SCIENCE LABORATORIES AND THE QUALITY OF OUTPUT FROM SECONDARY SCHOOLS IN ONDO STATE, NIGERIA

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Abstract

*This paper examined **science laboratories and the quality of output form secondary schools in Ondo State, Nigeria The design was made along the lines of a** descriptive survey while the study population comprised all the 257 secondary schools that presented candidates for the year 2003 senior secondary Certificate examinations in the State. The sample consisted of 168 secondary schools drawn randomly from the study population. The instrument used to collect data for the study was an inventory while the data collected were analysed using the one-way analysis of variance and Least Significant Difference test. Semi-structured interviews were conducted for principals and education officers while their responses were analysed through the content analysis technique. The findings showed that the quality of output was best in schools having laboratories in three science subjects, Physics, Chemistry and Biology.The mean scores were highest in schools having three science laboratories. The interviewees' responses agreed with the findings of the study. On the basis of the findings, it was recommended that Government should urgently provide laboratories in the three science subjects in schools with shortages of science laboratories.*

Introduction

Researchers have found science laboratories to be central to the teaching of science in secondary schools (Gyuse, 1982; Ige, 2000). Laboratories have been found to be the scientists' workshops where practical activities are conducted to enhance a meaningful learning of science concepts and theories (Seweje, 2000). They have also been found to be a primary vehicle for promoting formal reasoning skills and students' understanding, thereby enhancing desired learning outcomes in students (Jeske, 1990; Ogunleye, 2002).

Jones (1990) examined teacher provision in the sciences in many countries and found that 45% of the schools surveyed indicated insufficient laboratories. His findings agreed with Saeed's (1977) findings in Pakistan, Commonwealth Secretariat's (1977) findings in the Caribbean and Barrow's (1991) findings in Saudi Arabia all of which indicated inadequacy in the provision of laboratory facilities in schools. The findings were also consistent with those of Black,

Atwaru-Okello, Kiwanuka, Serwadda, Birabi, Malinga., Biumigishu, and Rodd, (1998) who found in Uganda that science education is faced with the problem of lack of resources with half the schools having no real laboratory.

In respect of output, researchers have argued that output represents the immediate results of the system's activities (Simkins, 1981; Tsang, 1988). Their views supported Sheehan (1973) remarks that "education yields outputs which are often not sold in the market and which in any event are not saleable indirectly". Their views also agreed with Blaug (1970) who outlined different concepts of evaluating output. According to him, these concepts include the number of students completing a course; the number of students completing a course of standard length (longer courses being regarded as more output) and the number of students with given achievement test scores. The Organisation of Economic Co-operation and Development (1965 p.134) too, gave four criteria that could be used to assess performance as a tool in the measurement of output. These criteria include the rate of progress of pupils through the system; the performance of pupils at the terminal examination measured by the scholarship awarded; the facilities in the schools and the range of subjects offered in the curriculum.

In this regard, Blaug and Woodhall (1968) measured output in terms of the number of school leavers weighted by different indices of quality or number of passes. Thias and Carnoy (1972) examined the influence of school factors on the quality of schools' output in Kenya. According to them the quality of output is equated with students' examination performance. Akangbou (1985) too, calculated the 'academic index' of output in Nigeria and remarked that the simplest measure of output of the Nigerian secondary education system is the number of school leavers.

Notwithstanding, researchers have found shortages in the number of laboratories in Nigerian schools (Alebiosu, 2000; Onipede, 2003). They argued that many schools do not have required laboratory facilities. Hence, students often fail to acquire science laboratory skills because their teachers were unable to conduct practical as they would like to and this always had inevitable consequences for students' learning (Keister, 1992). These shortages of laboratory facilities could have serious implications on the quality of schools' output. All these show the importance attached to science laboratories in schools. It is this importance that prompted the researcher to examine the number of science laboratories in secondary schools in Ondo State, Nigeria and their influence on the quality of output in terms of students' performance in the Senior Secondary Certificate (SSC) examinations.

Statement of the Problem

Common observations show that secondary schools in Ondo State, Nigeria have varied numbers of science laboratories. While some schools have three science laboratories, some have two laboratories while others have only one multipurpose science laboratory. The implication of this is that many students seem not to be exposed to practical work in the three science subjects, Physics, Chemistry and Biology, which are core subjects in secondary school curriculum. The problem of this study therefore, was what influence, the science laboratories have on the quality of output from secondary schools in Ondo State, Nigeria? In addressing this problem, the following research questions were raised:

1. What is the performance level of students in Physics, Chemistry and Biology in the SSC examinations in Ondo State secondary schools?
2. What influence does the number of science laboratories have on the quality of output from secondary schools in Ondo State, Nigeria?

Method

This study was designed along the lines of a descriptive survey. Babbie (1973) defined a descriptive survey as a study conducted for the purpose of making descriptive assertions about some populations. Cressey (1982) described it as one that studies a situation as it is without attempting to manipulate variables. Gay (1996) regarded it as the collection of data from members of a population in order to determine the status of the population with regard to one or more variables. On this note, the study population comprised all the 257 secondary schools that presented candidates for the year 2003 senior secondary Certificate examinations in Ondo State of Nigeria. Out of this, a sample of 168 schools (65% of the population) was taken. The stratified random sampling technique was applied in the selection of the sample while variables such as school-location and school–sex were considered in the selection of the sample.

The instrument used to collect data for this study was an inventory. The inventory requested among other things data on enrolment figures, number of science laboratories in each school and grades obtained by students in Physics, Chemistry and Biology in the year 2003 SSC examinations in the State. The content validity of the inventory was made by experts in Tests and Measurement who examined each item of the inventory to determine whether the instrument actually measured what it was supposed to measure. The three science subjects examined in this study were chosen since the Nigerian science curricula are subject-based with Physics, Chemistry and Biology being the core science

subjects (National Policy on Education, 1998; Bello, 2000). The data collected was analysed through the use of the One- way analysis of variance (ANOVA) while the Least Significant Difference (LSD) test was used to determine the group difference in the quality of output among the three groups of schools.

Semi-structured interview was also conducted with 20 principals of schools and 20 education officers sampled randomly form the 257 principals and 451 education officers in the State. Their responses to the questions raised at the interviews were analysed through the content analysis technique while the proportion of the number of responses to each question was computed based on a maximum obtainable score of 100% (Easterby-Smith, Thorpe, & Lowe 1996).

Data Description

Schools in the sample were classified into three groups on the basis of the number of science laboratories available in each school. Thus, schools having one science laboratory were classified into group 1. Schools having two science laboratories were classified into group 2 while schools having three science laboratories were classified into group 3. Table 1 shows the distribution of the schools with the different numbers of science laboratories on the basis of school location.

Table 1: Cross-tabulation of Science Laboratories with School Location

Location	Schools with 1 Lab.	Schools with 2 Labs.	Schools with 3 Labs.	Total
Urban	7	19	47	73
Urban	30	31	34	95
Total	37	50	81	168

As indicated in table 1, schools having three science laboratories were in larger number in urban areas than in rural areas whereas schools having less than three science laboratories were more in the rural areas than in urban areas. Schools having less than three science laboratories were 61 in rural areas while they were only 26 in urban areas.

Data Analysis

Research Question 1

What is the performance level of students in Physics, Chemistry and Biology in the SSC examnations in Ondo State secondary schools? Students?

In answering this question, performance was computed through the frequency counts of the number of students who obtained credit grades 1 to 6 in

each subject in the examinations were transformed from discrete data into continuous data through secondary analysis. The weighted average performance is computed using the formula:

$$P = \frac{n_1A_1 + n_2A_2 + n_3A_3 + n_4C_4 + n_5C_5 + n_6C_6}{N}$$

Where: p = performance; n1, n2 ..... .n6 = number of times each grade occurs; while A1, A2, ...C6 = numeric weights of each grade. Table 7 shows the findings.

Table 2 shows the distribution of schools in respect of the credit performance in the subjects.

Table 2: Schools Having Credit Performance in Year 2003 SSC Examinations

	Number of Schools		
Credit Level	Physics	Chemistry	Biology
0.20 & below	86	94	81
0.21 -0.40	35	27	30
0.41-0.60	28	23	34
0.61-0.80	13	15	18
0.81-1.00	6	9	5
Total	**168**	**168**	**168**

As indicated in table 2, the bulk of the schools scored below 0.20 credits in each of the three science subjects. The highest score obtainable per school was 3 credits per student and schools that scored one credit per student were few. Thus, the performance level of the schools was low and almost the same in all the subjects.

Research Question 2

What influence does the number of science laboratories have on the quality of secondary schools output in Ondo State, Nigeria?

In examining influence does the number of science laboratories have on the quality of secondary schools output, the question was transformed to the following hypotheses.

Ho: There was no significant difference in the quality of output between schools having laboratories in three science subjects, Physics, Chemistry and Biology and between schools having less than three laboratories in the three science subjects in Ondo State, Nigeria.

In testing this null hypothesis, the quality of output was measured by examination performance (Bluag, 1970; Blaug & Woodhall, 1968; Simkins, 1981; Akangbou, 1985). The one-way analysis of variance statistical technique was utilized in testing the hypothesis while the findings are indicated in table 3.

Table 3: ANOVA Findings on Students' Performance in SSC Examinations

	Mean for Groups			SD for Groups			Sum of Squares		Mean Square		F Ratio.	F Prob	Decision
Subjects	1	2	3	1	2	3	SSb	SSw	MSb	MSw			
Physics.	.04	.06	.12	.05	.07	.13	.37	7.52	.19	.03	8.42	.01	Significant
Chem.	.07	.10	.18	.08	.11	.19	.69	11.8	.31	.03	9.51	.01	
Biology	.12	.19	.23	.13	.19	.22	.44	9.47	.23	.02	7.83	.00	

*N for group 1 = 37; N for group 2 = 50; N for group 3 = 81. * df = 2, 166

In table 3, the probability was less than 0.05 in each of the subjects. This shows a significant difference in the quality of output on the basis of the three groups with difference number of science laboratories, although the F-test has not shown where the difference was located among the groups. In order to identify the between-group difference in performance, the Least Significant Difference (LSD) test was conducted as indicated in table 4.

Table 4: LSD Findings indicating Mean Values in Physics, Chemistry and Biology

			Grp 1	Grp 2	Grp 3
Physics	Mean	Science Lab.			
	.04	Grp. 1			
	.07	Grp. 2			
	.12	Grp. 3	*	*	
Chemistry	Mean	Science Lab.			
	.06	Grp. 1			
	.10	Grp. 2			
	.19	Grp. 3	*	*	
Biology	Mean	Science Lab.			
	.12	Grp. 1			
	.18	Grp. 2			
	.23	Grp. 3	*		

(*) Indicates significant differences which are shown in the lower triangle.

In table 4, the mean value for each group increased monotonically for each subject as the mean values incrsed with increases in the group. The mean for group 1 was lowest for each of the subjects while the mean for group 3 was highest. The show a significant differences in the quality of output between group 1 and group 3 and between group 2 and group 3 in Physics and Chemistry and between group 1 and group 3 in Biology. The difference between the groups was statistically significant.

Thus, students of schools in group 3 with three Science laboratories had better performance than students of schools in group 2 with two laboratories and students of schools in group 1 with one Science laboratory in Physics and Chemistry. In Biology, students of schools in group 3 had better performance than students of schools in group 1. There was however, no significant difference between the performance of students in schools in group 2 with two Science laboratories and the performance in schools in group 3 with three Science laboratories in Biology. The findings also show that quality of output in schools in group 2 with two Science laboratories was not significantly better than the quality of output in schools in group 1 with one science laboratory in any of the subjects.

The content analysis of the responses to each question raised at the interview with principals and education officers are along the following lines:

Question 1: *What is the position of science laboratories in the three science subjects, Physics, Chemistry and Biology in secondary schools in Ondo State Nigeria?*

In response to this question, the principals and the education officers agreed that there many schools in the State had less than three science laboratories. Seventeen of the principals (85%) and sixteen of the education officers (80%) gave this response.

Question 2: *What do you think about the adequacy of science equipment in schools' science laboratories?*

Responding to this question, the interviewees reported that science equipment were in short supply in schools. All the principals claimed that many schools had obsolete equipment while seventeen of the education officers (85%) argued that the few science equipment available in schools were unserviceable.

Question 3: *What is your view about the quality of output in the State secondary schools in science subjects?*

Responding to this question, Eighteen of the principals (90%) and seventeen of the education officers (85%) reported that the quality of output was low in the three science subjects.

Question 4: *What suggestions can bring about an improvement?*

In response to this question, the principals and education officers seemed to agree in some areas. For instance, they all claimed that since science laboratories are of considerable importance for effective teaching and learning of science in schools, the state government should provide science laboratories and equipment in the three science subjects in all schools. They however, disagreed in some areas. Eighteen of the principals (90%) suggested that government should increase the running grants to schools to fund science laboratories while nineteen of the education officers (95%) argued that schools could raise funds through endowment and donations to fund science laboratories.

Discussion

The foregoing had examined the influence of Science laboratories on the quality of secondary school output in Ondo State, Nigeria. The findings have revealed significant differences in the quality of output among the three groups of schools with different numbers of science laboratories. Schools tend to get better results with more science laboratories threby agreeing to the findings of previous researchers (Gyuse, 1990, Tairab, 1992; Cash, 1993) who reported that school resources such as Science laboratories are strongly related to students' performance while science achievement scores are better in buildings with good science laboratories. The findings were in consonance with Hamide & Geban's 1996; Greenwald, Hedges and Laine's (1996) findings that school facilities such as Science laboratories are related to quality of output from schools. The findings also agreed with Linn's (1997) findings that laboratory facilities could improve learning outcomes. The findings were consistent with Alebiosu's (2000) and Adeyegbe's (2002) findings which attributed the low performance level of students in science subjects in SSC examinations in Nigeria to, among other things, the inadequacy of science laboratories in schools.

The findings suggest that the choice of schools might perhaps be the same for all students at the time of entering secondary schools while the number of science laboratories in any school which a candidate selected was a predictor of

value added. As such, a schools' possession of three science laboratories is a critical factor in performance or a proxy for some other critical factors. This implies that schools with extra laboratories tend to attract bright students.

The interviewees' responses tend to buttress the findings of this study. Although there were some agreements and disagreements in the responses made by the principals and education officers, their responses were supportive evidences to the findings of this study. Their responses agreed with the findings made by Animola (1990) and Onipede (2003) that there were shortages of science laboratory facilities in schools. The interviewees however disagreed in some areas. While the principals suggested an increase in school grants to schools, the education officers argued that schools could source funds from local sources such as through endowment funds and donations from parents/ teachers associations thereby agreeing with Hoover-Dempsey & Sandler (1997) who reported that parents must have a strong sense of efficacy for helping children to succeed in school.

Conclusion

Based on the findings of this study, it is concluded that science laboratory is a critical variable in determining the quality of output from secondary schools. The findings show that science laboratory had significant relationship with quality of output from secondary schools. Schools having laboratories in the three science subjects performed best in the examinations out of the three groups of schools with different numbers of science laboratories.

The findings of the study has led the researcher to conclude that there was inadequate provision of science laboratories and equipment in many secondary schools in Ondo State, Nigeria. In this regard, it is recommended that the state government should as a matter of urgency provide laboratories in the three science subjects, Physics, Chemistry and Biology in all schools having shortages of science laboratories in the state in line with the provisions of the Federal Republic of Nigeria National Policy on Education (1998) in improving standards in schools. The Federal Government could also assist through the Education Trust Fund in funding science laboratories in. schools.

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