The Effect of Science Specialist Delivery Model on Primary School Pupils' Achievement in Science in South West Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Author MAOS designed the study, wrote the protocol and supervised the work. Authors MAOS, EOS, GAB and NAO carried out the field work. Authors MAOS and NAO performed the analysis of the study. Author MAOS managed the analysis. Authors MAOS, EOS, GAB and NAO managed the literature charges and edited work. Author NAO wrote the first draft. Author NAO edited the manuscript. All authors approved read and approved the final draft.

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ABSTRACT

This study examined the effect of the science specialist delivery model on pupils' achievement in Primary science. Only one hypothesis was tested at 0.05 level of significance. The study adopted a pretest-posttest control group quasi experimental research design. A total of 403 primary school pupils (coeducational public and private schools) selected from twelve schools in three states in the southwestern Nigeria. The instrument for data collection was the Basic Science Achievement Test. The result revealed that pupils exposed to science specialist delivery model had a significant higher mean score than those exposed to the generalist delivery model. It was concluded that science specialist model will provide a better background to pupils in science than the generalist model.

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1. BACKGROUND

1.1 Introduction

Primary or basic education is the first level of education which a child undergoes before he/she moves on to the other levels. It is the bottom line education, upon which every other education whether formal, informal or non-formal can be built, without which any educational structure erected will not have chances of success. The core objectives of Primary Education in Nigeria, are the universalization of access and quality in the delivery.

Primary science has been recommended on the basis of the argument that the children's idea about the world are developing throughout the primary years whether or not they are taught science. Primary education seeks to provide literacy at its basic level. Being literate means to be able to engage effectively in different aspects of modern life [1]. Teaching science is the only means to attain scientific literacy at the primary school level. Scientific literacy includes a basic understanding of key science concepts often delineated into the categories of physical life, earth and space science [2].

According to [3] children need to experience science activity for themselves at a time when these attitudes are being formed. Furthermore, [4] revealed that recent research evidence asserts that most students develop interests and attitudes towards science well before the age of 14 and many before the age of 11. This implies that if science is not well thought at the primary school level students may not acquire the scientific literacy require at the basic level.

Unfortunately, level of poverty, environmental pollution and degradation in Nigeria has been ascribed to the level of ignorance and illiteracy among the citizenry [5]. The society live depends on an ever –increasing extent on technology and the scientific knowledge that makes it possible [6]. The level of scientific literacy of Nigerian at all levels has been very low [7,8]. The underlying problems have been traced to many factors including poor teacher preparation, resulting in poor teaching skills among science teachers and poor method of instructions [9,6]. The delivery model recommended by the national policy of education in Nigeria is that of the specialist. Unfortunately the generalist instructional model is widely used to teach science at the primary school level in Nigeria. This popularity of the generalist has made many stake holder to assume that the specialist delivery model is not the recommendation of the National Policy of Education.

There are various type of delivery models for teaching science at primary school level. These include classroom generalist, classroom specialist, support teams, departmentalization, and science specialist [10,11]. Classroom generalist delivery model is a model in which the science instruction is delivered by the same teacher who delivers instruction in all the other subjects in primary school curriculum in one classroom. Departmentalization is the delivery model which one teacher would be designated as the science teacher irrespective of the discipline of the teacher. This teacher rotates the class teaching specialized content like science. Science support team involves a science specialist who is assigned to a self-contained classroom for some part of the school day to promote science instruction. In some cases the support team involves the collaboration between 3-4 teachers and the specialist in implementing instruction, any of them may be involve in the implementation of instruction. Classroom science specialist is the delivery model that involves a teacher taking the lead role in science instruction in a school, it could be as a result of formal or informal training in science. This particular teacher acts as a generalist in his or her own classroom in the same school. The science specialist model is the best delivery science model in primary school [10,11]. This science teacher which is trained in science is given the primary responsibility of previewing and selecting science curricular materials and ordering and maintaining science equipment, thus creating a division of labour for the benefit of all [9]. The difference between the classroom specialist and science specialist is that the science specialist delivery models involve a teacher who is solely responsible for science instruction and therefore has a higher degree of science interest, enthusiasm, and content expertise.

The choice of the instructional model is important because [9] opines that the science content knowledge, scientific skill and scientific attitude; pedagogical knowledge and skill; knowledge of students; knowledge of curriculum; time in science instruction; personal costs; science

material location among other things vary from one delivery model to the other.

This study is situated around Bandura Social learning theory. According to [12] the importance of observing and modelling the behaviours and attitudes of others is central to teaching and learning process. The theory explains human behaviour in terms of continuous reciprocal interaction between cognitive, behavioural, and environmental influences. That is, people learn through observing others' behaviour, attitudes, and outcomes of those behaviours. [13] opined that the social learning theory presents cognition as very important in the process of learning. Therefore, attention plays a critical role in learning. The theory states that for learning to take place, learners need to observe or pay attention to the model. This implies that what the students will learn depends on the quality of the teacher who is the model. The science taught at the Primary Schools requires that the learner acquire scientific skills, scientific knowledge, and attitude. Therefore, it is necessary to ensure that the quality of the science teacher is not undermined. The assumption that Primary School pupils are small children and they may not require specialist teachers because the generalist teacher have the ability to provide instruction they require may not be true [14]. On the contrary, [14] established that much of the current research posits that specialist teacher bring a number of dimensions to any subject they are teaching. Therefore it can be infered that to have a good science background at Primary School level, it is important to ensure that the learners are exposed to teaching from a specialist science teacher. In addition to this, the specialist science teacher has limitation in some aspects of science when it comes to teaching and learning. If this is the case for a specialist; how much more a generalist with little training in the science content.

However, given the aspiration of Nigeria to attain the status of a developed nation in the shortest possible time, it is important to determine if the science specialist delivery model will make a difference in terms of the declining achievement in primary schools.

1.2 Statement of the Problem

Science and Technology is the engine room of development of any nation. Science education is the fuel that drives this engine. Primary science is the foundation and bedrock of any the future of

any science instruction. Primary science also provides basic science literacy for students whose choice of career is outside of science. Nigeria being a nation that desire development at a very fast rate, has leveraged on science education to attain her noble desire. Unfortunately the poor performance of the students at all levels of education is increasingly poor. This has been consistently traced to the poor science background of students at the primary school level. The bane of the weak background has been traced to the generalist delivery model which is common at the primary school level in Nigeria. The generalist delivery model is cheap but contradicts the recommendation of the policy of primary education in Nigeria. This study therefore determined the effect of specialist delivery model on students' achievement in primary science.

1.3 Hypothesis

There is no significant effect of treatment on primary school pupils' achievement in Basic Science.

2. METHODOLOGY

2.1 Research Design

The pretest-posttest, control group quasi-experimental research design was adopted for this study. The study made use of two instructional groups. One experimental group and one control group; the experimental group was exposed to treatment (Instruction by a specialist) while the control group was exposed to instruction by a generalist.

2.2 Variables in the Study

The following are the variables in the study.

2.2.1 Independent variable

The independent variable is the instructional delivery model which was manipulated at two levels namely:

  i.   Specialist delivery model
  ii. Generalist delivery model

2.2.2 Dependent variable

The dependent variable is students' achievement in Basic Science.

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2.3 Selection of Participants

The population for this study is all the primary school students in the South -Western state in Nigeria. This includes students in public and private schools. The participants for the study were selected using a multistage sampling techniques. At the first stage three states were randomly selected from the six South Western states in Nigeria. The selected states were Ogun, Oyo and Osun. The participants were made up of Primary five (Basic five) students selected purposively from primary schools in the capital city of the three selected states (Abeokuta, Ibadan and Osogbo). The choice of Primary five was premised on the fact that the pupils were already towards the end of middle basic level of basic education (pupils are already immersed in the model there school practice for more than four years): and the schools were more disposed to release them for research. The criteria for selections of schools are as follows;

i.   the school must have been in existence for more than 10 years.
ii. The school must be a co-educational institution.

At the last stage of sampling, the delivery model of the schools in the capital was identified (Findings showed that very few were specialist and many were generalist). At the end of this survey two schools using specialist delivery model were identified (one public and one private); similarly two schools using generalist delivery model were also identified (one public and one private).

2.4 Research Instruments

Five instruments were used for the purpose of collecting data for this study, they include:

(i)   Basic Science Achievement Test (BSAT).
(ii) Instructional Guide on Generalist Delivery Model (IGGDM).
(iii) Instructional Guide on Specialist Delivery Model (IGSDM).
(iv) Performance Assessment Sheet (TPAS).
(v)   Lesson Note on domestic and wild animals (LNSW).

2.4.1 Basic Science Achievement Test (BSAT)

Basic Science Achievement Test was self-designed it contains multiple choice items, true or false items, fill in the gap and matching items. It contains section A and B. Section A is to provide information on students gender, name, location and school type. The section B contains a total fifty items. This was obtained after a pull of one hundred items was given to two primary school science teachers and one science education expert who are doctoral degree holders. Based on their scrutiny seventy items survived. The seventy items test was trial tested by administering it to forty primary school five students who are not part of this study. The scores obtained were used to compute the difficulty and discrimination indices of test. Only fifty items had difficulty index (0.4-0.6) and discrimination index between 0.4-0.6. Therefore 20 items were deleted. The remaining 50 items test covers the main topic –domestic and wild animal. The table of specification is as shown in Table 2.1.

2.4.1.1 Validation of basic science achievement test

The BSAT was administered to 30 students who are not part of this study after three weeks an alternative form of this test was administered to the same set of students. This method is called test retest method. The scores of the students were subjected to Cronbach alpha analysis and the reliability value of 0.83 was obtained.

2.4.2 Instructional guide on generalist delivery model

The instructional guides were developed to show teachers what to do and how to do it. They also contain students' activities during the course of teaching.

Table 2.1. Specification for BSAT

Domestic and wild animal	Knowledge	Understanding	Thinking	Total
Classification of domestic and wild animals	5	4	4	13
Reproduction	5	7	4	16
Feeding	6	2	2	10
Other characteristics	4	5	2	11
Total	20	18	12	50

2.4.3 Instructional guide on specialist delivery model

The instructional guides were developed to show teachers what to do and how to do it. They also contain students' activities during the course of teaching.

2.4.4 Teaching Performance Assessment Sheet (TPAS)

The TPAS is a self-designed instrument to assess the research assistants' competence at delivering instruction using either generalist or specialist models. The total mark obtainable was 40 and the six teachers with the highest scores were selected to participate in the study.

2.4.5 Lesson notes on domestic and wild animals

There are two types of lesson notes used for this study. The lesson notes were written in a workshop organized for two specialists and two generalist primary science teachers. The first lesson note was written by two specialist and the second one was written by two generalist. The instrument contains the steps used to teach each of the five lessons on domestic and wild animals.

3. PROCEDURE FOR DATA COLLECTION

The data was collected using to the following procedural steps:

i.   Selection of schools and training of participating subject teachers and research assistants.
ii. Administration of the Pretest.
iii. Treatment.
iv. Administration of the Posttest.

The number of weeks schedule for data collection are summarised below:

Selection and training of teachers	2 weeks
Pretest administration	1 week
Treatment	4 weeks
Posttest administration	1 week
Total	8 weeks

3.1 Procedure for School Approval

The researcher collected a letter of introduction from the Department of Integrated Science, Federal College of Education, Osiele. Which was taken to the selected schools for this study for the purpose of seeking the school authority's consent and consequent approval to undertake the study in their schools.

3.2 Selection and Training of Research Assistants

The researcher explained the strategy to be used to the primary science teachers who would serve as research assistants for the study before the commencement of the training process. The training was for a period of two weeks and it covered three stages:

(i)   Explanation: the researcher explained the processes involved in the use of the Generalist and Specialist delivery Models.
(ii) Illustration: the researcher presented a demo-teaching using the primary science teachers as learners, this is necessary in order to illustrate as well as emphasize the important aspects in the explanation.
(iii) Practice: the practice session involved the participating teachers who were tasked to practically demonstrate the mastery of the content of the instructional guides by teaching other students apart from the ones to be used for the actual study. This is necessary so as to assess the extent of their mastery of the use of the instructional packages. This exercise was graded by using the teaching performance assessment sheet (TPAS).

3.3 Administration of the Pretest

The pretest was for a week (the third week of the experiment). This involved exposing students in the generalist and specialist groups to the basic science achievement test.

3.4 Treatment Stage

The treatment stage involved two groups - the experimental group was taught using the specialist group while the control group was exposed to generalist delivery model. One out of the five periods allotted to primary science per week on the school timetable was used for the study and the treatment lasted for a period of eight weeks. A generalist teacher is assigned to teach two generalist schools (one private and one public). Similarly a specialist was assigned to teach two specialist schools (one private and one public) in each location. During this stage, the researcher visited the schools on regular basis to monitor the teaching, practice and

testing sessions. The treatment stage covered a period of eight weeks.

3.5 Administration of the Posttest

The posttest was for a week (eigth week of the study). This involved exposing students in the experimental and control groups to post-achievement test in Basic Science (BSAT).

4. METHODS OF DATA ANALYSIS

The data collected were analyzed using descriptive statistics of mean and standard deviation as well as inferential statistics of Analysis of Covariance (ANCOVA) using the pretest scores as covariates. The estimated marginal mean was used to explain the main effect of treatment.

5. RESULTS

Hypothesis 1: There is no significant main effect of treatment on primary school pupils' achievement in Basic Science.

Table 5.1 indicates that there is a significant effect of treatment on pupils' achievement in basic science ($F_{(1,378)}$=29.99;P<0.005 η^2=0.078). Therefore hypothesis is rejected. This implies that that the treatment has a significant effect of treatment on pupils' achievement in basic science with an effect size of 7.8%.

Table 5.2 shows that the estimated marginal mean of students' posttest achievement scores according to treatment. Table 5.2 shows the students exposed to specialist delivery model had a higher posttest mean score (x=41.90) compared to those exposed to generalist delivery model (x=38.32). This implies that the significant main effect observed in the treatment is largely due to the specialist delivery model. The estimated marginal mean is shown in the Fig. 1.
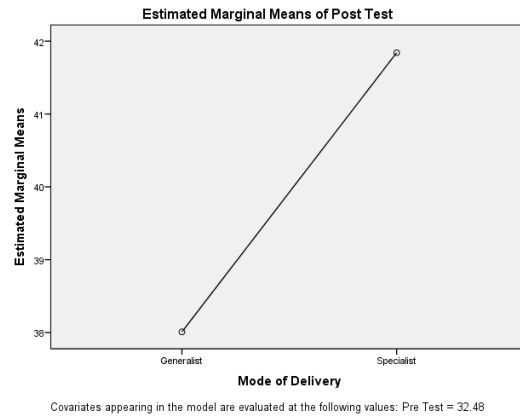

Fig. 1. Graph of estimated marginal mean

6. DISCUSSION

The result of this study indicates that the science specialist delivery models is more effective than the generalist delivery models in public and private primary schools. The efficacy of the specialist delivery model that is very profound is a solution to the consistent poor performance widely reported in primary science. This implies that if schools adopt the science specialist instructional model in basic science as recommended by the policy of education, there will be improvement in pupils' performance in science and probably other subjects using the specialist delivery model. This findings is in line with [15] that specialist delivery model is more effective than that of generalist delivery models. This findings is also similar to the findings of [16] that specialist Music Teachers are more amenable to the implementation of all the nine standards of Music education in elementary schools than their generalist counterparts. The findings of this study is also in agreement with the findings of [17] that being a Physical Education specialist predicted higher scores in instructional strategies and classroom management in Physical Education.

Table 5.1. ANCOVA for the effect of delivery models on pupils achievement in basic science

Source	Df	Mean square	F	Sig	Partial eta square
Corrected model	24	1563.244	50.287	0.000	0.761
Intercept	1	3500.064	112.592	0.000	0.230
Pretest	1	11983.123	385.480	0.000	0.505
Mode of delivery	1	932.562	29.999	0.000	0.074
Error	378	31.086			
Total	403				
Corrected total	402				

α= 0.05

Table 5.2. Estimated marginal mean of treatment groups

Mode of delivery	Mean	n
Generalist	38.32	232
Specialist	41.90	171

7. CONCLUSION

This study concluded that the delivery model adopted by schools to teach science in primary schools is very important to provide improved learning of students. This study support the popular saying that "Jack of all trade master of none". A specialist one cannot say that he or she is good in all aspect of science, not to talk of a generalist who was trained to handle all subjects. It is most likely a generalist has his or her interest in other subject other than science and as a result of this the generalist will likely direct his energy in the subject.

8. RECOMMENDATIONS

a) It is recommended that schools adopt the specialist delivery model for science instruction in primary schools.
b) The government should ensure that the policy statements that recommends that science is taught by specialist is enforced so that all stake holders in primary education adhere.

9. LIMITATION OF THE STUDY

The findings of this study cannot be generalized based on the following reasons,

1. Other extraneous variables like school location, gender, school location and school type were not taken into consideration in this study.
2. The fact that the specialist and generalist teachers visit a school outside his or her home school where he or she was employed could affect the quality of his delivery in either school.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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