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Investigating the Knowledge of Mathematics and Its Impact In Learning Physics among Senior Secondary School Students In Jos North Local Government Area, Plateau State

[1]Ejiga Peter Job; [2]Adinoyi Victor&[3]Rilwanu Mohammed
[1,2]Department of Science and Technology Education,
Faculty of Education
University of Jos, Jos, Nigeria
[3]Department of Physics, Aminu Saleh College of Education Azare, Bauchi State, Nigeria

ABSTRACT : The study investigated the knowledge of mathematics and its impact in learning physics among students in senior secondary schools in Jos North, Plateau state. The objective of the study was to find if the knowledge of mathematics (computational, manipulative) could enhance students' achievement in physics. The study employed ex post- facto research design. The population of the study comprised 352 students from 10 schools randomly selected in Jos North, plateau state. The sample size of 10 secondary schools drawn from the population using simple random sampling technique and all the physics students in the sampled schools formed the sample for the study. Three research questions and three hypotheses guided the study. The data collected were secondary data (S.S.II mathematics and physics terminal results). Data collected were analyzed using mean, simple regression for research questions while person moment correlation and t-test of independent sample were used for testing of the hypotheses at a significant level of 0.05. The findings of the study revealed that the students' knowledge of mathematics has significant relationship with their achievement in physics on the other hand, students' achievement in physics based on their application of knowledge of mathematics is influenced by their gender. Based on this findings, it was recommended that students should be given proper mathematical knowledge to be able to apply same in solving problems in physics as most physics task are mathematical inclined. Secondly, both mathematics and physics teachers should be critical in understanding students learning and academic achievement been relation to their gender so that no child is left behind in the teaching and learning of these two subjects as they have related features.

KEYWORDS: physics, mathematics, achievement.

I. INTRODUCTION

Physics is one of the important science subjects offered in senior secondary schools. It is an important aspect of science that concerns itself with the study of matter in relation to energy and motion. According to (Charles-organ and okoye,2004) it is conceptualized as the study of the systemized knowledge produced by careful observation, measurement and experiment with the motive of establishing basic physical laws and explanation of physical phenomena. Similarly, (Awodun and Ojo, 2013) defines Physics as the bedrock of technological development of any nation because of the application of its principles, theories and laws in the technological world. Physics being a science subject is taught in senior secondary school to enhance intellectual, computational experimental, communication and analytical skills of the students and prepare them for further education in vital science based courses such as electrical engineering, petrochemical engineering, computer engineering, medicine pharmacy even single honour courses like chemistry, Mathematics, and biology. As a result of this skills acquired, by the students it will conversely provide the manpower need in those area for scientific and economic development of the nation. Studying physics strengthens quantitative reasoning and problems solving skills that are valuable in areas beyond physics. The importance of the knowledge of Physics in the development of any country cannot be overemphasized. This is because the skills of Physics can help individual students to provide basic literacy in Physics for functional living in the society, stimulate and enhance creativity, acquire essential skills and attitudes as a preparation for application of technological knowledge for the development of the nation (Adeyemo, 2013).

Through the knowledge of physics, the development of electrical components such as the computer gadgets, medical equipment such as Magnetic Resonance Imaging machines (MRI), construction of bridges, airplanes, surgical equipment such as Radiographs, telecommunication networks, harnessing of different forms of energy has been made possible. it is undoubtedly, physics is the bedrock of scientific and technological development of any nation. In recognition of the benefits of Physics to the scientific development of the nation,

The federal government of Nigeria included Physics as one of the science subjects in the senior secondary schools as the foundation for advancement of Physics. According to the National Education Scheme designed for secondary school Physics (1985) as cited by Adegun (2013) has it that the objectives of teaching Physics include among others, to provide basic literacy in Physics for functional living in the society, to acquire essential scientific skills, and attitudes as a preparation for technological development. The teaching of Physics in senior secondary schools is intended to produce young scientists who would be able to design the technological devices that would make day to day activities easier and living more comfortable (Ajayi, 2008). The attainment of Physics objectives will help in laying a sound foundation for future engineers, architects, astronomers and others who will propel the nation to greatness like developed nations.

However, it is pertinent to note that in learning the key of the computational and manipulative skills of physics, a fundamental knowledge of mathematics could be required for a better comprehension, this is because physics cannot be learnt properly in isolation with computational and manipulative skills, which are mathematical in nature. This implies that mathematics and physics inter-related, such that often no separation between "pure" mathematics and "pure" physics is possible, Gesche 2015). The proper shaping of the inter play of mathematics and physics in physics education is important for giving the students an insight not only in physics but into the nature of physics, (Hestsenes, 2013). In spite of the importance of the knowledge of Physics for scientific and technological development for the nation, students' achievements in the subject have not been encouraging. Analysis of Senior Secondary Certificate Examination in physics conducted by WAEC in the country from 2013-2018 reports the following percentage credit pass respectively 51.27%, 63.94%, 68.74%, 46.62%, 60.75%, 59.40% and a corresponding percentage fail given as 18.27%, 11.76%, 2.92%, 12.27%, 13.27% West African Examination Council (WAEC) Head Quarters, Yaba, Lagos). The aforementioned statistics calls for serious attention from allstakeholders in changing the outcomes of students' achievement in the subject. Also, the West Africa Examination Council (WAEC) Chief examiner's report showed that students lost marks in Physics based on their Mathematics error. Many factors have been attributed to the underachievement of students in physics, such as poor computational and manipulation skills as well as gender issue (WAEC chief examiners reports of 2010 -2015, Babajide, 2013).

This is in corroboration with Ariyo (2014) who asserted that poor grounding in mathematics is manifested in their overall performance in physics which over the years have experienced a downward trend in senior certificate examination. Wanhar (as cited in Aida: 2017) explains that low computational and manipulation skills of mathematics affect the students' performance in physics. In the same vein, Odual (2013) discovered that students are deficient in mathematical skills, hence, they perform poorly in Physics. In view of the aforementioned physics features such as acceleration, velocity, momentum, speed, are undoubtedly related to features in mathematics such as variation, transformation, change of subject formula, integration this is because they all involve formulas, equations and arithmetic. Corroborating this assertion, (Redish & Kou, 2015) explains that the application of mathematics to problems in physics will physically increase comprehension to interpret mathematical functions e.g. the following examples in physics equation $V= V_0 +$ at where V is the velocity of an object, V_0 is the initial velocity, and a is the constant acceleration of the object, and t is the time. This equation is mathematically identical to a = dv/dt and can be seen as a representation of linear relationship. Based on these reports, and findings of students' low achievement in physics as a result of their poor mathematical skills as well as knowledge, this study intends to examine the relationship between students' achievement in physics in Jos North L.G.A. Studies on academic achievement have shown that students achievement is not only a function of their cognitive ability but can also be influenced by factors like gender, school type, school facilities, class size among others.

However, this study intends to examine the achievement of students' mathematics and their corresponding achievement in physics in relation to gender. This is because studies have found that gender is one of the variable which affects students' academic achievement in different areas of human learning. Studies Mkpanang (2016), Mcphee Bates and Donnelly 2011) found that boys performed better than girls in physics, these are at variance with the findings of Ogunleye and Babjide (2011) who obtained a non-significant difference in the achievement of male and female students in physics. In view of the conflicting findings, it becomes imperative for more research to find out exactly the effect of gender on students' achievement in Physics as a result of their mathematical knowledge. However, the researcher is not aware of any research on the knowledge of mathematics and its impact in learning physics in Jos North Local Government Area. This serves as a motivating factor for this study, hence this study intends to find out the impact of Mathematical knowledge on students' achievement in Physics.

Physics and Mathematics are two areas of intellectual activity that have been deeply entwined throughout the long history of science and yet they represent two separate ideological entities. This situation reflects the complication of representing both disciplines in school curricula. Physics teachers often state that their students do not understand Physics due to the lack of mathematical knowledge and claim that such knowledge guarantees successful learning of Physics (Pietrocola, 2008). While it is clear that learning Physics requires mathematical knowledge, the exact dependence of Physics education on Mathematics should be refined in order to ensure that teaching effectively supports students' understanding of Physics. The apparent complexity is evident from the fact that teachers of Mathematics and Physics often employ the same mathematical tools – derivatives, equations, and functions –emphasizing different aspects of certain concepts. Our results suggest that establishing complementary perspectives – the cultural knowledge of the subject – may clarify the concepts shared by the two fields and prevent current confusion. Previous analysis of the Mathematics-Physics relationship demonstrated that Mathematics is essential in Physics problem solving, although the "language" of Mathematics in Physics does not coincide with the one used in Mathematics class (Redish, 2006). Physicists employ numbers to quantify physical entities ("quantities"), whether variables or parameters, or constants. Ignoring the distinction between them, between physical and mathematical meanings make the physical claims obscure.

Al though often considered inseparable Mathematics and Physics education are distinguished in formal and cognitive skills required for their study (Uhden, et al., 2011). In addition, the current situation in Israel reveals other dimensions of complexity. While Mathematics is mandatory throughout the K-12, Physics, unlike many other countries, is an elective in high school, and chosen by 7% of students filtered by high requirements of Mathematics. Given the lack of Physics instruction in the middle schools (more exactly, an ineffective course of integrated science), we face Physics oblivion in school education. Clarification of the nature and relationship of the two disciplines may imply important changes in their teaching. There is a rich anecdotal evidence of parents, teachers, students, school administrators, and policy makers in the Ministry of Education who hold various views on the subject. Physics is often perceived to be far more "complex", confusing, demanding of cognitive maturity, labour consuming, expensive to support by the school, and "unrewarding" in terms of matriculation assessment results. Physics possess an image of the area for a few brilliant savants, usually males, often arrogant and disconnected from their fellow classmates. Moreover, Physics teachers often blame Mathematics education for the difficulties they face with students unprepared in Mathematics. Students need to have a deep understanding of Mathematics and utilize it when necessary while engaging with Physics concepts (Ataide & Greca, 2013). Even in the explanation of basic concepts in Physics, students bring required components from Mathematics, including symbols, structures and algebraic equations, and embed them into the problem situations by combining the Mathematics and Physics concepts (Ataide & Greca, 2013; Hudson & McIntire, 1977).

Al though, students can have an understanding of Mathematics and Physics content separately, they may experience difficulty in applying Mathematics properly and thus incorrectly interpret the physic concepts (Basson, 2002). At this point, an awareness of the importance of a close relationship between Mathematics and Physics becomes apparent (Heller, 1997; Kapucu, 2014a; Martinez-Torregrosa, Lopez-Gay & Gras-Marti, 2006). This relation can be introduced in two ways. In the first place, some argue that Mathematics is necessary for understanding Physics (Basson, 2002; Rohrlich, 2011). This focuses the discussion on the math-dependence for understanding Physics. Rohrlich (2011) looked at this situation through the eyes of the historical development of the laws of nature, which is Physics. It has been argued thatthe laws of nature are first explained qualitatively. However, the “enormous usefulness of Mathematics in the natural sciences” is emphasized by Winger (1967, cited in Rohrlich, 2011, p.366).The state of usefulness of Mathematics changes to a need component for understanding Physics. This is because there is a need to generalize the laws of nature and to make them more precise. Therefore, explaining them quantitatively becomes a fundamental part of the advancement of natural sciences including Physics (Rohrlich, 2011). In fact, one of the famous quotations “the laws of nature are written in the mathematical language” by Galileo also emphasizes the importance of Mathematics. Apparently, Physics uses Mathematics as a language to introduce the laws of nature (Rohrlich, 2011). These ideas are similar to the findings of educational studies, too. For example, Olatoye (2007) considered the Mathematics as a fundamental subject for making connection among other interrelated disciplines including the natural sciences. Students’ perceptions also indicated the beliefs of Mathematics dependence for understanding Physics. The results of a study with pre-service science and Mathematics teachers about the relationship between Mathematics andPhysics learning indicated that the highest student conceptions were that the Physics was dependent on Mathematics (Kapucu, 2014a).

Secondly, Physics and Mathematics have similar features, which highlighted the interrelation between them. Toluk, Uçar, Pişkin, Akkaş and Taşçı (2010) studied elementary school students' beliefs about Mathematics and found that the students viewed some disciplines as similar in some aspects, particularly for the subjects, Physics and Mathematics. This similarity takes different forms including content (i.e., Science Education International 255 use of geometric shapes, figures, tables), use of formulas and symbols (Nalçacı, Akarsu& Kariper, 2011). Besides, daily-life word problems are unavoidable parts of Mathematics curricula and textbook (Jitendra, Griffin & Xin, 2010), but Physics itself is a discipline to explain the natural world (Munier & Merle, 2009). From the point of required skills for students to solve problems. Moreover, this idea is supported with university students' conceptions based on their Physics and Mathematics achievement levels. According to their conceptions, students who are successful in Mathematics are also probably successful in Physics (Kapucu, 2014a). Moreover, students' insufficient knowledge of Mathematics can negatively influence their attitudes toward Physics (Kapucu, 2014b; Semela, 2010). Students might not choose a Physics course in their education (Semela, 2010) and they might even hate Physics (Kapucu, 2014b) due to their low-level achievement in Mathematics. The relationship between these disciplines also influences students' learning. Although Physics uses Mathematics as a language to explain the natural world, its use of numbers, variables and equations differs when comparing it with Mathematics application (Basson, 2002). While students combine content of Mathematics and Physics, and apply components of Mathematics in explaining physical phenomena, the knowledge of Mathematics that students hold in their mind gains importance. They no longer consider the knowledge of Physics and Mathematics as separate topics. That means students use the knowledge of Mathematics by giving attention to its meaning in the corresponding knowledge of Physics and in interpreting it (Bing & Redish, 2006).

Sometimes, students begin with components of Mathematics and translate them into physical ideas. The inverse may also appear during studying a problem situation. For example, when students try to solve problems in Physics, they need to know not only the sufficient knowledge of Mathematics, but also how to utilize it. Therefore, students need to see close interrelation between Mathematics and Physics in succeeding in doing so (Bing & Redish, 2006). In many cases, learning does not always appear at an expected level when studying Physics that requires Mathematics. Students may struggle with Physics during blending, or combining it with Mathematics (Clay, Fox, Grunbaum & Jumars, 2008). There are several reasons of such difficulties according to the scholars. Transferring the knowledge of Mathematics into Physics is not an easy task to accomplish for students (Mestre, 2001; Woolnough, 2000). It is very common that students use formulas and perform numeric computations but do not know what these procedures stand for in Physics (Martinez-Torregrosa et al., 2006). After learning new knowledge in Physics, students are required to analyze them among multiple contexts and relate them to previously learned knowledge by using necessary parts of knowledge of Mathematics (Munier & Merle, 2009). However, this is not always put into practice in school environments. Students often have difficulties in linking graphs, or diagrams to physic concepts or to the real world (Basson, 2002). In addition, students believe that they need higher levels of Mathematics skills to do Physics. These influences students' attitudes toward learning Physics negatively (Ornek et al., 2007). In fact, the teaching of Mathematics, Physics, or any other discipline in science is taught separately in schools (Clay et al., 2008). Therefore, it is very possible for students in schools to have a belief that Mathematics and Physics can be considered as unrelated subjects. Even with the universities, it is very common in engineering or science faculties providing courses such as "Mathematics for Physics/engineering/science." This initiates a discussion whether there is a need of preparing students for specific Mathematics content in such faculties to learn science. Therefore, Science Education International 257 there is a presupposition that only some parts of Mathematics are necessary to learn science and the rest is unrelated to it (Clay et al., 2008). However, there is no consensus on whether integration of components of Mathematics into science including Physics has an improving effect on students' understanding of the content taught, or a confusing effect on their learning of abstract mathematical principles or scientific phenomena (Kim & Aktan, 2014).

Man is a social animal and human life depends upon the co-operation of each other. Group work helps social skills. The ability to work together on tasks with others can build various social skills. In order to live a social life, mathematical knowledge is needed, because of the give and take process, business and industry depends upon the knowledge of Mathematics. The change in the social structure with regards to the modern facilities like mode of transport, means of communication and progress in the field of science and technology is due to Mathematics only. In this way Mathematics has played an important role in not only understanding the progress of society but also to develop the society. The "functional" aspect of Mathematics stems from its importance as the language of Science, Technology and Engineering, and its role in their development. This involvement is as old as Mathematics itself and it can be argued that, without Mathematics, there can be neither science nor engineering. In modern times, adoption of mathematical methods in the social, medical and physical sciences

has expanded rapidly, confirming Mathematics as an indispensable part of all school curricula and creating great demand for university-level mathematical training. Much of the demand stems directly from the need for mathematical and statistical modeling of phenomena. Such modeling is basic to all engineering, plays a vital role in all physical sciences and contributes significantly to the biological sciences, medicine, psychology, economics and commerce. Mathematics has been successfully used in the development of science and technology in 20th –21st century.

II. STATEMENT OF THE PROBLEM

The aim of Physics in senior secondary school is to prepare students acquire basic literacy in Physics for functional living in the society as well as stimulating and enhancing creativity, acquiring essential skills and attitude as preparation for technological application of Physics. It will also leverage them to read courses like engineering astronomy, geography computer sciences among others. The low achievements of students in Physics in senior secondary school's certificate examination (SSCE, WAEC). This according to chief examiner report 2004-2005 is due mostly to weakness of students in knowledge of Mathematics manipulation of figures and computational which are mathematical in nature. The low achievement of students in Physics could be an indication that they possess a poor background knowledge in Mathematics which consequently increase the rate of failure in Physics. Consequently, if students continue to have problems in Physics it may lead to little or no expertise or professionals in courses such as professional teaching of Physics, engineering, geology and mining and astronomy, this will also limit their employment opportunities in area mentioned, hence the need to examine the relationship between students' achievement in Physics and Mathematics, which is the thrust of this study.

Purpose of the Study: The main objective of this study is to examine the impact of mathematical knowledge on students' achievement in Physics conversely their academic achievement in Physics in secondary within Jos north. The outline of these objectives is:

1. To ascertain if there is a relationship between students' mathematical knowledge (background) and their achievement in Physics.
2. To find out whether female S.S.2 students achievement mean score differ from that of male S.S.2 students who learn concepts in Mathematics applying them to related concepts in Physics.
3. To find out whether the result of students' achievement in Mathematics can be used in predicting their achievement in Physics.

Research Questions: The relevant research questions related to this study are:
1. What is the difference in the achievement mean scores of students in Mathematics and Physics?
2. What is the difference in the achievement mean score of female and male S.S.2 students in Physics?
3. How well does Mathematics mean score predict their achievement in Physics?

Research Hypotheses
1. There is no significant relationship between S.S.2 students' understanding of mathematical concepts and their achievement in Physics.
2. There is no significant difference between the mean score of male and female S.S.2 students taught some concepts in Mathematics applying them to related concepts in Physics.
3. Results of students in Mathematics cannot be used in predicting students' achievement in Physics.

Research Design and Procedure: This chapter describes the method and procedure employed in data collection and analysis. Presentation was done under the following sub heading: research design of the study, population of the study, sample size and sample techniques, instrument of data collection, method of data collection and method of data analysis. This study employed expost-facto research design. The design was considered appropriate for the study because the students' achievement in Mathematics and Physics were already documented, and the researcher will collect and compare their relationship as they were.

Population And Sample Of The Study: The populations of the study consist of all senior secondary schools in Jos north Local Government Area of plateau state. Jos north has a total number of ninety-four (94) senior secondary schools, 68 are private owned and 26 are public schools, and all SSII students offering Physics in the study area. The sample for the study constitute 10 senior secondary schools randomly selected out of the 96 secondary schools in the study area. This sample of the SSII Physics Students' Mathematics and Physics terminal results constitutes all the Physics student results found in each of the sampled school. The schools have the following population of the students who form the sample of the study is two hundred and twenty (220). The

sampling technique that was used for this study was the simple random sampling. The sampling technique was used to draw a sample of 10 secondary school from the population of 96 school randomly. The total number of students offering Physics in the sampled schools formed the sample for the study. The instrument for data collection for this study was the terminal results of S.S.II students' results in Physics and Mathematics 2018/2019 academic session. Reliability was conducted for this study as it involves the use of secondary data. Validation was carried out for the study, as secondary data was employed. The researcher obtained a letter of introduction from the Head of Departments, Science and Technology Education to the principals of the ten (10) sampled schools. With the letter of introduction, the researcher sought for permission to collect Physics and Mathematics results of S.S.II students for 2018/2019 academic session. The researcher employed descriptive and inferential statistical methods of analysis. The mean, simple regression was used in answering the research questions while t-test of independent sample and Person product moment correlation was used for testing the hypotheses at 0.05 level of significance using SPSS software.

III. RESULTS

This chapter consists of the results and discussion of the research work.it involves calculation and the analysis of the information gathered. The information obtained were scored, tabulated and analyzed to answer the research questions and hypothesis.

Research Question 1

What is the difference in the achievement mean scores of students in Mathematics and Physics?

Subject	N	Mean	Std. Deviation	Mean difference
Mathematics	220	50.30	17.17	1.42
Physics	220	51.72	16.78	

Summary of the difference of the students' achievement mean score of students in Mathematics.

Table one reveals the students' achievement mean scores in Mathematics and Physics. From the table above the mean score of students in Mathematics is ($\bar{x}$) 50.30 while the mean score of Physics students in Physics is ($\bar{x}$) 51.72 with a mean score difference of 1.42 in favour of Physics achievement. Students achieved better in Physics compare to Mathematics.

Research Question 2

What is the difference in achievement mean score of male and female students in Mathematics and Physics?

Table 2

Summary of The Difference in Achievement Mean Scores of Male and Female Students in Mathematics and Physics.

Gender	N	Math $\bar{x}$	S.D	Physics $\bar{x}$	S.D	Mean difference
Male	116	53.88	16.73	53.06	16.72	-0.82
Female	116	47.38	17.03	50.22	16.81	2.84

Table 2 reveals that achievement mean scores of male and female students' in Mathematics and their related scores in Physics as they apply Mathematics knowledge in solving problems in Physics. From the table, the male students' obtained a mean score ($\bar{X}\bar{X}$ = 53.88) in Mathematics and ($\bar{x}$ = 53.06) in Physics while the female students obtained ($\bar{x}$ = 47.38) in Mathematics and ($\bar{x}$ = 50.22) in Physics. Thus implies that the knowledge of Mathematics skills did not influence male students' achievement in Physics as they had a mean difference of 0.82. On the other hand, the knowledge of Mathematics skills did influence the female achievement Physics as they had a mean difference of 2.54.

Research Question 3

To what extent does students' Mathematics mean score predicttheir achievement in Physics?

Table 3. Regression Summary Showing the Relationship Between Students Score in Mathematics and Physics.

a. Predictors (content), Mathematics scores
b. Dependent variable Physics scores

The Table 3 shows how much of the variance in the dependent variable (Physics scores is explained by independent variable (Mathematics scores). from the table, the value of R2 0.605 expressed as a percentage (60.5%) explains the variation in Physics score. This implies that the students' mathematical scores predict their achievement in Physics.

Hypotheses 1
There is no significant relationship between students' achievement in Mathematics and their achievement in Physics.

Table 4.Pearson product moment correlation between students' achievement mean score in Mathematics and Physics.

Variables	N	Mean	Std. Deviation	r	P-Value
Mathematics	220	50.30	17.17	0.779	0.000
Physics	220	51.72	16.78		

P < 0.05
Table 4 reveals the correlation coefficient of 0.0079 with a p-value of 0.000 indicating a strong and positive correlation between students' achievement mean scores in Mathematics and Physics hence the p-value is less than the level of significance 0.05, the null hypotheses is rejected that there is no significant relationship between students' achievement mean score in Mathematics and Physics.

Hypothesis 2
There is a significant difference between the achievement mean scores of male and female students taught some concepts in Mathematics applying them to related concepts in Physics.
Table 5
Summary of t-test of independence samples Analysis for difference the achievement Mean Score of Male and Female in Mathematics and Physics.

Gender group		N	$\bar{X}$	S.D	df	T	p-value	Decision
Physics	Male	116	53.06	16.72	218	1.25	0.21	
	Female	104	50.22	16.81	215			
Mathematics	Male	116	53.88	16.73	218			
	Female	104	47.33	17.03	214	2.88	2.88	

Physics score > 0.05
Mathematics score < 0.05

Table 5 reveals, the results of t-test of independence sample analysis of male and female achievement mean score in Mathematics and Physics. The results show a significant difference between male and female in Mathematics mean score at 0.05 level of significance. The results yielded t (218) = 2.85 for male and t (2.4) = 2.85 for female-value of 0.05 is less than the alpha level of 0.05, the null hypothesis was rejected because the data did not provide sufficient evidence to accept the null hypothesis. On the other hand, the results on male and female students' achievement in Physics shows a significant difference in the mean score at 0.05 level of significance. The result yielded t (218) = 1.28 for male and t (215) = 1.25 for female p >0.05. Since the p- value of 0.211 is higher than the alpha value at a level of significance of 0.05, the null hypothesis is retained because the data provided sufficient evidence to accept it.

Hypothesis3
Results of the students in Mathematics cannot be used in predicting students' achievement in Physics.

Table 6
Regression summary indicating the variation of students' Mathematics score in Physics scores.

Model	Sum of square	Df	Mean score	F	sig.
Regression	37460.161	1	37460.161	337.112	0.000
Residual	24224.366	218	111.121		
Total	61684.527	219			

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

The result in the table 6 above indicated that there is significant contribution of the variation in students Physics scores by students' achievement in Mathematics. Hence, the regression ANOVA product f (1,128) = 337.112, P< 0.05, the null hypotheses was rejected. This implies that there was significant contribution of students' mathematical knowledge in their achievement in Physics.

IV. DISCUSSIONS

The aim of this study was to investigate Mathematics knowledge and its impact in learning Physics in senior secondary school, Jos North Plateau State. The findings on research question one revealed that students achieved better in Physics owing to their knowledge in Mathematics, in other words students will perform better in Physics if they possess a good manipulative, computing and calculating skill of Mathematics. This finding is in consonance with the outcome of the study of Odual (2013) and Charles-Organ and Okey (2017) who reported a positive relationship between Mathematics ability and achievement in Physics. Students who perform better in Mathematics also perform better in Physics. A good mathematical skill helps Physics students to achieve higher scores in Physics as the language of Physics is Mathematics.

The finding on research question two, reveals students' achievement in Physics based on their knowledge of Mathematics according to gender. It was found that male students achieve higher scores in Physics than their female counterparts. This indicates that male students achieved better in Physics owing to their manipulative, computational and calculating skill in Mathematics. The finding is in agreement with the findings of Bates and Donnelly (2011), Mkpanang (2016) that boys perform better than girls in Physics. However, the findings of Ogunleye and Babajide (2011) found no significant difference in the achievement of male and female students in Physics.

Furthermore, findings on research question three reveal that Physics students' mathematical scores predict their achievement in Physics. The result on hypotheses one indicates that there was a strong and positive relationship between students' Mathematics knowledge and their achievement in Physics. This finding is supported by Ayodele, Awofala and Adekoya (2014) who reported a statistically significantly positive relationship between achievement score in Physics and Mathematics. The findings from data analysis for hypotheses two affirmed the findings revealed in the research question two that there is a significant difference in the male and female mean score in Physics owing to their Mathematics knowledge in favour of female students. Contrary, Ayodele, Awofala and Adekoya (2014) found no significant difference between male and female achievement Mathematics.

Also, the results of findings of hypothesis three which asserts that results of the students in Mathematics cannot be used in predicting students' achievement in Physics reveal that there is a significant difference between male and female in Mathematics mean score in favour of the male This implies that male performed better than female in Physics These findings agree with that of Ebugara in Tsu and Anyor (2006) who found out that knowledge of Mathematics is needed if students are to score high in science subjects especially in Physics. Therefore, from the findings it is evident that for a student to perform well in Mathematics he/she must have a good foundation of mathematical knowledge and application. Thus, students should be given proper

mathematical knowledge to be able to apply same in solving problems in Physics as most Physics task are mathematical inclined.

V. CONCLUSION

Based on the findings of this study, it can be concluded that the knowledge of Mathematics is important in learning Physics as both subjects have related features such as calculations, equations formulas among others. Also gender has influence on students' academic achievement in Physics.

RECOMMENDATION

In view of the findings of this study, the researcher hereby recommended that:

1. Students should be given proper mathematical knowledge to be able to apply same in solving problems in Physics as most Physics task are mathematical inclined.
2. Both Mathematics and Physics teachers should be critical in understanding students learning and academic achievement in relation to their gender so that no child is left behind in the teaching and learning of this two subjects as they have related features.

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