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Investigating Students' Mathematical Approach To Problem Solving In Physics In Nigerian Senior Secondary Schools: Implication In Sustaining Nation's Building

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ABSTRACT
The study investigated students' mathematical approach to problem solving in physics in the Senior Secondary Schools in Nigeria. The purpose was to examine the level at which students give correct mathematical interpretations to definitional statements in Physics. A descriptive type of survey research design was adopted in the study. The sample for the study consisted of 480 Senior Secondary School class two Physics students. They were purposively selected at random across the sixteen Local Government areas of Ekiti state, Nigeria. Three hypotheses were formulated and tested at 0.05level of significance. The research instrument was a questionnaire prepared and administered by the researcher on the respondents. The data collected were analysed through inferential statistics. The results showed that a high percentage of students find it difficult to translate definitional concepts in Physics into their mathematical expressions. It was also revealed that male and female students have the same disposition to mathematical symbols and figures in Physics irrespective of their school. Based on the results of this study, it was recommended that more attention should be given to the mathematical interpretations of definitional concepts in Physics.

KEY WORD: Mathematical approach, Definitional concept, Problem solving.

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I. INTRODUCTION

Physics is an important subject in the field of science that has crucial applications in the intellectual and technological growth of people and their environment. It is a practical oriented subject useful in solving problems of the society. Every society is clamoring for technological growth. This cannot be achieved without the application of physics concepts. In spite of the relevance of this subject to man and society, a lot of problems are militating against its study. The performance of students in the subject is not encouraging, both in internal and external examinations. This is why Adedayo (1998) observed that the performance of students in physics needed proper attention.

The problems of physics study lie with the students, their teachers, parents and the government. Many students are lazy and not ready to study, neither are they prepared for any type of vigorous task or to strain their brain (Adedayo, 1998). This may be the reason why many of them find it difficult to relate theoretical facts to reality. On the part of the teachers, they are not encouraged on the job. This is evident in their poor condition of service (Ajayi,1994). Thus, they seem to be bias as regards to the conduct of their duties as they have little or no dedication in discharging their duties. The socio – economic condition is posing the teachers to series of financial embarrassment and psychological imbalance. Thus, they lack full dedication on their job. The desire of a host of the teachers to secure a better paid job and/or find alternative means of livelihood has reduced their dedication to teaching. This is adversely affecting the students' learning in the classroom and physics in particular.

The regular change in government policy on education poses the school calendar and learning – teaching activities into confusion. For instance, the federal government of Nigeria ordered the closure of all primary and secondary schools in the country for three weeks in January, 2011 because of voters' registration exercise. During this period, all academic activities in the schools were put on holds, thereby disrupting the school preplanned programme and calendar. The areas of the curriculum to be covered during this period were delayed.

Any topic in physics is of three aspects which are definition of concept, interpretation (symbolically) and application. The first aspect i.e. definition is easily mastered (or memorized) by the students. But unfortunately, personal experience of the researcher over the years showed that a high percentage of students find it difficult to translate definitional statements into their mathematical interpretations, talkless of being able

to apply them to practical live situation. A number of factors may be attributed to this. As a result of students' laziness and unreadiness to engage in any strenuous task, they are only interested in memorizing definitions and the fundamental facts. Scholars (Comber and Keeves 1973; Adedayo 1998,2008,) noticed that boys are better than girls of the same age, class and background in mathematical skills. However, girls are better in definitional aspects as Soyibo (1992) discovered that " in Biology, the females shown better knowledge". This perhaps may be due to the fact that biology is a science subject that deal majorly with facts and not involving much mathematical skills. The discovery of Soyibo (1992) may be linked to the biological and natural endowment of females with language eloquence and softness than the males, who are characterized by coercive nature.

Statement of the Problem

The cost of education in Nigeria in increasing every day as evident in the fees being paid in the schools presently compared with few years back. The financial implication on any student in school involves fees for tuition, accommodation, feeding, clothing, body upkeep and enrolment for external examinations. It would thus be a colossal lost for the parents and the child for spending so much on education and still lack I such vital aspect as mathematical approach to solving problems which is the pivot of Physics. Poor mathematical interpretation of definitional concepts in Physics would automatically results into failure both in the classroom performances and ore particularly at the Senior Secondary School Certificate Examination. The consequence of this could be low number of qualified candidates for admission into some careers with Physics as one of their major requirements such as medicine, pharmacy, engineering, computer science, physics, e.t.c. This will invariably reduce the availability of would be technological manpower of the nation and consequently affect negatively the sustainability of the nation's technology building.

Research Hypotheses

The following hypotheses were formulated and tested at 0.05 level of significant:
Ho1: There is no significant relationship between students' ability to translate definitional statements in Physics to their mathematical expressions and vice-versa.
Ho2: There is no significant relationship between male and female students' ability to translate definitional statements in Physics to their mathematical expressions.
Ho3: There is no significant relationship between Public and Private schools students' ability to translate definitional statements in Physics to their mathematical expressions.

II. METHODOLOGY

The study employed a descriptive type of survey research design. It collected data that were already available. The population of the study consisted of all Senior Secondary School (SSS) class two Physics students in Ekiti state. The sample for the study comprised 200 SSS class two physics students randomly selected from 20 secondary schools in Ekiti state. In each school, 5 boys and 5 girls were purposively chosen at random making a total of 10 students per school. Out of the 20 sampled schools, 18 were government owned schools, thereafter referred to as public schools in this study while 8 were owned by private or non-governmental corporate bodies hereto called private schools.

Research Instrument

The instrument used for the study, tagged Performance Test (PT), was generated by the researcher. The instrument has two sections, A and B. A contained the Bio data of the respondents such as the name of the school, type of school (public or private) and sex. Section B contained 15 test items to determine the students' ability to translate definitions in physics to their mathematical expressions and vice – versa. The test items were drawn from topics that are inherent in the normal SS class two Physics scheme of work such as work, energy power, expansivity and mirror.

The validity of the instrument was confirmed for face and content validities by a Physics education lecturer from University of Ado Ekiti, an experienced physics teacher from a secondary school in Ekiti state and an expert in test and measurement. Each item of the instrument was studied, weighed and judged for its assumed relevance to the study.

The reliability of the instrument was determined through test retest method with two weeks interval. It was administered on SS two Physics students outside the coverage of this study. The scores obtained were analysed using the Pearson Product Moment Correlation analysis. The reliability coefficient of 0.89 was obtained which was considered adequate for the study.

Administration of the Instrument

The researcher visited the sampled schools with the copies of the instrument. The SS 2 physics teacher in each school was contacted and assisted in administering the instrument on the students. The instrument was

collected back immediately after responding to the test items. The duration for the test was 30 minutes while the test was administered within a month in all the selected schools.

The responses in section B were scored in weight where every correct response was ranked 1 and wrong response ranked 0. These scores were summed up to determine the total performance of each respondent.

Data Analysis

The weighted responses were subjected to descriptive statistics using frequency counts and mean as well as t-test statistics.

III. RESULTS

Ho1: There is no significant relationship between students' ability to translate definitional statements in Physics to their mathematical expressions and vice-versa.

Table 1: Pearson Product Moment Correlation of Students' Mathematical approach to Physics

Variable	N	$\dot{X}$	r_{cal}	r_{tab}	Decision
Definition to Mathematical Translation	200	5.20	0.426	0.195	Sigt
Mathematical to Definition Translation	200	4.60			

$P < 0.05$

The r_{cal} (0.426) is greater than the r_{tab} (0.195). Thus, the null hypothesis is rejected. This means that there is a significant relationship between students' ability to translate definitional statements in Physics to their mathematical expressions and vice-versa.

Ho2: There is no significant relationship between male and female students' ability to translate definitional statements in Physics to their mathematical expressions.

Table 2: t-test analysis of students' mathematical approach to Physics by Gender

Variable	N	$\dot{X}$	S.D.	df	t_{cal}	t_{tab}	Decision
Definition to Mathematical	100	5.20	1.70	198	2.58	1.96	NS
Mathematical to Definition	100	5.00	2.35				

$P > 0.05$

The t_{cal} (2.58) is less than the t_{tab} (1.96). The null hypothesis is therefore not rejected. It implies that there is no significant relationship between male and female students' ability to translate definitional statements in Physics to their mathematical expressions.

Ho3: There is no significant relationship between Public and Private schools students' ability to translate definitional statements in Physics to their mathematical expressions.

Table 3: t-test analysis of students' mathematical approach to Physics by school type

Variable	N	$\dot{X}$	S.D.	df	t_{cal}	t_{tab}	Decision
Public Students	120	5.47	2.20	198	3.44	1.96	Sigt
Private Students	80	5.58	3.15				

$P< 0.05$

Since the t_{cal} (3.44) is greater than the t_{tab} (1.96), the null hypothesis is rejected. This means that there is a significant relationship between public and private students' ability to translate definitional statements in Physics to their mathematical expressions.

IV. DISCUSSION

The result of this study showed that there is a significant relationship in students' ability to interpret definitions in physics to their mathematical expressions and in reverse order. Students find both processes very difficult. However, they find it easier to translate definitions to formular than in the reverse order. This is in agreement with Adedayo (1998) who discovered that students score higher percentage in definition to formula translation than in the reverse order.

The finding of this study also revealed that both male and female students are relatively at the same low level to translate definitions in physics to their mathematical expressions. This is however contrary to the earlier findings of Adedayo (1998) that male students performed better than their female counterpart in Physics. Soyibo's (1992) observation that girls perform better in aspects of science that deal with statements is as well at variance to the findings of this study.

It was further discovered in the study that students in both public and private schools are the same in translating definitional statements in physics to their mathematical expressions. It thus implies that students are

the same in their mathematical approach to problem solving in physics irrespective of their school type either public or private.

V. CONCLUSION

The findings of this study revealed that students find it difficult to translate definitions in physics to their symbolic expressions irrespective of their gender or school type.

VI. RECOMMENDATIONS

The following recommendations are made in view of the findings of this study:

1. Students should be exposed by the teacher to the basic mathematical operations that are applicable to physics.
2. Students should be guided by the teacher to realize the relationship between definitions in Physics and their symbolic expressions as having the same meaning.
3. Female students should be encouraged to offer physics as much as their male counterpart since gender in no barrier to performance in science.

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