 to 2017. Document analysis research design was adopted for the study. The population of the study comprised all past Basic Education Certificate Examination questions in Basic Science. The research instrument used for the data collection was a designed checklist along table of specification. A pilot study was conducted and a reliability index of 0.86 was obtained using Cronbach alpha analysis. Three research questions were raised with two hypotheses tested at 0. 05 level of significance. The result of the findingp=0.000 revealed that there is no significant difference between the topics in the Basic Science curriculum

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and those examined in the Basic Education Certificate Examination questions in Basic Science. Again, the result 0.675 showed that there is significant difference between the weights assigned to the various levels of cognitive domain in the Basic Science curriculum and those weights assigned to them in Basic Education Certificate Examination Basic Science question papers. Based on the findings, it was recommended that re-training, workshops, conferences and seminars should be organized for Basic Science teachers and external examiners regularly to update their knowledge on test construction.

1. INTRODUCTION

The importance of secondary education in an educational system cannot be over-emphasised. Apart from serving as a link between primary and tertiary education, secondary school education provides opportunity for a child to acquire additional knowledge, skills and desirable attitudes after the primary education level. The purpose of secondary education in Adamawa State and Nigeria at large is to provide children with knowledge, skills, attitudes and ability which can enable them acquire tertiary education. That is, it is aimed at developing the child for better education beyond the primary education by acquiring literacy, numeracy and communication skills [1,2]. The Federal Republic of Nigeria [3] through the National Policy on Education (NPE) introduced six-year duration for secondary education given in two stages of three years each, that is, the junior secondary school and senior secondary school respectively. These two levels of secondary school education in Adamawa state have different examination bodies conducting certification examination for junior secondary school three (JSS3) students and senior secondary school three (SSS3) students.

In order to improve the standard of education at all levels in Nigeria and to lay a sound foundation for senior secondary school, Junior Secondary Certificate Examination was introduced in 1992 which are prepared by each state of the federation and the name changed from JSCE to BECE in 2009. Adamawa State Government like any other state keyed into the programme. It is assumed that students who are admitted into senior secondary school (SSS) level have passed their Basic Education Certificate Examination which may enable the students possess basic skills, knowledge, attitudes and ability to cope with the challenges of senior secondary school level such that they would perform well at the end in either National Examination Council (NECO), National Business and Technical Examinations Board (NABTEB) or West African Senior Secondary Certificate Examination (WASSCE). WAEC and Adeyemi cited in [4] observed that some students who were promoted to Senior Secondary School one (SS1) because they obtained acceptable grades at Basic Education Certificate Examination (BECE) later failed at the WASSCE and National Examination Council (NECO), thus questioning the content validity of Basic Education Certificate Examination questions. Junior secondary education is the second level in the Nigerian system of education. The junior secondary school is for children from ages 11 or 12 years and above. The Federal Ministry of Education (FME) in its National Policy on Education stated that the junior secondary school system shall be pre-vocational, academic, tuition free, universal and compulsory for the three years after which the Basic Education Certificate Examination (BECE) is taken both at the state and federal levels. A total of twenty-two different subjects are administered at the Basic Education Certificate Examination (BECE) level and a candidate is expected to sit for a minimum of ten subjects and maximum of 13 subjects. Candidates are deemed to pass the Basic Education Certificate Examination at credit level with Mathematics, English Language and Basic Science as subjects that are pre-requisite for admission into senior secondary one (SS I) [3].

The assessment of learning outcomes by using questions to assess students' academic performance is one of the basic issues in educational system of Adamawa State. Tests like the Basic Education Certificate Examination questions in Basic Science are usually used to measure how well students understood Basic Science at the junior secondary level and for promotion to the next class. There is therefore the need to ensure that tests administered by Adamawa State Educational Resource Centre are as fair as possible for all students in junior

secondary schools across the state. Basic Science is a subject taught at both primary and junior secondary school levels of education in Adamawa State. It is an introductory course which gives background knowledge to students for the study of science and science related subjects in the senior secondary schools. It is a pre-requisite subject and compulsory for all junior secondary school students, because it aids the students to study science subjects in the Senior Secondary Schools (SSS). Omiko [5] stressed that Basic Science as a science in undifferentiated form stresses the fundamental unity of science. Basic Science involves the study of elementary Biology, Chemistry, Geography and Physics as a single science subject in the primary and junior secondary schools. Basic Science as a subject offers students with the basic training in scientific skills required for human survival, sustainable development and societal transformation. These account for reasons why students' performance in Basic Science should be a major concern.

Basic science as a subject in the curriculum over the years has been a problem for most students [6]. A recent report (2018) by the Educational Resource Centre (ERC), Yola, states that only 33.34% of candidates registering for Basic Education Certificate Examination make credit in Basic Science. This remark however, is very alarming and calls for rapid attention if Adamawa as a state is to compete with the other states in Nigeria. Students' academic performance in Basic Science as in other subjects may be influenced by a lot of factors which may not allow one to have a judicious knowledge of their real performance. It is also evidenced that students' performance in Basic Science can be measured using tests or examinations [7].

Some of the important factors to be considered in judging quality of a good test are relevance, fairness, efficiency, objectivity, specificity, discrimination, adequacy, reliability and validity [8]. Validity is the degree to which a test items in Basic Science measures what it intends to measure accurately or it is the degree of accuracy with which Basic Science test items measure what it intended to measure. Nkwocha [9] stressed that content validity is the extent to which questions consist of a representative sample of subject matter and objectives the test item is designed to measure. It is very important that test questions make a fair coverage of the subject matter contents because if few areas of the subject matter are consistently emphasized

by the questions designed and administered over a few testing period by the examiners, students may not perform well and also may not fully discover their ability, capability, skills and knowledge. This type of practice tends to lead students to study only these few areas for examination sake, while the other areas are neglected.

Other causes of students' poor performance in BECE might be the presence of bias in questions which may be through poor representation of the topics thereby threatening the content validity of such examination. According to Opara and Uwah [7], test items arrangement plays a vital role in determining the performance of students in examinations. Test items arrangement based on descending order of difficulty arrangement has negative effect on students' performance in Mathematics among junior secondary school students.

In Adamawa State, the BECE is conducted by Adamawa State Ministry of Education (MOE) for both public and private junior secondary schools in the state. The state Educational Resource Centre (ERC) receive directives from the state Ministry of Education to develop or construct questions, administer the questions, mark the scripts, award grades and certificates to the examinees under their jurisdiction. But what they normally do is to ask individual teachers on subject basis to set questions and send them to the ERC. Unfortunately, from the preliminary survey of past question papers by the researchers and inspectors of Science Annual Reports, some questions are repeated many times in one question papers; wrong spellings; and some options are missing or are left out blank and these may be responsible for the students' poor performance in Basic Education Certificate Examination in Basic Science in Adamawa State [10].

In practice, teachers used by various schools to set these questions may not be competent in their subjects or they are not test experts to construct valid questions that may cover the levels of the cognitive domain with consideration of the representativeness of the topics in the curriculum. This may explain why academic performance of students in junior secondary schools has been poor in BECE particularly in Basic Science in Adamawa State year after year. In Adamawa State for example, from the survey of the past results, about 57% of junior secondary school students performed below

average. Hence, the academic performance of students in Basic Science in Adamawa State has been deteriorating. At state level, the trend of pass rate for JSS III was as follows: 36.6% in 2013, 33% in 2014, 38% in 2015, 20.1% in 2016 and 39% in 2017. Thus, this situation is not progressive to the state and students at large.

Some of the causes of students' poor performance in junior secondary schools in Adamawa State BECE could be as follows: use of ambiguous statements, unclear questions, inappropriate terms, use of irrelevant technical terms, non-coverage of the content, non-usage of table of specification by examiners and teachers, presence of bias in the questions, difficulty of questions, incorrect arrangement of questions, poor arrangement of options and examination malpractice which may reduce the validity of the examination, leading to students' poor performance [11,7].Therefore, performance of students in BECE in Basic Science in Adamawa State has not been encouraging for the past years. Some of the causes of failure of students in BECE Basic Science in Adamawa State could also be poor quality of teachers recruited, non-usage of table of specification by the teachers or examiners, lack of knowledge on test construction techniques might lead to poor performance of students' in BECE. Therefore, none of the research work carried out above was conducted in Adamawa State to examine content validity of questions set by ERC. Hence, there is a need to assess the content validity of the BECE questions in Basic Science in Adamawa State by examining how proportionate these questions are distributed among the topics in the Basic Science curriculum and the various levels of cognitive domain.

The main purpose of the study was to validate the content of the Basic Education Certificate Examination question papers in Basic Science by examining how proportionally questions are distributed among the topics in the Basic Science curriculum and levels of the cognitive domain. Specifically, the objectives of the study are to determine the representation of:

I. Topics in the junior secondary school Basic Science curriculum in the Basic Education Certificate Examination Basic Science questions from 2013 to 2017.
II. Performance objectives stated in the Basic Science curriculum to the various levels of the cognitive domain.

III. Various levels of the cognitive domain in the Basic Education Certificate Examina tion Basic Science questions from 2013 to 2017.

The following research questions were raised to guide the study:

- What percentage of the topics in the three years basic education Basic Science curriculum was covered in the Basic Education Certificate Examinations Basic Science questions from 2013 to 2017?
- What percentage of the performance objectives stated in the Basic Science curriculum was assigned to the various levels of the cognitive domain?
- What percentage of the various levels of the cognitive domain was covered in the 2013 to 2017 Basic Education Certificate Examination Basic Science questions?

The hypotheses formulated and tested are as follows:

$H0_1$. There is no significant difference between the topics in the junior secondary school Basic Science curriculum and those examined in the Basic Education Certificate Examination questions in Basic Science.

$H0_2$. There is no significant difference between the weights assigned to the various levels of the cognitive domain in the junior secondary school Basic Science curriculum and those assigned to them in the Basic Education Certificate Examination (BECE) questions in Basic Science.

2. LITERATURE REVIEW

Conceptual framework was used to pin the major variables of the study as seen in Fig. 1. [12] conducted a study on content validity of Junior Secondary School Certificate Examination (JSCE) questions in Business Studies in Imo State, Nigeria and they found that authors of the curriculum for Business Studies and examiners of JSSCE do not make use of a table of specification; therefore, the questions were not valid in content. Also, Orluwere and Asiegbu [13] carried out a study on detecting items bias in Rivers State JSSCE (now BECE) Business Studies using Item Response Theory Approach and the study revealed that there was a school type bias in the Rivers State JSSCE Business Studies test items for 2009.
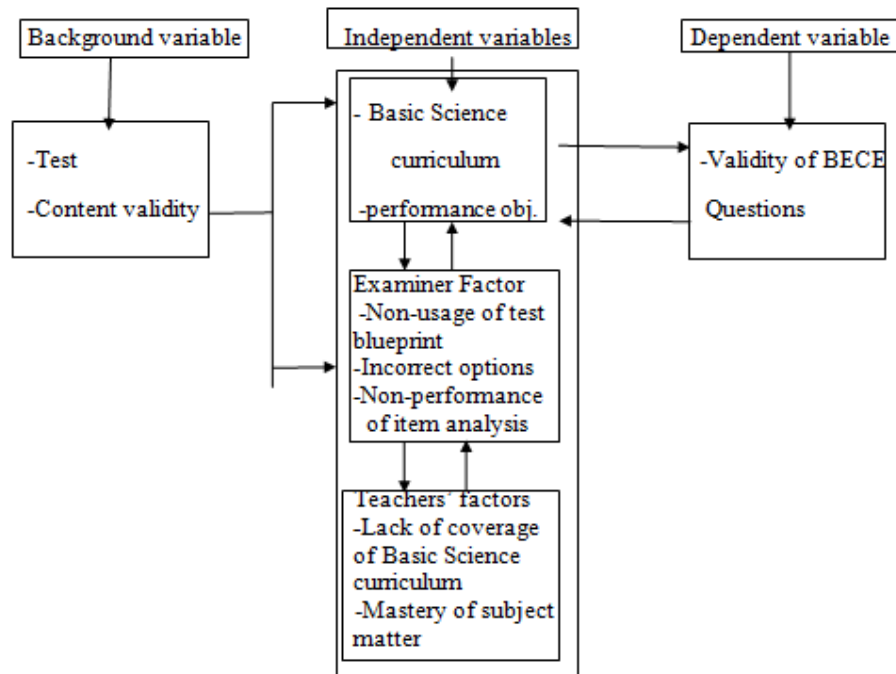
Fig. 1. Conceptual model of content validity of basic education certificate examination in basic science

Amajuoyi et al. [14] stated that most questions designed by WAEC examiners test lower levels of the cognitive domain, which might be responsible for the poor performance of students in Chemistry May/June WAEC examinations in Akwa Ibom state, Nigeria. Furthermore, [15] carried out a study on content validity of independently constructed curriculum-based examinations in Malawi. The study revealed that there is inadequacy in the rating of the cognitive levels because the questions emphasised the high levels of cognition than the lower levels. Agu et al. [16] noted in their study that there is significant difference in test constructed by experienced and less experienced teachers in favour of the experienced teachers. Robin et al. [17] conducted a study on analysis of written examination papers of undergraduate Anatomy. The purpose of the study was to analyse written examination papers of undergraduate Anatomy. The study revealed that different subdivisions of Anatomy are not given proper weightage in the Anatomy written examination. Iweka [18] carried out a study on Content Validity of the West African Senior School Certificate Examination (WASSCE) questions in Biology. The findings indicated that the WAEC (May/June) Biology has a low content validity which may be as a result of the examiners over-emphasized some cognitive

levels while others are under-emphasized and some are totally ignored by the examiners, hence leading to students' poor performance. Chinelo and Osaze [19] conducted a study on Determining Reliability and Content Validity of the Mathematics Tests conducted by Senior Secondary School Mathematics Teachers in Edo state, Nigeria. The objective of the study was to determine reliability and content validity of the Mathematics tests conducted by senior secondary school Mathematics teachers. The results indicated that the tests have moderate internal consistency reliability and low in content validity.

3. METHODOLOGY

This study employed document analysis research design. It is document analysis research design because it deals with existing artifacts or records of examination question papers with the Educational Resource Centre. The population of the study consists of all past Basic Science examination question papers for BECE in Adamawa State from 2013 to 2017. The sample was the whole BECE Basic Science question papers from 2013 to 2017. The purposive sampling techniques was used for the study because only the more recent BECE

question papers in Basic Science were purposively selected to ensure recency in coverage over time. The instrument used for the data collection was checklist for the past questions designed along Table of Specification (considering the cognitive levels a question falls in).The instrument was validated using experts in Tests and Measurement, Basic Science experienced teachers; that is, those teachers that have been teaching Basic Science for at least ten years. The experts validated the instrument by considering 30 questions adopted by the researcher from BECE question papers in consideration to their Basic Science curriculum and then classified the questions against the levels of the cognitive domain it emphasized. The instrument was pilot-tested in two Junior Secondary Schools (JSS) in Adamawa State which were not part of the sample of the study. The reliability of the instruments was established using Cronbach alpha analysis which yielded value of 0.86.

All the topics expected to be tested in BECE from the curriculum for Basic Science were obtained in course of the study. The actual topics tested in BECE over the five years (from 2013 to 2017) were also obtained from Adamawa State BECE question papers in Basic Science. For each year, there was one paper (objective and essay parts) for the BECE in Basic Science. For the five years, there were altogether 288 questions for Basic Science examinations. The total number of questions set for each topic of the curriculum of Basic Science was determined and this became the observed weight of the topics tested by Adamawa State BECE Basic Science. The cognitive levels as outlined in Bloom's Taxonomy of Educational Objective were used in classifying the performance objectives stated in the curriculum for Basic Science. This classification was also used across the 288 questions that were used in the study. Similarly, the total number of each cognitive level of the classified performance objectives in the curriculum was calculated. The number of objectives for a particular level was converted to the proportion of the total number of 288 items involved in the study. Research questions 1, 2 and 3 were answered using percentages while hypotheses 1 and 2 were tested using Chi-square at 0.05 level of significance. This is because Chi-square test is used to determine relationship between two nominal variables data collected is nominal in nature. The frequency of each category for one nominal variable is compared across the categories of the second nominal variable.

4. RESULTS AND DISCUSSION

The results of the data analyses are presented in the following Tables:

Research Question 1: What percentage of the Basic Science curriculum topics was covered in the Basic Education Certificate Examinations Basic Science questions from 2013 to 2017?

From Table 1, it indicates that out of the 17 major topics in the Basic Science curriculum, topic six which is on "living and non-living things" has the highest percentage of questions 39.07% followed by topic eight "systems and organs of the body" with a percentage of 13.76% . Topic 1 "family health and traits" has 6.23%, topic 2 "environment" has 5,94%, topic 3 "diseases, immunization and prevention" has percentage of 4.69, topic 4 "drug abuse" has 4.38%, topic 5 "earth in space" has 2,82%, topic 9 "information and communication technology" has 2.50%, topic 10 "simple machines" has 4.06%, topic 12 "metabolism in human body" has 3.12%, topic 14 "ethical issues in science and development" has 1.87% topic 16 "crude oil and petro-chemicals" has 3.75%, topic 17 "matter, energy, work, power and forces" has 3.43%, topic 11 "depletion of ozone layer" has 2.19%, topic 15 "magnetism and radioactivity" has 1.25% while topics 7 "gravitational and weightlessness" and topic 13 "skill acquisition" have the lowest percentages of 0.62 and 0.31 respectively.

Research Question 2: What percentage of the performance objectives stated in the Basic Science curriculum was assigned to the various levels of the cognitive domain?

Table 2 shows that performance objectives were highest at the comprehension level of cognitive domain (47.33%) in the junior secondary school Basic Science curriculum followed by application and knowledge levels of cognitive domain (18.72%) and (17.93%) respectively. Analysis, synthesis and evaluation were weighed least with percentages of 7.26% for analysis, 4.57% for synthesis and 4.19% for evaluation.

Research Question 3: What percentage spread of the various levels of the cognitive domain was covered in the 2013 to 2017 Basic Education Certificate Examination Basic Science questions?

Table 3 reveals that the comprehension level of cognitive domain had the highest percentage of 42.02% followed by application with a percentage of 22.22% and knowledge having

percentage of 20.83 respectively. The other three levels of cognitive domain had decreasing percentage spread as they go from analysis to evaluation. Analysis has a percentage of 5.91%, synthesis has 4.51% and evaluation has 4.51%.

$H0_1$: There is no significant difference between the Basic Science topics in the junior secondary school curriculum and those assigned to them in the Basic Education Certificate Examination questions in Basic Science.

$H0_2$. There is no significant difference between the weights assigned to the various levels of the cognitive domain by the 9-year basic education junior secondary school curriculum and those assigned to them in Basic Education Certificate Examination (BECE) questions in Basic Science.

5. DISCUSSION

From the findings of research question one it was found out that the distribution of the BECE questions among the topics in the junior secondary school Basic Science curriculum is not equal. The findings in table one is in favour of two topics namely; living and non-living things and systems and organs of the body. The remaining 15 topics were under-emphasised in the construction of BECE Basic Science question papers over the period under study. The over-

emphasis of the two topics may be as a result of the examiners not using the 9-year basic education Basic Science curriculum during construction of BECE Basic Science questions. This study is in line with the study of [17], which showed that questions designed by the examiners to assess students' progress in a particular unit or curriculum were not given proper weights in the examination question papers. Again, this study is in agreement with a study carried out by [13] who reported in their study on Detecting Items Bias in Rivers State JSSCE Business Studies that JSCE questions in Business Studies has bias in distribution of the questions to the topics in the junior secondary school Business Studies curriculum. On the other hand finding of research question one is in disagreement with the study of [11] on content coverage and students' achievement in senior secondary school Physics. The study found out that percentage of questions was well spread across the curriculum. The high percentage spread of questions to topics 6 and 8 in this study could be as a result of the weights assigned to them in the curriculum. The weights assigned to topics 6 and 8 were greatly higher than those assigned to these topics in the Basic Science curriculum. On the other hand the other 15 topics were under-emphasized in the construction of BECE Basic Science questions for period under study, 2013 to 2017.

Table 1. Percentage of basic science topics in the Basic Education Certificate Examination (BECE) basic science question papers from 2013 to 2017

S/N	Topics	2013	2014	2015	2016	2017	Total Spread	% Spread
1.	Family (health and traits)	1.55	1.55	1.55	4.69	21.90	31.24	6.23
2.	Environment	0.00	0.00	3.13	7.81	18.75	29.69	5.94
3.	Diseases, immunization and prevention	0.00	6.25	3.13	4.69	9.38	23.45	4.69
4.	Drug abuse	0.00	0.00	15.63	3.13	3.13	21.89	4.38
5.	Earth in space	3.13	3.13	0.00	4.69	3.13	14.08	2.82
6.	Living and non-living things	54.69	46.89	43.75	40.63	9.38	195.34	39.07
7.	Gravitational and weightlessness	1,55	1.55	0.00	0.00	0.00	3.10	0.62
8.	Systems and organs of the body	18.75	10.94	15.63	4.69	18.75	68.76	13.76
9.	ICT	3.13	3.13	0.00	6.25	0.00	12.51	2.50
10.	Simple machines	4.69	4.69	3.13	7.81	0.00	20.32	4.06
11.	Depletion of ozone layer	0,00	4.69	0.00	0.00	6.25	10.94	2.19
12.	Metabolism in human body	1.55	3.13	6.25	1.55	3.13	15.59	3.12
13.	Skill acquisition	0.00	1.55	0.00	0.00	0.00	1.55	0.31
14.	Ethical issues in science and development	3.13	1.55	0.00	4.69	0.00	9.37	1.87
15.	Magnetism and radioactivity	1,55	4.69	0.00	0.00	0.00	6.24	1.25
16.	Crude oil and petro-chemicals	4.69	4.69	3.13	6.25	0.00	18.76	3.75
17.	Matter, energy, work, power and forces	1.55	1.55	4.69	3.13	6.25	17.1	3.43
	Total % spread of the topics	100	100	100	100	100	100	100

Table 2. Percentage spread of various levels of the cognitive domain in the basic science curriculum

S/N	Topics	Knowledge %	Comprehension %	Application %	Analysis %	Synthesis %	Evaluation %	Total %
1.	Family (health and traits)	1.527	1,908	0.382	0.382	0.382	0.382	4.93
2.	Environment	3.435	8.015	0.763	1.145	0.763	0.763	14.884
3.	Diseases, immunization and prevention	1.527	1.908	0.000	1.145	0.000	0.763	5.343
4.	Drug abuse	0.382	3.435	0.763	0.000	0.000	0.000	4.198
5.	Earth in space	0.000	2.672	0.763	0.000	0.000	0.000	3.435
6.	Living and non-living things	4.580	5.725	6.489	1.908	1.908	1.527	22.137
7.	Gravitational and weightlessness	0.782	0.782	0.782	0.000	0.000	0.000	1.146
8.	Systems and organs of the body	2.290	6.489	0.763	0.763	0.382	0.383	11.069
9.	ICT	0.000	1.527	0.000	0.000	0.000	0.000	1.527
10.	Simple machines	0.000	2.290	1.145	0.000	0.000	0.000	3.435
11.	Depletion of ozone layer	0.382	0.382	0.763	0.000	0.000	0.000	1.527
12.	Metabolism in human body	0.763	0.763	0.000	0.000	0.000	0.000	1.526
13.	Skill acquisition	0.382	0.382	0.763	0.763	0.000	0.000	2.290
14.	Ethical issues in science and development	0.000	0.763	0.000	0.000	0.000	0.000	0.763
15.	Magnetism and radioactivity	0.763	1.145	0.382	0.763	0.382	0.000	3.435
16.	Crude oil and petro-chemicals	0.000	0.763	0.382	0.000	0.000	0.000	2.290
17.	Matter, energy, work, power and forces	1.145	9.160	4.580	1.145	0.763	0.382	17.175
	Total	17.960	47.330	18.720	7.260	4.260	4.190	100

Table 3. Percentage spread of the levels of cognitive domain in the 2013 to 2017 BECE basic science question papers

Cognitive levels (in %)	2013	2014	2015	2016	2017	Total spread	% spread
Knowledge	10	11	12	19	8	60	20.83
Comprehension	26	20	28	27	20	121	42.02
Application	18	19	15	10	2	64	22.22
Analysis	1	6	5	4	1	17	5.91
Synthesis	7	3	1	2	0	13	4.51
Evaluation	2	5	3	2	1	11	134.51
Total	64	64	64	64	32	288	100

Table 4. Summary of χ^2 analysis for weights of topics in the curriculum in basic science and in the BECE Basic Science Questions

Sources	Curri.		BECE	
BOS	29	(36.7)	48	(40.3)
CP	3	(2.9)	3	(3.1)
DA	11	(11.4)	13	(2.6)
DIP	14	(12.4)	12	(13.6)
DOL	4	(4.3)	5	(4.7)
ESD	2	(3.8)	6	(4.2)
EN	39	(23.3)	10	(25.7)
ET	9	(8.6)	9	(9.4)
FM	13	(12.4)	13	(13.6)
GW	3	(2.4)	2	(2.6)
ICT	4	(5.7)	8	6.3)
LT	58	(85.7)	122	(94.3)
MEWPF	45	(26.2)	10	(28.8)
MHB	4	(5.7)	8	(6.3)
MR	9	(6.7)	5	(7.3)
SA	6	(3.3)	1	(3.7)
SM	9	(10.5)	13	(11.5)
N	500	500	500	500
df	16	16	16	16
χ^2	76.56	76.56	76.56	76.56
Sig.	0.000	0.000	0.000	0.000

From Table 4, the χ^2 = 76.56, df = 16 and P= .05 level of significance. Since the p-value (0.000) is less than the level of significance, then it is significant

It was also found out from research question two that comprehension level achieved highest percentage of the performance objectives stated in the Basic Science curriculum followed by application and knowledge levels. While, Analysis, synthesis and evaluation levels were found to have lower percentages than the knowledge, comprehension and application levels. This finding is in agreement with the study of Amajuoyi et al. [14] which reported that performance objectives were highest at the comprehension level of cognitive domain followed by application and knowledge levels. However, the study is in disagreement with that study of Nwana et al. [12] which stated that performance objectives were highest at the analysis level of cognitive domain. The result of this study is expected because the junior secondary school students are at the lower age of cognitive development, which is from 10 to 13 years. This can be attributed to the cognitive stage of development of the students. Amajuoyi et al. [14] classified analysis, synthesis and evaluation levels as the highest cognitive domain levels which are concerned with the ability to judge the value of an idea, principle, law and theory. Thus, the majority of questions test the lower cognitive levels because the students are generally in the low stage of development to engage in much value judgment.

From research question three, percentage spread of questions to the various levels of cognitive domain in the 2013 to 2017 BECE Basic Science question papers; it was found out that comprehension level of cognitive domain has the highest percentage followed by application and knowledge. The other three

Table 5. Summary of χ^2 weights assigned to the levels of cognitive domain by the 9-Year basic education curriculum in basic science and those assigned to them in Basic Education Certificate Examination (BECE) Basic Science Question Papers

Sources	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation	N	df	χ^2	Sig.
Curriculum	45 (50.0)	127 (118.1)	49 (53.4)	18 (16.7)	12 (12.4)	11 (11.4)				
							500	5	3.165	0.675
BECE	60 (55.0)	121 (129.9)	63 (58.6)	17 (18.3)	14 (13.6)	13 (12.6)				

From Table 5, the χ^2 = 3.165, df = 5 and p = .05 level of significance. Since the p-value is greater than the level of significance; hence the null hypothesis is upheld

levels of cognitive domain have percentage spread decreasing as they go to higher levels. The implication of this result is that out of the 288 questions involved in the study, 85.07% tested the lower cognitive levels and only 14.3% tested the higher levels of cognitive domain. The result is expected because junior secondary school students are at lower cognitive stage of development and so low cognitive levels should be emphasised in the construction of their questions. This result of research question three shows that examiners of educational resource center Yola, Adamawa State may not have used Tables of Specifications in constructing the questions used in examining students for the five years under study. As a result of this, BECE Basic Science questions for the period under study have highest percentage allocated to comprehension level of cognitive domain instead of considering the other two lower levels of cognitive domain. Orluwere and Asiegbu [12] study is in line with this study in that they found out that Junior School Certificate Examination (JSCE) possesses highest percentages of items at the comprehension level of cognitive domain. They attributed this to the fact that examining bodies do not use Tables of Specifications and they employ non-test experts in the construction of their test items. This study is also in agreement with the study of Iweka [18] who confirmed that comprehension have the highest percentage of items in the levels of cognitive domain in May/June Biology Questions. On the other hand this study is in disagreement with the study of Elias [15] who reported that Malawi School Certificate Examination has highest percentages at the higher levels of cognitive domain.

The finding of research hypothesis one again showed that BECE did not maintain the weights assigned to the topics in the junior secondary school Basic Science curriculum in the construction of BECE Basic Science question papers under period of study. The researcher tested the differences using chi-square analysis; the calculated value = 76.562 while the P-value = 0.000. Consequently, the null hypothesis was rejected. Thus, there is a significant difference between the weights assigned to the topics in the junior secondary school Basic Science curriculum and those assigned by BECE Basic Science questions. It is very likely that BECE body did not use table of specifications appropriately in constructing the questions with which they have been examining the students' for the five years under study. This showed that

the BECE Basic Science questions had a very low content validity. This study is again in line with the study carried out by Orluwere and Asiegbu [12] he study revealed that authors of the curriculum for Business Studies and examiners of JSCE do not make use of a table of specification; therefore, the questions are not valid in content. This study also is in agreement with the study of Chinelo and Osaze [19] who confirmed that junior secondary school Mathematics test questions have moderate internal consistency reliability and low in content validity. On the other hand this study is in disagreement with the study of Elias [15] who confirmed in his study that Malawi School Certificate Examination (MSCE) posed high content validity. It is very likely that BECE body did not use table of specifications in constructing the questions with which they have been examining the students for the five years under study. They all attributed this low content validity of BECE Basic Science to the fact that Educational Resource Centre (ERC) do not use test experts and table of specifications in constructing questions.

Again, the finding of research hypothesis two showed that the BECE maintains the weights allotted to the various levels of cognitive domain in the junior secondary school Basic Science curriculum. This implies that the examiners of BECE over-emphasized comprehension level of cognitive domain only instead of distributing the questions proportionally among the lower cognitive levels. The reason for this may be because the teachers usually emphasized comprehension level of cognitive domain in teaching their subjects for the five years under study. As a result, they distribute the questions in-proportionate across the lower cognitive levels as well as the higher cognitive levels. Thus, result of hypothesis two is in line with the study of Elias [15] who reported that Malawi School Certificate Examination (MSCE) examination tests possessed high content validity. The study again disagreed with the study of Iweka [18] who confirmed that WAEC May/June Biology questions have low content validity, so also with the study of Amajuoyi et al. [14] they reported that WAEC May/June Chemistry questions have low content validity. The upheld of hypothesis two could be because BECE examiners do not use expert in the construction of the BECE Basic Science questions. It could also be Educational Resource Centre examiners do not make use of table of specification and services of tests experts in developing its questions.

With regards to the findings of this study, it can be deduced that the examiners of BECE over-emphasized comprehension level of cognitive domain only instead of distributing the questions proportionally among the lower cognitive levels. The reason for this may be because the teachers usually emphasize comprehension level of cognitive domain in teaching their subject areas for the five years under study. As a result, they distribute the questions in-proportionately across the lower cognitive levels as well as the higher cognitive levels.

6. CONCLUSION

In conclusion, the BECE Basic Science questions are lopsided in favour of some topics and these are caused by examiners when setting BECE questions. This study therefore, can contribute immensely to education with regards to students' performance and content validation of questions. Content validity helps examiners to construct questions that are representative sample of the topics in the basic education curriculum for better coverage.

Based on the findings of the study, the following recommendations are made:

- The curriculum designers of Basic Science should be properly made by supervisory and monitory bodies to consistently and persistently maintain the spread of topics across the lower levels of cognitive domain in the Basic Science curriculum while designing the curriculum.
- The Educational Resource Centre (ERC) examiners should be made to understand through re-training, supervision, workshops, seminars and conferences the implication of over-emphasising and under-emphasizing some topics and lower cognitive levels when constructing BECE Basic Science questions.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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