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Causes of Low Enrollment of Physics as a Subject of Study by Secondary School Students in Nigeria: A Descriptive Survey

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Abstract

Physics is a basic requirement for obtaining admission into higher institutions in the pure and applied sciences, engineering and medicine. It is also the most basic requirement for the attainment of technological self-reliance by any people. But the enrollment of the subject by students in Nigerian secondary schools has been very low over the years. In this work the causes of low enrollment of students in physics in Nigerian secondary schools were investigated. Twelve schools were selected from four states in south-eastern Nigeria, by stratified random sampling. Student-respondents were selected from the chosen schools by stage sampling while teacher-respondents included all available and willing science teachers in the schools. The instruments of data collection were questionnaires for the students and science teachers, interviews with some of the principals and other senior staff of the schools, and data from the State Education Boards. Four research questions were formulated, on which the structure of the instruments of research were based. The questionnaires were randomly distributed to the respondents and re-collected after their responses. Then the responses were extracted, collated, analyzed and used to answer the research questions. It was discovered that the major causes of low physics enrollment in schools were: students' notion that physics was difficult to understand; their subject combinations and envisaged career choices which exclude physics; inadequate exposure and motivation; student's negative affective attitude towards mathematics and physics; insufficient physics teachers; and insufficient teaching materials and ill-equipped physics laboratories. A number of recommendations to stem the low physics enrollment syndrome were proffered.

Keywords: Causes, Low Enrollment, Physics, Secondary School, Students, Descriptive Survey.

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BACKGROUND TO THE STUDY

Physics has been one of the basic sciences offered at secondary school level in Nigeria since the grammar school era. Students have nearly always had the option to choose the subject or not. And fortunately enough, the prospects offered by some knowledge of physics have always remained broad. For example, no candidate can be offered admission in any institution of higher learning to study engineering, medicine, pure and applied sciences, environmental studies or science and technical education without at least a credit pass in physics. The annual JAMB Brochure (1996) attests to this fact. Also, job advertisements on the pages of newspapers and elsewhere show that companies, hospitals, maintenance outfits, oil and gas industries, etc. employ artisans, attendants and technicians who have at least a pass in physics. Even on grounds of direct personal benefit, a basic knowledge of physics enables one to rectify minor faults in home appliances, personal computers (pc's), private cars, etc.

On a broader scale, the level of development of any nation is hinged on the extent of its acquisition and utilization of technological innovations, which in turn cannot be attained without a working knowledge of physics. In line with this fact, the McGraw-Hill Encyclopedia of Science and Technology (1977) states under the aim of physics that every area of physics is characterized not so much by its subject-matter content as by the precision and depth of understanding which it seeks. The aim of physics is the construction of a unified theoretical scheme in mathematical terms whose structure and behaviour duplicates that of the whole natural world in the most comprehensive manner possible. Where other sciences are content to describe and relate phenomena in terms of restricted concepts peculiar to their own disciplines, physics always seeks to understand the same phenomena as a special manifestation of the underlying uniform structure of nature as a whole.

Thus physics is a unifying factor for all disciplines in life, being beneficial to the learner, his catchment environment (or discipline) and the world (or knowledge) at large. But surprisingly, students' enrollment of this vital subject which largely defines the development status of any nation has been on the decline in Nigerian secondary schools over the years. Several feelers point to that fact, as exemplified for the case of the University of Nigeria Secondary School, Enugu Campus: out of 126 students who sat the 1995 SSCE, 82 offered physics, but in 1996, only 65 out of 130 students offered the subject. In some schools, there were even no candidates for the subject for some years. At tertiary level some institutions enroll only a scanty number of students in their physics departments, because the few students who offered physics at senior secondary certificate (SSC) level, thereafter opt for medicine, engineering and other seemingly prestigious and lucrative fields of study. The problem is one of the reasons why it is difficult to have university graduate teachers of physics, chemistry and mathematics is because the good students of these subjects invariably go in for engineering and medicine. In fact, one of the most depressing problems colleges of education in Nigeria face is the perennial loss of good students in the sciences to the universities after one session, not to study education but invariably medicine, engineering architecture or pharmacy (Ukeje, 1986). This is not peculiar to Nigeria, according to Wenning (2002), Samela (2010) and Taale (2011) in their submissions agree that the situation as a universal one, creeping up to university level.

This state of affair is unacceptable because in complementary sciences like biology and chemistry, enrollments are comparably higher. For example, the data from the University of Nigeria Secondary School, Enugu Campus, showed that all the 126 students who took the SSCE in 1995 and all the 130 students who took the same examination in 1996 in the school offered biology. The question which then arises is 'What is the reason behind this unhealthy disparity?' At junior secondary school (JSS) level, integrated science which is the prerequisite subject for all the senior secondary school (SSS) science subjects is offered by all students compulsorily. And a look at the curriculum of integrated science from JS1 to JS3 reveals that all the component science branches – physics, chemistry, biology, agricultural science and earth science – are given comparably equal attention and basic introductory presentations. One then wonders why on entering the SSS, majority of the students tend to opt more for the other science subjects than physics. Notably also, mathematics which is complementary to the study and prerequisite to the understanding of physics is compulsory for all students both at JSS and SSS levels. Something therefore seems to be fundamental to the low enrollment of students in physics.

In terms of choice satisfaction there is no doubt that everyone enjoys the outcome of the study and knowledge of physics. People who offer physics as one of their subjects are always happy they did, more so as even their contemporaries in the other branches of knowledge usually esteem them highly, and more so if they are females. Physics experiments and results are appreciated by all and sundry. Percentage failure in SSCE in physics is usually the least when compared with the other science subjects (WAEC, 2014). More so, future prospects for physicists are even wider than for the other subjects. These facts make one wonder all the more why less people offer physics in their choice of subjects. Talking in terms of facilities, physics is not the worst off, compared with the other sciences. Once a school has been accredited to offer physics, the school usually establishes and equips laboratories that serve both as lecture rooms and as demonstration and experiment bases. Although some of these laboratories may be ill-equipped, one must also agree that for most schools, physics is usually given preference among the other subjects in terms of attention and facilities. These developments should therefore be points of attraction for most students to opt for physics; but alas, the contrary is observed.

The effect of this abandonment of physics is more than expressible because it triggers a chain of consequences on our national outlook as a whole. It stalls our technological advancement, leads to inadequate number of physics teachers for the present and future generations, leads to a proliferation of the arts subjects and excessive demand for admission and jobs in those areas, while such demands in the area of physics remains low and sometimes totally lacking. The repercussion of the neglect remains prominent, as people who avoided physics often, later in life, operate or supervise the use of gadgets that require basic knowledge of physics. Such people eventually get frustrated or muddle up things, and this in turn leads to inefficiency, low output, or even disaster. Thus the low enrollment of students in physics is an ill-wind that blows nobody any good. The root causes of the problem are investigated in this study, so that proper solutions can be proffered for its remedy.

Statement of the Problem

Nigeria is a vast country, having a considerably large number of secondary schools which evolved from a single mission school by 1859, to a presently estimated figure (by 2014) of around 10,000. Observation showed that these schools evolved at various rates with time, majorly out of necessity to absorb the relatively teeming number of candidates yearning for post-primary education at those times. However in recent times (say in the last ten to fifteen years), the school proprietorship trend appears to be borne out of desire to show affluence, create class distinction for the pupils, invest accumulated wealth, fulfill parochial, ethical or moral standard, or meet admission and consistent academic calendar gaps. As expected, the total enrolments in the schools have also appreciated over time. Complete records are not readily available, but the advancement in number of secondary schools, and the trend in enrolment for recent years are shown in Table 1 (Adesina, 1977; Ndaji in Ukeje *et al*., 1986; Ukeje: 1991; FGN, 2009; US Embassy, 2012).

Table 1: Evolution of secondary schools and students enrollments in Nigerian schools system

Year	No. of schools	Students enrolment	Year	No. of schools	Students enrolment
1859	1	-	1970	1227	-
1909	2	-	1975	1654	-
1955	161	-	1980	4236	-
1956	275	-	1985	6231	807,755
1957	297	-	2004	-	6,297,402
1958	303	-	2005	-	6,398,343
1959	305	-	2006	-	6,536,038
1960	311	168,309	2010	-	9,213,011
1965	-	252,586	2014	≈ 10,000	≈ 11,000,000

The final examinations (Senior School Certificate Examination, SSCE) of the secondary schools are presently conducted in Nigeria mainly by the West African Examinations Council (WAEC) and the National Examinations Council (NECO). WAEC started it all as early as during the colonial era, and covers all the

English-speaking West African countries. The SSCE has therefore also evolved with time, and some of the relatively recent participation figures are shown in Table 2 (WAEC: 2014). More complete records show that not only is the percentage of students offering physics low for over 80% of the schools in Nigeria, but in addition, for over 50% of the schools, the enrolment figures continue to fluctuate and diminish on the average. This trend is seen as dangerous for the future of a developing country like ours; and if nothing is done now to find out the root causes of the situation with the aim of countering them, it might even degenerate to a point whereby we might have no physics teachers at all, or enough people going into advanced courses requiring physics as prerequisite.

Table 2. WAEC SSCE Enrollment from 1996 to 2014

Year	Number participating	Year	Number participating	Year	Number participating	Year	Number participating
1996	519,667	2001	1,040,104	2006	1,181,515	2011	1,540,250
1997	622,433	2002	925,289	2007	1,257,330	2012	1,627,224
1998	640,626	2003	939,507	2008	1,369,142	2013	1,689,188
1999	761,060	2004	844,540	2009	1,373,009	2014	1,692,435
2000	643,378	2005	1,080,162	2010	1,351,557	2015	-

Purpose of the Study

The purpose of this study is to:

- bring to lime-light the fact that such a vital subject as physics is an 'endangered species' in our secondary school system;
- investigate the immediate and remote causes of the detestable trend; and
- prescribe possible solutions to arrest the ugly situation of low enrollments in physics.

Significance of the Study

This study has both explicit and multiplier expositions for students, teachers, school administrators, parents and education planners. The study will hopefully:

- help students to develop awareness for physics and avoid a repulsive approach to it in relation to other subjects;
- point out what physics teachers can do to broaden the awareness of students in physics and make the subject attractive to them;
- highlight the role of the principal and other relevant school leaders in the task of making the students to like and opt for physics;
- make parents realize their roles to encourage their children, show interest in their competences and help them in choosing their careers properly;
- sensitize the zonal boards, ministries of education and education planners about the anomaly, for them to act appropriately to remedy it; and
- enhance the chances for rapid technological advancement of Nigeria, after the problem has been properly addressed.

Research Questions (RQs)

Research questions which arose with respect to the research topic are as follows:

- What are the factors responsible for students' low enrollments in secondary school physics?
- Do secondary school students avoid physics as a result of fear, uncertainty, hindrances or otherwise?
- What special points do biology and other science subjects have that attract students to them more than physics?
- Are there things which physics teachers, parents, school authorities and other concerned agencies could do to manage or solve the problem?

METHOD

Research Design

This is a descriptive survey research design in which the factors responsible for low enrolment of students in SSCE physics in Nigeria were explored. The research design is quite modest, and was used to effectively investigate and explain why the undesirable situation of physics abandonment exists in the Nigerian schools system. According to Nkpa (1997):

> Descriptive studies make no attempt to manipulate variables. Their concern is to either describe and interpret existing relationships, attitudes, practices, processes and trends, or compare variables.

Thus all that one was required to do under this design was to collate respondents' opinions, add data from the school authorities and education boards, analyze them, and then identify and publish the observed causes of low enrollment of physics in Nigerian schools. The data were extracted from the research instruments, standardized and used to reach the conclusions. Some other relevant data were obtained from the Statistics Divisions of the State Secondary Education Boards (SEBs), the principals or other top officials of the secondary schools in the selected schools for research, science teachers in such schools and their SS 2 students.

Population of the Study

The target population was four states of Abia, Anambra, Enugu and Imo States in the South East zone of the Nigeria. A local government area (LGA) was randomly chosen from each state, and three schools were chosen from each LGA (i.e. each state) by stratified random sampling. Thus a total of twelve schools were selected. The total number of students in the selected schools was eleven thousand, seven hundred and eighteen (11,718), and the total number of science teachers in them was one hundred and thirty two (132) (See Table 3). These formed the study population.

Samples and Sampling Techniques

The study samples were selected from the twelve schools chosen as described above. The schools in the selected LGA (state) were stratified into boys' schools, girls' schools and mixed schools. Ratios were calculated for the strata and cluster sampling method used to randomly select schools according to the ratio worked out for each stratum. Thereafter, a single school was picked from each stratum. Cohen and Manion (1987) explained these sampling processes thus:

> … Stratified sampling involves dividing the population into homogeneous groups, each group containing subjects with similar characteristics.... By cluster sampling we can randomly select a specified number of schools and test all the children in those selected schools.

Randomization was ensured by numbering each stratum, writing down similar numbers in pieces of paper, folding and then picking after some shuffling. The number picked was then folded back and replaced before another sample was similarly selected. After that, the sample school was picked. This method is in fact stage sampling, which Cohen and Manion (1987) defined thus:

> … Stage sampling is an extension of cluster sampling. It involves selecting samples in stages, that is, taking samples from samples.

The twelve schools selected were coded as represented in Table 3 with their sample populations.

Table 3. Selected Schools for Survey and their Sample Populations.

State	School	Type of School	SSS Students	Science Teachers
Abia (A)	A1	Boys	846	9
	A2	Girls	1398	14
	A3	Mixed	512	8
Anambra (B)	B1	Boys	150	4
	B2	Girls	647	8
	B3	Mixed	974	17
Enugu (C)	C1	Boys	1612	7
	C2	Girls	1042	12
	C3	Mixed	1360	13
Imo (D)	D1	Boys	586	11
	D2	Girls	1693	17
	D3	Mixed	898	12

Further stratification was done for students in each school on a 50-50 basis to randomly select an average of ten science students and ten non-science students for the survey. The science students were those offering all the basic sciences, while the non-science students offered biology as their only science subject. All students selected were SS 2 students because they were considered to be a kind of average of the SS 1, SS 2 and SS 3 classes. Two other important reasons for using only SS 2 students for the survey were that the SS 3 students were writing their SSCE during the period of the survey, while SS 1 students were considered not to be mature enough to supply cogent responses to the required information. Still further stratifications were done in mixed schools to sample equal number of boys and girls vis-à-vis the stratification on science-non-science students basis. Such extended stratifications as deemed necessary conform to the opinion of Lewis (1973) that 'bias might be avoided by stratified sampling'.

Instruments for Data Collection

The main instruments of data collection for the survey were questionnaires. Two different questionnaires were produced, one for senior secondary school students (SQ) and the other for science teachers (TQ). In either questionnaire, information directly and indirectly leading to answers to the research questions (RQs) were sought for. Though quite exhaustive, the questionnaires were framed in such a way that an enthusiastic respondent would need ten to fifteen minutes to complete either. Both questionnaires are reproduced in the appendices. On the whole, one thousand questionnaires were produced, nine hundred for students and one hundred for science teachers. Information demanded from each questionnaire differed almost entirely from the other, but were aimed at the same goal. Additional data were obtained by oral interviews with the school principals, vice principals, deans of studies and heads of science departments, depending on where one was directed to. Such data included SSS populations, enrollment for each science subject, and science staff strength.

The list of schools, types, staff strengths and students enrolments in the selected LGAs were obtained from the Statistics Division of the State Secondary Education Boards, or the heads of visited schools.

Administration of the Instruments

Questionnaires were distributed to students as stratified, without preconditions until the number of questionnaires for the particular stratum was exhausted. In the case of science teachers they were all given questionnaires for responses as long as they were present and willing to respond. The reason for this is that science teachers were relatively few in number. To ensure high percentage of response and minimum wastage, the questionnaires were either collected on the spot or entrusted to willing teachers who gathered the students, got them fill the questionnaires and collected them back for return to the researcher. In any case, the students were fully briefed on how to fill the document and given room to seek clarification on any item.

Validity and Reliability of the Instruments

Validity: Validity of the instruments of research was adopted on the basis of face value (face validity) by experts in the field of educational research, measurements and evaluation.

Reliability: According to Nkpa (1997), the degree of random error is inversely proportional to the degree of reliability. Reliability was ensured in the present research by using the test-retest method. This was carried out in two of the sampled schools and certified okay.

Methods of Data Analyses

Analyses of procured data were mainly based on the computation of the extent (proportion) of response to each test item within item members in the questionnaires. All two and most three-member items were converted to percentage by the usual formula:

$$X\% = \frac{n}{N} \times 100 \qquad (1)$$

where: X is the percentage score of the option;
n is the number choosing that option;
N is the total number responding to that item.

All other (mostly five-member) items were analyzed by finding their standard deviation, SD, according to the formula:

$$SD = \sqrt{\frac{\sum(f-F)^2}{N}} \qquad (2)$$

where: $\sum$ = summation sign;
f = a sub-item score (or frequency);
F = average score of the sub-item;
N = number of sub-items.

The SDs were then standardized by converting them to Z-scores according to the formula:

$$Z = \frac{f-F}{SD} \qquad (3)$$

To enhance comparison with other scores and facilitate decision making, the standard (Z-) scores were upgraded to (standard) T-scores according to the formula (see Lewis: 1973):

$$T = 10Z + 50 \qquad (4)$$

This allowed for a uniform mean of 50 and a uniform standard deviation of 10 for all the test items, thereby making comparison among both intra-group and inter-group items easy.

Percentage or T-score of each sub-item was subsequently tested for acceptance or rejection under the 5% (0.05) level of significance. While the limit for percentage scores was given by the same value (i.e. 5%), that for the T-scores was given by:

$$\begin{aligned} \sum T \times 0.05 &= N \times T \times 0.05 \\ &= 5 \times 50 \times 0.05 \\ &= 12.5 \qquad (5) \end{aligned}$$

The scores above the required limits were then used to answer the research questions (RQs).

Analyses

Procured data from both questionnaire species were taken up and analyzed according to their relationship with the research questions (RQs). Items from the SSS questionnaire were designated as ‘SQ’ while those from science teachers questionnaire were designated as ‘TQ’. Out of the 900 questionnaires served to students, 400 went to male students while 500 went to female students. The questionnaire items, however, were not analyzed by gender strata. Valid returns were 392 from males and 490 from females, giving a total of 882 valid returns, or,

$$\frac{882}{900} \times 100 = 98\%. \qquad (6)$$

The wastage (arising from the twelve non-returns and invalids) was therefore 100 – 98 = 2%. Ninety six questionnaires were served to teachers and they were all returned and correctly filled. Thus the validity and returns in this case was 100%.

One can now re-familiarize oneself with the research questions (RQs) 1 to 4 earlier itemized, as the items are now analyzed under them. For any item or sub-item analyzed, the condition for acceptance (√) or rejection (x) as a contributory factor to the research problem was its value under the 0.05 level of significance. For T-scores, this is:

≥ 12.5 ………. acceptance; (7)
< 12.5 ……….. rejection.

Percentage scores were considered as they were, so that for such an item value we have

$\geq 5\%$ ………… acceptance; (8)
$< 5\%$ ………… rejection.

RESULTS

Research Question 1 (RQ 1)

Answers to RQ 1 were obtainable from questionnaire items SQ 5(b), 6, 7(a), 8, 11, 12 and TQ 6. For SQ 5(b), 706 students or 80% preferred biology to physics by making biology either their first or second choice in the list. Reasons for such a choice (including for those who preferred physics – 19%) were analyzed under SQ 6 in Table 4. The factors that influenced the students' choice of subjects, apart from parental factors, were analyzed under SQ 7(a) in the table. For item SQ 8, a total of 662 or 75% of the respondents indicated that biology lessons were both interesting and easy to understand; 132 respondents or 15% indicated that physics lessons were both interesting and easy to understand, while another 176 or 20% were of the opinion that physics lessons were interesting but difficult to understand. Thus a total of 311 students or 35% indicated that they liked physics lessons, though with varied cognitive perceptions.

Table 4. Analyses of Items SQ 6, 7(c), 12 and TQ 6 for RQ 1

Test Item	Frequency (f)	Z – Score	T – Score	Accepted/Rejected
SQ 6(i)	325	0.402	54.02	√
(ii)	616	1.784	67.84	√
(iii)	130	-0.523	44.77	√
(iv)	66	-0.827	41.73	√
(v)	64	-0.836	41.64	√
Mean (M) SD	240.20 210.69	0 1.00	50.00 10.00	
SQ 7(c)(i)	247	0.890	58.90	√
(ii)	72	-1.061	39.39	√
(iii)	250	0.923	59.23	√
(iv)	45	-1.362	36.38	√
(v)	222	0.611	56.11	√
Mean (M) SD	167.20 89.69	0 1.00	50.00 10.00	
SQ 12(i)	346	0.521	55.21	√
(ii)	8	-1.825	31.75	√
(iii)	439	1.166	61.66	√
(iv)	298	0.187	51.87	√
(v)	264	-0.049	49.51	√
Mean (M) SD	271.00 144.08	0 1.00	50.00 10.00	
TQ 6(i)	65	1.929	69.29	√
(ii)	33	-0.075	49.25	√
(iii)	20	-0.889	41.11	√
(iv)	28	-0.388	46.12	√
(v)	25	-0.576	44.24	√
Mean (M) SD	34.20 15.97	0 1.00	50.00 10.00	

In the case of SQ 11, over 616 respondents or 70% were of the opinion that physics textbooks were expensive and difficult to understand. The other views about physics textbooks were less the 0.05 level of significance. Item SQ 12 seems to be the most directly related item to RQ 1. Its analysis is also shown in Table 4. Item TQ 6 was almost concordant with SQ 6. Its analysis is also in Table 4. In SQ 12 the major responses of the respondents to 12 (v) were lack of (good) teachers, poor laboratory facilities and difficulty in understanding the subject (physics). Some of them also asserted that they were not being taught well enough.

Research Question 2 (RQ 2)

Answers to this RQ were provided by questionnaire items SQ 8, 12, TQ 6(v), 8. All the items were analyzed under RQ 1 above, except item TQ 8. Sub-item TQ 6(v) which had a T-score of 42.24 related further opinions of teachers on the student's affection to the sciences. According to 24 (or 25%) of them, many students avoid physics and chemistry and cling more to biology and agricultural science because they have a fearful attitude towards mathematics and calculation. To some extent, this opinion agrees with that of students under SQ 12(v). Analyses of affirmative responses for the three parts of item TQ 8, which was on examination performance, is presented in Table 5. It should be noted that TQ 8(iii) which was for higher failure rate in physics is lowest.

Table 5. Analysis of TQ 8 for RQ 2.

Test Item	Frequency (f)	Z – Score	T – Score	% 'Yes' Response
TQ 8(i)	37	0.568	55.68	40
(ii)	40	0.837	58.37	43
(iii)	15	-1.405	35.95	16
Mean (M) SD	30.67 11.15	0 1.00	50.00 10.00	

Research Question 3 (RQ 3)

Questionnaire items SQ 6, 8, 10, TQ 6, 8, 12 provided answers to this RQ. All of them except SQ 10 and TQ 12 had been analyzed under RQ 1 and RQ 2. Of particular note under this RQ are the following sub-items with indicated T-scores or percentages:

- SQ 6(i) relating to rate of comprehension (T-54.02);
- SQ 6(iii) relating to synthesis/evaluation (T-44.77);
- SQ 8 on affection and cognition - 75% all-positive for biology;
  - 15% all-positive for physics;
- TQ 6(i) also on subject comprehension (T-69.29);
- TQ 6(v) on further observation of teachers (T-44.24);
- TQ 8(iii) as analyzes in Table 5 (16%).

For item SQ 10(a), 344 of the respondents or 39% were physics students. Their reasons for doing physics, SQ 10(b), are analyzed in Table 6. The analysis shows that the most prominent single factor that influenced those who chose physics was their future career. Although it was not investigated, it is likely that such a reason (future career) was also cogent for those who chose chemistry and biology, but who are greater in number. For TQ 12, 530 respondents or 60% were of the view that biology was adequately staffed, while 176 respondents or 20% were of the view that physics was adequately staffed. On the reverse side (inadequate staffing), there were 247 or 28% for biology and 485 or 55% for physics. Statistics on staff strength from school authorities, however, showed an average teacher-student ratio of about 1:255 for both biology and physics. This was probably because, although all the schools visited had more biology teachers than physics teachers (to an average ratio of 5:1), each of the schools equally had more biology students than physics students (to about a similar ratio, especially schools situated in rural and sub-urban settings).

Table 6. Analyses of SQ 10(b) for RQ 3.

Test Item	Frequency (f)	Z – Score	T – Score	Accepted/Rejected
SQ 10(b)(i)	43	-0.582	44.18	√
(ii)	118	1.458	64.58	√
(iii)	99	0.941	59.41	√
(iv)	32	-0.881	41.19	√
(v)	30	-0.936	40.64	√
Mean (M) SD	64.40 36.77	0 1.00	50.00 10.00	

Research Question 4 (RQ 4)

The most number of items in the questionnaires seem to fall under this RQ. Items that hold possible answers to the RQ include SQ 6(iv) (T-41.96), 7(a), (b), 9, TQ 6(ii) (T-42.37), 7, 9, 10, 11, 12. For SQ 7(a), 341 respondents or 39% indicated that their parents had some influence on their choice of subjects. Over 75% of such students were physics students. 529 respondents or 60% indicated that their parents had no influence over their choice of subjects. In SQ 7(b), those influenced by their parents in choosing their subjects responded as analyzed in Table 7.

Table 7. Analyses of SQ 7(b), TQ 9(b) and TQ 11 for RQ 4.

Test Item	Frequency (f)	Z – Score	T – Score	Accepted/Rejected
SQ 7(b)(i)	140	1.696	66.96	√
(ii)	88	0.110	51.10	√
(iii)	91	0.201	52.01	√
(iv)	46	-1.171	38.29	√
(v)	57	-0.836	41.64	√
Mean (M) SD	84.40 32.78	0 1.00	50.00 10.00	
TQ 9(b)(i)	75	1.376	63.76	√
(ii)	50	0.314	53.14	√
(iii)	22	-0.875	41.25	√
(iv)	56	0.569	55.69	√
(v)	10	-1.385	36.15	√
Mean (M) SD	42.60 23.54	0 1.00	50.00 10.00	
TQ 11(i)	5	-1.203	37.97	√
(ii)	62	0.691	56.91	√
(iii)	65	0.791	57.91	√
(iv)	70	0.957	59.57	√
(v)	4	-1.237	37.63	√
Mean (M) SD	41.20 30.08	0 1.00	50.00 10.00	

For item TQ 9(a), 94 or 98% of the responding teachers claimed that they encouraged their students to offer physics. Analyses of how such encouragements were made, TQ 9(b), is also presented in Table 7. Analyses of item TQ 11 on the teachers' welfare are also in the table.

For item TQ 7, 65 respondents or 68% stated that the biology laboratories in their schools were adequately equipped, 67 or 70% felt that their physics laboratories were adequately equipped. Items SQ 9 and TQ 10 are closely related to each other and were analyzed as in Table 8.

Table 8. Analyses of SQ 9 (Biology and Physics only) and TQ 10 for RQ 4

Item	Once per Week	Once in a While	None at all
SQ 9 Biology	461 (52%)	282 (32%)	139 (16%)
SQ 9 Physics	80 (60%)	39 (29%)	15 (11%)
TQ 10	62 (65%)	29 (30%)	5 (5%)

It can be seen that while the middle of the table (Once in a while) almost tallied (in percentage), the claims of the two different sets of respondents (students and teachers) differ more from each other at the two extremes of the table. Item 12 was analyzed under RQ 3.

Other Findings

A few other items on the questionnaires attracted noteworthy responses. These are as follows:
SQ 3: Majority (85%) of students interviewed were day-students, just as most of the schools in the school system (80%) were day-schools, with only 20% having boarding facilities. This situation, however, had no visible effect on the response patterns of the day-students and the relatively few boarding students interviewed.

SQ 4: Only 25 students (3%) of those interviewed indicated that he/she would like to read either physics or education for further studies. It was either medicine, engineering or computer science for science students, or accountancy, law, etc. for non-science students.

SQ 5: All the schools offer all the basic sciences – biology, agricultural science, chemistry, and physics. Students' enrollments (and preference) for the subjects were decreasing in that order, with the average ratio of 4:3:1:1, the preference for chemistry being just slightly more than that for physics.

TQ 3: 14 of the science teachers (15%) interviewed were physics teachers, and all had at least first degrees). 3 (21%) out of the 14 majored in areas other than physics (mathematics and engineering). 88 (92%) of the science teachers had degrees, while 8 (8%) had the National Certificate in Education (NCE). Only 60% of the teachers, however, had teaching qualifications.

DISCUSSION OF FINDINGS

This discussion must start by underlining one fact: the survey has substantiated that there is indeed low physics enrolment in all the schools in south-east Nigeria, to the average of less than 40%. From contemporary feelers, this precarious situation is actually prevalent in all schools nationwide. Consequently, the results emanating from the analyses adequately provide answers to the research questions, and forebear solutions to the research problem. The conversion of the raw scores or frequency data to Z- and T- scores standardized all the results, thereby providing a valid statistical basis for accepting or rejecting any of the items under the 0.05 level of significance. The analytical process also made it easy to make a quick comparison or judgment based on a standardized average (T-50 or 50%)

For RQ 1, significant answers obtained under the 5% level of significance gave an in-depth answer to the question of the causes of low enrollment in physics. The most significant answers (>50% or T > 50) were provided by items as follows:

- SQ 6(i), 8, 11, TQ 6(i) (T-54.02, >80%, 70%, T-69.29 respectively) – the students' low rate of understanding physics as compared to other subjects.
- SQ 6(ii), 12(i) (T-67.84, 55.21 respectively) – because of their envisaged career choices and subject combinations.
- SQ 7(c)(i), 12(iii) (T-58.90, 61.66 respectively) – lack of adequate exposure and motivation in physics.
- SQ 8 (>80%) – poor affective attitude of the students for physics.
- SQ 7(c)(iii), 12(iv) (T-55.91, 51.87 resp.) – performance in physics examinations.

The greatest factors causing low enrollment of physics by students seem to be their poor affective attitude (>80%) and inadequate awareness cum motivation (T-58.90, T-61.66) to the subject. These outcomes in general agree with the findings of Adamu (1992) and the opinion of such authors as Okonkwo *et al* (1989), French (1990), Hornig in Briscoe et al (1979), the UNESCO (1962) conference, and Taale (2011). The other responses, though significant at the 0.05 level, are considered to be less significant at T-50 or 50% (i.e. on the average) level.

RQ 2 sought to highlight the reasons that directly centre on the students attitudes and environments. The outcome hinges around these items:

- SQ 8 (>80%) – many students think that physics is difficult.
- SQ 12(i) (T-55.21) – due to the above reason most of the students adopt subject combinations which exclude physics.
- TQ 8(ii) (T-58.37/43%) – physics is at par with other science subjects in SSCE performance, which should make the students to give it equal consideration in choice.

The last outcome above is at variance with authentic SSCE results, however, which show that physics results have usually been better than other science subjects (WAEC: 2014). But again, the other results tend to agree with the research findings of Adamu (1992) and to a lesser extent on the opinion of French (1990). Further answers to the RQ are found under the other RQs, viz.:

- lack of motivation (SQ 12(iii), TQ 9);
- high cost and difficulty of physics textbooks (SQ 11);
- peer influence and exposure (SQ 7(c)); and
- parental attitudes (SQ 7(a), (b)).

Motivation visibly plays a pivotal role in attracting subject preference, and this is perhaps the reason behind the observation of Ukeje *et al* (1986). Lack of motivation and awareness substantially contributes to the 'brain-drain' in physics.

RQ 3 sought for causes arising from the vintage points of the other subjects, particularly biology, or the disadvantage points of physics. The items furnishing such responses are highlighted as follows for items scoring more than 50% or having T>50.

- SQ 6(i), 8, TQ 6(i) (T-54.02, >80%, T-69.29 respectively) – most students find their biology lessons easy to understand.
- SQ 6(ii), 10(b)(ii) (T-67.84, 64.58 respectively) – most students have subject combinations which include biology but exclude physics.
- TQ 12 (60%) – there is higher proportion of biology teachers in all schools. They possibly serve as role models to the students, thereby making most of them to be attracted to biology.

Here again, the findings of Adamu (1992) are confirmed; plus the opinion of French (1990) and Hornig in Briscoe *et al* (1979). Some other test items no doubt contributed answers to this RQ, but these were either better considered under some other RQs, or were deemed less significant (at 0.5 level) than the ones represented.

The discussion on answers to RQ 4 is most elaborate, as the RQ embraced a wide spectrum of subjects. Highlights of answers to the RQ are as follows.

- SQ 6(iv), TQ 9(a) (T-41.73, 98%) – most students did not feel that they were encouraged adequately enough by their teachers to offer (or like) physics, despite the teachers' claims to the contrary.
- SQ 7(a), (b)(i), (ii), 10(b)(i) (39%, T-66.96, 51.10, 44.18 respectively) – a minority number of the overall respondents indicated that their parents did influence their choice of subjects either directly

or indirectly through a guardian. Most of these students (75%) were physics students, meaning that the rest were influenced against choosing physics.
- SQ 10(b)(i) (T-44.18) – most students who chose physics did so mainly because of their proposed careers, other factors notwithstanding.
- TQ 11(ii), (iii), (iv), 12 (T-56.91, 57.91, 59.57, 60% respectively) – responses indicated that physics teachers are poorly remunerated and grossly overworked, while basic teaching materials are generally lacking.

Enlightened parents are duty-bound to orientate their wards towards the importance of physics. For the physics teachers, they may be working hard enough but the affective domain of learning needs to be seriously exploited by them in their pedagogues. The observations of Okonkwo *et al.* (1989) relating to poor facilities, inadequate and unskilled manpower should be looked into. Poor remuneration and 'brain-drain' respectively highlighted by Norris (1979) and Schweitzer *et al.* (1972) are also serious factors.

Summary

The findings of this descriptive survey have shown that there is indeed low enrollment of secondary school students in physics, and that the situation is mostly caused by the students':

- assumption of physics as being difficult to understand;
- envisaged career picks and subject combinations which inadvertently reject physics;
- lack of adequate exposure and motivation towards physics;
- negative affective attitude (bias) of most students for physics;
- fear of mathematics and all subjects deeply rooted in it;
- lack of interest in physics and physics education at tertiary level (due to poor income of physics teachers), leading to inadequate physics teachers in schools;
- lack of enlightenment on physics as a subject and poor endearment of students to physics by parents, teachers and authorities;
- ill-equipped physics laboratories and inadequate teaching materials in most schools.

Contrary to anticipation and with regards to some literature review, gender considerations did not contribute significantly to the topic at stake. Gender factor however, was not given prominence in this research. Since females make up not less than 50% of entire students populace, it should be ordinarily expected that they should equally make up not less than 50% of all physics classes. But that is far from reality, as physics is generally known to be a male-dominated discipline. Such authors as French (1990), Adamu (1992) and Ivie *et al* (2002), among many others, had discussed low participation of women in physics as a critical issue in the development of the discipline; but perhaps the gender aspect of the malaise is better handled as a full discourse of its own. On the other hand, the non-significance of gender influence here supports another observation of Adamu (1992), that enhanced learning environment grants equal motivation to both sexes for science. What this implies is that the same factors that cause prospective male students to do physics, or not to do it, also affect female students similarly.

Educational Implication of Findings

Although the problem of low enrollment in physics has been with us for as long a time as our school system, only a superficial attempt, if any, had been made to articulate its causes from such a scientific research and analyses as in this work. It is therefore hoped that the effort made in reaching at these findings will not be in vain. Students who come across this research document will hopefully be awakened to clearly define their educational aims and objectives, recognize the juicy prospects before them should they opt for physics, identify the possible obstacles on their way to pursuing the physics goal, and then brace up and adjust appropriately to tackle them headlong. Their primary task is to liberalize their tabula rasa towards physics and mathematics. Parents and guardians on their parts must realize that whatever germane courses their wards undertake essentially demand both their advice and encouragement. Noteworthy here is the additional comments of a few of the physics students, that their parents used to discuss (or even teach them) physics and some of their other strategic subjects, and/or hire some hands to help them comprehend and assimilate the topics better. The author of this work is one of the few determined students in his days (even with meager 'pocket-money' from the parents), who had to hire external hand to teach them physics when their school had no physics teacher. With the acknowledged strategic importance of physics in virtually every facet of human discipline, students themselves and parents in particular should start early in life to awaken their consciousness to physics and physics phenomena, which of course inevitably surround the whole of human life and development.

The findings reveal to the physics teacher his areas of weakness, and also point to the fact that if nothing tangible is done, his discipline might be at the brink of extinction from the school diary. The onus is on him to constantly review his pedagogic technique. Although he is already overworked, he still has an onerous responsibility of encouraging as many students as possible to develop interest in physics, and continue with it even beyond secondary school level.

School authorities are not exonerated from the issue at stake. For one, they must note that if the findings highlighted here persist in their schools instead of diminishing the status quo, the result would be the 'natural death' of physics in their schools, and the continued over-production of school leavers in the arts disciplines. The after-effect is that the chances for such disciplines in tertiary institutions will continue to be highly competitive, and manpower in those areas continuously over-produced. Such a situation cannot put our nation any step ahead in a world like ours, pervaded by rapid technological transformation. Principals should therefore use every wit and resources at their disposal to redress the precarious situation in their schools.

Local and state education authorities as well as the Federal Ministry of Education are the sectors that must take particular note of the findings of this research. This will help them greatly in planning for the sustenance of technological education in our school system. Ignoring the situation or leaving it as it is implies that what one may call 'technological decay' is on board. If more students are not encouraged to read physics up to university level, there cannot be physics teachers for the morrow; if there are no physics teachers there cannot be prospective students even for medicine and engineering; and the boomerang continues. In particular, existing and prospective physics teachers will continue to dessert the profession for 'greener pastures' until those in the profession are properly remunerated. Similarly, no meaningful teaching and learning of physics can ever take place without adequate teaching materials and laboratory facilities, as well as laboratory assistants who are conversant with the use of available facilities. And while these issues (findings) persist, there will continue to be high failure rate in physics, or at best the production of 'white-wash' physics graduates from our schools. Perhaps the most persona-social effect of the absence of physics (or scientific) culture, and the over-production of graduates in the arts and humanities, will be the collapse of scientific reasoning (Renner & Stafford: 1972). The consequence would be an overall populace with citizens of low level IQs.

Recommendations

From the foregoing, the following recommendations are hereby proffered.

1. Students should start early in life to develop interest in physics as a subject. This will make the subject easy for them when they now choose it as one of their subjects at school. Moreover, they should realize that the extra effort they may put in order to understand and pass physics is a credit to both themselves and the nation. To make such efforts concrete, students should develop more interest in their mathematics lessons and make every effort to know it and also pass it well. Then they would have a comparative advantage over their mates and be happy with their subject choices then and after.
2. Parents should arrange extra lessons for their children in the sciences, particularly in such areas as mathematics and physics which they find somewhat difficult. Where they can afford it, parents should also provide some gadgets and instruments like computers, science films, science novels, and simple

apparatus which will help to broaden the view, awareness and knowledge of the children in the core sciences and mathematics. Verbal encouragement and guidance, even in the absence of everything else, will also help tremendously to put the children in the right track regarding their careers. If disposed enough, the parents should from time to time teach the children by themselves, or at least discuss their problems in their subjects with them.

3. The teachers on their part should cease to stick to strictly orthodox ways of teaching as it concerns the sciences, particularly physics and mathematics. Less formal approaches should be adopted in order to first and foremost impart a positive attitude and friendly posture on their pupils in relation to themselves and their subjects. Sacrifice is also required, as physics teachers could make out extra time for additional teaching, problem solving or laboratory demonstrations, so that the students would be ‘at home’ with their course. The usual ‘master-servant’ and ‘pontius pilate’ posture of science teachers in their official relationship with their students worsens the students’ regard to the course.
4. School principals and heads of science departments, though operating on tight budget, could still do a lot to tilt the interest of their students towards physics. They could liaise with the teachers to improvise some unaffordable apparatus, or borrow from sister schools. Commendation of teachers’ efforts and fruitful dialogs on their problems will also help in bringing out the best out of the teachers. Principals should not hesitate to nominate and sponsor their physics staff for training and re-training, and for participation in science workshops, exhibitions, book-fairs and excursions. Benefits and emoluments accruing to the teachers should not be delayed or withheld for any reason. If these steps are taken, the morale of the teachers would be high enough to bring out the best out of them and attract others to the profession.
5. The educational authorities have the greatest role to play in remedying the ugly situation. To start with, they should mount up campaigns on the media, schools and communities to enlighten people on the importance of the sciences, particularly physics, and urge them to encourage their wards to do them for obvious benefits they hold, not only for them but for society in general. The science laboratories should be adequately equipped and training programmes scheduled for the science teachers and laboratory technicians, so that effective use would be made of provided equipment. Well-informed science supervisors should also be sent to schools from time to time to assess the progress of work in the sciences and hold fruitful discussions with both the school authorities and the science teachers themselves. Annual budgets at all levels of governance should make specific and adequate provisions for science enlightenment and expansion of scientific culture in our schools, and the funds disbursed timely and accordingly. Science teachers’ allowances should be raised across the board, and the general conditions of service of physics teachers in particular enhanced so that those in service would remain, and more students would be encouraged to take up the profession as they leave school.

Delimitation of the Study

The present study did not include the effect of poor planning and supervision on the causes of low enrollment in physics by prospective students. It also did not delve into the reasons why prospective school leavers would not undertake to study physics or education. Although gender factor in low physics enrollment in schools was highlighted, it was not thrashed in full.

Limitations

The researcher was partially handicapped in his study by limited fund and wide geographical spread of the study area. This resulted in the study being limited to a single local government area (LGA) in each of the states studied, and limiting the states to four out of five, in the studied geo-political zone (South-Eastern Nigeria). The sampling however, was deemed representative enough for objective assessment of the topic and generalization nationwide.

CONCLUDING REMARKS

Researches of this nature are very helpful to both the educational communities and the society in general. It is therefore suggested that school and university authorities, as well as governments at all levels, take part in funding such research. Respondents for oral or questionnaire interviews should oblige without hesitation, and needed data from which ever sector should readily be made available to the researcher to ease his 'bottlenecks'. On a last note, governments, at both state and federal levels, are urged to study this document and take appropriate actions to ameliorate the ugly situation.

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APPENDIX A

QUESTIONNAIRE FOR SS STUDENTS ON THE CAUSES OF LOW ENROLLMENT OF STUDENTS IN SSCE PHYSICS IN NIGERIA

This questionnaire is for a research to find out the causes of low enrolment in physics among students. Kindly complete the questionnaire by ticking (√) or filling in the gaps as appropriate.

PART A

1. Name (Optional) ……………………………………………………………………………
2. (a) Age: ………….. years. Sex: Male / Female Class: SS 1 / SS 2 / SS 3
3. (a) School: …………………………………………………………………………………….
   (b) Does the school have boarding facility? Yes / No.
   (c) If 'Yes', are you a border? Yes / No.
4. (a) Do you hope to enter higher institution after your SSS? Yes / No.
   (b) If 'Yes', to do what course? (Tick one)
   (i) Medicine / Engineering / Biomedics / Architecture.
   (ii) Physics / Pure or Applied Science / Education.
   (iii) Accountancy / Banking / Insurance / Business Administration.
   (iv) Arts / Humanities / Journalism / Political Science.
   (v) Any other course not listed:………… ………………………………………………

PART B

5. (a) Which of the following science subjects does your school offer?
   Agricultural Science / Biology / Chemistry / Physics. (Tick all that apply)
   (b) Which of them do you offer? (Please write them down in order of preference)
   (i) …………………. (ii) …………………. (iii) …………………. (iv) ………………….
6. What are the most likely reasons for your number (i) and (ii) choices in 5(b) above?
   (i) I find them easiest to understand.
   (ii) I require them for my future career.
   (iii) I score high marks in them.
   (iv) My teachers encouraged me to do them.
   (v) Any other reason: …………………………………. (Tick all that apply to you)
7. (a) Did your parents in any way influence your choice of subjects? Yes / No.
   (b) If 'Yes', in what ways? (Tick all that apply to you)
   (i) They urged me to do them (for my future career).
   (ii) They made me to develop interest in many of the subjects.
   (iii) They directed me to some people who guided me.
   (iv) They asked some people to choose subjects for me.
   (v) Any other way: ………………………………………………………………………..
   (c) What else influenced your choice of subjects? (Tick all that apply to you)
   (i) Internet, videos, television and radio programmes.
   (ii) My closest friends also do / did them.
   (iii) Past students I know did well in them.
   (iv) Nothing but to have enough subjects to register.
   (v) Any other influence: ……………………………………………………………….

8. Indicate in the table below how you find the lessons in the listed science subjects. (Tick)

	Interesting and easily understood	Interesting but difficult to understand	Uninteresting but easily understood	Uninteresting and difficult to understand
Agric. Science				
Biology				

Chemistry				
Physics				

9. Indicate in the table below how often you have practicals or demonstrations in the subjects you offer . (Tick)

	At least once a week	Once in a long time	None at all
Agric. Science			
Biology			
Chemistry			
Physics			

10. (a) Do you offer physics? Yes / No
(b) If 'Yes' why? (Tick all that apply to you)
(i) My parent's wish.
(ii) It is needed for my future career.
(iii) It is quite easy to learn.
(iv) I just like the subject.
(v) Any other reason: ……………………………………………………………………

11. What would you say about physics textbooks? (Tick in the table below as appropriate to you)

	All	Some	None
Physics textbooks are few in number.			
Physics textbooks are difficult to understand.			
Physics textbooks are expensive.			
Physics textbooks do not contain SSCE topics.			
Any other opinion: ……………………………………………			

12. Suggest two reasons why some students do not offer physics in the secondary school. (Tick the ones you suggest)
(i) Because of their career choices.
(ii) Gender (sex)-related considerations.
(iii) Lack of motivation or encouragement.
(iv) Because of high failure rate in physics.
(v) Any other reason: ……………………………………………………………………

THANK YOU; GOD BLESS YOU.

APPENDIX B

QUESTIONNAIRE FOR SCIENCE TEACHERS ON THE CAUSES OF LOW ENROLLMENT OF STUDENTS IN SSCE PHYSICS IN NIGERIA

This questionnaire is for a research to find out the causes of low enrolment in physics among secondary school students. Your cooperation is highly solicited in completing it. tick (√) or fill in the gaps as appropriate.

PART A

1. Name (Optional) ………………………………………………………………………………
2. (a) School: …………………………………………………………………………………….
   (b) Location of school: Urban / Semi-urban / Rural.
   (c) Is it a co-educational institution? Yes / No.
3. (a) Qualification(s): ……………………………………………………………………...
   (b) Course(s) studied: ……………………………………………………………………………
   (c) Teaching experience: …………………………….. years.
4. (a) Teaching subject(s): ………………………………………………………………………….
   (b) Class(es) taught: (Tick all that apply to you) SS 1 / SS 2 / SS 3.

PART B

5. (a) Which of the following science subjects does your school offer?
   Agricultural Science / Biology / Chemistry / Physics. (Tick all that apply)
   (b) Kindly list them in order of students enrolment (estimate) starting with the highest.
   (i) …………………. (ii) …………………. (iii) …………………. (iv) ………………….
6. Adduce possible reasons for the trend in 5(b) above? (Tick all that apply)
   (i) Rate of comprehension of the subjects by the students.
   (ii) Because of their subject combinations.
   (iii) Parental influence.
   (iv) Effect of proper/improper career guidance and counseling.
   (v) Any other possible reason: ………………………………………………………….
7. What would you say is the state of your school laboratories? (Tick in the table below)

	Adequately equipped	Fairly equipped	Poorly equipped	Cannot assess	No lab. for the subject
Agric. Science					
Biology					
Chemistry					
Physics					

PART C

8. Assess the performance of your past students in SSCE with respect to the above listed science subjects. On the average, would you say that performance in physics is:
   (i) better than performance in the other sciences? Yes / No;
   (ii) the same as performance in the other sciences? Yes / No;
   (iii) poorer than performance in the other sciences? Yes / No.

9. (a) When in a position to do so, and in your capacity as a science teacher, do you encourage your students to offer physics? Yes / No.
   (b) If 'Yes', how? (Tick all that apply to you)
   (i) By enlightenment on subject combinations and future prospects.
   (ii) Encouraging personal rapport between myself and the students.
   (iii) Motivation with gifts / high marks / prizes / relevant video films / excursions.

(iv) By giving extra (free) lessons on my subject / physics.
(v) Any other way: …………………………………………………………………………

10. How often do you organize practicals / demonstrations on your subject? (Tick one)
    (i) At least once per week.
    (ii) Once in a long time.
    (iii) Almost none at all.
11. What would you consider to be two greatest handicaps of physics teachers in your school? (Tick two)
    (i) Lack of proper qualification.
    (ii) Poor remuneration / incentives.
    (iii) Inadequate teaching materials.
    (iv) Too much work load.
    (v) Any other: ………………………………………………………………………………
12. How do you assess the manpower situation in your school as regards to the science subjects? (Tick in the table below)

	More than enough	Just adequate	Inadequate	Grossly inadequate
Agric. Science				
Biology				
Chemistry				
Physics				

THANK YOU; GOD BLESS YOU.