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MATHEMATICS AS A PREDICTOR OF STUDENTS' ACADEMIC PERFORMANCE IN SCIENCES

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Abstract

The study investigated whether the performances of students in the Senior School Certificate Examination (SSCE) in Physics, Biology and Chemistry could be predicted from their grades in Mathematics mock examination. 60 students were randomly selected from four Secondary Schools in Ekiti State with the instrumentality of mock examination and achievement test. The instrument was validated by the experts in science education and curriculum studies. The reliability coefficient of the instrument was found to be 0.84 using test-retest methods. Regression analysis was used to analyse the result at 0.05 level of significance. The result of the findings indicated that the performances of students in Mathematics could be used to predict results of SSCE Physics, Biology and Chemistry. Based on the findings, it was recommended that Mathematics teachers should be committed to the teaching of the subject using the best approach because of its importance to sciences and consequently for technological development of the nation.

Keywords: Mock results; Mathematics; Predictors; Physics; Biology; Chemistry; Performance

Introduction

The world of science and technology seems to have accepted Mathematics as a universal language, without which knowledge explosion in this 21st century would have been watered down with the metaphysical and literary worldview. In a society driven by science and technology, the role of mathematics cannot be underestimated. Although, many high schools and colleges' graduates in science, technology, engineering and mathematics have been reported as unknowledgeable about basic scientific concepts (Lee, 2002).

The discipline of science is concerned with accuracy and precision of numerical measurement. Lack of understanding of many scientific concepts poses problems for the students whose background in Mathematics is very poor. It is therefore necessary that science teaching should be given more premiums through Mathematical knowledge. Most science educators believe that arithmetic and logical skills are important for students to understand scientific systems.

Overtly or covertly, physical sciences like physics, chemistry and part of biology are rooted in mathematical knowledge. For instance, the fundamental units (meter, kilogram, amount of mole and seconds) in physics and chemistry are the basis for scientific signs and symbols. Most of these scientific notations and results were used for prediction, estimation, calculation, forecasting and even drawing conclusion on issues of general interest in all facet of human endeavour. Many of the expression used in science subjects are borrowed from Mathematics. According to Ale (1981) the relationship and association between science, technology, engineering and mathematics (STEM) cannot be quantified as Adesoji (2003) affirmed that the bedrock of the physical sciences such as chemistry and physics is mathematics.

Laboratory experiments in Physics cannot be completed without the plotting of graphs (which is a tool in the hand of a lay man to understand information) and any student who intends to be proficient in Physics needs to possess a strong

background in Mathematics. Unfortunately, a lot of problems exist with the teaching of Mathematics at the secondary school level. Adepoju (2001) described the approach used by many teachers of Mathematics as one, which does not give room for students to develop their intuition, imagination and creative abilities.

Declining in the students' performance at their external and internal examination has become a subject of discourse among stakeholders. According to WAEC Chief Examiner's report (1997) the weaknesses noticed in the candidates of sciences at the SSCE level are; inability to express ideas logically and in clear terms; lack of adequate knowledge of fundamental of Physics and lack of calculative skills. Secondary education in Nigeria is associated with a declining trend in science students' enrolment and achievement (Iroegbu, 1998; Orji, 1998)

Purpose of the Study

The focus of this research was to confirm whether the students' academic achievement in Mathematics influences students' ability to reason scientifically.

Research Questions

The following research questions were raised.

- (i) Would mathematics examination significantly related to academic performance in Physics, Chemistry and Biology?
- (ii) Would mathematics examination predict academic performance in Physics, Chemistry and Biology?

Methodology

The target population for the study was all the Senior School Certificate Candidates who offered Physics, Biology, Chemistry and Mathematics in 2012 May/June WAEC conducted examination in Ekiti South West Local Government Area of Ekiti State, Nigeria. The sample was made up of one hundred students who were randomly selected from four secondary schools in Ekiti South West Local Government Area of Ekiti State. Twenty five students

were selected from each school to make up the sample using Simple random sampling method. Forty eight of the samples were females while fifty two were males. The research instrument used was S.S.C.E results and Mock results of students. The students' results were obtained directly from the academic offices of the selected schools in Ekiti South West Local Government area of Ekiti State. Hence, validity and reliability was not necessary

Data Analysis

This involved the use of regression analysis and stepwise multiple regression (backward procedure) to examine the relationship between the independent variable (Mathematics) and the dependent variables (Senior School Certificate Examination grades in Physics, Biology and Chemistry). Scheffe's post hoc comparison test was also used.

Results

- (i) Would mathematics examination significantly related to academic performance in Physics, Chemistry and Biology?

Table 1: *Correlation of Mathematics on student's performance in SSCE in Physics, Chemistry and Biology*

Source of variation	N	\bar{x}	r	r^2	σ
Mathematics (Y)	60	16.13			
Physics (X_1)	60	14.73	0.761	0.5791	0.4209
Chemistry (X_2)	60	10.67	0.3239	0.1049	0.8951
Biology (X_3)	60	9.47	-0.2981	0.0889	0.9111

Table 1 shows the correlation between Mathematics, Physics, Chemistry and Biology. The correlation between Mathematics and Physics is 0.761; this implies that there is high positive correlation between Mathematics and Physics. The correlation between Mathematics and Biology is -0.2981 which implies that

there was a negative correlation between mathematics and biology. The correlation between Mathematics and Chemistry is 0.3239 which implies that there is positive but low correlation between both subjects. The dependent variable (*Mathematics*) Y that X_1, X_2, X_3 could account for are 57.9%, 10.5% and 8.9% of variation. This implies that physics account for 57.9% degree of variability in Mathematics. Chemistry accounted for 10.5% degree of variability in mathematics while Biology accounted for 0.8% degree of variability in mathematics. The degree of alienation between mathematics and physics, mathematics and chemistry as well as mathematics and biology are 42%, 90% and 91.1%

(ii) Would mathematics mock examination predicts academic performance in Physics and chemistry?

Table 2: *Regression of Mathematics on student's performance in SSCE in Physics and Chemistry*

Y	R	R^2	ξ_1	ξ_2	<i>constant</i>
0.3721	0.7925	0.6281	0.084	0.279	11.9194

*Significant at $P < 0.05$

The regression equation that connect mathematics with physics and chemistry is given by $Y = a + \xi_1 x_1 + \xi_2 x_2$; where ξ_1, ξ_2 are the beta weights, a is the constant, Y is Mathematics score, X_1 is Physics scores, X_2 is the Chemistry

$$y = 11.9194 + 0.084 x_1 + 0.279 x_2 \dots\dots\dots(i)$$

Which implies that, (i) if x_1 is set aside, for every extra 1 mark increase in x_2 there exist a corresponding increase of 0.279 in Y .(ii) if x_2 is set aside, for every extra 1 mark increase in x_1 there exist a corresponding increase of 0.084 in Y . (iii) If X_1 and X_2 is set aside, for every extra 1 mark in other variables

order than X_1 and X_2 there exist an increase of 11.9194 in Y , X_2 is a better predictor of Y .

The degree of accountability of X_1 and X_2 in Y (eta square) is 0.6281 while the degree of non- determinant (Y) is 37.2% , which means that X_1 and X_2 cannot account for 37.2% in mathematics

(iii) Would mathematics mock examination predicts academic performance in physics and Biology?

Table 3: *Regression of Mathematics on student's performance in Physics and biology*

Y	R	R^2	ξ_1	ξ_3	<i>constant</i>
0.908	0.3033	0.0920	0.040	-0.236	17.778

*Significant at $P < 0.05$

The regression equation that connect mathematics with physics and biology is given by $Y = a + \xi_1 x_1 + \xi_3 x_3$;where ξ_1 , ξ_3 are the beta weights, a is the constant, Y is Mathematics score, X_1 is Physics scores, X_3 is the biology

$$y = 17.778 + 0.040 x_1 - 0.236 x_3 \dots\dots\dots(ii)$$

Which implies that, (i) if x_1 is set aside, for every extra 1 mark in x_3 there exist a corresponding decrease of 0.236 in Y .(ii) if x_3 is set aside, for every extra 1 mark increase in x_1 there exist a corresponding increase of 0.040 in Y . (iii) If X_1 and X_3 is set aside, for every extra 1 mark in other variables order than X_1 and X_3 there exist an increase of 17.778 in Y , X_1 is a better predictor of Y .

The degree of accountability of X_1 and X_2 in Y (eta square) is 0.0920 while the degree of non- determinant (Y) is 90.8% , which means X_1 and X_2 cannot account for 90.8% variability in mathematics

(iii) Would mathematics mock examination predicts academic performance in Chemistry and biology?

Table 4: *Regression* of Mathematics on student's performance in SSCE in Chemistry and biology

Y	R	R^2	ξ_1	ξ_2	<i>constant</i>
0.912	0.2966	0.088	0.4590	0.2646	2.035

*Significant at $P < 0.05$

The regression equation that connect mathematics with and biology is given by $Y = a + \xi_2 x_2 + \xi_3 x_3$; where ξ_2, ξ_3 are the beta weights, a is the constant, Y is Mathematics score, X_2 is chemistry scores, X_3 is the biology score

$$y = 2.035 + 0.4590 x_2 + 0.2646 x_3 \dots\dots\dots(iii)$$

Which implies that, (i) if x_2 is set aside, for every extra 1 mark in x_3 there exist a corresponding increase of 0.2646 in Y . (ii) if x_3 is set aside, for every extra 1 mark increase in x_2 there exist a corresponding increase of 0.04590 in Y . (iii) If X_2 and X_3 is set aside, for every extra 1 mark in other variables order than X_2 and X_3 there exist an increase of 2.035 in Y , therefore, X_2 is a better predictor of Y .

The degree of accountability of X_2 and X_3 in Y (eta square) is 0.088 while the degree of non- determinant (Y) is 91.2% , which means X_2 and X_3 cannot account for 91.2% variability in mathematics

Findings

The result of the findings revealed that physics has the highest correlation of 76.1% with mathematics. Invariably, mathematics is the language for working physics. However, there was a positive but low correlation between mathematics and chemistry. It was also revealed that there was a negative correlation between mathematics and biology. The findings showed that chemistry scores is the best predictor of students' academic performance in mathematics while biology is the worst predictor of academic performance in mathematics. This implies that students with higher scores in chemistry

performed better than those students in physics and biology while subjected to SSCE examination.

Discussion

The findings of this study indicated that results of students in Mathematics could be used to predict results in Physics, Biology and Chemistry (Sciences). This established the fact that Mathematics is very useful for the understanding of physical science. This finding is consistent with those of Adesoji (2003), Ale (1981); and Orji (1998) that affirmed that Mathematics is an essential ingredient for sciences. The findings is in line with Wang & Santos, (2003) who found a positive relationship between performance in science and mathematics. The finding is parallel to the study of Kolawole, Oginni and Fayomi (2011a) that ordinary level result in sciences predicts students' academic performance in chemistry in South-west Nigeria universities. The study also gave credence to the findings of Kolawole, Oginni and Fayomi (2011b) that UTME and post-UTME can also predict students' academic performance in chemistry in Nigerian universities

The result of the study contradicted the findings of Kobus et. al (2006) who found that positively skewed learner performances around the low median showed that learners did not perform well in the science and mathematics test in general.

Conclusion and Recommendations

The results of this study require educational planners to go back to the basics and redefine the intended achievement aims in mathematics and sciences. These intentions need to be uncluttered by political rhetoric, research fads, fashions, and ideologies. As is the case in other countries, Nigeria urgently needs a mathematically and scientifically literate citizenry to ensure survival upon its thriving and travail in search for knowledge and possible way to solve her lingering problems in science, technology, engineering and mathematics..

Recommendations emanating from this study is that teachers of Mathematics need to be more serious in teaching the subject using the best approach because of its importance to science and consequently for technological development of the nation.

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