



RESEARCH PAPER

Evaluation of Students Academic Performance in Mathematics and Physics in Ibrahim Badamasi Babangida University Lapai

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ABSTRACT

The objective of this research is to determine whether there is a relationship between students' academic performance in Mathematics and Physics in Ibrahim Badamasi Babangida University Lapai (IBBUL). The regression equation predicted the dependent variable significantly well. The R-square value of 0.867 indicated that the predictor variable accounts for 86.7 percent of the variation in students' academic achievement. The variables Mathematics Cumulative Grade Point Average (CGPA) and Physics CGPA were strongly and highly positively correlated; this revealed that good mathematics performance is associated with good physics performance. The findings revealed a significant positive relationship between students' mathematics and physics abilities. As a result, students who succeeded in mathematics also succeeded in physics as well. The findings also revealed that students who neglected or lacked interest and skill in mathematics performed poorly in physics (especially mathematical aspects of physics). Therefore, succeeding in physics involves both mathematical understanding and ability; for students to excel in Physics they must have good background of Mathematics.

Keywords: Mathematics, Physics, Regression, Correlation, Academic Performance

INTRODUCTION

Various challenges plague Nigerian students' academic performance in science education, one of which is the students' repeatedly poor academic performance in science subjects, notably in mathematics and physics. This has prompted experts, instructors, parents, and the government to seek alternative techniques to help students improve their mathematics abilities (Amoo, 2002). Grilli (2020) stated that Mathematicians, physicists, and philosophers have investigated the relationship between mathematics and physics since prehistoric days, as have educators and historians more recently. This is usually thought to have a close connection, with mathematics being described as "a fundamental instrument for physics" and physics being described as "a rich source of inspiration and insight in mathematics".

De Cock (2022) mentioned physics as one of the topics explored by Aristotle in relation to how mathematicians' and physicists' studies vary. Pythagorean conceptions such as "Numbers govern the world" and "All is number" can be found in Pythagorean notions, and were also stated by Galileo Galilei two millennia later:

"The book of nature is written in the language of mathematics". Mathematics has a long history of interdisciplinary collaboration with physics, chemistry, and other natural sciences. To put it in another way, mathematics is beneficial in a wide range of scientific subjects. All science and technology pursuits are built on the foundation of mathematics. Mathematics is the Queen and Servant of the Sciences (Rose, 2022). De Cock (2022) argued that measuring and other mathematical instruments are essential in the activities of physicists (Rose, 2022).

Science and technology are becoming inextricably linked to the lifeblood of our society, operating as the major engine of our country's economic growth and progress. Mathematics is used in many fields of sciences. This relationship is explained by some who consider mathematics as the "Queen and Servant" of sciences. A physicist's work, for example, requires measurement and other mathematical methods. The physicists utilise a graph, a mathematical

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tool, to show the relationship between varying parameters such as temperature and the presence of saturated moisture in the atmosphere. Algebraic equations are used to express physics laws (Rose, 2022).

Mathematics as a body of knowledge assists in the study of other sciences like physics (Galoyan & Betts, 2021). In their theory of identical elements, they argued that information could be transferred from one situation to another if the two situations shared identical or comparable elements. As a result, learning transfer might well be possible between two activities that share a set of stimulus qualities. Given the many similarities between mathematics and physics, it is probable that when learners are adequately guided in learning mathematics, such group of learners may be able to retain and transfer such thoughts into learning physics. Individuals' capacity to learn things is often enhanced when they practise on a series of similar or related tasks, according to their concept of learning to learn (Pereg & Harpaz, 2021). Tenzin, Tendar and Zangmo (2022) stated that the choice of science topics in Nigerian schools, particularly Physics, is highly impacted by the learner's math skills, because mathematical skills are crucial to the study of Physics and science in general. The researchers looked into the impact of mathematics and physics on student performance in this context.

Tenzin *et al.* (2022) stated that humanity will have a hard time exploring the universe if they don't understand physics. Understanding Physics, according to Chen, Wei and Zhang (2022) revealed that students comprehend the contents of the cosmos while also developing observation skills, accuracy, analytical ability, and creative thinking. They went on to argue that for science students, learning physics is crucial. As a result, no science student will be admitted to a university, polytechnic, or college to pursue a science degree, including science education, engineering, medical and biomedical sciences, technological studies, computer science, or pharmaceutical sciences, unless they have a credit level pass in Physics. Because of mathematics relevance in science, researchers claim that "mathematics is the queen of science." This means that a strong knowledge of mathematics is required to comprehend all sciences, from physics to biology. Nemati (2022) pointed out that physics and mathematics have

long been intertwined, with examples of people discovering new mathematical concepts while conducting physics research and people discovering new physics ideas while conducting mathematics investigation.

According to Cristalli and Pietarinen (2021), mathematics is described as "the science that draws crucial conclusions." Mathematics aids in the logical evaluation and reduction of complex events and industrial problems. It is the reason for how numbers have been used to describe nature and science, thanks to many mathematicians that contributed to engineering and natural sciences. Others have claimed that mathematics "assists you in comprehending and describing the universe" by tackling "numerical concerns" (Lazorenko & Chernogor, 2020).

Mathematics, according to Daidzic (2022), is a tool for scientific and technological development that has historically contributed to scientific discoveries and will continue to do so in the future. All life fields, according to Daidzic (2022), have a connection with Physics, including mathematics, engineering, biology, and chemistry and specifically mathematics and physics are related.

This research was therefore aimed at finding the relationship between the academic performance of mathematics and physics students in IBBUL.

METHODOLOGY

A structured questionnaire sample of 100 students was used with purposeful sampling, obtaining a response value of 86 responses. The responses were students from the Mathematical Sciences and Physics departments of IBBUL.

Regression Analysis

The regression equation is given by;

$$q = ap + b \quad (1)$$

Multiply both sides of equation (1) by p

$$pq = ap^2 + bp \quad (2)$$

Adding equation (1) and (2), we obtain

$$\sum p = a \sum q + bn \quad (3)$$

$$\sum pq = a \sum p^2 + b \sum p \quad (4)$$

Multiplying equation (3) by $[\sum p]^2$ and (4) by $\sum p$, we obtain;

$$\sum q (\sum p)^2 = a \sum q (\sum p)^2 + nb(\sum p)^2 \quad (5)$$

$$\sum p q \sum q = a \sum q (\sum p)^2 + b(\sum p)^2 \quad (6)$$

Subtracting equation (6) from (5), we obtain;

$$\begin{aligned} \sum q (\sum p)^2 - \sum pq \sum p &= nb (\sum p)^2 - b (\sum p)^2 \\ b (n (\sum p)^2 - (\sum p)^2) &= \sum q (\sum p)^2 - \sum pq \sum p \\ b &= \frac{\sum q (\sum p)^2 - \sum pq \sum p}{n (\sum p)^2 - (\sum p)^2} \end{aligned} \tag{7}$$

Inserting the value of b into equation (3) yields;

$$\begin{aligned} \sum q &= a \sum p + n \left[\frac{\sum q (\sum p)^2 - \sum pq \sum p}{n (\sum p)^2 - (\sum p)^2} \right] \\ a \sum p &= \sum q - n \left[\frac{\sum q (\sum p)^2 - \sum pq \sum p}{n (\sum p)^2 - (\sum p)^2} \right] \\ a \sum p &= \sum q - \frac{n \sum q (\sum p)^2 - n \sum pq \sum p}{n (\sum p)^2 - (\sum p)^2} \\ a \sum p &= \frac{n \sum q (\sum p)^2 - \sum q (\sum p)^2 - n \sum q (\sum p)^2 + n \sum p \sum qp}{n (\sum p)^2 - (\sum p)^2} \\ a \sum p &= \frac{n \sum p \sum qp + \sum q (\sum p)^2}{n (\sum p)^2 - (\sum p)^2} \\ a &= \frac{n \sum p \sum qp + \sum q (\sum p)^2}{\sum p [n (\sum p)^2 - (\sum p)^2]} \\ \therefore a &= \frac{n \sum qp - \sum q \sum p}{n (\sum p)^2 - (\sum p)^2} \end{aligned} \tag{8}$$

Correlation Coefficient

$$r = \frac{n \sum pq - (\sum p)(\sum q)}{\sqrt{[n \sum p^2 - (\sum p)^2][n \sum q^2 - (\sum q)^2]}} \tag{9}$$

Spearman Rank Correlation ρ

The Spearman rank correlation test is a non-parametric tool for determining how closely two variables are related. It was created by Spearman, hence the name "Spearman rank correlation." When the variables are measured on an ordinal scale, the Spearman rank correlation test is the best correlation analysis since it makes no assumptions about the data distribution. The following formula is used to determine the Spearman rank correlation coefficient:

$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}$$

where ρ = Spearman rank correlation coefficient
 d_i = the difference between the ranks of corresponding values X_i and Y_i
 n = number of value in each data set.

RESULTS AND DISCUSSION

Analysis of the Predictors on CGPA

Table 1 showed the exact regression model as: $Y = -0.416 + 0.218(\text{SH}) + 0.177(\text{LM}) + 0.932(\text{SI}) + 0.279(\text{PFTE}) + 0.352(\text{LMSM})$ where SH, LM,

SI, PFTE and LMSM denoted as seen in the table. The constant value of -0.416 is the intercept which indicated the total output of the students' academic performance in terms of their CGPA, the dependent variable, all other factors are held constant provided that all the predictors are zero. The coefficients of SH, LM, SI, PFTE and LMSM are 0.218, 0.177, 0.932, 0.279 and 0.352 respectively. This indicated the extent to which the students' CGPA would increase for every 1-unit change in SH, LM, SI, PFTE and LMSM respectively.

Model Summary of Other Regression Coefficients

Table 2 revealed a strong positive relationship between students' CGPA as the dependent variable and studying habits, student interest, preparation, lecturers' mastery, and lecture technique as the independent factors, with an R-value of 0.931. This indicated that the predictors' behavioural patterns have a considerable impact on the students' overall academic achievement (CGPA). The R-square value of 0.867 indicated that the predictor variable accounts for 86.7 percent of the variation in students' academic achievement.

Table 3 showed that the regression equation predicted the dependent variable significantly well. Since the p-value is $0.000 < 0.05$, we therefore conclude that the regression model statistically predicts the outcome variable (that is, the model is a good fit for the data).

Table 4 showed that the variables Mathematics Cumulative Grade Point Average (CGPA) and Physics CGPA were strongly and highly positively associated, with correlation value of 0.778 and highly significant at 0.000 as shown in Table 4. This suggested that good mathematics performance is associated with good physics performance. That is the students who excelled in mathematics will excel in physics, and vice versa.

Table 5 revealed a substantial positive relationship between students' CGPA and their study habits, with a correlation value of 0.729, which is highly statistically significant with a p-value of $0.000 < 0.05$. This means that students with good study habits would have better CGPA than those with poor study habits. Also, there was a substantial relationship between students' interest in their course of study and their CGPA, with a correlation of 0.807 that is statistically

highly significant with a p-value of $0.000 < 0.05$. This indicated that students' interest or lack of interest in their course of study would have a highly significant effect on their CGPA. Furthermore, with a correlation value of 0.539 at a p-value of 0.000 statistically highly significant at the 0.05 level of significance, there was a moderate positive correlation between the students' CGPA and their test/exam readiness. This revealed that the students' preparations for exams also have significant impact on their

CGPA. Likewise, the correlation between CGPA with lecture method and lecturers' mastery of subject matter indicated a moderate and weak positive associations with correlation values of 0.692 and 0.365 respectively. Their associations also showed a highly statistical significance with p-values of 0.000 and $0.001 < 0.05$ respectively at 5% significance level. This revealed that the lecturer's approaches to lectures and mastery of the subject matter have a significant effect on the academic performance of the students.

Table 1: Regression Coefficients^a

| Model | Unstandardized Coefficients | | Standardized Coefficients | | Sig. |
|--|-----------------------------|------------|---------------------------|--------|-------|
| | B | Std. Error | Beta | T | |
| (Constant) | -0.416 | 0.208 | | -1.999 | 0.049 |
| Studying Habits (SH) | 0.218 | 0.06 | 0.217 | 3.635 | 0.000 |
| Lecture Method (LM) | 0.177 | 0.103 | 0.115 | 1.726 | 0.088 |
| Student's Interest (SI) | 0.932 | 0.099 | 0.545 | 9.380 | 0.000 |
| Preparation for Test and Exam (PFTE) | 0.279 | 0.146 | 0.111 | 1.909 | 0.060 |
| Lecturers Mastery of Subject Matter (LMSM) | 0.352 | 0.06 | 0.332 | 5.846 | 0.000 |

a. Dependent Variable: CGPA (Academic Performance)

Table 2: Model Summary

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|--------------------|----------|-------------------|----------------------------|
| 1 | 0.931 ^a | 0.867 | 0.859 | 0.29039 |

a. Predictors: (Constant), Lecturers Mastery of Subject Matter, Student's Interest, Studying habits, Preparation for Test and Exam, Lecture Method

Table 3: ANOVA^a

| Model | Sum of Squares | Df | Mean Square | F | Sig. |
|------------|----------------|----|-------------|---------|--------------------|
| Regression | 43.963 | 5 | 8.793 | 104.269 | 0.000 ^b |
| Residual | 6.746 | 80 | 0.084 | | |
| Total | 50.709 | 85 | | | |

a. Dependent Variable: CGPA (Academic Performance)

b. Predictors: (Constant), Lecturers Mastery of Subject Matter, Student's Interest, Studying habits, Preparation for Test and Exam, Lecture Method

Table 4: Spearman's Correlation Coefficient between Students' Performance in Mathematics and Physics

| | | MTH CGPA | PHY CGPA |
|----------------|----------|-------------------------|----------|
| Spearman's rho | MTH CGPA | Correlation Coefficient | 1 |
| | | Sig. (2-tailed) | 0.778** |
| | | N | 47 |
| Spearman's rho | PHY CGPA | Correlation Coefficient | 0.778** |
| | | Sig. (2-tailed) | 0 |
| | | N | 39 |

** . Correlation is significant at the 0.01 level (2-tailed)

Table 5: Correlation Between Students' CGPA and other Factors that Affect it

| | | CGPA (Academic Performance) | Studying habits | Student's Interest | Preparation for Test and Exam | Lecture Method | Lecturers Mastery of Subject Matter |
|--|-----------------------------------|-----------------------------------|--------------------|-----------------------|-------------------------------------|-------------------|---|
| Spearman's rho | CGPA (Academic Performance) | Correlation Coefficient | 1 | 0.729** | 0.807** | .539** | 0.692* |
| | | Sig. (2-tailed) | 0 | 0 | 0 | 0 | * |
| | | N | 86 | 86 | 86 | 86 | 86 |
| Studying habits | | Correlation Coefficient | 0.729** | 1 | 0.520** | .498** | 0.659* |
| | | Sig. (2-tailed) | 0 | 0 | 0 | 0 | 0 |
| | | N | 86 | 86 | 86 | 86 | 86 |
| Student's Interest | | Correlation Coefficient | 0.807** | 0.520** | 1 | .213* | 0.699* |
| | | Sig. (2-tailed) | 0 | 0 | 0 | 0.049 | 0 |
| | | N | 86 | 86 | 86 | 86 | 86 |
| Preparation for Test and Exam | | Correlation Coefficient | 0.539** | 0.498** | 0.213* | 1 | 0.304* |
| | | Sig. (2-tailed) | 0 | 0 | 0.049 | 0 | 0.004 |
| | | N | 86 | 86 | 86 | 86 | 86 |
| Lecture Method | | Correlation Coefficient | 0.692** | 0.659** | 0.699** | 0.304** | 1 |
| | | Sig. (2-tailed) | 0 | 0 | 0 | 0.004 | 0 |
| | | N | 86 | 86 | 86 | 86 | 86 |
| Lecturers Mastery of Subject Matter | | Correlation Coefficient | 0.365** | 0.296** | -0.056 | 0.561** | -0.081 |
| | | Sig. (2-tailed) | 0.001 | 0.006 | 0.605 | 0 | 0.46 |
| | | N | 86 | 86 | 86 | 86 | 86 |

** . Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Conclusion

The findings revealed a strong positive relationship between mathematics and physics students' academic performance. As indicated by the tests, there is a statistically significant positive relationship between students' academic achievements in both departments. As a result, we can deduce that success in mathematics can be used to predict physics success and vice versa. The R-square value of .867 indicated that the predictor variable accounts for 86.7 percent of the variation in students' academic achievement.

Furthermore, the correlation and regression analyses revealed a strong positive relationship between students' CGPA and factors that influence their academic performance, such as study habits, interest in course of study, test/exam preparations, lecture methods, and lecturers' mastery of subject matter. These factors were found to have a significant influence on the students' overall academic achievement.

The findings also revealed that students who neglected or lacked interest and skill in mathematics performed poorly in physics (especially mathematical aspects of physics). Consequently, succeeding in physics involves both mathematical understanding and ability.

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