

INFLUENCE OF KNOWLEDGE OF MATHEMATICS POSSESSED BY SENIOR
SECONDARY SCHOOL STUDENTS ON THEIR ACADEMIC PERFORMANCE IN
PHYSICS IN OGBOMOSO SOUTH LOCAL GOVERNMENT AREA

BY

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ABSTRACT

This research work was carried out to investigate the influence of knowledge of Mathematics possessed by Senior Secondary School Students on their Academic Performance in Physics in Ogbomosho South Local Government Area of Oyo State, Nigeria. Influence of students' gender on their academic achievement in Physics based on the knowledge of Mathematics the Students possessed was specifically investigated. The study adopted the descriptive survey research design. Two research questions were answered and two hypotheses were also tested. The population comprised of all the Senior Secondary School Two Physics Students (SS2) in the study area. A total of Two hundred (200) Physics Students were sampled for the study which comprised of one hundred and seventeen (117) male and eighty three (83) female. Two research hypotheses were formulated and tested. Students Achievement Test in Mathematics (SATM) and Students Achievement Test in Physics (SATP) were the instruments for the study. The two instruments were validated. Using test retest method, reliability index of 0.71 and 0.75 were obtained, respectively. The data collected were analyzed using ANOVA. The result indicated that there was a significant influence of the knowledge of Mathematics possessed by senior Secondary School Students on their academic performance in Physics. Also, Students' gender has influence on their academic performance in Physics based on the knowledge of Mathematics the Students possessed. It was recommended among others that Mathematics teachers should teach Students with zeal and use strategies that will develop Students' interest in the subject.

KEYWORDS: *Influence, Knowledge of Mathematics, Knowledge of Physics, Academic Performance,*

INTRODUCTION

Physics is a physical science which is the study of matter in relation to energy and motion. Charles-Organ and Okey (2017) conceptualized Physics as the study of systematized knowledge produced by careful observation, measurement and experiment with the motive of establishing basic physical laws and explanations of basic physical phenomenon. Physics has been identified as the bedrock of technological development of any nation; because of the application of its principles, theories and laws in the technological world (Awodun and Ojo, 2013). In another dimension, Obafemi and Ogunkunle (2013) submitted that Physics is an interesting subject which used Mathematics as its official language to link the principles learnt in the classroom and experimental results obtained in the laboratories with the practical applications in every human endeavour.

Adeyemi (2017), Awodun and Ojo (2013), Odual (2013), and Redish (2015) affirmed the submission of Obafemi and Ogunkunle (2013) by acquiescing that Mathematics is the language of science in general and of Physics in particular. The researchers admitted that without Mathematics, there is no science and that without science, there is no technology, and without technology there is no modern society. This is the major reason why Mathematics is a compulsory subject for students in the primary and secondary school levels in Nigeria.

Mathematics is also, a requirement for admission into tertiary institutions of learning. Every subject, tribe and society has its own language. Adequate and sound knowledge in a language of a particular subject is a requirement for success in the subject, sound knowledge in language of a particular environment, tribe or society is a requirement for such a person to belong and flow well in such environment, tribe and society. Hence, before one can be said to have understood a subject or belong to a particular society or environment, one should be able to speak the language of that subject or speak the language of such society or environment. No wonder, students who travel to study in overseas countries such as Russia, Spain, Italy, Japan and Germany must first study and pass the respective language of the country of study before the commencement of the major course of study.

Hence, Physics students must possess adequate knowledge of Mathematics, the language of Physics before such a student can perform excellently in the subject. Although some individuals may argue that students who are not grounded in Mathematical knowledge but

grounded in English language will be able to define, explain and apply Physics concepts to practical situations but will not be able to calculate can still pass Physics at the level of ordinary pass or average since Physics concepts can both be expressed in English language and Mathematics, but this is not a good foundation for engineering, medicine and technological inventions and other related science professions. This is in agreement with Thanormsuay, (2010) that science and Engineering students need strong Mathematics background to succeed in the area of specialization.

However, Physics was considered as a difficult subject and was not attracted by students because of its mathematical nature (Obafemi, 2013; 2015). In the same vein, Owolabi (2010) discovered that students are deficient in mathematical concepts; hence, they perform poorly in Physics. Also, Ighomereho (2015) found that students who perform poorly in Physics have inadequate mathematical background. Also, the West Africa Examination Council (WAEC) Chief examiner's report (2015) showed that students lost marks in Physics based on their Mathematics error.

It is pertinent to note that Mathematics being the language of Physics does not mean that all Physics concepts are expressed in Mathematics, but are both expressed in English and in Mathematics but the mathematical expression supersedes the English expression because any English language error committed by students in Physics is pardonable but mathematical expression error committed is not pardonable in Physics. It therefore follows that students who are well knowledgeable in Mathematics will do well in the calculation aspect and those who are good in English language will do well in the non-calculation aspect of Physics (Ighomereho, 2015). The overall performance in Physics may probably be affected by mathematical knowledge.

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. According to Esiobu (2015), Science, Technology and Mathematics (STM) education play a dominant role in the developmental effort of nations. Science and technology are seen as the foundation of national power and productivity. Technological advancement seems to be the gateway to present day economic growth, social well-being, political power and military superiority. Esiobu, (2015), It means that the knowledge of physics contributes to the cognitive reservoir that facilitates the sustenance and advancement of technologically oriented society.

Physics links the principle learnt and the phenomena observed in the classroom to applications in engineering and allied fields.

The importance of physics cuts across human endeavour such as medicine, pharmacy, agriculture, petroleum engineering, geology, engineering, industries and computer. The feats of science and technology are in every facet of human endeavour. It could be rightly said that every sector of the society now depends on science and technology for proper functioning and mathematics as the creation of human mind (Awofala, Arigbabu, & Awofala, 2014) is the universal language used to describe the problems arising in most branches of science and technology.

Mathematics, the creation, representation analysis, interpretation of numbers and symbols affects all aspects of the human environment significantly, but at varying degrees. The social, economic, political, geographical, scientific and technological aspects of man's life centre on number. One very important fact is that all other disciplines of numbers- Arithmetic, statistics, accounts etc. are integral parts of mathematics, (Ogunleye, Awofala and Adekoya). Civilization is also traceable to the knowledge of Mathematics.

The earliest civilization of mankind came through mathematical manipulation. The pyramid of Egypt constructed several years ago still remains tourist attraction to date. The construction of the pyramids involved sound and intelligent mathematical calculation. Owing to its numeral and symbolic nature, it is more married to the scientific and technology facets of our world than to any other aspect. It occurs and reoccurs in physical and natural sciences which are mainly represented by physics and chemistry in our secondary schools. Based on this circumstance, it is an established fact that mathematics is and remains a dominant contributing factor to the performance of students in physics and chemistry and the control tool of mathematics remains the basic skills underlying all scientific and technological skills (Akinsola, 2019). Mathematics is a subject that is related to other science subjects such as physics and chemistry in areas like Number and numeration—fractions, logarithms indices, Algebraic processes solution of equations, variation, graph, and also in volume and students often perform poorly in the sciences (Jegede, Okota, and Eniayeju, 2012; Mkpananga, 2015).

However, Physics educators have identified several factors which are responsible for the poor achievement in Physics, few of which are: poor method of instruction (Adegoke, 2009; Babajide, 2013) misconception about the nature of Physics (Babajide, Adeyemo&Ogunleye,

2018); poor home and classroom environment (Adeyemo, 2010) and students' poor attitude towards Physics (Adeyemo, 2012). Suggested solutions to the affirmative problems were provided such as the use of students centred approaches that will correct students' misconceptions, improved classroom environment, and students' positive attitudes towards Physics etc. Yet the problem has not been totally eradicated; this implies that there are still other factors. Consequently, the poor performance of students in Physics may be due to poor mathematical knowledge of Physics students who sat for the external examination. A poor mathematical knowledge may prevent Physics students from engaging in any career in Physics science related field such as Engineering, Computer Science, Marine Science etc., as Physics remains a pre-requisite for studying such courses. Gender and type of schools are moderator variables whose influence was investigated in this study. The choice of these variables is due to the fact that the issue of gender in science and Physics in particular in Africa is still debatable, some authors identified Physics and Mathematics as a male subject while arts and humanities are ascribed to female (Okigbe & Okeke, 2011; Babajide, 2010).

Akinloye, Adu, & Adu (2015) also agreed that the students in private schools did better than their counterparts in public schools academically in Economics. They attributed these achievements to socio-economic class of parents and the availability of instructional resources in private secondary schools. Sunday (2014) concluded that pupils in the private primary schools performed better than their counterparts in the public schools. This is due to certain facilities available only in the private schools which include; efficient instructional encounter in the classroom as a result of frequent and thorough supervision, dynamic school administration, frequent class assignments, prompt payment of teachers' salaries and allowances, mutual parent-school relationship, positive pupil-teacher interactions, absence of teachers industrial actions, provision of adequate furniture and the maintenance of the standard teacher-pupil ratio. The researcher observed that most of the structures in public schools are dominated by dilapidated buildings, while majority of the private ones are housed in uncompleted buildings which in turn may not be conducive for teaching-learning processes. Marc and Ping (2015) affirmed that private high school students' scores in mathematics were significantly higher than public high academic achievement in Conventional Method than the academic achievement of their female counterparts.

As indicated above, some researchers obtain that students from the public schools

achieved better in Physics than students from private secondary schools (Adetutu, 2014). Also, Marc & Ping (2015) obtained that students in the private schools achieved better than those from the public schools in Physics. However, much has not been done on the achievement of students in Physics in Ogbomoso South Local government area, Oyo state.

Statement of the Problem

Mathematics is the language of Physics, every Physics student is expected to be well grounded in Mathematics and apply the knowledge of Mathematics in solving daily problems in Physics. Hence, every physicist can be said to be a mathematician but not all mathematicians can be said to be physicists. Physics, an important science knowledge is needed for technological development of a nation. Practically, students generally have phobia for Mathematics and any other Mathematics related subjects such as Physics. Could this Mathematics phobia be a cause of poor achievement of students in Physics? This may probably be due to poor knowledge of students in Mathematics or could it be that the achievement of students in Physics may not even be connected to Mathematics knowledge? The study therefore investigates the impact of knowledge of Mathematics possessed by senior Secondary School Students on their Academic Achievement in Physics in Ogbomoso South Local Government Area.

Research Questions

The study provided answers to the following research questions.

- i. What is the impact of knowledge of Mathematics possessed on academic achievement of senior Secondary School Students in Physics?
- ii. What is the influence of gender on achievement of senior Secondary School Students in Physics based on the knowledge of mathematic the students possessed?

Research Hypotheses

- H0₁: There is no significant impact of the knowledge of Mathematics possessed by senior Secondary School Students on their academic achievement of in Physics in the study
- H0₂: There is no significant impact of gender on academic achievement of Senior Secondary School Students in Physics based on the knowledge of Mathematics possessed by the students in the study area

METHODOLOGY

The study was a descriptive research of survey method. The population was all senior secondary school physics students in the study area. Ten secondary schools that offered physics were purposively sampled (five public and five private). From the sampled schools, two hundred Senior Secondary School two (SS2) Physics Students were randomly sampled for the study. Two research instruments were used for the collection of data for this study and these are Students' Mathematics Knowledge Test (SMET) and Students' Physics Achievement Test (SPAT). The instruments were given both face and content validity. Using test-retest method, the reliability index for SMET and SPAT were 0.75 and 0.78, respectively.

Data was collected personally by the researcher with the help of the physics and mathematics teachers of the sampled schools. The researcher visited a school a school twice, SMET was conducted at the first visit while SPAT was administered at the second visit. The administration of each instruments lasted for one hour. Two schools were visited in a day. The administration of the instrument lasted for Ten working days. Research questions were answered with mean scores while hypotheses were tested via ANOVA.

ANALYSIS OF RESEARCH QUESTIONS AND RESULTS

Research Questions 1: What is the impact of knowledge of Mathematics possessed on academic achievement of senior Secondary School Students in Physics?

Table 1

Mean test score of students on Impact of Mathematics on Achievement of Students in Physics.

Variable	N	Mean	Std.D	R	Sig
Mathematics	200	51.52	12.11		
				0.153	0.053
Physics	200	11.02	2.91		

Table 1 shows that mathematics knowledge positively influence the performance of students in Physics ($R = 0.153$). This implies that the mathematics knowledge is quite relevant in explaining students' performance in Physics in secondary schools.

Research Question 2: What is the influence of gender on achievement of senior Secondary School Students in Physics based on the knowledge of mathematic the students possessed?

Table 2

Mean Test Scores of Male and Female Students in Physics

Variable	N	Mean	Std.D	R	Sig.
Male	117	17.77	6.58	0.157	0.074
Female	83	16.54	5.01		
Total	200				

Table 2 shows that mathematics knowledge possessed by students influence positively, their academic performance in Physics based on their gender ($R = .157$). This implies that the male students performed better than female students' in Physics based on the knowledge of mathematics the students possessed in the study area. This implies that the male students that are good in mathematics are also good in physics more than their female counterparts.

TESTING OF HYPOTHESES

Hypotheses 1

There is no significant impact of the knowledge of Mathematics possessed by senior Secondary School Students on their academic achievement of in Physics in the study area.

Table 3***ANOVA Table of Mathematics knowledge and Students' Academic Achievement in Physics***

	Sum Squares	of Df	Mean Square	F	Sig.
Regression	29.136	12	2.428	2.23	0.023
Residual	203.17	188	1.081		
Total	232.306	200			

P* < 0.05

A Regression analysis of variance was conducted to explore the impact of the knowledge of Mathematics possessed by senior Secondary School Students on their academic achievement in Physics as shown in table 3. There was significant impact of the knowledge of Mathematics possessed by senior Secondary School Students on their academic achievement in Physics with the result: $p0.023 < 0.05$. Since the impact of mathematics knowledge on students' academic performance in physics were found to be significant, it implies that mathematics knowledge have a relationship with academic performance of students in physics in senior secondary school in the sampled area. Therefore, the above null hypothesis is rejected.

Hypotheses 2

There is no significant impact of gender on academic achievement of Senior Secondary School Students in Physics based on the knowledge of Mathematics possessed by the students in the study area

Table 4***ANOVA Table of Mathematics knowledge and Students' Academic Achievement in Physics******Based on students' Gender***

	Sum Squares	of Df	Mean Square	F	Sig.
Female	112.83	83	1.359	1.58	0.043
Male	119.476	117	1.021		
Total	232.306	200			

P* < 0.05

Analysis of variance was conducted to explore the impact of gender on academic

achievement of Senior Secondary School Students in Physics based on the knowledge of Mathematics possessed by the students in as shown in table 4, $p0.043 < 0.05$. There was significant impact of gender on the academic achievement of students in Physics based on the students' knowledge of Mathematics. Since gender has impact on students' academic performance in physics is found to be significant, it implies that gender have a relationship with academic performance of students in physics in senior secondary school in the sampled area. Therefore, the above null hypothesis is rejected.

DISCUSSION OF RESULTS

It was discovered from the first hypotheses tested that there is a significant influence of students' mathematics knowledge possesses by students on their performance in physics in Ogbomosho South local government area of Oyo state. It was also discovered from the result of the first hypothesis which investigated the impact of the knowledge of Mathematics possessed by senior Secondary School Students on their academic achievement in Physics in the study area. The finding is in contrary with the Awodun and Ojo (2013) findings that mathematics skills jointly influence the performance of Physics students. The result is in line with the research outcome of Liu, (2017) that there is strong interrelationship between Physics and mathematics in historical views and the result also agree with the findings of Yeo-Kee (2013) that Physics curriculum had similar aims with mathematics curriculum since as both emphasize skills in decision making and problem solving. Also the finding of Ayodele, Awofala and Adekoya (2014) who reported a statistically significantly positive relationship between achievement score in Physics and Mathematics agreed with the result of this study.

The result of the analysis of hypothesis two revealed that there was a significant relationship between students' gender and students' academic achievement in physics in Ogbomosho South Local Government area, Oyo State. This is in line with the findings of Mkpanang (2016), McPhee, Bates and Donnelly (2011) that male performed better than female in Physics. But contradict with the findings of Ogunleye and Babajide (2011) who obtained a no significant difference in the achievement of male and female students in Physics.

CONCLUSION

The study concludes that the knowledge of Mathematics possessed by senior secondary students influenced their performance in Physics as well as students gender.

RECOMMENDATION

Based on the findings of this study:

1. Mathematics should be a prerequisite for allowing students to study sciences in secondary schools;
2. Mathematics teachers should teach the subject with passion and enthusiasm towards improving the students knowledge in the subject; and
3. Special attention should be paid to female students and other students that are academically weak in the subject.

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