TEACHERS UTILIZATION OF FORMATIVE ASSESSMENT STRATEGIES IN ENHANCING THE TEACHING AND LEARNING IN SCIENCE SUBJECTS AMONG SENIOR SECONDARY SCHOOL STUDENTS IN ABIA STATE

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Abstract

This study investigated teachers' utilization of formative assessment strategies in enhancing the teaching and learning of science subjects in Abia State. Two research questions were answered and two null hypotheses were formulated to guide the study. The study adopted descriptive survey research design. The population for the study was 1636, made up of all the senior secondary Agricultural Science, Biology and Physics teachers in Abia State. Proportionate stratified random sampling technique was used to select 104 Agricultural Science teachers,173 Biology teachers and 86 Physics teachers making a total sample size of 363 science teachers (198 males and 165 females teachers). A structured questionnaire titled "Teachers Utilization of Formative Assessment Strategies in Enhancing Teaching and Learning in Science Subjects (TUFASTLSS) was developed by the researchers. The instrument was subjected to face validation by three experts in measurement and evaluation. A reliability coefficient of 0.83 was obtained using Pearson's Product Moment Correlation Coefficient. The data collected were analysed using descriptive statistical tools. Frequency counts, mean and standard deviation were employed to answer the research questions with a set mean value of 2.50, while Analysis of Variance (ANOVA) was used to test the null hypotheses at 0.05 level of significance. The findings of the study revealed that Science teachers use commonly known formative assessment strategies and neglect the more sophisticated and upgraded ones. Based on the findings, it was recommended among others that Science teachers in secondary schools should be trained on the use of the sophisticated and upgraded formative assessment strategies.

Keywords: Science Teachers, Formative Assessment Strategies, Learning, Utilizations.

Introduction

Science and technology are potent sources of social and economy changes. Mankilik (2017) considers science as an important tool for effective development. Ajeyalemi (2011) equally states that the role of science education to national building could not be over emphasized. It is an important instrument for reduction and removal of illiteracy and poverty. It is a very strong instrument for developing a culturally and socially tolerant people, who exercise ethical and moral considerations in local, national and international affairs. It plays a vital role in economic development and is indispensable for personal and community health, and has been described as the basis for building the country's knowledge and economy.

The importance attached to science education has drastically changed the objectives of education in many nations including Nigeria. Onwu (2014) thus proposed a research agenda that focuses on the production of knowledge and improved understanding that is linked to the relevance of progress of science education, among others. In Nigeria, great emphasis is placed on science as a school subject at all levels of education up to the tertiary level. Accordingly, the National Policy on Education (FRN, 2013) states that university and other levels of Education system will be required to pay greater attention to the development of scientific orientation. To this end, more colleges of technology and polytechnics will be opened in a bid to improve technological and science education. According to Ogunleye (2012), science is a dynamic human activity concerned with understanding the workings of the world. This understanding helps man to know more about the universe. Without the applications of science, it would have been difficult for man to explore the other planets of the universe. Science comprises the basic disciplines such as Biology, Physics, chemistry, Mathematics as well as Agricultural Science, Many investigations have shown that secondary school students are exhibiting dwindling interest in Science especially in Biology, Agricultural Science and Physics (Esiobu, 2015).

Biology is a life science that involves the study of plants and animals. The contents range from microscopic organisms to the biosphere in general, encompassing the earth's surface and all living things. Umar (2011) sees biology as a natural science that deals with the living world: How the world is structured, how it functions and what these functions are, how it develops, how living things came into existence, and how they react to one another and with their environment. The teaching and learning of biology is very important to the development of any nation.

Biology provides opportunities to learn about the processes of all living things. What students learn is directly relevant to our species and environment. Biology as a school subject helps students learn to make more informed decisions about their own health and about significant biological issues such as genetically modified crops, the use of antibiotics, and the eradication of invasive species. Biology helps students to recognize the importance of agriculture and horticulture and potentially to contribute to its future.

Biology has a universal application in agriculture, human and veterinary medicine, development of vaccines and drugs for the prevention and curing of diseases. Biology is usually regarded as the most simple to understand among all the science subjects and thus it is the one that usually attract the widest enrolment (Ofoegbu, 2008). Despite the fact that Biology is the simplest to comprehend among the science subjects, the level of academic achievement among students is not much different from other science subjects (Adewale, Nzewuihe & Ogunshola, 2016). Biology has a close connection with agriculture. Agriculture is a biological production, which depends on the growth and development of plants and animals in a given environment (Okwo &Tartiyus, 2014).

Agriculture is at the heart of our daily life, vital to the economy and society. Agriculture is the Science and Art that deals with the cultivation of crops and rearing of animals for man's use. In other words, it involves the deliberate efforts made by man to till the soil, cultivate crops and rear animals for food and other purposes (Iwena, 2012). Agricultural sector plays a strategic role in the process of economic development of a country. It has already made a significant contribution to the economic prosperity of advanced countries and its role in the economic development of less developed countries especially Nigeria is of importance. Introduction of Agricultural science in secondary school curriculum in Nigeria is a worthwhile effort geared towards adequate food security by equipping the greater percent of the youths. Agricultural Science plays vital roles in the educational sector of Nigeria especially in Veterinary Medicine, Animal Science, Crop Science, Soil Science and Geology as well as Agro-chemical and Mining industries (Iwena, 2012). As such, it has an indispensible role in human and national development in terms of employment creations, provision of food, shelter, foreign exchange earnings and so on.

On the other hands, Physics is a branch of science concerned with the nature and properties of matter and energy. The subject matter of Physics includes mechanics, heat, light and other radiation, sound, electricity, magnetism and the structure of atoms.

The general sense for the secondary school Physics programme encompass three main objectives; acquisition of relevant knowledge with understanding, ability to handle and process information and problem solving through acquired knowledge, experimental skills and scientific investigation (Omosewo, 2013). Ette (2011) has asserted the importance of physics by saying that the technological potential of a country is more accurately gauged by the quality of its physics education than any other single index. Physics is an important subject in its own right but it also supports other subjects. Students who want to acquire higher educational qualifications in the fields of engineering or medical sciences must have strong background knowledge of physics. So, providing secondary students with clear and standard basic physics knowledge which they can utilize in their future studies has broad value. However, as important as Physics is, science educators have been lamenting over the poor achievement of students in the subject in our senior secondary schools for the past decades. (Njoku, 2012 & Umar, 2011). Contrary to the intentions of the general objectives of Physics, many students that sat for the external examination are still below the total pass at credit level in Physics (Abdulhamid, 2013).

The role and place of Science Subjects in Nigerian educational setting cannot be over-emphasized, hence the continuous need to ensure pragmatic teaching and learning of the sciences in the basic and senior secondary schools in Nigeria. One of the ways Science Subjects learning can be better enhanced is by employing the right teaching methods and in depth assessment for learning strategies that would engage the learners, spur their interest and facilitate cognitive permanence of Science Subjects concepts.

Classroom assessments fall into three subcategories. They include: diagnostic, formative and summative assessments. Each assessment may serve different purposes, but their primary focus is on the students 'performance index. Assessments (whether diagnostic, formative or summative) are pivotal to the promotion of learning and are the most reliable ways to identifying problems at the system, school or at individual student level (Gathungu, 2017).

Assessment for learning is an incredibly important part of the teaching process. It is a process of seeking and interpreting evidence for use by learners and their teachers to decide where the learners are in their learning, where they need to go and how best to get there(UK Assessment Reform Group, 2002). Dodge (2018) quipped that "in classrooms where

assessment for learning is practiced, students are encouraged to be more active and productive in their learning."

Formative assessment can otherwise be called or act as "assessment for learning"(Gathungu, 2017; Dodge, 2018). Formative assessment is the day-to-day, often informal, assessment to explore students' understanding (Council for Curriculum, Examinations and Assessment (2018). It is a wide variety of methods that teachers use to conduct in-process evaluations of students comprehension, learning needs, and academic progress during a lesson, unit or course (The Glossary of Education Reform, 2014). It is an integral part of effective teaching and learning that enables the teacher to decide how best to help the learners understand the subject matter and support their learning during learning process (Dodge, 2018). It also helps teachers to identify concepts that students are struggling to understand, skills they are having difficulty in acquiring, or learning standards they have not yet achieved so that adjustments can be made to lessons, instructional techniques, and academic support (The Glossary of Education Reform, 2014).

Formative Assessment Strategies are therefore essential teaching strategies during teaching and learning to help teachers and students evaluate progress in terms of understanding and skills acquisition, and provide guidance and feedback for subsequent teaching and learning (Cambridge Assessment International Education, 2017). Formative assessment technique could be simple as a teacher asking students to raise their hands if they feel they have understood a newly introduced concept or it could be as sophisticated as having students complete a self-assessment of their own writing that the teacher will review and comment on (The Glossary of Education Reform, 2014). However, Alonge (2004), Perry (2013) and Dodge (2018) have established that formative assessments are not school grade assessments that can be used to judge a teacher's performance, and any activities associated with the use of formative assessments should not result in an evaluation or grading for placement or promotion of the students.

The contributions of Formative Assessment Strategies in the enhancement of teaching and learning are critical; therefore, it is expected that teachers (especially those that teach Science Subjects) should be equipped to use these strategies in the course of their teaching engagements with the students. Surprisingly, studies have shown that some teachers are not aware of formative assessment strategies. Herman (2017) reported that some teachers had never heard about formative assessment, not to talk of the strategies, and by implication, it means that the teachers are not using formative assessment strategies during teaching. It is on this basis that the researchers investigating teachers' utilization of Formative Assessment Strategies in enhancing teaching and learning of Science Subjects in Abia State.

Research Questions

The following research questions guided the study

1. Do Science Subjects teachers utilize Formative Assessment Strategies in the teaching and learning of Science Subjects?
2. What are the impacts of Formative Assessment Strategies in enhancing teaching and learning in Science Subjects?

Hypotheses

The following hypotheses formulated were tested at 0.05 level of significance.

1. There is no significant difference between the mean responses of Biology, Agricultural Science and Physics teachers on the utilization of Formative Assessment Strategies in teaching and learning of Science Subjects.

2. There is no significant difference between the mean responses of Biology, Agricultural Science and Physics teachers on impacts of Formative Assessment Strategies in enhancing teaching and learning in Science Subjects.

Method

The study adopted descriptive survey research design. The population for the study was 1636, made up of all the senior secondary Agricultural Science, Biology and Physics teachers in Abia State. Proportionate stratified random sampling technique was used to select 104 Agricultural Science teachers, 173 Biology teachers and 86 Physics teachers making a total sample size of 363 science teachers (198 males and 165 females teachers) from the three education zones of Abia State. A structured questionnaire titled "Teachers Utilization of Formative Assessment Strategies in Enhancing Teaching and Learning in Science Subjects (TUFASTLSS) was developed by the researchers. The instrument was subjected to face validation by three experts in measurement and evaluation. A reliability coefficient of 0.83 was obtained using Pearson's Product Moment Correlation Coefficient. The instrument consisted of 20 items that were raised to answer the two research questions that guided the study. The instrument was designed following 4points likert rating of Strongly Agreed (SA), Agreed (A), Disagreed (D), and Strongly Disagreed (SD) weighted 4, 3, 2, and I respectively. The data generated for the study were analyzed using descriptive statistical tools, frequency counts, mean and standard deviation were employed to answer the research questions with a set mean of 2.50, while Analysis of Variance (ANOVA) was used to test the hypotheses at 0.05 level of significance

Results

Research Question 1: Do Science Subjects teachers utilize Formative Assessment Strategies in teaching and learning Science Subjects?

Table 1: Mean and Standard Deviation on the Utilization of Formative Assessment Strategies by Junior Secondary School Science Subjects Teachers

	Items	Mean	Std. Dev	Decision
	I use the following formative assessment strategies:			
1.	Ungraded Quiz	2.56	0.72	Accepted
2.	Oral Questioning	2.66	0.70	Accepted
3.	Observation of Students' work	2.93	0.73	Accepted
4.	Traffic light (green, yellow, red response cards	2.26	0.62	Rejected
5.	Observation of students' facial expressions	3.10	0.65	Accepted
6.	Teachers' comment on students' work	2.63	0.80	Accepted
7.	Hand raising	2.70	0.86	Accepted
8.	Home work	2.76	0.67	Accepted
9.	Class work	2.32	0.84	Accepted
10.	Peer corrections	2.86	0.56	Accepted
11.	Listen-Think-Pair-Share	2.02	0.69	Rejected
12.	Progress monitoring system	2.42	0.87	Rejected
13.	Student self-Assessment	2.22	0.81	Rejected
14.	Exit Assessment	2.45	0.74	Rejected
	Cluster Mean/Standard Deviation	**2.63**	**0.10**	

N= 363

Analysis of data in Table 1 showed that Science Subjects teachers in Abia State Secondary Schools utilize some of the Formative Assessment Strategies in their day to day teaching and learning activities as indicated in items 1, 2, 3, 5, 6, 7, 8, 9 and 10 with mean scores of 2.56,

2.66, 2.93, 3.1, 2.63, 2.7, 2.76, 3.23, and 2.86 respectively. The teachers, however, agreed that they do not frequently use the following types of Formative Assessment Strategies (Traffic light cards, Progress monitoring system, Self assessment and Exit assessment) when teaching the students, based on the responses to items 4, 11, 12, 13 and 14 (with mean scores of 2.26, 2.02, 2.42, 2.22 and 2.45 respectively).

Research Question 2: What are the impacts of Formative Assessment Strategies in enhancing teaching and learning in Science Subjects?

Table 2: Mean and Standard Deviation on the Impact of Using Formative Assessment Strategies in Enhancing Teaching and Learning in Science Subjects by Secondary School Teachers

	Item	Mean	Std. Dev	Decision
1.	Formative Assessment Strategies simplifies the teaching of Science Subjects concepts	3.47	0.72	Agreed
2.	Formative Assessment of Strategies Improve learner's outcome	3.42	0.56	Agreed
3.	Formative Assessment Strategies facilitate students' confidence and self efficacy	3.45	0.58	Agreed
4.	Formative Assessment Strategies increase students' independence and active participation	3.36	0.70	Agreed
5.	Formative Assessment Strategies aids faster cognitive learning of Science Subjects	3.32	0.69	Agreed
6.	Formative Assessment Strategies enable a supportive and collaborative classroom	3.13	0.81	Agreed
	Cluster Mean/Standard Deviation	**3.36**	**0.09**	

N= 363

Table 2 above showed the impacts of using FAS in enhancing Science Subjects teaching and utilization of Formative Assessment Strategies immensely enhances the teaching and learning of Science Subjects. Mean score responses to items 15, 16, 17, 18, 19, and 20 which are 3.46, 3.46, 3.45, 3.33, 336, and 3.13 respectively confirmed that Formative Assessment Strategies impact on the teaching and learning of Science Subjects.

Hypothesis One

There is no significant difference between the mean responses of Biology, Agricultural Science and Physics teachers on the utilization of Formative Assessment Strategies in teaching and learning of Science Subjects.

Table 3 one-way analysis of variance (ANOVA) on Mean Responses of Science Teachers on the Utilization of Formative Assessment Strategies in the Teaching and Learning of Science Subjects

Source of variation	Sum of square	DF	Mean Square	F_{cal}	P-value	Decision
Between groups	2.38	2	1.19			
Within groups	171.74	360	.477			NS
Total	174.13	362		2.50	0.084	

NS = Not Significance

The results of the above analysis showed the calculated F-value of 2.50 when tested at 0.05 level of significance with (2, 360) degree of freedom. Since the alpha at 0.05 is less than the P-value of 0.084. Therefore, the null hypothesis which states that there no significant difference between the mean responses of Biology, Agricultural Science and Physics teachers on the utilization of Formative Assessment Strategies in teaching and learning of Science Subjects is upheld. It implies that there is no significant difference between the mean responses of Biology, Agricultural Science and Physics teachers on the utilization of Formative Assessment Strategies in teaching and learning of Science Subjects.

Hypothesis Two

There is no significant difference between the mean responses of Biology, Agricultural Science and Physics teachers on impacts of Formative Assessment Strategies in enhancing teaching and learning in Science Subjects.

Table 4 one-way analysis of variance (ANOVA) on Mean Responses of Science Teachers on Impacts of Formative Assessment Strategies in Enhancing Teaching and Learning in Science Subjects

Source of variation	Sum of square	DF	Mean Square	F_{cal}	P-value	Decision
Between groups	3.14	2	1.57			
Within groups	189.09	360	.525			NS
Total	192.22	362		2.99	0.061	

NS = Not Significance

The results of the above analysis showed the calculated F-value of 2.99 when tested at 0.05 level of significance with (2, 360) degree of freedom. Since the alpha at 0.05 is less than the P-value of 0.061. Therefore, the null hypothesis which states that there no significant difference between the mean responses of Biology, Agricultural Science and Physics teachers on impacts of Formative Assessment Strategies in enhancing teaching and learning in Science Subjects is upheld. It implies that there is no significant difference between the mean responses of Biology, Agricultural Science and Physics teachers on impacts of Formative Assessment Strategies in enhancing teaching and learning in Science Subjects.

Discussion

The finding of the study revealed that not all the Formative Assessment Strategies that were identified by the researchers were utilized by the Biology, Agricultural Science and Physics teachers in teaching Science Subjects. The teachers only made use of the very common and general forms of formative assessment strategies. The more sophisticated and upgraded result-oriented forms of formative assessment strategies were avoided. Some of the unutilized sophisticated and upgraded result-oriented strategies include: Listen-Think-Pair-Share, Progress monitoring system, Student self-assessment, and Exit assessment. The corresponding hypothesis affirmed that there is no significant difference between the mean responses of Biology, Agricultural Science and Physics teachers on the utilization of Formative Assessment Strategies in teaching and learning of Science Subjects. This finding is in agreement with Dixon and Williams (2001) that reported that teachers lack clarity about

the distinctions between formative and summative assessments and how to use them. Cambridge Assessment

International Education, (2017) stated effective teachers are expected to integrate formative assessment strategies in their lessons as a natural part of what they do. This is supported by Gathungu, (2017) who stated that teachers that use formative assessment approaches and techniques are better prepared to meet diverse students' needs and achievements.

The finding of study also showed that the utilization of formative assessment strategies greatly enhance the teaching and learning of Science Subjects. The corresponding hypothesis affirmed that there is no significant difference between the mean responses of Biology, Agricultural Science and Physics teachers on impacts of Formative Assessment Strategies in enhancing teaching and learning in Science Subjects. This finding is in conformity with Cambridge Assessment International Education, (2017) that asserted that formative strategies help low-achieving students to enhance their learning. Gathungu, (2011) funther affirmed that formative assessments provide specific feedback to teachers and

Conclusion

This study investigated teachers' utilization of formative assessment strategies in enhancing Science Subjects teaching and learning in Abia State. The result of the study showed that teachers only implement the commonly known formative assessment strategies and neglect the upgraded and sophisticated types

Recommendations

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

1. Science Subjects teachers should be trained on the use of the sophisticated and upgraded formative assessment strategies.
2. School administrators should organize seminars and workshops.
3. Government and school owners should provide enabling environment and learning facilities to the teachers so s to facilitate optimal performance.

References

Abdulhamid, A. (2013). Effects of teaching method on retention of Physics knowledge in senior secondary schools of Bauchi local government area, Nigeria. *International Journal of Science and Technology Educational Research. 4 (4), 63-69.*

Adewale, A. M. Nzewuihe, G. & Ogunshola, F. (2016). Academic performance in biology at secondary school certificate examination (SSCE) and the influencing factors among students in Owerri municipal of Imo State, Nigeria. *International Journal of Education and Evaluation 3(2), 1-10*

Ajeyalemi, D. (2011). *Science and Technology Education in Africa.* Focus on seven Sub-Saharan Countries. Lagos. University of Lagos Press.

Cambridge Assessment International Education (2017). What is Assessment for Learning? Retrieved 12th July, 2019 from: www.Cambridge-community.org.uk

Council for Curriculum Examinations and Assessment (2018). What is Formative Assessment? Retrieved 13th June, 2019 from: http:// ccea.org.uk

Dixon, H. & Williams, R. (2001). Teachers Understanding of Formative Assessment. In the *Journal of British Educational Research Association 2(3), 34-58*

Dodge, J. (2018). What are Formative Assessment and Why Should We Use Them? Retrieved 9th July, 2019 from: htt://www.scholastic.com/teachers/articles/

Eberly Center (2016). What is the Difference between Formative and Summative Assessment? Retrieved 15th May, 2019 from: https:www.cmu.edu

Esiobu, I. T.(2015). *Improvision in Science Teaching philosophy and Practice*. Abak Publishers: Belpot Nigeria company.

Ette, F.E (2011)The Psychology of Learning. An introductory text book for teachers and students in Africa. Malthouse press ltd. P. 75.

Federal Republic of Nigeria (2013). National Policy on Education. Lagos. NERDC Press.

Gathungu, G. (2017). An Examination of the Contribution of Diagnostic Assessment on Achievement of Learning in Kenya. *International Journal of Education Assessment in Africa 11(3), 23-47.*

Herman, I. (2017). Enhancing Teaching and Learning through Formative Assessment in Large Cameroonian Classes. *European Science Education Research Association 4(2), 123-164.*

Iwena, O.A (2012). Essential Agricultural Science for Senior Secondary Schools, Tonad Publishers Limited. Ikeja,

Mankilik, M. (20017) An Analysis of Students Misconceptions of Physics Concepts Among Remedial Students In University Of Jos. *Standardizer of The Nigerian Academic 3(2) 165-170*

Njoku, Z.C. (2012) Effective use of models for science and technology instruction. *Journal of Science Teachers Association of Nigeria 34 (2) 45-50*

Ofoegbu, T.O.(2008). Challenges of implementing Senior Secondary One (SS1) curriculum in Nigeria. *Journal of the Science Teachers Association of Nigeria, 38(1&2) 46-50.*

Ogunleye, P. O. (2012). Effects of team teaching on student's performance in science subjects: Implication for quality assurance in secondary. *Nigeria journal of curriculum studies 15(2), 60 –67.*

Okwoh, F.A., and Tartigus, I., (2014) Effect of position of diagram and cognitive style on Biology Achievement of Pre-National Diploma Students. *Journal of Science Teachers Association of Nigeria, 39(2). 88-92.*

Omosewo, E.O. (2013). Impact of discovery methods of teaching of students achievement in physics. *Journal of Nigeria Association of Teachers of Technology 3(1) 1-10.*

Onwu, G. O.M. (2014). Refocusing research in science technology and mathematics (stm) education : mapping out a research agenda for the future. *Proceedings of the 45th Annual Conference of Science Teachers' Association of Nigeria.2004. Key Note Address.*

Perry, L. (2013). Formative Assessment Use and Teaching in Africa. Retrieved 12th July, 2019 from: https/:Smu.edu

The Glossary of Education Reform (2014). Formative Assessment. Retrieved 12th July, 2019 from: www.edglossary.org/formative-assessment/#leftNav

UK Assessment Reform Group (2002). Assessment for Learning. Retrieved 12th July, 2019 from: www.assessmentforlearning.edu.au.

Umar, A. A. (2011). Effects of biology practical activities on students' process skill acquisition in Minna, Niger State, Nigeria. *JOSTMED, 7(2), 118–126.*