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Full Length Research Paper

Science, technology and mathematics education resources in junior secondary schools for the attainment of the millennium development goals

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This study investigated the resources allocated to Science, Technology and Mathematics Education (STME) in junior secondary schools in Anambra State between 2003 and 2006. The study, which was based on three research questions and one null hypothesis, adopted the ex-post-facto research design. Twenty-six schools were selected using proportionate stratified sampling from 261 junior secondary schools in Anambra State. A twenty-one item researcher-developed questionnaire titled "Science, Technology and Mathematics Education Resource Allocation Inventory (STMERAI)" was used in collecting data. Mean scores were used in answering the research questions while the Analysis of Variance were used to test the null hypothesis at the 0.05 significance level. The findings of the study indicate that the resources allocated to the STME subjects (integrated science, introductory technology and mathematics) were highly inadequate irrespective of the subject. This implies that, the allocation of experienced teachers, materials, laboratory equipments and books to these subjects needs to be improved, so that inadequate resources do not hinder the provision of high quality education needed for the attainment of the Millennium Development Goals.

Key words: Educational resources, science, technology and mathematics education, millennium development goals, quality education, resource allocation, teachers, facilities.

INTRODUCTION

In outlining the eight Millennium Development Goals (MDGs), several world leaders expressed a commitment to meet human rights' to survival, health, education, and global development among others. A close look at the Millenuim Development Goals (MDGs) shows that, not much could be achieved unless education is an integral part of programming strategies and plan.

There are challenges in achieving the MDGs in the face of dwindling resources in most developing countries especially Nigeria where education's budget as proportion of the total national budget has been down nosing. Yet, the resources estimated for achieving the EFA goals alone have been enormous. The constraint of limited resources to back up the national efforts at achieving the Millennium Development Goals has become a major concern in Nigeria. For instance, Obioma (2006) noted that, inadequate resources are a major reason why the Nigerian Education system has not succeeded in transforming our nation.

A report from the Operation Reach all Secondary Schools (ORASS, 2006) survey in Nigeria indicated that inadequate resources (teachers, facilities, materials and funds) characterize most secondary schools in Nigeria. In

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Abbreviation: STME, Science, technology and mathematics education; **STMERAI,** science, technology and mathematics education resource allocation inventory; **MDGs,** millennium development goals; **TSR,** teacher student ratio; **UBE,** universal basic education.

the absence of adequate resources, quality education for the attainment of the MDGs cannot be realized.

The United Nations' International Children's Education Fund (UNICEF, 2007) described quality education as the key to sustainable development, and a major key to the attainment of Millennium Development Goals (MDGs). Nigeria, just like other countries of the world is a partner in the attainment of these goals (United Nations, 2007). Hence, one of the biggest challenges facing Nigeria at present is the provision of quality education for all the citizens

An area in which Nigerian government has persistently emphasized the need for the provision of high quality education is in Science, Technology and Mathematics Education (STME) in junior secondary education. According to Amoo and Efunbajo (2003), a strong background in STME is crucial for many careers and job opportunities in today's increasingly technologically society. STME is expected to contribute immensely to the attainment of the MDGs.

In the junior secondary schools, three core subjects make up the STME. These subjects are integrated science, introductory technology and mathematics. To ensure quality in these subjects, there is need to allocate adequate resources (Fraser and Jegede, 1992; Ibe, 2008). Resources are the vast ranges of human and non-human variables used to facilitate the effectiveness of the educational programmes (Oguntuka, 2005). Resource allocation means the provision of resources, their utilization and management. Part of resource allocation function, for instance, it is the provision of experienced teachers, payment of teacher salaries, provision of funds for laboratory, machines equipment, books and allocation of instructional hours to various subjects in the schools curricular (Okeke, 2005). These resources are vital tools for efficient and effective delivery of education packages spelt out in the STME curricular.

In Anambra State, as in every other state in Nigeria, the allocation of resources to STME in junior secondary school education deserve serious attention because this level of education is now part of the Universal Basic Education programme expressed in goal two of the MGS. Aghenta (2000) noted that, the junior secondary level spans three years from junior secondary one to three. Thus, a cohort of students is used to describe intakes for a particular year that graduated after three years. For example, 2003 and 2004 cohort comprises of students that entered JSS one in 2003/2004 and took JSSCE in 2006. When these students entered JSS one, they were provided with resources and they took in addition to other subjects, integrated science, introductory technology and mathematics for these three years. The effective teaching of these subjects required a lot of resources. Hence, the problem of this study is to find out the extent to which resources were allocated for these STME subjects in junior secondary schools in Anambra State for the 2003/2004 cohort.

Research questions

The following research questions guided the study:
(i) How well resourced is each of the STME's subjects [Integrated Science, Introductory Technology and Mathematics] at the junior secondary school level in Anambra State?
(ii) Does the level of resources allocated to STME pose as a threat to the attainment of the MDGs in the state?

Hypothesis

The following null hypothesis was tested at the 0.05 level of significance level.
Is there any significant difference in the level of resource allocation among the three STME's subjects?

Research design

The ex-post-facto survey design was used in this study. Akuezuilo and Agu (2003) stated that an ex-post-facto design is where a researcher carried out empirical inquiry but did not have direct control of the independent variables because their manifestations had already occurred. In this case, resource allocation to the STME subjects already existed so the researcher could not manipulate them.

Sample and sampling technique

The sample for this study comprised 26 principals of junior secondary schools in Anambra State selected through stratified–random sampling technique. The 261 secondary schools in the state were stratified on the basis of the education zones where they are located. From each education zone, 10 percent of the schools were selected. By so doing, a total of 26 schools were selected from the 261 schools in the population. Then the entire 26 principals in these schools were chosen as sample to provide the data for this study. However, the school was taken as the unit of analysis to enhance collation of data on resource allocations in the schools.

Instrument for data collection

A researcher-developed inventory titled "Science, Technology and Mathematics Education Resource Allocation Inventory (STMERAI)" was used in collecting data for this study. The inventor was divided into two parts.

Part 1 comprised 3 open-ended statements that elicited background information on the respondents' education zone, number of years in the school, and number of students' enrolment. Part 2 of the inventory consisted of five sections (Sections A - E). Section A had 2 items on the human resources (teacher salaries, number of teachers, job experiences of teachers, subjects taught, number of classes and students taught per teacher. Section B contained 3 items on the material resources (laboratories, equipment, supplies, manipulative, and other teaching aids). In Section C, five items on books in the library were stated while section D also had five items on instructional periods allocated per subject. All the items were open ended. In section E, 6 statements were listed for principals to indicate either yes or no, if the present status of any of the resource indicators in the schools poses a threat to the attainment of the MDGs.

Validation and reliability of instrument

Three lecturers in the department of science education, curriculum studies and measurement and evaluation validated the instrument. The test-re-test method of ascertaining reliability was applied. The researcher administered ten copies of the inventory to principals serving in ten secondary schools in Imo State. The copies of inventory were administered again after two weeks. Computation of the Pearson Product moment correlation between the two sets of scores yielded a coefficient of 0.93, which the researcher considered adequate for the study.

METHOD OF DATA COLLECTION

The researchers collected data with the help of thirteen research assistants who were teachers in secondary schools in Anambra State. Two research assistants covered each school studied. The researcher and the assistants visited the schools and distributed copies of the inventories to the school principals in their offices. Given the documentation nature of the inventory, they allowed each principal for three days to fill in a copy of the inventory before retrieving them.

They also collected relevant documents on teacher salaries, material costs, and laboratory supplies. All the distributed copies of the inventory were collected back with relevant school documents. Thus, a 100% return rate was witnessed.

Scoring of instrument

(i) In the estimation of teacher salaries, the number of teachers who taught each subject to a class cohort for the three years were identified. Then, the annual salaries earned by the teachers were calculated. The next step was to divide the annual salary earned by the teacher with the number of students taught for the three years. The total teacher cost per student in each subject was used as a measure of the total expenditures on teachers' salaries in that subject.

(ii) Percentage of experienced teachers; Teachers with six years of teaching in a particular subject were regarded as more experienced teachers (ETPS), while those with less than six years of teaching in a particular subject area were regarded as less experienced. In estimating the number of experienced teachers, the total number of experienced teachers that taught each subject for the three years was added up. Then, the total number of experienced teachers was divided by the class enrolment and multiplied by 100. The value obtained gave the percentage of experienced teachers in each subject for three years.

(iii) To calculate the teacher student ratio (TSR), the total number of teachers that taught each subject for the three years was simply added and divided by the total enrolment in the five subjects for the three years.

(iv) Section B; the material resources considered in this study were limited to laboratory facilities and consumables, equipment, and teaching aids. The records of materials provided in each school were obtained. The proofs of purchase were also obtained where possible. The costs of the items in the market from 2002 - 2006 obtained were possible. To estimate the cost of each item of equipment, the quantity provided was multiplied by the unit cost and the total cost was simply added up for each class level. Then, the total cost of equipment and supplies was divided by the class enrolment per level (JSS 1, 2, and 3). Thus, at each class level, the total cost of equipment and supplies per student was obtained, and the overall total was obtained by adding up the unit cost for the various class cohorts.

(v) Book cost per student. Here, the total number of books in each subject area for JSS 1 - 3 in the library was obtained in each school. Then, the cost of each book was obtained and multiplied by the total quantity per subject to get the total book cost per subject. Using the total cost of book per subject was divided by the total enrolment per subject for each class level. The overall total of the cost of book per student was obtained by simply adding up book per student ratios at various levels.

(vi) Instructional time; to obtain the average instructional time per subject, the school timetables from 2002 - 2006 were obtained. The number of periods and minutes allocated for each subject in a week was identified. To get the actual instructional hours of instruction per year, the number of minutes per period was multiplied by the number of periods per week and finally by the number of weeks in a school year (holidays were excluded). This calculation gave the actual hours of instruction in a class per year in each subject. To derive the unit measure, the actual total hours per subject in a year was divided by class enrolment for each level. For instance, if an English language teacher taught a JSS 2 of 200 students, for 364 hours per annum, then the unit instructional time for the subject was 1.82 hours. To obtain the total instructional time per student, the unit measures for the classes were then summed up and divided by the class enrolment.

Method of data analysis

Frequency counts and percentages were first of all taken on the inventories collected from the principals. Then, the mean score of the each resource in the inventory per subject was computed and used in answering the research question 1. Frequencies and percentages were used to answer research question 2.

Presentation and analysis of data

Research question 1

How well resourced is each of the STME's subjects [Integrated Science, Introductory Technology and Mathematics] at the junior

Table 1. Means of resource allocation to STME by subject in Anambra State from 2003 -2006.

Resource input	Integrated science	Introductory technology	Mathematics	Aggregate mean
	$\bar{X}$	$\bar{X}$	$\bar{X}$	
Teacher salary	62.37	53.2	74.73	63.44
Experienced teachers	3.49	4.13	5.10	12.72
Teacher student ratio	1:64	1:63	1:50	1:59
Material cost	18.04	9.76	10.20	12.66
Book per student ratio	32.44	32.02	32.09	32.18
Instructional hours	5.91	6.36	11.78	8.02

Table 2. Frequency and percentages of principals' responses to resource allocation for STME as a threat to attaining MDGS.

Statement	Frequency	Percentages
Teacher salaries are poor; to motivate them is to implement the MDGs.	26	100
The MDGs cannot be realized with the present number of experienced teachers in schools.	24	92.30
The large class sizes make teacher-student ratio to be a threat to the achievement of MDGs.	21	80.76
Materials provided for schools are grossly inadequate for attaining the MDGs.	26	100
Insufficient books threaten the attainment of the MDGs.	25	96.15
The instructional hours allocated for Science, Mathematics and Technology subjects are inadequate for the attainment of the MDGS.	6	23.07

secondary school level in Anambra State?

The results shown in Table 1 indicate that between 2003 - 2006, the aggregate mean for teachers' salaries for the three subjects was ₦63.44. The mean of the percentages for experienced teachers (%ETPS = teachers with six years experience and above) in the subjects was 12.72 while the mean teacher-student ratio was 1:59. The mean for materials cost (laboratory equipment, teaching aids and supplies) for the three subjects was ₦12.66. Finally, the Table showed the aggregate mean of instructional hours to be 8.02. This analyses shows that none of the subjects is well resourced.

Research question 2

Does the level of resources allocated to STME pose as a threat to the attainment of the MDGs in the state?

In Table 2, most of the principals considered statements 1 to 5 as posing a threat to the attainment of the MDGS. However, only a few of them saw item 9 as a threat. Therefore, apart from instructional hours, the quantity of the other types of resources allocated to STME poses a threat to the MDGS.

Hypothesis one

Is there any significant difference in the level of resource allocation among the three STME's subjects?

Data for null hypothesis one was tested with ANOVA for the three subjects (Integrated Science, Introductory Technology and Mathematics] and presented in Table 3.

In Table 3, the F- calculated value of 4.61 was obtained against the F- critical value of 2.70 (at 0.05 level of significance). Since the calculated F-value is greater than the Table value, the decision is to reject the null hypothesis. Therefore, there is a significant difference between the types of resources allocated to integrated science, introductory technology, and mathematics.

DISCUSSION OF FINDINGS

Data was obtained to identify the resources provided for the students from the year they entered JSS one to the year they took Junior Secondary School Certificate Examinations (JSSCE). One cohort was specifically studied: the 2003/2004 cohort. The results shown in Table 1 suggest that, over the three-year period of the students' attendance, the mean of the total expenditures on teachers' salaries per student did not exceed ₦66.39.

The expenditures were rather low particularly when it is realized that expenditures on teachers' salaries reflect the qualification and experience of teachers, other things being equal; variables according to Oguntuka (2005), in turn reflect the quality of teachers. How teachers could cope with such low salaries under this period of inflation might have negative consequences for the attainment of the Millennium Development Goals (MDGs). Hence, the poor salaries as observed in research question two poses a threat to the attainment of the Millennium Development Goals. This might explain why Okoye (2006) found that teachers engaged in trading and other ventures to supplement their salaries thereby being less committed to

Table 3. ANOVA summary for resource allocation in integrated science, introductory technology and mathematics (2002 - 2006).

Source of variation	Sum of scores	Df	Mean square	F-cal	F-crit	P < 0.05
Between subjects	33753.31	4	8438.32	4.61	2.70	Significant
Within subjects	973212.01	25	38928.48			
Total	1006965.32	29				

their teaching tasks.

The percentage of experienced teachers ranged from 3.49% in integrated science to 5.1% in Mathematics. This could be interpreted to mean that in integrated science, for instance, three experienced teachers were engaged for every 100 students over the three – year period that the students studied these subjects. This is an indication that the number of experienced teachers allocated to teach the 2003/2004 cohort was highly inadequate when these are compared with the standard minimum of 7.5 and 12.5% in the STME recommended by the United Nations International Children's Education Fund (UNICEF, 2001). It was also found that, a greater number of the principals indicated that this number of experienced teachers is a threat to the MDGS.

There is no doubt that when experienced teachers are not adequately recruited to teach the students, it would have adverse effects on the quality of teaching and learning. With respect to teacher – student ratio, findings also indicated that the number of students to a teacher in each of the three subjects varied according to the nature of the subject. For instance, the mean value in integrated science is 1:64; introductory technology is 1.63, while mathematics is 1:50.

These Figures indicate that there were quite a high number of students under a teacher for the three and years each student was in the junior classes. This observation simply shows that the number of teachers teaching in the junior secondary schools were insufficient to meet the teeming number of students enrolling for secondary education. As a corollary, the principals also indicated that the present teacher-student ratio for the STME subjects is a threat to the attainment of the MDGS.

Two major assumptions arise from this finding. In the first place, one can say that there is high enrolment of students, which might have been occasioned by the introduction of Universal Basic Education (UBE) programmed in Nigeria. In fact, Nwachukwu (2003) noted that since 2002, secondary schools in Anambra State have been witnessing an unprecedented rise in secondary school enrolment due to government policy on free education, which brought the backlog of primary school leavers who could not get admission in the previous years. This high enrolment is likely to have resulted in a high number of students per teacher in the junior secondary schools. Another assumption is that government has failed to recruit sufficient teachers for the junior secondary level of education in Anambra State. Obienyem (2004) warned about the declining quantity of teachers in secondary schools in Anambra State, as many teachers are leaving the job for more profitable ventures and government do not make efforts to recruit more teachers.

The total cost of materials (laboratory equipment, teaching aids and supplies) to which students were exposed in the sciences indicates that over the three-year period they were taught these subjects, the mean materials costs per student was not even up to N20.00. These monetary values are rather low particularly when it is realized that N20.00 can hardly buy a set of scientific equipment. The values suggest a low level of laboratory equipment and other materials in schools. This being the case, the schools are far from being equipped with materials needed to provide Universal Basic Education among students as stipulated in the MDG report (2006). Hence, the principals in this study also saw inadequate materials a threat to the MDGS. A situation where students are not provided with a variety of stimulating materials and equipment such as computers, technology equipment, science consumables and mathematical shapes etc can place serious limitations in what can be presented to students and place students at a distinct disadvantage relative to what they would have achieved with these materials.

Findings also revealed inadequate book per student cost across cohorts. The low book per student ratio cost found for all the subjects suggest that, the books in the libraries are inadequate for students' use. To buttress this finding, majority of the principals indicated that insufficient books are a threat to the attainment of the MDGs. Even more glaring is the observation that many of the schools visited had libraries with few recent book collections while some did not have libraries at all. Simply put, the available school libraries are not stocked with adequate books. This finding has some implications for the attainment of the MDGs in all the subject areas. In the first place, many researchers have noted the dearth of books and inability of students to buy the recommended books (Mbadugha, 2002; Obioma, 2004). This has led a great number of students to over rely on basal-readers and key-points, a situation that is likely to have negative effect on student progression and attainment of the MDGs.

Findings also indicate that, the instructional hours allocated to Mathematics were higher than the other subjects,

although the instructional hours for all the subjects are in consonance with the standard minimum recommended by UNICEF (2006). Hence, most principals in this study did not see instructional hours allocated for the STME's subjects as a threat to the attainment of the MDGs. This goes to confirm that the instructional time allocated for the subjects are adequate to give due emphasis to STME subjects in the secondary school curriculum.

Finally, the test of the null hypothesis showed significant differences in resource allocation among the three subjects. This indicates that the allocation of specific resource of input variables varies from one subject area to another. However, while differences in resource allocation were significant, one can still maintain the level of resource allocation across subjects that were low. In a related study, Betiku and Ochepa (2004) also found out that, resources for STM were highly lacking the Nigerian education system. Indeed, if one of the objectives of the government with respect to junior secondary school education is to promote quality in STME, part of the strategy to be adopted by educational planners is to allocate resources fairly and rationally to schools and subjects.

Conclusion

The findings of this study indicate that, the resources allocated for STME subjects are grossly inadequate. In the opinion of secondary school principals, such inadequate resources pose a threat to the attainment of the MGDs. This is rather unfortunate considering the fact that STME in junior secondary education is being emphasized across the globe for the attainment of the MDGs. Therefore, the finding is an indication that Nigerian governments' emphasis on STME that has not been matched with adequate resource allocation to the STME subjects.

And one cannot expect astronomical developments in the field of STME without adequate resource allocation. Government should match their emphasis on Science, Technology and Mathematics education with adequate special allocation of resources to these areas. There is need to improve the various materials and books allocated to junior secondary education in all the STME subjects. Libraries and laboratories should be stocked with current and adequate books, and equipment especially in introductory technology.

Principals should seek for alternative sources of funding. This will help them to procure the resources needed for the various subjects. Unless they do this, Anambra State might continue to lag behind in science and technological developments. As it stands, one can say that allocation of experienced teachers, materials, laboratory equipments and books demand serious attention, as they are likely to hinder the provision of high quality education needed for the attainment of the Millennium Development Goals.

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