INTERRELATIONSHIP BETWEEN STUDENTS' PERFORMANCE IN MATHEMATICS AND PHYSICS IN SENIOR SECONDARY SCHOOLS OF BIRNIN-KEBBI LOCAL GOVERNMENT AREA OF KEBBI STATE

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By

[1]Muhammad Sani Abdurrahman

+2348039273164, +2348077543985

Department of Mathematics,
Waziri Umaru Federal Polytechnic,
Birnin Kebbi, Kebbi State, Nigeria
E-mail: *muhammadsaniabdurrahman@yahoo.com*

&

[2]Ahmad Madugu

+2348063330279

[2]Department of Mathematics,
Isah Kaita College of Eduation,
Dutsin-Ma, Katsina State, Nigeria
Email: *ambtr64@gmail.com*

ABSTRACT

Mathematics has an age-old relationship with physics and other natural sciences. It is the foundation of science and technology and the functional role of mathematics to science and technology is multifarious, that no area of science, technology and business enterprise escapes its application. This study interrelate the performance of students' in mathematics and physics in senior secondary schools. The paper highlighted two pertinent points; first to determine the relationship between mathematics and physics, and second is to see whether success in mathematics can be used to predict success in physics and visa-visa. One null hypothesis was formulated to guide the study. Research data were extracted from 2009, 2010, 2011 and 2012 WAEC examination results from three secondary schools in Birnin Kebbi local government area of Kebbi state. The study adopted a descriptive survey design that employs simple linear correlation regression analysis in order to test the null hypothesis. The R values of 0.384, 0.104, 0.022 and 0.158 for the year 2009, 2010, 2011 and 2012 respectively indicated moderate to weak correlation. A test of significance, F-ratio was applied to the results. Since the calculated values of F were less than the critical values of F (F=1.62) at 5% level of significant, the null hypothesis was accepted. The result of the study therefore showed no significant correlation between students' performance in physics and their performance in mathematics.

Keywords: *Interrelationship, students' performance, mathematics and physics*

1 INTRODUCTION

Secondary education is an important sub-sector of the entire education system. On one hand, it provides lower level workers for the economy and, on the other; it acts as a feeder for higher levels of education. The quality of higher education, which is expected to produce high quality professionals in the different fields of social, economic, and political life of the country, depends upon the quality of secondary education. This level of education, therefore, needs to be organized in such a way that it should prepare young men and women for the pursuit of higher education, as well as making them able to adjust their practical lives to be full and productive.

More than at any time in the past, the future of every country depends on the quality and type of education received by its citizens. The countries that benefit the most are those that have a well educated population. Not only most of the countries need to be well educated in such traditional fields as languages, history, religions, but also in the scientific and technical disciplines that characterize the 21st century. Science and technology has become an integral part of the blood stream of modern civilization and is the major driving force for economic growth and development, Khan [1]. Mathematics serves in many of the branches of science. This relationship is explained by Herbert [2] who views mathematics as the ‘Queen and Servant” of the sciences. For example, measurement and other mathematical techniques are vital in the work of the physicist. The physicist uses the mathematical device called

the graph to give a clear picture of the relationship between different values like temperature and presence of saturated water vapour in the atmosphere. The laws of physics are stated in the form of algebraic formulae. The importance of mathematical knowledge in understanding engineering and technical education studies cannot be over emphasized. It is common knowledge that mathematics and science is one of the major requirements for admission into engineering and technical education programmes in Nigeria and elsewhere. The classroom practitioners, notably the professional teachers of science and even non-science teachers believe that no student can make a head way in science and technology without a basic knowledge of mathematics and according to Taylor [3] fewer people seem to be aware that mathematics carries the main burden in all of scientific reasoning and is the core of the major theories of physical science. In recent years all fields of science have become more and more quantitative. The distinguishing feature of mathematics is its quantitative character. All sciences depend on investigations and all investigations depend on measurements and measurement is a branch of mathematics, Barnes [4]. Most investigators in the sciences are of the opinion that competence in mathematics is an essential part in the study of most courses in physics. Lloyd [5] carried out a study which intends to identify cognitive abilities needed by students for success in first level college mathematics for science majors. Study findings indicated that the possession of

basic mathematics skills ability to use fractions, exponents' best discriminates between those who were likely to succeed as science majors and those who would not.

The interrelatedness of mathematics and physics can be clearly interwoven and complementary with one another by looking at West African Examination Council (WAEC) and National Examination Council (NECO) syllabi.

Table 1:Interrelatedness of mathematics and physics

S/N	Mathematics topics	Applications in physics
1	Transformation of formulae	Simple pendulum, laws in electricity etc.
2	Angle properties of a triangle	Prisms
3	Variations	Boyles Law, force acceleration, inertia.
4	Geometrical properties	Center of gravity
5	Differentiation of complex numbers	Electrostatic current
6	Negative exponential equations	Radioactive decay
7	Segments of chords theorem	Spherical mirrors distance
8	Area under curve	Indicator diagrams in work on steam and petrol engines.

Source: [WAEC & NECO syllabi, 1999-2002].

The annual releases of senior secondary certificate examination results (SSCE) conducted by West African Examination Council (WAEC) of secondary school students' performance in different school subjects. For instance, the percentage of students scores of Mathematics and Physics from 2009-2012 is shown below.

Table 2: Mathematics West African Examinations Council (WAEC) Result for Students' Achievement in May/June, 2009-2012

YEAR	TOTAL NO OF CANDIDATE	CREDIT A1-C6 (%)	PASS P7-P8 (%)	FAIL F9 (%)
2009	1,019,524	33.97	28.16	34.47
2010	1,054,853	38.20	25.36	34.41
2011	1,149,277	41.12	31.09	24.95
2012	1,249,028	46.75	26.72	24.24

Source: (WAEC statistics office, Lagos, Nigeria, 2013).

Table 3: Physics West African Examinations Council (WAEC) Result for Students' Achievement in May/June, 2009-2012

YEAR	CREDIT A1-C6 (%)	PASS P7-P8 (%)	FAIL F9 (%)
2009	29.59	32.80	37.61
2010	25.36	37.71	36.93
2011	34.48	35.87	29.65
2012	29.94	43.52	26.54

Source: (WAEC statistics office, Lagos Nigeria, 2013)

1.1 Statement of the problem

Perhaps, it is in realization of the importance of mathematics that it is made compulsory at primary and secondary levels of education besides admission into higher institutions and professional institutions. The questions to ask here are: Why are science students required to do mathematics? Is there any relationship between mathematics and physics? Can success in mathematics be used to predict success in physics? Research evidence, has, to some extent, indicated that performance in

mathematics can form the basis for predicting success in physics and chemistry and vice versa, Lloyd [5]. Therefore, it is against this background that the researchers investigate the interrelationships between students' performance in mathematics and their performance in physics in Birnin Kebbi Local Government Area of Kebbi state.

1.2 Objectives of the study

The study intends to achieve the following objectives:

i. To determine the relationship between mathematics and physics.

ii. To see whether the success in mathematics can be used to predict success in physics.

1.3 Research questions

In line with the statement of the problem, the following research questions were raised in this study:

i. Is there any significant correlation between the performance of students in mathematics and their performance physics?

ii. Can success in mathematics be used to predict success in physics?

1.4 Research hypothesis

The following null hypothesis was formulated and tested at 5% level of significance

Ho: There is no significant correlation between the performance of students in mathematics and their performance in physics.

2 METHODOLOGY

The designed adopted for this study is a survey design. A linear correlation/regression statistics was used to treat the null hypothesis of this study.

2.1 Population and sample for the study

The target population is all the senior secondary school students in Birnin Kebbi Local Government Area of Kebbi state. The researchers adopted a purposive sampling technique in selecting the schools and the level of the students from which the result was drawn. These schools are: Nagari Science College Birnin Kebbi, Government Girls Unity Secondary School Birnin Kebbi and Abdullahi Fodiyo Day Secondary School Birnin Kebbi.

3 PROCEDURE

3.1 Procedure for data collection

The sources of data for this investigation consisted of 2009, 2010, 2011 and 2012 examination results of final year science students in mathematics and physics. The total number of scores from the school during the four-year period was 90-30. Both result of mathematics and physics of 35 students were randomly selected from the schools. The results were supplied by the schools examination officers.

Aggregate values of students' performance

Aggregate values of students' performance were based on the following guideline.

Range of Scores		Aggregate Values	
Above 75	-	1	(A1)
70 – 74	-	2	(B2)
65 – 69	-	3	(B3)
60 – 64	-	4	(C4)
55 – 59	-	5	(C5)
50 – 54	-	6	(C6)
45 – 49	-	7	(D7)
40 – 44	-	8	(E8)
Below 40	-	9	(F9)

3.2 Procedure for data analysis

Scores obtained from the results were presented in tabulator form using SPSS 17.0 software for data storage and for data calculation. The data obtained from the study were statistically analyzed using linear regression analysis at 5% level of significance.

4 RESULTS

The results of the null hypothesis tested were summarized in the tables below.

Ho: There is no significant correlation between the performance of students in mathematics and their performance physics.

Table 4A: Mean, standard deviation and standard error of regression of mathematics (Y) on physics (X) of the year 2009

Subject	N	Mean	S.D.	Std. Error	R	R^2
Physics (X)	35	5.89	2.139	1.050	0.384	0.148
Mathematics (Y)	35	6.17	2.135	0.161		

Table 4B: Summary of analysis of variance (ANOVA) of regression of mathematics (Y) on physics (X) of the year 2009

Model	Sum of Squares	Df	Mean Square	F	F-tab	Sig.
Regression	22.987	1	22.987	0.723	1.62	0.023
Residual	132.555	33	4.017			
Total	**155.543**	**34**				

Table 5A: Mean, standard deviation and standard error of regression of mathematics (Y) on physics (X) of the year 2010

Subject	N	Mean	S.D.	Std. Error	R	R^2
Physics (X)	35	6.34	1.798	0.779	0.104	0.011
Mathematics (Y)	35	5.69	2.471	0.126		

Table 5B: Summary of analysis of variance (ANOVA) of regression of mathematics (Y) on physics (X) of the year 2010

Model	Sum of Squares	Df	Mean Square	F	F-tab	Sig.
Regression	1.198	1	1.198	0.364	1.62	0.550
Residual	108.687	33	3.294			
Total	**109.886**	**34**				

Table 6A: Mean, standard deviation and standard error of regression of mathematics (Y) on physics (X) of the year 2011

Subject	N	Mean	S.D.	Std. Error	R	R^2
Physics (X)	35	6.54	1.961	0.895	0.022	0.010
Mathematics (Y)	35	5.54	2.280	0.150		

Table 6B: Summary of analysis of variance (ANOVA) of regression of mathematics (Y) on physics (X) of the year 2011

Model	Sum of Squares	Df	Mean Square	F	F-tab	Sig.
Regression	0.062	1	0.062	0.016	1.62	0.901
Residual	130.624	33	3.958			
Total	**130.686**	**34**				

Table 7A: Mean, standard deviation and standard error of regression of mathematics (Y) on physics (X) of the year 2012

Subject	N	Mean	S.D.	Std. Error	R	R^2
Physics (X)	35	5.63	2.402	1.486	0.158	0.025
Mathematics (Y)	35	6.57	1.899	0.217		

Table 7B: Summary of analysis of variance (ANOVA) of regression of mathematics (Y) on physics (X) of the year 2012

Model	Sum of Squares	Df	Mean Square	F	F-tab	Sig.
Regression	4.926	1	4.926	0.850	1.62	0.363
Residual	191.246	33	5.795			
Total	**196.171**	**34**				

The analyses of data presented in tables 4, 5, 6 and 7 indicate the following values: R=0.384, R=0.104, R=0.022 and R=0.158 for 2009, 2010, 2011 and 2012 respectively. Ordinarily, the above values indicate from moderate relationships to weak correlation involving students' achievement in mathematics and physics. What this implies is that achievement in physics is but moderate/weak predictors of success in mathematics. When the R^2 were subjected to test of significance using F-ratio, the following results were obtained as presented in table 8 below.

Table 8:Observed and critical values of F

Year	Observed F	DF	Critical F at p=0.05	Decision
2009	0.723	1,33	1.62	Ho
2010	0.364		1.62	Accepted
2011	0.016		1.62	
2012	0.850		1.62	

It can be observed from table 8 that for any of the periods under investigation, the critical value of F was far less than the observed F under appropriate probability level and associated degrees of freedom except in 2009. The null hypothesis was therefore accepted. The result of this investigation indicated no significant correlation between students' performance in physics and their performance in mathematics in 2009, 2010, 2011 and 2012.

4.1 Discussion of findings

The R values of 0.384, 0.104, 0.022 and 0.158 for the year 2009, 2010, 2011 and 2012 respectively indicated moderate to weak correlation involving students' performance in physics and mathematics during the period of this research. It is therefore difficult to use students' achievement in physics as accurate predictors of their success in mathematics.

The result of the null hypothesis which states that there is no significant correlation between the performance of students in mathematics and their performance in physics from the year 2009-2012 was accepted. This finding is in disagreement with that of Hogan [6] who correlates students' performance in mathematics and their performance in technical drawing, mechanical engineering technology, electrical engineering design and electric power and machines. The result of his study indicates an apparent multiple relationship existing between mathematics and engineering disciplines as well as technology education. So also the findings of Udom [7] to some extent indicated that performance in mathematics can form the basis for predicting success in physics vice versa.

5 CONCLUSION

On the basis of the findings of this investigation, the following conclusions were drawn:

- Weak, moderate or strong correlation involving a group of related subjects does not imply that knowledge, in the two subjects can cause success in another subject.
- The relationship of mathematics to physics and other sciences subjects is worthy of note by classroom practitioners as well as curriculum planners to influence the learners' achievements in engineering, vocational-technical education and other technical pursuits.
- Even though there appears to be a relationship between students' performance in physics and mathematics; the achievements in physics may not all the time be accurate predictor of success in mathematics.

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