The Challenge of Effective Science Teaching in Nigerian Secondary Schools

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Abstract

This paper attempts to highlight the performance of students in science in Nigeria, and some of the factors that affect performance in science. These include, Quality Science teaching, Teacher quality and the five indicators of teacher quality. These include; academic and professional qualification, In-service refresher courses and trainings, teacher experience and teacher salary and quality teaching –learning resources. All these factors affect largely the way science is taught in schools. Regrettably the teaching and learning of science in Nigerian schools cannot be said to be effective because of the poor performance of students resulting from inappropriate teaching methodologies, lack of adequate knowledge of subject matter, competencies, skills, inadequate teacher training and lack of in-service training and refresher courses, and lack of basic teaching-learning resources. The way forward to improving science education in Nigeria is also discussed and recommendations and conclusions made.

Keywords: *Performance, Quality, Teaching, Teacher, Resources*

1. Introduction

The 21st century is characterized by advancement in science and technology. For Nigeria to realize accelerated development in the 21st century, she needs qualitative science education in our schools especially in senior secondary schools. Over the last two decades, there have been repeated calls for reforms and innovations aimed at improving Science Education in Nigeria. This suggests that there are issues in science Education in Nigeria that needs to be improved upon.

Science is an organized body of knowledge in form of concepts, laws, theories and generalizations. Urevbu (2001) defines science as a study of nature and natural phenomena in order to discover their principles and laws. Science has three interrelated aspects: content, process and attitude. Content can be separated into physical, life and earth sciences. Process involves the fifteen inquiring skills proposed by the American Association for the Advancement of Science (AAAS) which include observing, classifying, experimenting, measuring, inferring, organizing data etc. Attitude concerns openness and objectivities (Omoifo, 2012)

Education is "The total process of human learning by which knowledge is impacted, faculties trained and skills developed" (Urevbu, 2001). Science Education is a field of study concerned with producing a scientifically literate society. It acquaints students with certain basic knowledge, skills and attitudes needed for future work in science and science related fields. Although there are several issues in science education in Nigeria, the following areas of emphasis have been identified for discussion: students performance in science and some factors influencing poor performance

which include Quality of Teaching, Teacher Quality and its indicators and Quality teaching learning resources.

2. Performance of Students in Science

Table 1: School certificate examination results for sciences subjects

Year	Subjects	Total students	Total pass	% pass	Total Failure	% Failure
1995	Physics	120,768	64,185	53.3	56,383	46.7
	Chemistry	133, 188	87, 262	56.6	45,926	34.5
	Biology	453, 353	222, 891	49.2	230, 462	50. 8
1996	Physics	132,768	57,321	43.2	75,446	56.8
	Chemistry	144,990	87,676	69.5	57,314	39.5
	Biology	506,628	208,231	41.2	297,789	58.8
1997	Physics	127,486	56,352	44.1	71,234	55.9
	Chemistry	138,572	64,923	46.9	73,649	53.1
	Biology	492,429	203,205	21.3	289,224	58.7
1998	Physics	169657	7356	43.36	93639	55.19
	Chemistry	182659	7973	43.64	95498	52.28
	Biology	626894	374779	59.77	243581	38.85
1999	Physics	210271	126055	59.94	777.09	36.95
	Chemistry	223307	121076	54.21	94347	42.24
	Biology	745102	411446	55.21	315919	41.97
2000	Physics	188312	129075	68.54	59237	31.45
	Chemistry	195810	114745	58.60	81056	41.39
	Biology	620291	3043372	49.06	315919	5093
2001	Physics	287993	209506	72.74	78487	27.25
	Chemistry	310740	191076	63.32	110664	36.67
	Biology	995345	527129	52.95	468216	47.04
2002	Physics	254188	20282	79.69	51606	20.30
	Chemistry	262824	167968	63.90	94856	36.09
	Biology	882119	548423	62.17	333696	37.82

By implication less than 50 percent of students pass their science examinations. This is further illustrated with the percentage of students who passed at credit level and above in 2000 to 2004 as shown in figure 1.
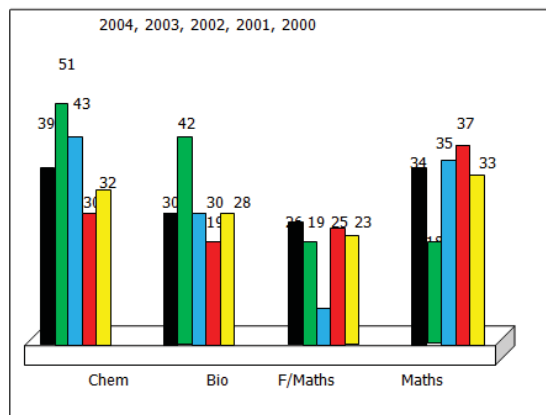

Fig. 1: WASSCE Percentage passes at Credit level and Above (source WAEC, 2004)

Table 2: Performance level for SSCE and JSSCE in Mathematics and Science in Ondo and Ekiti States (2005-2009)

State	Years	SSCE				JSSCE	
		Mathematics	Physics	Chemistry	Biology	Mathematics	Integrated Sc.
Ondo	2005	17	14	32	52	41	49
	2006	24	39	38	40	49	49
	2007	19	35	42	35	52	49
	2008	20	33	48	32	35	52
	2009	26	36	50	43	57	53
Ekiti	2005	10	8	17	34	40	49
	2006	14	25	20	19	60	52
	2007	11	19	24	18	57	50
	2008	13	18	26	17	54	50
	2009	16	19	27	25	55	53

Source: Adeyemi (2011).

For the five years the highest percentage pass was in biology in 2005. In the same year only 8 percent of the students passed in Physics. Although the picture seems better as the JSSC, it is disappointing that the highest percentage pass for integrated science is 52% in 2009. The situation is not better with National Examination Council (NECO) results. The summary of NECO results released for November/December 2011 examination is presented in figure 2.
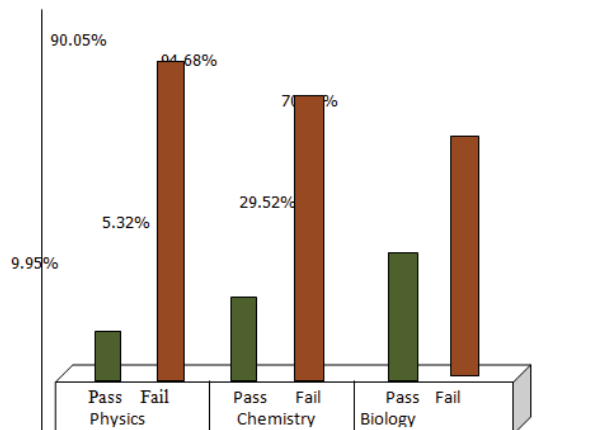

Fig. 2: NECO November/December 2011 Examination Result.

The November/December examination is for external candidates. Of the total number of students who sat for Physics 43,504 or 90.05% failed. Even though 9.95% of the students passed, only 24 candidates or 0.05% passed at credit level and above. In Biology, of the 97,595 that sat for the paper, only 29.52% passed out of which only 8109 or 7.57% passed at credit level and above, while 75486 or 70.48% failed. In Chemistry of the 44,950 that sat for the paper 2,577 or 5.32% had credit and above, 3,432 or 7.09% had passed, while 37, 973 or 70.39% failed.

The Tables, paints alarming downward trend and indicates poor performance. This downward trend in students' performance in external examination in science has become a source of worry to all.

3. Factors Influencing Students Performance in Science

3.1 Quality of Teaching

Inadequate teaching has been advanced as one of the problems of science education in Nigerian secondary schools. Quality science teaching is effective science teaching. Effective teaching occurs when students learn and achieve many scientific goals and not just being able to repeat scientific knowledge (Omoifo 2012). During effective learning, student learn how to learn, students develop conceptual understanding and thinking skills, thus helping students change their intuitive, everyday ways of explaining the world around them to incorporate scientific concepts and ways of thinking into their personal frameworks. Therefore students' ability to solve problems and perhaps enhanced learning occurs.

According to Okafor, (2007), quality teaching lies at the teacher's capacity to transform written knowledge into forms that are pedagogically powerful and yet adaptive to the students' abilities and backgrounds. Ayodele (2006) identified the use of inappropriate non-effective teaching methodology as a major factor hindering students understanding and achievement in science. The teaching and learning of science do not require theoretical and lecture approaches. Onose (2009), posited that many in experience teachers teach science in abstraction, thereby making science lessons boring and the students finding it difficult to grasp some scientific concepts, skills and principles.

Abdulahi (2007), and Ogbeba (2010).observed that most teachers emphasis theory rather than practical aspects of science subjects and most of them lack adequate knowledge of subject matter and the competence to deliver. In addition, they stressed that the teaching of science has been reduced to a descriptive exercises through the use of lecture method and very little inquiry. Although, the National Policy on Education (1998), emphasized the activity based and child-centered learning, most science lessons are of the traditional lecture. There are few classrooms with demonstrations, and when in use it is often teacher demonstration which makes students passive. There are also few traditional hands- on (practical) classes. Our science lessons are yet to be structured, guided and students directed. (Omoifo,2012).

3.2 Quality of Teachers:

Poor quality of science teachers in terms of adequate knowledge base and pedagogic skills is another factor identified to influence students performance. The teacher's academic qualifications and knowledge of subject matter, competencies and skills, and the commitment of teacher have a great impact on the teaching learning process. A science teacher is anyone who teaches science. Science teachers in Nigeria are prepared mainly at colleges of Education and faculties of Education of different universities.

Achieving the goals of science education requires qualified and highly scientifically literate teachers. Okureme (2003) posited that: An effective science teacher should be a master of his subject, as well as grounded in methods of teaching and be able to relate the science concepts to real life experience. Abd–El-phallic and Boulaoude (1997) conceived such teachers as those who understand the concepts, principles, theories and processes of science and are aware of the complex relationship between science, technology and society. Such teachers more importantly must develop an understanding of the Nature of Science. This is important because the portion of scientific knowledge science teachers choose to teach and how they carryout the instruction presents a particular view of the nature of science to their students. (Omoifo, 2012).

The teacher knowledge base for effective science teaching is very important in that they are to help the students completely understand the content and underlying philosophy of science. This has long been stressed and culminated in recent emphasis on teacher preparation programmes that will produce sound and effective scientifically literate teachers. Different studies showed that

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the most important resource input in the school that predicts student achievement is Teacher Quality and effective teacher will have students with good test score (Dahar, Dahar, Dahar and Faize, 2011)**.** The five indicators of teacher quality according to Dahar et al (2011) are academic qualification, professional qualification, in-service refresher courses and trainings, teacher experience and teacher salary.

3.3 Academic Qualification:

Academic qualification is a very important quality of a teacher. Academically qualified teacher has move authentic knowledge about the relevant subject than the academically less qualified teacher has Nigerian Science Teachers. Molnar (2002), reported some studies in which students taught by certified teachers consistently outscored those taught by uncertified teachers. He posited that a poorly trained teacher will likely produce a poor doctor, engineer, architect, fellow teacher and the like.

3.4 Professional Qualification:

Professional qualification can be termed as the preparation for life long journey into the teaching profession. The basic skills and abilities of the teaching learning process are developed in a teacher through professional qualification. Professional qualification can be categorized into pre-service and in-service professional qualification. The National Policy on Education (2004) in section 6:70b states that the qualification for entry into the teaching profession shall be the Nigeria certificate in education (NCE)″. Omayuli and Omayuli, (2009) posited that most of the science
     teachers are also not professionally trained. To the extent that an engineer is recruited to teach Mathematics, Physics and Chemistry, rather than specialists actually trained to teach the subjects.

3.5 Teaching experience:

Teaching experience is the time spent by a teacher in the teaching profession. With the passage of time teachers get command of their subjects and become competent in the art of teaching through experience. In other words, teaching experience improves the teaching skills and methodologies adopted.

3.6 Teacher Salary:

Teacher salary is very important as a predictor of students achievement because it has a capacity to uplift the other aspects of teacher quality. If a teacher gets a suitable salary that covers the basic living costs, he may be able to live comfortably and thus be more effective as he is motivated to use his abilities, competencies and skills. Poor remuneration affects the morale of teachers, distracts and hinders their commitment and effectiveness.

3.7 In-service Refresher courses and Training:

Over the years, the interplay of politics and economics on teacher training policies led to some degree of compromise in admission requirements. Consequently, a large proportion of what we have today as trained science teachers are professionally incompetent. This fact prompted Aluede (2003) to say that the general deterioration and collapse of the educational system have resulted in a guild of teachers who are unqualified and even uncommitted to leading the learners to expected destination. Odia and Omonfonmwan (2007) opined that the teacher training institutions have tended to produce teachers that are inadequate in terms of knowledge of subject matter and

pedagogic skills. The quality of teachers is dependent on the nature of their preparation and training. In-service education and training is a continuous on-going process for teachers throughout their professional life. It may be provided at any time between joining the service until retirement. Okhiku, (2005) summarized in-service training as all the activities, planned and structured engaged in by professionals (teachers) during their service aimed at helping the teacher to acquire basic skills for the efficient execution of the functions for which he was employed. As noted by Ajayi (1998) in Okhiku (2005), teachers are not finished products even after the completion of a preparation or pre-service programme. Science teachers are faced with the challenge of meeting with new innovations in science. It was in recognition of this fact, that it was stated in section 6:70b of the NPE that "Teachers shall be regularly exposed to innovations in their profession. Also In-service training shall be developed as an integral part of continuing teacher education and also take care of all inadequacies (6:75).

3.8 Quality Teaching Learning Resource

Lack of ideal resources for science teaching and learning in Nigerian schools has been a major issue of concern. It is a well known fact that the quality of education a student receives largely depends on the quality of teaching/learning resources provided. Teaching learning resources are all the things used by the teacher during teaching to aid understanding and make teaching successful and effective. They include, modern textbooks, equipments, consumables like chemicals and reagents, models, charts e.t.c. and the physical learning environments which include the science classrooms and laboratories.

One of the major objective of science education is to teach students the scientific process. Students need some investigative skills such as observing, measuring, classifying recording experimenting, analyzing inferring, e.t.c. To achieve this, science classrooms, laboratories and the general learning environment must be adequate and conducive. Inquiry focused science teaching demands a lot of activities on the part of the learner that require scientific materials and equipments.

Due to the fact that majority of schools lack the essential resources for imparting the knowledge of science concepts to students, many students learn little science, learning tends to be by rote and many students find science not interesting and boring (Ogunmade, 2006). The teacher student interactions in many science classrooms are not healthy because of lack of adequate resources. In most of our schools, there are no facilities for the teachers to demonstrate phenomena, let alone allow the students to have opportunities for finding out things for themselves (Audu and Oghogho, 2006).

The situation in many science classrooms in Nigeria is nothing to write home about. In many schools there are no laboratories. Some schools merely have empty rooms labeled laboratories. Students rarely have hands-on, minds-on experiences. Few days to science practical examinations, most schools acquire science equipments for teacher demonstration to students. This cannot make for effective learning and eventually results in poor achievement (Omoifo, 2012). To worsen the problem of lack of or inadequate resources, the few available ones are not properly maintained, protected and cared for. Ogunmade (2006) stated that "Majority of students do not have textbooks and most of the schools do not have libraries and where they have one, the textbooks in the libraries are outdated.

4. Improving Science Education in Nigeria for Effectiveness: The Way Forward

4.1 Science Education can be improved if the Teacher Quality is Improved

Concerted efforts should be made by authorities in our higher institutions of learning to establish and sustain non compromised high admission standard (Odia and Omofonwman 2007). Also, the

right caliber of teachers should be recruited and making of the teaching profession a dumping ground for those who cannot get employment elsewhere must be discouraged.

4.2 Teachers' Training and Retraining Issues.

Regrettably today in Nigeria, Science teaching cannot be said to be effective due to observed low performance of science students. The competence, effectiveness and efficiency of a teacher is a function of his training. Therefore training and retraining of science teachers should be given greater emphasis and implementation. Such training should take cognizance of effective teaching strategies, acquisition of adequate concept of the nature of science and adequate knowledge base/ content for effective science teaching. However if teachers are properly trained, it is expected that they will be effective. Therefore it is strongly recommended to improve the existing science teachers training programme with respect to admission criteria, curriculum, teaching practice and measurement and evaluation process. Proper training of teacher may strengthen the causal-relationship between the various qualities of teachers and academic achievement. (Dahar, Dahar, Dahar and Faize, 2011).

4.3 Quality of Teaching Issues.

Central to the calls for a new approach to science education, educators have suggested that special attention be given to teaching about science, i.e developing an understanding of the nature and methods of science. Quality Science teaching has three major aspects as pointed out by Ayodele (2006): These are:
   a. Learning Science (i.e acquiring and developing conceptual and theoretical knowledge).
   b. Learning about science (i.e developing an understanding of the nature and methods of science and an awareness of the complex interactions between science and society).
   c. Doing Science (i.e engaging in and developing the expertise in scientific inquiry by using the methods and procedures of science to investigate phenomena and solve problems).
   Akinyemi (2006) posited that "if we want performance of students in science to improve, they should be encouraged to use appropriate thinking strategies through innovative intervention by teachers. The emphasis now is on inquiry teaching because this will develop better understanding of the nature of science.

4.4 Resources for Science Teaching and Learning Issue

Since effective teaching and learning of science requires adequate resources such as classrooms, laboratories, textbooks, charts, models and consumables like chemicals and reagents for the teachers to engage students in practical and activity work, the stakeholders in science education should provide enough funds to build more classrooms, laboratories and provide the equipments and resources for the teaching and learning of science. Libraries should be provided with modern quality science textbooks for teachers and students.

5. Conclusion

The attainment of the goals of science education is largely dependent on the quality of teachers. Therefore there should be quality teacher development. Opportunities to enrich teachers' practices and competencies through in-service training, conferences, seminars and workshops should be provided on a regular basis to help them keep abreast with recent developments in the field of science and broaden their knowledge of subject matter.
   There should be proper staffing of schools in terms of quality and quantity. Good practices for effective implementation of inquiry based science education must be identified and properly

implemented. There should also be provision of modern teaching –learning resources in terms of quality and quantity as students need a variety of science materials to engage in inquiry-centered science learning. Libraries and laboratories should be provided and well equipped. The school administrators, managers, teachers, laboratory assistants, and students should develop good maintenance culture. If science is properly taught from the lower level, this will lay a sound foundation for science at higher levels.

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