# THE RELATIVE CONTRIBUTION OF MATHEMATICS TO STUDENTS' PERFORMANCES IN SCIENCE SUBJECTS IN ENGLISH-SPEAKING SECONDARY SCHOOLS IN CAMEROON

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## ABSTRACT

*This study which set out to determine the relative contribution of mathematics to students' performances in science subjects in English-speaking secondary schools was carried out in Mezam Division of the North West Region of Cameroon. It employed the Survey and the Correlational research designs. 357 Form five students from 14 secondary schools, drawn from a targeted population of 1147 students from 34 public secondary schools constituted the sample of the study. The sample was arrived at through stratified disproportionate random sampling technique. Performance was measured using students' 2017 General Certificate of Education (GCE) mock scores in mathematics, physics and chemistry at the Ordinary Level (O/L). Data was analyzed using the linear regression analysis. The findings suggest that there is a high positive correlation (R = 0.601) between mathematics and physics and a low positive correlation (R = 0.364) exists between mathematics and chemistry. The t-test further revealed that both relationships were significant. Thus the coefficient of determination ($r^2$) between mathematics and physics is 0.361, while that between mathematics and chemistry is 0.133. Thus 13.3% and 36.1% of the variations in students' performances in O/L chemistry and physics respectively, can be accounted for by their performances in mathematics. It was therefore recommended that educational authorities should have as target to improve students' performances in mathematics as a key way of improving their performances in the sciences.*

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## 1. INTRODUCTION

Studies in the sciences are generally perceived to be very interesting, gigantic, mathematically oriented and experimental in nature. Almost all aspects of life have something to do either with Mathematics, Biology, Chemistry or Physics [1]. The

knowledge of science subjects at secondary school level is a pre-requisite for the study of prestigious disciples such as: engineering, technology, medical and other applied science courses in the university. Science subjects are fast becoming increasingly interdisciplinary, as physicists for example, work with mathematicians, engineers, chemists and biologists in order to understand and be able to resolve a wide range of problems confronting society [2]. According to the famous Scottish-born mathematician, Eric Temple Bell, "mathematics is the queen and servant of the sciences." To him, studies in mathematics can progress without the sciences but studies in the sciences can go nowhere without making use of mathematics in one way or the other. Furthermore, mathematics is the bed rock of science and technology and the functional role of mathematics to science, technology and other disciplines is multifarious; thus no area of science, technology and business enterprise can escape its application [3]. Thus one can say with certainty that mathematics is like a mother to the sciences and other discipline. It seems impossible to comprehend how one could live a normal life in this $21^{st}$ century without making use of some kind of mathematics in one way or the other; a century in which mathematics seems to contribute immensely to every aspect of human life.

Science has proven to be indispensable in the development, emergence and life of every nation; it is the gate way to a healthy economy and good living. Developed as well as developing nations, such as Taiwan and Korea, became industrialized countries by exploiting advances in, for example, silicon microelectronics, achieved during the early sixties. Most recently, China and India have emerged as industrial leaders in manufacturing and information technology, respectively. Each of these countries has invested quite heavily not only on people but also on factories. Their successes no doubts, have had their roots from carefully designed and executed plans and strategies. Technology is thus the primary engine of economic growth around the globe and provides the key to unlocking any country's potentials. Countries that want to emerge and develop must therefore take time to invest significantly in science and technology at all levels. Such investments can only be arrived at by developing plans, knowledge and skills; the human capacity required to advance in this competitive world, considered to be a globally village.

It is, however, sad to note that Cameroonian students do not achieve as expected in Science subjects and Mathematics to meet the challenges of the nation in this era driven by the relentless necessity for scientific and technological advancements. Evidence from the Cameroon General Certificate of Education (CGCE) Examination Board and other competitive entrance examinations show that students of the English-speaking subsystem of education do not perform well in Chemistry, Physics, Biology and Mathematics in internal and external examinations [3]. The importance of science and mathematics in this fast changing world is probably not being considered well enough by parents, students, teachers and policy makers in the English-speaking subsystem of education in Cameroon. This statement can be justified by the fact that Mathematics, considered as a mother to other disciplines, still registers one of the worst performances each year at the CGCE O/L (Ordinary Level); hardly above 20% but with ever increasing number of candidates sitting

for the examination (Table 1). Furthermore, fewer students opt for science subjects as compared to arts subjects at the GCE O/L examination in Cameroon.

Table 1. Success rates in GCE O/L Mathematics

| Year | 2016 | 2015 | 2014 | 2013 | 2012 | 2011 | 2010 | 2009 | 2008 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Number sat** | 102857 | 97555 | 86724 | 81675 | 79384 | 65678 | 60875 | 55890 | 50419 | 44676 |
| **% passed** | 8.90 | 11.80 | 9.40 | 15.32 | 14.56 | 18.49 | 15.00 | 20.46 | 15.35 | 18.38 |

Source: GCE Board examination statistics booklets for listed years.

Considering the technological age in which we find ourselves and the importance of mathematics and science to our daily lives and to the development of our country, such performance in mathematics is unacceptable and thus considered not good enough for Cameroon as it aspires to be an emerging nation in 2035. Some authors have been very concerned in finding out the factors contributing to poor performances in the sciences.

The search for the causes of poor academic achievement in general and poor academic achievement in science subjects in particular is unending [4] and some of the factors put forward are: motivational orientation, self-esteem/self-efficacy, emotional problems, study habits, teacher factors and poor interpersonal relationships. Efforts have also been made [5] to categorize factors militating against good performances in the sciences into four principal areas which are:

- Causes originating from the child such as basic cognitive skills, physical and health factors, psycho-emotional factors and lack of interest in the subjects.
- Causes originating from the family such as cognitive stimulation/basic nutrition during the first two years, type of discipline at home, lack of role model and finance.
- Causes originating from the school such as school location and physical building, interpersonal relationship among the school personnel.
- Causes originating from the society such as instability of educational policy, under-funding of educational sector, leadership, societal views about subjects.

Drawing from the words of Eric Temple Bell, the famous Scottish mathematician who described mathematics as the queen or servant of the sciences [6], the poor performance in this subject probably also influences the learning of Science subjects in our secondary schools, considering the mathematical nature of these subjects, especially physics and chemistry. This assertion has been reiterated by another writer [7], who established that poor knowledge of mathematics is one of the major problems militating against students' progress in chemistry and physics. Accordingly, there is a growing public concern over this poor performance in the sciences and therefore, it is necessary to understand the problems and challenges facing science subjects so as to suggest appropriate remedies to improve performances in them.

Although many authors have identified poor knowledge of mathematics as one of the major problems militating against students' progress in the sciences [7], no known research study has been carried out to establish the strength of the relationships between performances in mathematics and performances in the sciences for English-speaking Cameroonian students.

## 1.1. Purpose of the study

The purpose of the study was to determine the relative contribution of mathematics to students' performances in science subjects (specifically Physics and Chemistry) in English-speaking secondary schools in Cameroon. The specific purposes of this study were as follows:

- ❖ To determine the nature of the relationship between students' performances in Mathematics and their performances in Physics.
- ❖ To determine the nature of the relationship between students' performances in Mathematics and their performances in Chemistry.
- ❖ To establish the percentage of students' performances in Physics that is accounted for by their performances in Mathematics.
- ❖ To establish the percentage of students' performances in Chemistry that is accounted for by their performances in Mathematics.

## 1.2. Research questions

- ❖ What is the nature of the relationship between students' performances in Mathematics and their performances in Physics?
- ❖ What is the nature of the relationship between students' performances in Mathematics and their performances in Chemistry?
- ❖ What is the percentage of students' performances in Physics that is accounted for by their performances in Mathematics?
- ❖ What is the percentage of students' performances in Chemistry that is accounted for by their performances in Mathematics?

## 1.3. Hypotheses

The following hypotheses were tested at a 0.05 level of significance:

$H_{01}$: There is no significant relationship between students' performances in Mathematics and their performances in Physics.

$H_{02}$: There is no significant relationship between students' performances in Mathematics and their performances in Chemistry.

## 2. RESEARCH METHOD

This study employed the Survey and the Correlational research designs. The study which was carried out in all the 7 sudivisions of Mezam Division in the North West Region of Cameroon, targeted 1147 students from 34 public secondary schools who wrote

all three subjects; mathematics, physics and chemistry during the 2017 Form five GCE Regional mock examinations. Statistics from the GCE board reveals that Mezam Division does not only provide majority of candidates for the GCE Examinations yearly, but is also the division with the highest number of successful ordinary level candidates each year compared to the other 57 divisions in Cameroon. Science subjects were delimited to physics and chemistry in this study. These two subjects are offered by all English-speaking secondary schools in Cameroon and by their nature, they employ a lot of mathematics. Furthermore, performances in these two subjects at the GCE O/L still leaves much to be desired.

Stratified disproportionate random sampling technique was used in getting the sample for the study; the schools were first stratified according to subdivisions. Using simple random sampling (lucky dip with replacement), 2 schools were selected from each subdivision. Thus 14 of the eligible 34 secondary schools in Mezam Division were selected. Data was then collected from the class lists for all students in the selected schools who had GCE mock scores for mathematics, physics and chemistry. The sample of this study therefore constituted 357 students drawn from 14 secondary schools. Performance was thus measured using students' mock scores in the three subjects of interest. The data collected was analyzed using Regression analysis (Pearson Product Moment correlation coefficient (R), the coefficient or index of determination ($R^2$) and t-test for correlation). The analysis was aided by Statistical Package for Social Sciences (SPSS) version 20.0.

**RESULTS AND DISCUSSIONS**

3.1. Descriptive statistics

Table 2 indicates that none of these subjects had a mean performance of up to eight out of 20. These means are below expectation considering the fact that those involved in this study must have decided to study the sciences since they are not compulsory at this level. Thus the analysis reveals that performances in mathematics, physics and chemistry in English-speaking secondary schools in Cameroon, continue to be poor.

Table 2. Summary of descriptive statistics

|  | N | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| **Mathematics Scores** | 357 | 1 | 17 | 7.93 | 2.61 |
| **Physics Scores** | 357 | 1 | 15 | 7.42 | 2.63 |
| **Chemistry Scores** | 357 | 1 | 15 | 6.67 | 2.65 |
| **Valid N (listwise)** | 357 |  |  |  |  |

3.2. Relationship between mathematics and physics.

Table 3 reveals that there is a strong positive correlation (R = 0.601) between mathematics and physics. It further reveals that the coefficient of determination ($R^2$) between mathematics and physics is 0.361, giving an adjusted R square value of 0.359. Since there are more mathematical concepts in physics than there are physics concepts in mathematics at the GCE O/L, it can be concluded that 36.1% of the variability in students' performances in O/L physics can be accounted for by their performances in mathematics.

Table 3. Summary of correlation between mathematics and physics

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .601[a] | .361 | .359 | 2.104 |

a. Predictors: (Constant), AVMATHS

Table 4 indicates that the t-value for the correlation between mathematics and physics is 14.168, giving a p-value.of 0.000, which is significant at 0.05 level of significance. This means that a significantly strong correlation exists between mathematics and physics. The regression analysis goes further to predict that if students' performances in mathematics is improved by one average, then their average in physics will witness a corresponding increase in the neighborhood of 0.605 (Table 4). This prediction could be made with a standard error of 0.043. Again, for students who score a zero in mathematics, the analysis predicts that averagely, their scores in physics will likely be in the neighborhood of 2.623. This suggests that Cameroonian students who perform well in mathematics, also have a likely chance of also performing well in physics and vice versa.

Table 4. Summary of regression analysis for correlation between mathematics and physics

Coefficients[a]

| Model | | Unstandardized Coefficients | | Standardized Coefficients | T | Sig. | 95.0% Confidence Interval for B | |
|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Lower Bound | Upper Bound |
| 1 | (Constant) | 2.623 | .356 | | 7.360 | .000 | 1.922 | 3.324 |
| | AVMATHS | .605 | .043 | .601 | 14.168 | .000 | .521 | .689 |

a. Dependent Variable: AVPHY

### 3.3. Relationship between mathematics and chemistry

Table 5 shows that there exists a low positive correlation of 0.364 between mathematics and chemistry. This yields a coefficient of determination ($R^2$) between mathematics and chemistry of 0.133, giving an adjusted R square value of 0.130. Again, since there are more mathematical concepts in chemistry than there are chemistry concepts in mathematics at the GCE O/L, it can be concluded that 13.3% of the variations in students' performances in O/L chemistry can be accounted for by their performances in mathematics.

Table 5. Summary of correlation between mathematics and chemistry

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .364[a] | .133 | .130 | 2.467 |

a. Predictors: (Constant), AVMATHS

The t-value for the correlation between mathematics and chemistry is 7.368, giving a p-value.of 0.000, which is also significant at 0.05 alpha level (Table 6). Consequently, the relationship between mathematics and chemistry is also significantly. The regression analysis goes further to predict that if students' performances in mathematics is improved by one average, then their average in chemistry will witness a corresponding increase in the neighborhood of 0.369 (Table 6). Again, this prediction could be made with a standard error of 0.050. Furthermore, for students who score a zero in mathematics, the analysis predicts that averagely, their scores in chemistry will likely be in the neighborhood of 3.748.

Table 6. Summary of regression analysis for correlation between mathematics and chemistry

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | T | Sig. | 95.0% Confidence Interval for B | |
|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Lower Bound | Upper Bound |
| 1 | (Constant) | 3.748 | .418 | | 8.970 | .000 | 2.926 | 4.570 |
| | AVMATHS | .369 | .050 | .364 | 7.368 | .000 | .270 | .467 |

a. Dependent Variable: AVCHEM

The above findings are in congruence with that of another researcher, [7], who established that poor knowledge of mathematics is one of the major problems militating against students' progress in chemistry and physics. Although correlation does not necessarily mean causation, the significant correlations established in this study is a pointer to the fact that mathematics has a non negligible contribution towards students' success in the sciences, given the fact that the sciences have a lot of mathematical applications.

The different percentages of the variabilities in students' performances in O/L physics and chemistry accounted for by their performances in mathematics are enormous given that some author, [4], [5], have also pointed out many other factor responsible for the poor performances of students in the sciences. Consequently, educational authorities in Cameroon should have as target to improve students' performances in mathematics as one of the ways of improving their performances in the sciences.

## 4. CONCLUSION

This study which set out to establish the Relative Contribution of Mathematics to Students'Performances in Science Subjects in English-speaking Secondary Schools in Cameroon, has arrived at the following conclusions: A significantly positive relationship exists between students' performances in mathematics and their performances in physics. Going further, up to 36.1% of the variability in students' performances in O/L physics can be accounted for by their performances in mathematics. There is also a significantly positive relationship between students' performances in Mathematics and their performances in Chemistry, with 13.3% of the variations in students' performances in O/L chemistry accounted for by their performances in mathematics. Therefore, educational authorities in Cameroon should have as target to improve students' performances in mathematics as one of the ways of improving their performances in the sciences.

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