STUDENTS' ACHIEVEMENT SCORES IN MATHEMATICS AS A PREDICTION OF THEIR SCORES IN PHYSICS AND CHEMISTRY

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Abstract
This study was conducted to find out if students' achievement scores in Mathematics can be used to predict their scores in Physics and Chemistry. Thirty-three students were drawn from a total population of 450 from a Government Secondary School in Ilorin, Kwara State as the sample of this study. Students' Mathematics scores in the Senior Secondary School examination were compared with those of Physics and Chemistry, using regression analysis. Results showed that there was a p;ositive linear relationship between students achievment scores in Mathematics, Physics and Chemistry. Additional evidences from the scattergram also showed that students' mathematics scores were so positively and linearly associated with those of Chemistry and Physics. Both null hypotheses were rejected. Implications for other predictive studies are given and recomendations were made.

Keywords:* *Achievement scores, Predictive, Mathematics, Physics, Chemistry

Introduction
In this scientific age, the importance of Mathematics cannot be underestimated because it has its limb in virtually all fields of study either mathematical or non-mathematical, not to discuss its influence in the mathematical related fields. In fact, Mathematics is the pivot on which sciences, engineering, business and even social sciences revolve. As a result of its importance many institutions of higher learning require a credit pass in Mathematics from senior secondary school students who seek admission to study various courses in their institutions. Mathematics is the language of Science and Technology, because it is the tool for solving science subjects like Physics and Chemistry, hence the need to verify its relationship with other related subjects, especially Physics and Chemistry. The significance of Mathematics in producing versatile and resourceful graduates that are needed for economic development cannot be overemphasised. Mathematics is seen as a fundamental subject that is necessary for the understanding of other fields of study such as science, technology, social sciences, medicine, etc. (Bello & Ariyo, 2014).

Physics and Chemistry, on the other hand, are parts of the basic sciences that touch our lives daily at every point. They involve the study of nature, underlying principles that govern the behaviour of the whole universe, all physical and chemnical things in the universe, be it living or non-living. The study of Physics and Chemistry requires a lot of representation like experiments, formulas and calculations, graphs and concepts explanation (Bello & Ariyo, 2014). Physics as one of the physical science subjects plays an important role in the technological development and industrial revolution of any nation. The knowledge of scientific skill in physics is of tremendous use in solving diverse problems of humanity and providing solution to natural and artificial problems in the world at large (Ayodele, Adeneye, Awofala, & Adekoya, 2014).

Can an event in one situation be used to predict another event in a different situation? Can a student's achievement score, in a subject be used to predict his or her achievement in another subject? Can the behaviour of a person in a certain situation be used to predict his or her behaviour in another similar situation? These and many other similar questions are what researchers have been asking over a long time. Azure, (2010) conducted a study to find out if students' self-image can be used to predict their achievement scores in science. He used questionnaires to guage students levels of their self-image and compared them with their achievement scores in science subjects by using linear regression analysis. The result was that students who had very positive self-image scored significantly higher than those with low or negative self-image. Azure then concluded that since self-image had positive correlation with students' achievement scores, it could be used to predict their future achievement in science sujects, on condition that such self-images are constant over a long time.

Hypotheses

$H0_1$: There is no significant relationship between students' achievement scores in Mathematics and their scores in Physics

$H0_2$: There is no significant relationship between students' achievement scores in Mathematics and their scores in Chemistry.

Methodology

The sample for this study was drawn from Senior Secondary School, Opolo, Ilorin, Kwara State of Nigeria. The school is a Government Co-educational Day Secondary School which was established in 2011. It has a total population of 450 students. Thirty three students from this population, selected through systematic sampling procedure, formed the sample for this study.

Students' scores in Mathematics, Physics and Chemistry for the SS 1 exammination for the year 2017 provided data for this study

Results

Table 1: Mean and standard deviation of students achievement scores in Physics and Mathematics

	Mean	Standard Deviation	N
Physics	46.48	12.89	33
Mathematics	32.85	11.13	33

$P < 0.05$

Table 1 shows that the difference between the standard deviation of students scores in Physics and Mathematics is only 1.76. This narrow margin is an indication of a cluster of students scores in Physics with their scores in Mathematics.

ISSN 2384-7662
E-ISSN 2705-2508

Table 2: Model Summary

Model	R	R Square	Adjusted R Square	Standard Error of the Estimate	R Square Change	Change Statistics F.Change	df.1	df.2	Sig.F. Change
1	576*	332	310	10.702	332	15.397	1	31	000

P < 0.05

*Predictors (constant) Mathematics

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	1763.570	1	1763.570		
Residual	3550.672	31	114.538	15.397	000
Total	5314.242	32			

(a) Dependent variable: Physics
(b) Predictors: (constant) Mathematics

The results of the simple regression analysis indicated that mathematics scores significantly predicted their physics scores. Mathematics scores accounted for 33.2 percent of the variance while R^2 = 332 and F = 15.397. All these testify that students' mathematics scores significantly predicated their physics scores hence the null hypothesis (Ho1) is rejected. Pearson' correlation was used to test Ho1, as an alternative. The result indicated that the calculated regression coefficient (R-value) of 0.576 was greater than the critical R-value of 0.344 (P<0.05) (df 31), hence rejecting the null hypothesis. This correlation co-efficient is a statistical tool, used to measure the amount (i.e. quantum or strength) of the linear association between students achievement scores in mathematics scores and physics. Thus since the calculated coefficient of R, (0.576) is significant and also positive, it means that the relationship between students' achievement scores in mathematics and physics is positive and significant also.

Evidences from the Scattergram

The Graphic illustration, (see Scattergram) shows the two variables under study. The variable, (Mathematics), which is assumed to be the cause has been plotted on the X-axis while the variable which is the effect (i.e. Physics) has been plotted on the Y-axis (Larson, 1975), because it depends on mathematics, which is the independent variable.

The scattergram shown on Fig.1.1.

Fig.1.1

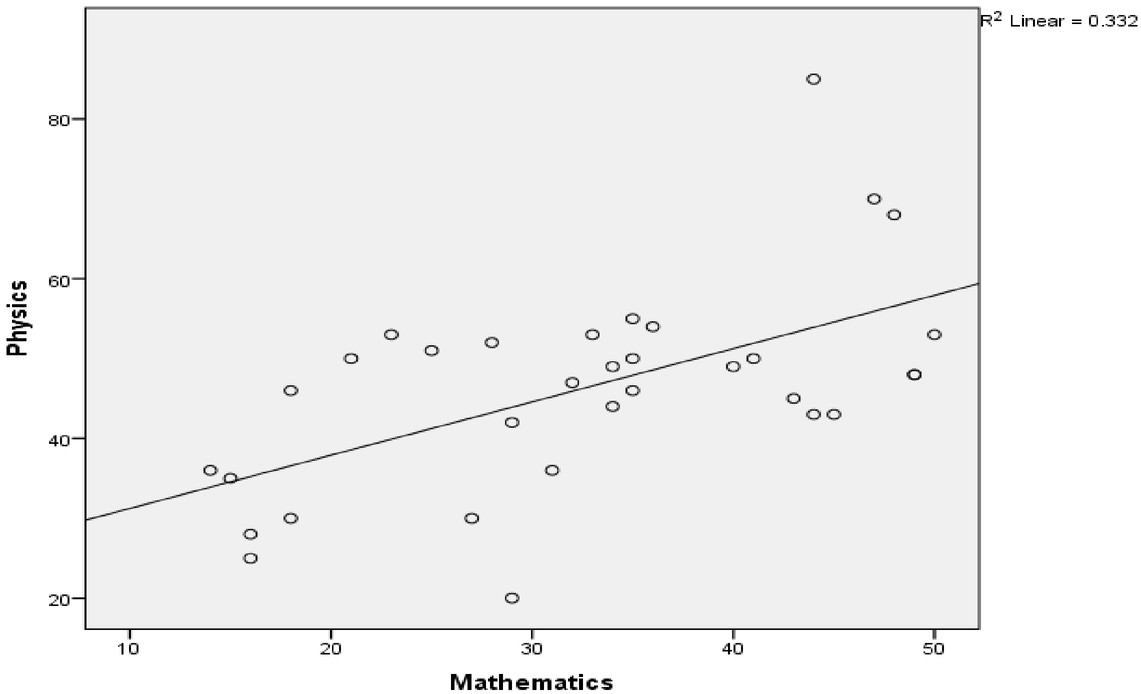

Fig.1.2

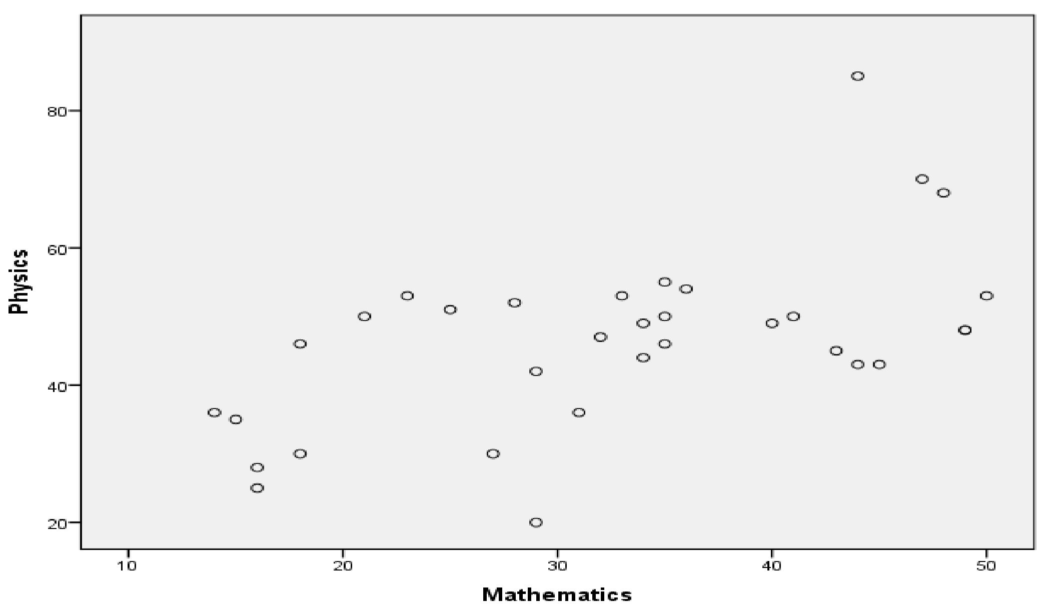

Fig.1.1 reveals two main features: The regression line which has been drawn through the middle of the scatter points is the Linear regression line. The scatter points represent the students' scores in Mathematics and Physics plotted on the graph. Since the relationship or association between students scores in

mathematics and physics seem to follow a straight line, it means that students' achievement scores in both subjects have a linear relationship and are therefore positively related. This linear relationship is a causal one in which one can be used to predict the other. If the regression line is projected, i.e. extrapolated, this linear relationship will continue to increase exponentially. Conversely, if this same regression line is intrapolaed, this linear relationship will continue to decrease exponentially. Null Hypothesis 2 (Ho2): There is no significant relationship between students' achievement scores in mathematics and their scores in Chemistry.

Table 4: mean and standard deviation of students' achievement scores in Chemistry and Mathematics

	Mean	Standard Deviation	N
Chemistry	58.85	15.748	33
Mathematics	32.85	11.127	33

Table 4 shows that the difference between the standard deviation of students scores in Chemistry and Mathematics is 4.619.

Table 4: Correlations coefficient of the regression

		Chemistry	Mathematics
Pearson Correlation	Chemistry	1.00	.735
	Mathematics	.735	1.00

Table 5 indicates that students' scores in mathematics correlated highly with those of chemistry (r = .735). The model summary also indicates that the coefficient of the regression (R) was R = .735.

Table 6: One-way Analysis of Variance

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	4290.784	1	4290.784		
Residual	3645.458	31	117.595	36.488	000
Total	5314.242	32			

Dependent variable: Chemistry
(a) Predictors: (constant) Mathematics

Table 6 indicates that the F-ratio, a measure of the variability between students mathematics and chemistry scores, is significant (F = 36.488). Results of the regression and ANNOVA indicated that the calculated R-value was greater than the table or critical value and the calculated F-ratio was greater than the critical F-ratio. All these indicate that students' mathematics scores significantly predicted their chemistry scores, hence the null hypothesis (Ho2) is rejected. Alternatively a graphical illustration (scattergram) was used to show this relationship better. (see Fig.2.1).

The variable, mathematics (the predictor) has been plotted on the X-axis while Chemistry, the dependent variable has been plotted on the Y-axis. Since the relationship between both variables as indicated by the regression line, seem to follow a straight line and is positive, it means that the relationship is a causal one, in which one can be used to predict the other. There is a significant relationship between students' achievement scores in mathematics and their scores in Chemistry.

Discussion

Results of this study indicate that both null hypotheses which were developed for the study have been rejected, implying that there is association between the two events i.e. students achievement scores in mathematics and physics on the one hand and their scores in mathematics and chemistry on the other. Data on table 1 – 6 show that there is a constant conjunction (i.e. a definite cause and effect linked in sequence). The data shows that students' scores in mathematics is followed by those of Physics and Chemistry, more often than one would expect and not by mere coincidence or by chance. The independent variable, mathematics, which is the predictor or constant, and the dependent variables, physics and chemistry are in a cause and effect relationship of the probabilistic or statistical kind. Although the correlation coefficients of r and F for the three subjects show a measure of strong positive linear association, they also indicate a direct linear relation.

Correlation does not always provide evidence of a causal relationship (Fuller and Lary, 1977). The graphical illustrations on Fig.1.1 – 2.2 provide supplementary facts and evidence to show the causal relationship between students' scores in mathematics and their scores in physics and chemistry (see scattergram Fig.2.1 – 2.2). Evidence from the scattergrams indicates that the linear regression lines passed through the middle of the scatter points. This linear relationship is a causal

One, in which one can be used to predict the other (Fuller and Lary, 1977). If the regression line in the midst of the scattergrams is extrapolated, the linear relationship will continue to increase exponentially. Conversely, if this same regression line (Fig.2.1.), is intrapolated, this linear relationship will continue to decrease exponentially.

Conclusion

Predictive studies such as this has wide applications in many fields of human endeavour such as forecasting election results, weather forecasts, helping students to get placement for courses or vocations. They are also useful for vital decision making by professionals in engineering and medical practice. Predictive studies such as this also include more complex situations where many causes combine to produce more complex effects. Data for such multiple events can be got through multiple regression analysis. Also, predictive studies such as this are useful for pilot projects, for forecasting the success of project in the military, agriculture, business and industry.

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