

**THE EFFECT OF FURTHER MATHEMATICS ON SECONDARY SCHOOL
STUDENTS' ACHIEVEMENT IN
MATHEMATICS, BIOLOGY, CHEMISTRY AND PHYSICS IN KATSINA STATE,
NIGERIA**

BY

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Abstract:

This study investigated the effect of Further Mathematics on students' achievement in mathematics, biology, chemistry and physics in Katsina State, Nigeria. One hundred and fifty (150) students from seven (7) Senior Secondary Schools were purposively selected for the study. Three Research Questions that correspond were formulated for this study. Experimental research design was employed. All the students selected were offering mathematics, biology, chemistry and physics. A 100 -item Achievement test was administered to the students. No further mathematics test was given. Exposure to further mathematics teaching for at least two years served as treatment. Findings showed that there was no significant difference between further mathematics and none-further mathematics groups in achievement in each subject. However, further mathematics students had significantly better overall achievement ($t_{cal} = 5.089$, $p < 0.05$). It is recommended among the other thing that all science students should be encouraged to offer further mathematics.

Key words: *Biology, Chemistry, Physics, Achievement, Further Mathematics, Science Achievement, Secondary, School, Students.*

Introduction

Further Mathematics is a highly respected subject and is recognised for its challenging content. It is particularly popular with and provides an essential base for students wishing to continue advanced and undergraduate study in Maths, Science, Engineering, Economics, Business and Computer related fields.

Further mathematic is relatively a new curriculum in Nigerian Educational System. Its introduction into the school curriculum was one of the recommendations of a national workshop on policies and strategies for the improvement of the teaching and learning mathematics at all levels organized by the National Mathematics Centre (NMC) [1]. A decision at this workshop among others was that there should be two parallel mathematics classes or streams at the secondary school level: the Senior Secondary School Mathematics Curriculum (SSMC) and Further Mathematics Curriculum (FMC). This decision was based on the critical issues raised on the insufficiency in the extent of coverage of the draft of New General Mathematics Curriculum

(1978)[2]. Furthermore, it was strongly felt that there is need to teach a meaningful mathematics that would offer something to different kinds of students vis-à-vis those who would and those who would not use mathematics in their later studies or profession [28].

Further Mathematics affords Senior Secondary School students opportunity to be introduced to some topics in Advanced Level mathematics in order to prepare them to study mathematics or mathematics related courses in their next level of education. While all students offer mathematics, only few science students normally offer Further Mathematics. The reason for this is not farfetched. National Council for Curriculum Assessment [2] noted that many students view mathematics as a difficult subject and perceive higher mathematics as an elite subject for only the best students.[3] asserted that students could only find the study of mathematics more appealing when they perceive the subject matter as interesting, useful and relevant to their daily living.

It is logical to think that students who offer further mathematics have opportunities to perform better especially in mathematics than their counterparts who do not offer further mathematics. There is a term in education called 'opportunities to learn'. In line with this, Ground[4] defined opportunities to learn with regards to mathematics and science as the extent of students have opportunity or chance to learn mathematics or any of the science subjects. This also bears directly on students' mathematics and science achievement.[25] explained that in maximizing opportunity to learn, attention should not be given to wide coverage of the syllabi, but there should also be conscious efforts to teach content and skill involved deeply. It can then be inferred that students who offer further mathematics have better opportunity to learn more mathematical concepts than their counterparts that do not.

Many topics in the science subjects (biology, chemistry and physics) are inter-related. This implies that there are overlaps or areas of intercession in the content areas. Atomic structure

is taught in physical chemistry as well as modern physics. Fermentation is a topic taught both in biology and chemistry. Many laboratory equipment used in one subject area can also be used in others.

However, many topics in the science subjects cannot be understood without sound knowledge of mathematics.

The trend of poor academic performance in Mathematics has created a shortfall in the number of qualified candidates required to fill the quota for mathematics and mathematics-oriented courses in our universities [5]. As the low level of mathematics achievement has become an issue of great concern, the necessity of investigating possible causes becomes more urgent. Several factors have been responsible for the high failure rate in Mathematics at the Secondary School level in recent years. These factors include attitude of students and teachers [6],[7]; content difficulty [10],[11],[12]; instructional techniques [13] and quantity and quality of teachers [14],[15].

[17] asserted that mathematics is a fundamental science which is necessary for understanding of most other fields. Probably, no subject forms such a binding force among the various branches of science - physical, biological and social as mathematics [16]. Mathematics is the language of science and central intellectual discipline of the technological societies (Kalejaye, 1985; Odeyemi, 1995)[17],[18]. A student needs basic knowledge of mathematics like change of subject to understand density which appears under major topics like Ecology in Biology, diffusion in Chemistry and Floatation in Physics. A vector quantity which is not taught in Ordinary Level Mathematics Syllabus is taught in Further Mathematics and Physics. Science students offering further mathematics therefore have a double opportunity to be taught vector quantities both in physics and further mathematics.

Students' achievement in mathematics at both Junior and Senior School levels worsen as years go by [18]. Many other researchers confirm low performance in mathematics at both the qualifying examination (SSCE) and placement examination like University Matriculation Examination – UME [19],[20],[21]. If the outcome of this study proves that science students who offer further mathematics perform better in mathematics and other science subjects, then mathematics may be recommended to all science students. This study therefore sought to find out the effect of Further Mathematics on students' achievement in Mathematics Biology, Chemistry and Physics in Katsina State Senior Secondary Schools, Nigeria.

Statement of the problem

This study attempt to investigate the effect of further-mathematics on senior secondary school students in Mathematics, Biology, Chemistry and Physics in Katsina state. This is bacuse there were a lot failures on Senior Secondary School Certificate examination and declining interest among students in science subjects especially mathematics

Objectives of the study

The main objectives of the study was to investigate the effect of further-mathematics on Senior Secondary school students' achievement in Mathematics, Biology, Chemistry and Physics.

Specifically, the study was designed to find out:

For the purpose of this research the following research questions were put forward:

- i. whether there would be difference between further mathematics and non-further mathematics students' achievement in Mathematics, Biology, Chemistry and Physics.
- ii. If there exist difference between further mathematics and None-Further Mathematics students' overall achievement in Mathematics, Biology, Chemistry and Physics.

iii. Whether there is the relationship in performance achievement between each of the subjects (Mathematics, Biology, Chemistry and Physics) and other science subjects?

Research Questions

For the purpose of this research the following research questions were put forward:

- i. Is there any significant difference between further mathematics and non-further mathematics students' achievement in Mathematics, Biology, Chemistry and Physics?
- ii. Is there any significant difference between further mathematics and None-Further Mathematics students' overall achievement in Mathematics, Biology, Chemistry and Physics?
- iii. What is the relationship between each of the subjects (Mathematics, Biology, Chemistry and Physics) and other science subjects?

Research hypothesis

Research Hypothesis

For the purpose of this research the following Null hypothesis were put forward:

- i. there no difference between further mathematics and non-further mathematics students' achievement in Mathematics, Biology, Chemistry and Physics.
- ii. there no difference between further mathematics and None-Further Mathematics students' overall achievement in Mathematics, Biology, Chemistry and Physics?
- iii. there is no positive relationship between each of the subjects (Mathematics, Biology, Chemistry and Physics) and other science subjects?

METHODOLOGY

Research Design

This study employed an experimental research design. There was one treatment group and also one control group. The treatment on the respondents was the teaching of further mathematics.

This was already occurring as part of the normal school programme before the tests of mathematics, biology, chemistry and physics were administered.

Population and Sample

The target population for this study consist of all the Senior Secondary School students offering Mathematics, Biology, Chemistry and Physics in all the Public Schools in Katsina State. All secondary schools that converged at Government Science Secondary School Batagarawa for Camping 2014 exercise were purposively selected for this study, because they are from different zones and some have further mathematics teachers. The sample selected was purely for research convenient.

At least seven (7) further mathematics and ten non-mathematics students were randomly selected from each of the ten Senior Secondary Schools to participate in the study. However, only seventy (70) further mathematics students and eighty (80) None-further mathematics students submitted the test conducted under examination conditions. Hence, one hundred and fifty served as the sample of the study.

Instrumentation

The data were collected during 2014 the Camping Exercise at Government Science Secondary School Batagarawa. An achievement test was used to collect data. The instrument for the study was achievement test extracted from WAEC past questions. The test was divided into four sections namely Mathematics, Biology, Chemistry and Physics. No further mathematics test was given. Each section of the test has 25 multiple choice objective items with options A to D. The maximum obtainable score was 100 and the minimum was zero (0). Students were asked to indicate their Schools on the objective answer sheets as well as their identification number. The students were not asked to write their names on the answer sheets. They were given pre-

determined numbers (called identification numbers) to write on their answer sheets, which allowed the research to separate the answer sheets into Further Mathematics and None Further Mathematics groups.

Validity and reliability of the research instrument

The instrument was both face and content validated. This is because the examination was set based on National Curriculum. Also, the results were duly approved by the examination Body (WEAC) as well as being moderated by external examiners. This made it more authentic and reliable.

Data Analysis

Data collected from the respondents were analyzed using t-test statistics to compare means of two groups. Pearson product-moment correlation was used to find relationships among the science subjects. The pattern of analysis is indicated below.

RESULTS

Research Question1: Is there any significant difference between Further Mathematics and None-Further Mathematics Students' achievement in Mathematics, Biology, Chemistry and Physics?

Table 1: Comparison of Further Mathematics and None-Further Mathematics Students' achievement in Mathematics, Biology, Chemistry and Physics

Subject	Whether students offer Further Mathematics or not	N	Mean	SD	t-cal	t-crit.	Rmks
Mathematics	F/Maths Students	70	14.93	5.61	3.04	1.96	Sign.
	None F/Maths Students	80	12.00	5.66			
Biology	F/Maths Students	70	13.00	5.87	-0.15	1.96	Not Sig
	None F/Maths Students	80	13.13	4.82			
Chemistry	F/Maths Students	70	14.536	6.06	0.20	1.96	Not Sig
	None F/Maths Students	80	14.338	5.93			

Physics	F/Maths Students	70	15.0714	5.20	1.50	1.96	Not Sig.
	Non F/Maths Students	80	12.750	5.62			

d.f = 148

Table 1 above shows that significant difference between Further Mathematics and None-further Mathematics Students' achievement exists only in Mathematics performance, but does not exist in Biology, Chemistry and Physics. This tends to suggest that the impact of Further Mathematics affects students' achievement only in Mathematics. Also, the mean scores of further mathematics students are higher except in Biology. This implies that though further mathematics students perform better than their non-further mathematics counterparts, then difference is not statistically significant. The mean achievement of students in the science subjects clusters around average (14) as the maximum obtainable score in each subject is 25

Research Question 2: Is there any significant difference between further mathematics and None-Further Mathematics students' overall achievement in Mathematics, Biology, Chemistry and Physics?

Table 2 Comparison of further mathematics and non-further mathematics students' overall achievement in mathematics, biology, chemistry and physics

Groups	N	Mean	SD	t-cal	t-crit	Rmrk
F/Maths student	70	54.214	22.931	5.089	1.96	Significant
Non-F/Maths students	80	33.625	26.612			

Research Question 2: Is there any significant difference between further mathematics and non-further mathematics students' overall achievement in mathematics, biology, chemistry and physics? Overall achievement in mathematics, biology, chemistry and physics means the sum of students' scores in achievement test administered in these various subjects. This was done to determine if further mathematics would influence the overall students' achievement in these

subjects. Interesting, there is significant difference between further mathematics and non-further mathematics students' science achievement. Further mathematics students have better overall mean score than non-further mathematics students. The comparison of means using t-test statistics shows that the difference in achievement is statistically significant ($t_{cal} = 5.089$, $p < 0.05$). Though, exposure to further mathematics has no significant impact on student achievement in each of the identified subjects as presented in table 1 however, it has significant effect on the overall achievement.

Research Question 3: What is the relationship between each of the subjects (Mathematics, Biology, Chemistry and Physics) and other science subjects?

Table 3: Correlation Matrix of Students' achievement in Science Subjects (N=150)

Subject	Mathematics	Biology	Chemistry	Physics	Overall
Mathematics	1.00				
Biology	0.512	1.00			
Chemistry	0.678	0.618	1.00		
Physics	0.890	0.588	0.719	1.00	
Overall					

Research Question 3: What is the relationship between each of the subjects (mathematics, biology, chemistry and physics) and other science subjects?

Table 3 above shows how each subject significantly and positively correlates or relates to each of the other subjects. 'Overall' in the table above means the sum of students' scores in mathematics, biology, chemistry and physics. Student performance in each of the subject correlates very highly and significantly with each other subject. The highest correlation is between physics and

Mathematics achievement ($r = +0.890$, $p < 0.05$) while the lowest but also significant relationship in between mathematics and biology ($r = +0.512$, $p < 0.05$).

Discussion

Based on the studies, it observe that students offering further mathematics have an overall advantage over their non-further mathematics counterparts. This advantage though present but not statistically significant in each science subject. Being exposed to further mathematics is no more than being exposed to advanced topics in mathematics even while at Senior Secondary School level.[29] asserted that mathematics is a fundamental science which is necessary for the understanding of most other fields. Probably no other subject forms a strong binding force among the various branches of science – physical, biological and social as mathematics [23]. [22] Affirmed that mathematics has been found to be very important because it is needed for all scientific, technological research and technical training. Students who have been taught vector in further mathematics have advantage over non-further mathematics students in the physics class because of better entry behavior. No doubt, science subjects are inter-related, a student that is good at one is likely to be good at others. Science subjects have many things in common. Apart from the overlap of content in some topics, the principles of science teaching and learning such as observation, formulating hypotheses, drawing influences and recording cut across all the science subjects. Mathematics on the other hand according to [23], forms a strong binding force among the various branches of science.[30]

Conclusion

Based on this analysis, offering of further mathematics is an advantage in understanding mathematics and other science subjects. Though, the effect is not significant in each of the subject, however, there is significant difference in the overall achievement of further mathematics and non-mathematics students, the former performed better. Mathematics is the language of science and it unites all the science subject. There is no science subject where at least elementary knowledge of mathematics is not required. Therefore, offering further mathematics at secondary school level provides further mathematics students opportunities to be exposed to advanced topics in mathematics which can enhance performance in mathematics, biology, chemistry and physics. If the effect of further mathematics can be very important at this

level, no doubt this knowledge will provide a good foundation for students in tertiary institution especially for those who will later study mathematics and engineering.

Recommendations

All science students should be encouraged to offer further mathematics as this will enhance their performance in mathematics and other science subjects. Teachers of further mathematics should teach the subject very well so that students will understand and apply the knowledge in other subjects.

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