EVALUATION OF SCIENCE TEACHERS PREPARATION AND EFFECTIVE USE OF INSTRUCTIONAL MATERIALS AND PERFORMANCE IN SCIENCES

By

MUHAMMED HUDU SAMBO
Department of Science, Technology and Mathematics Education,
Nasarawa State University,
Keffi.

ISAAC JANGSON KUKWI
Department of Educational Foundations,
Nasarawa State University,
Keffi.

ISAIAH AMEDU ODABGOYI
Department of Primary Education Studies,
College of Education,
Akwanga.

And

MUHAMMED AGAHU USMAN
Department of Chemistry,
College of Education,
Akwanga.

Abstract

This experimentally designed study with pre-test and post-test aimed at evaluating the effects of Science Teacher preparation and effective use of instructional materials on the performance of Senior Secondary School (SSS) Student's in Sciences. 450 SSS students (comprising of 270 males and 180 females) and 60 science teachers, (made up of 46 males and 14 females) were drawn from the three senatorial zones of Nasarawa state, Nigeria for the study. A reliability coefficient of 0.84 was obtained from the pilot study scores. The mean gain scores were used to compute for each group of the pre-test and post-test scores, as 7.9, & 6.5, 4.0 & 3.3 and 7.3 & 3.2 for experimental and control groups respectively. The students were exposed to workshop

experiences on the use or absence of Handout, Textbooks and Projectors by the 60 different categories of science teachers. The post-test group mean score were compared using a t-test statistical analysis. The t-values indicated by the different variables are, 4.57 (use of wks + hnd), 3.29 (use of wks + txb) and 4.68 (use of wks +pjt). The findings of this study revealed that there is a significant difference between the experimental and control groups at P<0.05, with df=49.

The ability of science teacher to organise classrooms, manage behaviour of their students and use instructional materials effectively in their teaching is critical to achieving positive educational outcomes. Although, sound behaviour management does not guarantee effective instruction possible, proper evaluation of science teacher preparation and use of instructional materials reduces classroom problems (Emmer & Stough, 2003 and Flick & Bell, 2005). A significant body of research also attests to the fact that proper evaluation of science teacher preparation and effective use of instructional materials competencies influence the persistence of new teachers in teaching careers (Ingersoll & Smith, 2004).

According to Okafor, (2004), Science Teacher preparation is that form of preparation which is properly planned and experimentally tailored and applied for the cultivation of those who teach or will teach particularly but not exclusively, in primary and post-primary levels of schooling. In its expected dimension, it encompasses the preparation of Administrators, Supervisors, and Guidance Counsellors within the same frame of reference. In the same vein, Umeoduagu, (2006), says that, it is the Academic curricular configuration designed solely for professional preparation of teachers, School Administrators, Supervisors and School Guidance Counsellors. The primary aim is to help science teachers help young stars under their tutelage to achieve maximum knowledge for optimum change of behaviour in minimum time under the given conditions (Ogunniyi, 2005).

National Science Teachers Association (NSTA, 2003), support science teacher preparation aligned with the goals and guidance provided by the National Science Education Standards (National Research Council 1996) and Educating Teachers of Science, Mathematics, and Technology: New practices for the new millennium (National Research Council (1996 & 2001), has adopted and applied Standards for Science Teachers Preparation (NSTA, 2003); and is committed to increasing the number of highly qualified Science teachers by ensuring that all those entering the profession demonstrate a deep understanding of pure and applied science as well as the knowledge and skills required to teach students science in a more meaningful ways. The primary aim is to help science teachers help students at that age of secondary schooling to achieve maximum knowledge for optimum change of behaviour in minimum time under the given conditions.

Evaluating performance in science education and the use of instructional materials seems a large, continuous, and sometimes insurmountable task. After a major

curriculum reforms initiated by the launch of Sputnik in October, 1957, many countries and educators thought the task was pretty well completed, but that was not the case.

Science as a body of knowledge was introduced into the Nigerian secondary school curriculum because of the awareness of its importance and its relationships with technology and society in general (Okafor, 2004 & Ogbonna, 2005). In view of this realisation, a number of science curriculum projects for our senior secondary schools has been developed which, are in constant review.

Despite this stipulation and the fact that science curriculum development has come a long way, science education generally is beset with a lot of problems. Problems emanating from shortage of Basic science teachers with inappropriate science background have been documented in most schools (Muh'd and Umar, 2005). Also, as opined by Jegede, (2004) and Jegede, (2005), in most of our schools (both primary and secondary schools), there is the non-availability and inadequacy of instructional materials such as textbooks, simple apparatus, and other teaching aids to demonstrate simple science experiments to the students. This therefore entails the importance of training and re-training of Basic science education teachers in the modern methods of instruction and the use of appropriate instructional materials and equipments. This is to provide an interesting and meaningful learning environment especially at this level of education when science and technology is a national priority.

The Authors agreed with Harlen and Deakin, (2003) and Jeanplerre and Freeman (2005), whose study of the Secondary schools, found that science and technology education improvement efforts requires focus on the entire schools, not just teachers or principals or curricula, or organisations or school community relations in evaluating science teacher preparation and the effective use of instructional materials-since our experience in the design and implementation of STS educational schemes supports this view. Only by ensuring that all those who will be affected by the proposed change understand its theoretical basis and practical application, can any reform effort such as evaluation 0f science Teacher preparation and effective use of instructional materials in science and technology education be effective. All too frequently, one or more of the key players was inadvertently left out of the process. By omitting these individuals most preparation are almost doomed to fail.

Policy makers, Business leaders, Non Govermental Organisations (NGOs), and parents increasingly ask if Nigerian students (especially at secondary schools), are achieving academically as much as they can'' National Science Board (NSB, 2005). International comparisms of student's achievement in the Third International Mathematics and science study (Schmidt and McKnight, 2002, Umeoduagu, 2006, and Ingersoll, and May, 2009), have raised serious concerns about the nature and quality of science education in Nigerian **a**nd have found out that school poverty, size, and the urban city of the school community were among the school demographic characteristics most correlated with teacher turnover in public schools. According to National Science Board, (NSB, 2005), Nigerian Educational Research and Development council, (NERDC, 1999), National Centre for Education Statistics, (NCES, 2003), and National

Science Teachers Association (NSTA, 2003), the key to energizing educational system throughout the states in Nigeria is consensus on content standards for the teaching and learning of Mathematics and science. This leaves much room for choice and diversity of process and pedagogy, while reinforcing a common market of demand for the skills that will dominate the 21st century.

Hypotheses

This study was conducted to find out the relative influence of teachers' experiences on workshops and the use of instructional materials – such as the use of: Handout, Projector and Textbooks, in the teaching and learning of science programmes at senior secondary school levels. In the same vein, the following null-hypotheses were postulated and tested for validity and reliability.

Ho1 – There is no significant relationship between mean scores of students taught by Science teachers with **wks** experience and use of **hnd** and those taught

By teachers with **nwks** and with **nhnd** in the test Administration:

wks + hnd vs nwks + nhnd

Ho2 – There is no significant relationship between mean score of students taught by

Science teachers with **wks** and the use of **txb** and those taught by science Teachers with **nwks** Experience and the use of the **ntxb** in the test Administration:

wks + txb vs nwks + ntxb

Ho3 – There is no significant relationship between mean score of students taught by

Science Teachers with **wks** experience and the use of **pjt** and those taught by

science teachers with **nwks** and **npjt** in the test Administration:

wks + pjt vs nwks + npjt

Methodology

Study Area

This investigation was carried out in Nasarawa state of Nigeria. The state covers a land area of 27,116.8 sq km and has a population of 3.2 million people, National Population Commission (NPC, 2006). The state is situated on the centre of Benue-plateau highlands. Nasarawa state lies within the Guinea savannah region along latitude 8^0 54N and longitude 8^0 39E and experience tropical climate with a moderate rainfall of 1311.75cm3 and a mean monthly temperature of 34^0c.

Collection of Data

This research design is an experimental one of the pre-test and post-test control group type. Data were collected from the achievement test administered on SSS Students performance in Sciences (Biology, Chemistry, and Physics,) through the various categories of teachers that taught them (see table 1) in the schools under review. The achievement test consisted of 200 questions of multiple choices, filling in the blanks and the True or false questions based on the current core curriculum for the SSS Students.

Sample and Sampling Techniques Used

The target population for this study was the senior secondary school (SSS) students in the three senatorial district of Nasarawa state, Nigeria. 150 students were randomly selected from each of the 3 senatorial districts of the state. A total of 450 SSS Students and 60 science teachers were randomly selected from the 3 senatorial districts of the state comprising of 270 males and 180 female students. Of the 60 science teachers used for the study 10 each were exposed to workshop experiences and with or without the use of Handouts (**hnd**), Textbooks (**txb**), and Projectors (**pjt**) respectively.

Table 1: Sample Frame for Data Collection

S/N	NAME OF SENATORIAL ZONES	NAME OF SCHOOLS	NO: OF SCIENCE STUDENTS			NO:OF SCIENCE TEACHERS PER SUBJECT			TOTAL
				Boys	Girls	Bio	Chm	Phy	
				30	20				
		-GSCS Lafia	50	30	20	4	3	3	10
1.		-GC Doma	50	30	20	2	2	2	6
	Nasarawa south zone	-FGC Keana	50			3	2	2	7
2.		-GC Keffi	50	30	20	2	2	1	5
	Nasarawa East zone	-GSS Karu	50	30	20	3	3	2	8
		-GSS Nass,kf	50	30	20	2	2	2	6
3.		-DSS COEAK	50	30	20	2	2	2	6
	Nasarawa North zone	-GSCS Wamba	50	30	20	2	1	2	5
		-GSCS N/Egg	50	30	20	3	2	2	7
						23	**19**	**18**	**60**
		TOTAL	**450**	**270**	**180**				

GSCS = Government Science School, GC = Government College, FGC = Federal Government College, DSS = Demonstration Secondary School, GSS = Government Secondary School

A total of 60 Science Education teachers (who teach Biology, Chemistry, Physics and few Integrated science Teachers) participated in the study, which were drawn from the Nine SSS in the state. Ten teachers were exposed to workshop experience, use of Handout, Textbook, and use of projector and ten teachers were not. These teachers were categorised thus:

(a) Ten teachers with workshop experience were given handouts;
(b) Ten teachers with workshop experience were given textbooks;
(c) Ten teachers with workshop experience were given projectors;
(d) Ten teachers were without workshop experience and without handouts;
(e) Ten teachers were without workshop experience and without textbooks;
(f) Ten teachers were without workshop experience and without projectors.

These science teachers were at various instances exposed to workshops, seminars and a lot of demonstrations on selected topics in Biology, Chemistry, Physics, topics in their Local Government Areas for Three Months before the commencement of this study.

Results and their Analysis

In order to find out the relative differences that existed in performance of the students taught by the different categories of science teachers in the test administration, the means of the scores were succinctly calculated **(** as in Gardner & Cowan, 2002). In addition, a t-test statistical analysis was employed to determine if the difference in the mean score of each of the experimental groups and control groups were statistically significant. The tables and discussions that follow actually illustrates the actual evaluation of teacher preparation and effective use of instructional materials on students performance in the three major science subjects-Biology, Chemistry and Physics, in the sampled Senior Secondary Schools (SSS).

Table 2: Mean Scores of Students in Basic Science Test in the Nine Local Government Areas

Local Govt Areas	Experimental Group		Control Group		Experimental Group		Control Group		Experimental Group		Control Group	
	wks + hnd		nwks + nhnd		wks + txb		nwks + ntxb		wks + pjt		nwks + npjt	
	pre-test	post-test	pre-test	post-test	pre-test	post-test	pre-test	post-test	pre-test	post-test	pre-test	post-test
Lafia	43.8	49.2	30.2	21.2	44.4	42.6	42.2	45.0	41.3	44.1	40.3	417
Doma	34.5	44.4	41.4	32.5	34.2	37.2	21.3	32.4	43.3	43.2	24.6	45.3
Keana	28.4	45.5	35.1	24.1	34.4	44.9	36.0	40.0	45.0	35.0	31.4	33.1
Keffi	25.3	37.4	23.3	22.5	31.2	39.7	22.5	24.4	33.9	45.4	28.5	32.4
Karu	30.5	38.4	30.2	22.3	34.3	42.5	38.2	29.7	33.5	39.0	30.1	30.2
Nasarawa	30.0	41.4	31.5	29.4	36.2	32.1	35.1	31.3	48.6	43.7	24.3	30.3
Akwanga	34.0	35.3	30.4	27.4	41.1	43.3	28.2	37.0	29.1	32.3	28.4	32.1
Wamba	43.4	35.1	34.2	23.2	33.6	44.3	28.2	36.5	30.4	31.7	26.6	25.2
N/Eggon	24.5	34.5	30.2	25.3	40.5	45.5	26.3	38.5	33.4	47.5	37.4	25.6
All the nine LGA	**294.8**	**366.2**	**286.5**	**227.9**	**329.9**	**366.7**	**278.0**	**307.0**	**336.5**	**402.5**	**267.6**	**296.1**
Average	**32.8**	***40.7**	**31.8**	**25.3**	**36.7**	*** 40.7**	**30.8**	**34.1**	**37.4**	*** 44.7**	**29.7**	
	32.9											

*The highest mean scores were obtained by the Experimental groups, wks= Workshop Experience, hnd=Handouts, txb=Textbooks, pjt=Projectors, nwks=No Workshop Experience, nhnd= No Handouts, ntxb=, No Textbooks, npjt= No Projectors

Table two shows the Pre-test and Post-test mean scores of students in Basic science Education test in the three (3) Senatorial Zones, based on the Experimental and Control groups in the Nine Local Government Areas of the state, indicating that the highest mean scores obtained were shown by the Experimental groups. The table further reveals the obvious difference in mean scores of the students taught by teachers who had workshop experience and handouts (wks, 32.8 and hnd 40.7), workshop experience and textbook (wks 36.7 and txb 40.7), workshop experience and projectors (wks 37.4 and pjt 44.7) which are the experimental group as against the mean scores of students taught by teachers who had no workshop experience and handouts (nwks, 30.8 and ntxb, 34.1) and no workshop experience and no projectors (nwks, 29.7 and npjt, 32.9) which are the control groups indicating both the pre-test and the post-test respectively.

Discussion of Results

Based on the findings of this study, it was clear that the Science Teacher preparation by exposure to workshop experience has immense contribution on the teachers. The use of instructional materials (such as Handouts, Textbooks, and Projectors), inadvertently improved the quality of the teacher's instruction which was reflected in the performance of the students. Thus, the students they teach had an edge over students taught by teachers who had not had the privilege of a workshop experience and use of instructional materials (see table 1 above).

This work has a direct bearing with that conducted by Roger, Bond, and Nottingham (2003), NCES, (2003), Ryan, and Ackerman, (2004), Gyuse (2004) and Wu, (2004), who observed in their work that, science teachers lack the initiative and interest to improvise materials due to certain factors inherent in them, and further reiterated the need for science teachers to be retrained in the new methods of instruction and how to use related learning materials and equipment to enhance students learning of science education, which actually agreed with the findings of this work, based on averages(of the pre-test and post-tests respectively), exemplified by the different teachers in the sampled local Government areas of the state.

Conclusion/Recommendations

Science teachers are generally prepared with more depth in the content of a given field than are teachers of younger students. Since the major divisions of the natural Sciences are Biology, Chemistry, and Physics, all teachers licensed in a given discipline should know, understand, and teach with the breath of understanding reflected in the core competencies for that discipline. All secondary science teachers should be specialists in their disciplines and also have achieved the advanced competencies for that discipline, and should be prepared to lead students through the use of unified instructional materials to enhance their teaching.

The findings of this research have made it possible to put on record that there is the urgent need to prepare science teachers right from the scratch before they are allowed to teach in all levels of our educational endeavours. The importance of instructional materials or teaching aids such as textbooks, handout and projectors and all other related ones cannot be over-emphasized in the teaching and learning of science education.

This is because, science teachers generally strive continuously to grow and change, personally and professionally, to meet the diverse needs and aspirations of their students, school, community, and profession through effective use of instructional materials, they should have a desire and disposition for growth and betterment. To show their disposition for growth, it is recommended that science teachers must be able to:

a. Engage actively and continuously in opportunities for professional learning through the use of effective instructional materials and leadership that reach beyond minimum job requirements.
b. Use information from students, supervisors, colleagues and others to improve their teaching and facilitate their professional growth.
c. Interact effectively with real materials, colleagues, parents, and students; mentor new colleagues; and foster positive relationships with the community.
d. Reflect constantly upon their teaching and identify ways and means through which they can/may grow professionally.

Furthermore, from the results of this study, the researchers are of the opinion that:

e. Provision of the recommended textbooks, projectors, and other related teaching materials in the schools to facilitate or ease the problems of teachers as most students cannot afford to buy them.
f. The schools are provided with a store or room in which improvised materials and other concrete instructional materials such as models and specimens could be stored for the purpose of science teaching in our secondary schools.
g. Governments on their part should sponsor secondary school science teachers to be attending workshops in order to acquaint them with new trends in science teaching, use of simple apparatus and improvisation of instructional materials.
h. Identify and locate technology-based materials and resources and evaluate them for suitability and accessibility for science instructional purposes.
i. Understand how integrating technologies into science instruction can enhance science teaching and learning for all.
j. Model technology-based science curricular activities with appropriate pedagogy.
k. Design activities involving technology-integrated materials to promote student-centred, inquiry-based learning for all. (Lederman, Gess-Newsome and Latz, 2003).

References

Emmer, E.T. & Stough, L.M.(2003). *Classroom management: A critical part of Educational psychology, with implications for teacher education.* Educational Psychologist

Flick, L. & Bell, R. (2005). Preparing tomorrow's science teachers to use technology: Guidelines for Science educators. *Contemporary Issues in Technology and Teacher Education*, 1 (1), 39-60.

Gyuse, E.Y. (2004). *The status of science in primary schools in Plateau State.* 23rd annual conference proceedings of the Science Teachers Association of Nigeria. 31-32.

Gardner, J. & Cowan, P. (2002). *Testing the test. A study of the reliability and validity of the Northern Ireland transfer procedure test in enabling the selection of pupils, for grammer school places,*: Queens University of Belfast. P. 93-105.

Harlen, W. & Deakin, C.R. (2003). Testing and Motivation for learning. *Assessment in Education*. 10(2), 169-208.

National Center for Education Statistics, (NCES, 2003). *Integrated post secondary educational data system* (IPEDS). Data file. Washington, DC: US Department of Education.

Ingersoll, R.M. & Smith, T.M. (2009). The wrong solution to the science teacher shortage. *Educational leadership,* 60 (8), 28-34.

Jegede, O.J. (2004). *Integrated science in Nigeria. A review of the problems and prospects*. 24th annual conference proceedings of the science Teachers Association of Nigeria (STAN). 209-220.

Jegede, O.J. (2005). **T**eacher Education at a crossroad. Being a keynote Address delivered at the 2nd national teachers summit on teacher recruitment, retention, and professional development organised by the NTI, Kaduna on 20th -22nd April, 2004.

Jeanplerre, B. & Freeman, C. (2005). Characteristics of Professional development that effect change in secondary school science teachers' classroom practice. *Journal of Research in Science Teaching.* 42(6), 668-690.

Lederman, N.G.; Gess-Newsome, J. & Latz, M.S. (2003). The nature and development of preservice science teachers conceptions of subject matter and pedagogy. *Journal of Research in Science Teaching.* 31(3), 129-146.

Mohammed, A.M. & Umar, A. (2005). *Teacher Education in Nigeria: Past, present, and future.* Kaduna: NTI Press.

National Science Board (NSB, 2005). *Preparing our children: Mathematics, and science education in the national interest.* An NSB report on Mathematics and science achievement (NSB, 99-31).

National Research Council (NRC) (1996). *National Science Education Standards,* Washington, DC: National Academy Press.

National Research Council (NRC)(2001). *Educating teachers of science, mathematics, and technology*: New practices for the new millennium, Washington, DC: National Academy Press.

Nigerian Educational Research and Development Council (NERDC, 1999). *National primary school science project.* Teachers guide 1, year 1-3, NERDC, Lagos-Nigeria.

National Science Teachers Association (NSTA)(2003). *Standards for Science Teachers Preparation.*

Arlington, VA: National Science Teacher Association. Revised Edition. National Population Commission (NPC)(2006).

Ogunniyi, M.B. (2005). Teaching and learning primary *science.* 23rd annual conference proceedings of the Science Teachers Association of Nigeria , 33-37.

Ogbonna, B.B.O. (2005). ***S****cience and technology education for national development.* Published by Zimak Communications, Jos-Nigeria.

Okafor, F.C. (2004). *Nigeria teachers education: A search for new direction*. Enugu: Fourth Dimension publishing comp. Ltd.

Rogers, L.; Bond, S. & Nottingham, J. (2003). *Motivation as a factor in the professional development of preservice science teachers*. Paper presented at the National Association for Research in Science Teaching, Oak Brook, Illinoise.

Ryan, S., & Ackerman, D.J., (2004). *Getting Qualified: A Report on the efforts of preschool Teachers in New Jerseys Abboth Districts to Improve their Qualifications*. New Brunswick NJ: NIEER.

Schmidt, W.H. & Mcknight, C.C. (2002). What can we really learn from TIMSS? *Science,* 282, 1830-1831.

Umeoduagu, J.N. (2006). Innovative science, technology and mathematics. expectations in the 21st century. The Nigerian Teacher today. *A Journal of Teacher Education.* Kaduna. NCCE Publications.

Wu, W.D., (2004). Challenges of teacher preparation and professional development. In the Chinese society of education & Chinese Teacher Association Society (Eds). *Research in Issues of Teachers Professional Development*, p. 3-24. Taipei, Taiwan: PE Press.