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Teaching and Assessment Methods for Effective Implementation of the 3-Year Upper Basic Science and Technology Curriculum in Nigeria

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Abstract

The study assessed the extent to which specified teaching and assessment methods are used by upper Basic Science and Technology teachers in North Central Nigeria. A cross-sectional survey design was used. The population comprised 10,688 teachers with a sample of 288 randomly selected from 72 secondary schools. BSTCOS was used for data collection. The two research questions were answered using mean and standard deviation, and the hypotheses were tested at 0.05 level of significance using independent t-test. Findings revealed that teachers in government and private secondary schools use specified teaching and assessment methods to less extent. This implies that teachers do not vary their teaching and assessment methods to include creative and problem solving methods. It was recommended based on the findings that the government and other relevant agencies should ensure teachers in both government and private secondary schools use

specified teaching and assessment methods to a great extent for effective implementation of the curriculum for the attainment of Sustainable Development Goals (SDGs).

Keywords: Basic Science and Technology, Curriculum Implementation, Teaching and Assessment Methods, Science Education, Basic Education

Introduction

The 21st century child is born in a rapid scientific and technological driven society that calls for highly innovative and creative teaching/learning methods. Accordingly, science education teaches young learners problem-solving skills through critical thinking while technology enhances the application of the acquired skills translating to different professions of human endeavors. Alismail and McGuire (2015) asserts that, the teaching and assessment methods used by teachers in implementing the 21st century science and technology education curriculum should focus on how to think, learn, solve problems and make informed decisions. The authors are of the opinion that these skills should be the major component of any teaching/assessment method for curriculum implementation right from early childhood education. In order to produce young brains that would bring about significant breakthrough in science, engineering, and technology, for the attainment of the Sustainable Development Goals (SDGs) by the year 2030.

According to Adams *et al.* (2018) only science and technology has the capacity to localize the production and proliferation of mobile and electronic devices, robotics, and digital communication/information systems to facilitate instant flow, and exchange of various forms of data, work, and capital, especially in developing countries. This is because these developments and activities have forever transformed the nature and organization of life, including human and non-human operations. Above all the 21st century science and technology curriculum could only be meaningful if its implementation is based on explorative instructional methods and definite evaluation techniques that could allow learners discover new ideals themselves (Henriksen, Mishra & Fisser 2016). Jordan (2012) states that science and technology is important to every society in order to provide lasting solutions to the series of globally interconnected and locally specific challenges such as; climate change, the quality and security of food, water and air pollution, poverty, migration, diseases and other forms of sociopolitical and economic inequalities.

A method of teaching denotes the strategy by which a teacher delivers his/her subject matter to the learners based on some predetermined instructional objectives in order to promote learning (Buseri & Dorgu, 2011). The authors assert that the effective implementation of any curriculum depends to a large extent on the availability of various methods of teaching. Thus to teach is to impact knowledge, an attempt to help the learner have a change of attitude and acquire skills through series of planned activities. A teaching method is recurrent instructional technique applicable to subjects which can be learned and applied by any teacher. Teaching methods are usually named after the dominant activity employed in the course of the lesson. They are very vital in any teaching learning situation. Omiebi-Davids (2011) opines that the way the teacher presents the lesson to the learners may make them like or dislike the subject. It may also generate in them love for, or alienate them from school and all that is associated with it,

since the method of presentation is so important. Teachers including the service teachers should be concerned not only with general methodology but also motivational and innovative methods of teaching various subjects. According Dorgu (2015) the teacher has to use different methods during the teaching process; also a combination of more creative and problem solving teaching/assessment methods would evidently produce a better result. The author points out that the process of teaching, methods often supplements one another; Lecture/Presentation, discussion, field trip, dramatization and so on. Teaching and assessment methods work hand in hand; it is no exaggeration to say the type of teaching method employed by the teacher determines the nature of assessment technique to be used in order to ascertain the extent to which knowledge is acquired by the learners.

According to Baranovskaya and Shaforostova (2017) assessment is the process of gathering evidence of what the child can do. It plays a number of roles in the life of a student, their learning patterns, educational focus and allocation of time is directly influenced by assessment. It does more than mere allocation of grades or degree classifying students based on performance. Assessment plays an important role in focusing students' attention and developing their mental capacities, actually assessment derives students' learning (John, 2015). Gibbs (2003) states that assessment has 6 main functions:

i. Capturing student time and attention;
ii. Generating appropriate student learning activity;
iii. providing timely feedback which students pay attention to;
iv. Helping students to internalize the discipline's standards and notions of equality;
v. Generating marks or grades which distinguish among students or enable pass/fail decisions to be made;
vi. Providing evidence enables learners to judge the appropriateness of course standards.

Gibbs (2003) states that with the exception of the last two points, these functions should occur as frequently as possible to support effective learning. The purpose of assessment and evaluation is to give students the opportunity to show what they have learned rather than catching them out or to show what they have not learned.

It is only when teaching and learning is backed up with adequate and appropriate techniques to assess students' performance (achievement) that the overall aim of curriculum implementation could be ascertained. Benton and Ryalls (2016) state that Classroom Assessment Techniques (CATs) are generally simple, in-class activities are designed to give the teacher and the students useful feedback on the teaching-learning process as it is happening. It could be at the end or during the lesson activities or end of term/session in form of multiple choice questions, essays, practical activity or project. This process serves as a feedback for teaching improvement, developing a portfolio for job application, or gathering data as part of personnel decision such as reappointment or promotion and tenure. Linse (2017) is of the opinion that because there are many dimensions to teaching and learning, it is better to use multiple measures involving diverse sources of data to access the range of instructional activities, which can include the following:

i. Instructional Delivery (including quality, amount, and level of practical activities)
ii. Course Planning (including development of course materials, course revision and development of new courses)
iii. Grading and Assessing Student Learning (including appropriate level of assignments, exams, grading standards which are normally specified and recommended).

The recommended or specified instructional and assessment methods in Basic Science and Technology as contained in the National Minimum Standards Specifications. According to Universal Basic Education Commission (UBEC, 2012) in line with international best practices include teaching methods and strategies such as; e-teaching/learning, brainstorming, discovery, demonstration, inquiry, experimentation, discussion, role-play, simulation, games/drama, problem solving, cooperative teaching[learning, field trip among others. The assessment techniques and tools prescribed by UBEC to be used by all schools whether government or private include; student self-assessments, daily practice assignments, quizzes, oral questions, multiple choice, true or false, completion of blanks, students' practical work, pencil-and-paper tests, holistic rating scales, projects, oral and written reports. These assessment techniques are based on criteria set by the Ministry of Education in collaboration with Universal Basic Education Commission (UBEC, 2010).

The implementation of school curriculum especially in developing countries in Africa is constrained in so many ways, which include under funding, insufficient trained teachers and inadequate instructional resources (Mkandawire, 2010). The economy of a nation determines the success of her curriculum implementation. In developing countries, the number of learners keeps rising but government budgetary allocation to education every year remains small. It has been observed that very little amount of money is voted for payment of teachers' salaries, teaching materials, books, in-service training, monitoring and other things needed for the smooth implementation of curriculum (Ada, 2017). Although the government introduced tuition fees in secondary schools and higher institutions of learning to cushion the dwindling resources, the move has had just little positive impact as most learning institutions still lack funds to run programmes, which is a bad signal for curriculum implementation.

The effective implementation of any curriculum depends to a large extent on the utilization of students-centered methods like inquiry, laboratory and demonstration (Dorgu, 2015). Buseri and Dorgu, (2011) asserts that, there are a variety of teaching methods, and it is through the use of such methods that teachers are able to implement the school curriculum. That means in situations where teachers fail to use appropriate teaching methods, a good curriculum plan could turn out to be damaged. The main purpose of curriculum implementation is to translate the ideas into a workable blue print, and this can be achieved basically by using appropriate teaching methods in class and specific assessment techniques to ascertain learning outcomes (Donche, 2013). The secondary school curriculum as planned learning experiences provided to assist the learners in attaining the designated learning outcomes can be achieved by the use of

effective teaching methods. The teacher through his teaching methods makes direct use of the curriculum thereby implementing it. This means the teacher uses the appropriate teaching methods and correct assessment tools and resources to actualize learning.

According to Ogar and Awen (2015), the major problem of the Nigerian education system is how to operationalize the well-intended and articulated curriculum via feasible and full-scale implementation commitment. The authors observe that there are many curriculum implementation issues in Nigeria such as inadequate trained teachers, shortage of physical facilities and instructional materials, absence of monitoring taskforce to ensure strict compliance to the national minimum standards specifications for the implementations of the curricular by government and private schools operating in the country. Other serious issues for curriculum implementation include; funding, absence of Information and Communication Technology facilities and low motivation of teachers which result to the use of inappropriate instructional methods and assessment techniques by many teachers (Mkandawire, 2010).

Ogungbesan (2012) evaluated the implementation of the Basic Science curriculum in the south west Nigeria. The result showed that 70% of the teachers surveyed were using lecture and discussion methods with oral questioning for Basic Science instruction. Moyinoluwa (2014) assessed teaching and evaluation methods used in the FCT Basic Education schools. Results revealed that most schools poorly implemented methods/strategies like Guided Discovery, Concept-mapping, Individual projects, and Group works/assignments, also the predominant assessment method used was oral questioning during instruction. Achuonye (2015) surveyed predominant teaching strategies in schools, implications for curriculum implementation in Mathematics, Science and Technology, in the six BRACED states namely Bayelsa, Rivers, Akwa-Ibom, Cross-River, Edo, Delta states in the South-south region. The finding indicated that lecture and discussion methods are still prevalent in schools at all levels with oral questioning as the most common evaluation technique. Omiko (2016) evaluated the Classroom Experiences of Basic Science Teachers in Context of Competencies and Opinions, in junior secondary schools in Ebonyi State, Nigeria. The results showed that Basic Science teachers seem to have a little performance level in the use of assessment techniques and classroom management, since many of the teachers use oral questions only during instruction. It was also found that most teachers who teach Basic Science used lecture and discussion methods.

Statement of the Problem

Nigeria as a developing country can only witness a radical break through in Science and Technology if the citizenry have completely received both scientific and technological literacy. That means the important subject in the present Universal Basic Education programme that can assure this at both the lower and upper Basic Education levels is Basic Science and Technology. However, previous studies by Ogungbesan (2012), Moyinoluwa (2014) and Achuonye (2015) reported that teachers implementing the curriculum of individual subject areas that now merged as Basic Science and Technology in both government and private schools were predominately using lecture and discussion

methods with oral questioning assessment technique in the implementation of the single subject area curricular. In view of this background, now that these individual subject areas are merged, to what extent have the teachers embraced the specified teaching and assessment methods? As contained in the National Minimum Standards Specifications for the implementation of the curriculum according to UBEC (2012). It is to answer this question that this study assessed the extent to which specified teaching and assessment methods are used for effective implementation of the 3-year upper Basic Science and Technology curriculum in North Central Nigeria.

Purpose of the Study

The purpose of this study was to assess the extent to which the specified teaching and assessment methods are used by Basic Science and Technology teachers for effective implementation of the 3-year Upper Basic Science and Technology Curriculum in Government Secondary Schools (GSS) and Private Secondary Schools (PSS), in the North-central geopolitical Zone of Nigeria. Basically, the objectives of the study were to;

i. To find out the extent to which specified teaching methods are used by Basic Science and Technology (BST) teachers for effective implementation of the curriculum.
ii. To determine the extent to which specified assessment methods are used by Basic Science and Technology teachers during instruction.

Research Questions

The following research questions were asked in this study:

i. To what extent are specified teaching methods used by teachers for effective implementation of BST curriculum in government and private secondary schools?
ii. To what extent are specified assessment methods used by BST teachers during instruction in government and private secondary schools?

Research Hypotheses

The following hypotheses were tested at 0.05 level of significance.

i. There is no significant difference in the mean rating scores of teachers on the extent to which specified teaching methods are used in government and private secondary schools for effective implementation of BST curriculum.
ii. There is no significant difference in the mean rating scores of teachers on the extent to which specified assessment methods are used in government and private secondary schools during instruction.

Methodology

The study adopted a cross sectional survey design on the extent to which specified teaching and assessment methods are used by Basic Science and Technology teachers for effective implementation of the 3-year Upper Basic Science and Technology curriculum.

The population comprised all 10,688 Basic Science and Technology teachers in North Central Nigeria. The sample consisted of 288 teachers randomly selected in both government and private secondary schools in the study area. Basic Science and Technology Classroom Observation Schedule (BSTCOS) was used for data collection. The instrument was validated by three experts, two in Science Education and one in Test and Measurement. The reliability coefficient of the instrument was determined using Cronbach alpha and internal consistency of instrument was obtained as 0.78. The instrument which contained two sections A and B was developed on a modified Likert-type four point rating scale of 4, 3, 2, and 1 as follows: each item in the two sections of the instrument has; Great Extent (GE) = 4pionts = 3.50 – 4.00, Moderate Extent (ME) = 3pionts = 2.50 – 3.49, Less Extent (LE) = 2pionts = 1.50 – 2.49, No Extent (NE) = 1piont= 0.50 – 1.49. Meanwhile, any item with the mean of 2.50 and above was accepted while items with the mean of 2.49 and below were considered less extent. The instrument was administered to the respondent by the researcher alongside one trained research assistant. The data collected was analyzed using descriptive statistics of mean and standard deviation, while the two null hypotheses were tested at 0.05 level of significance using independent t-test.

Results

The presentation of the data for this study is done according to the research questions and research hypotheses.

Research Question One

To what extent are specified teaching methods used by teachers for effective implementation of BST curriculum in government and private secondary schools?

Table 1: Mean and standard deviation of teachers' ratings on the extent to which specified teaching methods are used by Basic Science and Technology teachers

S/N	Teaching Methods	GSS			PSS		
		$\bar{X}$	SD	DEC	$\bar{X}$	SD	DEC
1	Project method	2.51	1.17	ME	2.62	1.25	ME
2	Demonstration method	2.84	1.27	ME	2.65	1.52	ME
3	Discovery Method	2.72	1.98	ME	2.59	1.17	ME
4	Individualized method	2.66	1.98	ME	2.50	1.27	ME
5	Discussion method	4.70	1.98	GE	4..50	1.51	GE
6	Concept mapping	1.46	1.05	LE	1.15	1.10	LE
7	Inquiry method	1.47	1.08	LE	2.50	1.19	ME
8	Laboratory method	1.49	1.59	LE	2..52	1.31	ME

9	Programmed Instruction	2.14	1.02	LE	2.44	1.51	LE
10	Team Teaching	2.67	1.04	ME	1.37	1.27	LE
11	Role playing	2.26	1.14	LE	2.59	1.32	ME
12	Simulation and games	2.36	1.14	LE	2.56	1.18	ME
13	Excursion/field trip	2.27	1.08	LE	2.47	1.52	LE
		2.43			**2.52**		
	Composite Mean= 2.48						

Key: Great Extent (GE) = 4, Moderate Extent (ME) = 3, Less Extent (LE) = 2, No Extent (NE) =1.

The data in Table 1 presents the classroom observation rating report on the extent to which specified teaching methods are used by Basic Science and Technology teachers in teaching the content of the curriculum. Although it was observed that in both government and private secondary schools, discussion method is used to a great extent, government secondary schools (GSS) used other specified teaching methods to a less extent with a total mean of 2.43, while the private secondary schools (PSS) used the methods to a moderate extent with a mean of 2.52. However, the entire cluster had a mean of 2.48. This means that the methods are used to a less extent.

Research Question Two

To what extent are specified assessment methods used by BST teachers during classroom instruction in government and private secondary schools?

Table 2: Mean and standard deviation of teachers' ratings on the extent specified assessment methods are used in assessing students during Basic Science and Technology instruction

S/N	Assessment Methods	GSS			PSS		
		$\bar{X}$	SD	DEC	$\bar{X}$	SD	DEC
1	Oral question	4.63	1.01	GE	3.63	1.21	GE
2	Quizzes	2.55	1.11	ME	2.70	1.22	ME
3	Essay writing	2.68	1.98	ME	2.88	1.19	ME
4	Multiple-choice alternative	3.20	1.92	ME	3.45	1.92	ME
5	True or false	2.32	1.97	LE	3.04	1.21	ME
6	Matching of items	2.44	1.94	LE	2.75	1.22	ME
7	Completion of blanks	2.16	1.94	LE	2.50	1.21	LE
8	Assignment	2.50	1.81	ME	2.68	2.65	ME

9	Project assessment	2.78	1.96	ME	2.90	1.52	ME
10	Practical assessment	2.00	1.74	LE	2.45	1.74	LE
		2.73			**2.89**		
	Cluster Mean = 2.81						

Key: Great Extent (GE) = 4; Moderate Extent (ME) = 3; Less Extent (LE) = 2; No Extent (NE) =1.

The data in Table 2 shows the classroom observation rating report on the extent to which assessment methods are used by Basic Science and Technology teachers during instruction. The result reveals that teachers in government secondary schools (GSS) and private secondary schools (PSS) used specified assessment methods moderately with means of 2.73 and 2.89 respectively. The cluster mean of 2.81 also shows moderate utilization of assessment methods during Basic Science and Technology instruction entirely.

Research Hypothesis One

There is no significant difference in the mean rating scores of teachers on the extent to which the specified teaching methods are used in government and private secondary schools for effective implementation of BST curriculum.

Table 3: t-test of independent sample of the difference in the mean ratings of teachers on the extent to which the specified teaching methods are used in government and private secondary schools for effective implementation of BST curriculum

Variables	N	Mean	SD	t	df	p	Level of Sig	Decision
GSS	288	2.4269	0.5121	0.055	65	0.040	0.05	Significant
PSS	288	2.4969	0.5131					

The t-test of independent sample on the extent specified instructional methods are used in government and private secondary schools recorded t-test value of 0.055 with a p-value of 0.040 which is less than 0.05 level of significance ($p = 0.040 < 0.05$). Therefore, the null hypothesis is rejected. This implies that, there is significant difference on the extent to which specified instructional methods are used by Basic Science and Technology teachers in government and private secondary schools.

Research Hypothesis Two

There is no significant difference in the mean rating scores of teachers on the extent to which specified assessment methods are used in government and private secondary schools during instruction.

Table 4: t-test of independent sample of the difference in the mean ratings of teachers on the extent to which specified assessment methods are used in government and private secondary schools during instruction

Variables	N	Mean	SD	t	df	p	Level of Sig	Decision
GSS	288	2.7260	0.5000	0.055	65	0.035	0.05	Significant
PSS	288	2.8990	0.5129					

The t-test of independent sample on the extent to which specified assessment methods are used in government and private secondary schools recorded t-test value of 0.055 with a p-value of 0.035 which is less than 0.05 level of significance ($p = 0.035 < 0.05$). Therefore, the null hypothesis is rejected. This implies that, there is significant difference on the extent to which specified assessment methods are used by Basic Science and Technology teachers in government and private secondary schools.

Discussion of Findings

The result on research question one on the extent to which specified teaching methods are used by Basic Science and Technology teachers for effective implementation of the curriculum. The finding indicates that some difference exist in the teaching methods employed by teachers in government secondary schools (GSS) and private secondary schools (PSS). The t-test of independent sample on the extent to which the specified instructional methods are used in government and private secondary schools recorded t-test value of 0.055 with a p-value of 0.040 which is less than 0.05 level of significance ($p=0.040<0.05$). Therefore, the null hypothesis is rejected. This implies that, there is significant difference on the extent to which specified teaching methods are used by Basic Science and Technology teachers in government and private secondary schools. This means that although discussion method is used by teachers in both schools to a great extent, those in private secondary schools (PSS) used the specified teaching methods only to a moderate extent. The finding is in line with Ogungbesan (2012) who earlier discovered that 70% of the teachers surveyed were using lecture and discussion methods for Basic Science instruction. The finding is also in agreement with Achuonye (2015) who reported that lecture and discussion methods are still prevalent in schools at all levels.

The t-test of independent sample on the extent to which specified assessment methods are used in government and private secondary schools recorded t-test value of 0.055 with a p-value of 0.035 which is less than 0.05 level of significance ($p=0.035<0.05$). Therefore, the null hypothesis is rejected. This implies that, there is significant difference on the extent to which specified assessment methods are used by Basic Science and Technology teachers in government and private secondary schools. This shows that although oral questioning is widely used by both teachers, those in PSS used more specified assessment methods compared to GSS teachers. The finding is in conformity with Achuonye (2015) who discovered that oral questioning is the most common assessment method at all levels of education. The findings also agreed with Moyinoluwa

(2014) who stated that oral questioning is the major assessment method teachers employed in Basic Education schools.

Conclusion

It is concluded based on the findings that teachers in both government and private secondary schools do not vary their teaching and assessment methods. To include creative and problem solving methods as specified for effective implementation of the 3-year upper Basic Science and Technology curriculum. This implies that, teachers in both government and private secondary schools used specified teaching methods to a less extent while specified assessment methods are used only moderately.

Recommendations

It was recommended based on the findings that; the government through the Ministry of Education (MOE), State Universal Basic Education Boards (SUBEB), Private School Owners and other relevant agencies should ensure that;

i. Teachers in both government and private secondary schools use specified teaching and assessment methods to a great extent.
ii. Vary their teaching and assessment methods to include more creative and problem solving methods for effective implementation of the curriculum.

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