

EFFECT OF KNOWLEDGE OF MATHEMATICS ON ACHIEVEMENT OF STUDENTS IN PHYSICS

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Abstract

The study investigated the effect of the knowledge of Mathematics on Achievement of Physics students in secondary School in Lagos State. The study employed a pre-test, post-test control group quasi experimental research design, using school types and gender as moderator variables. A sample size of one hundred and ninety-four (194) Physics students were purposively selected from five (5) senior secondary school (two Private, one Federal and two Public Senior Secondary School in Lagos State) from the population of 51 and 43 Senior secondary schools of Educational districts ii and iv in Lagos State respectively. Two validated research instruments Mathematics Knowledge Test (MKT) $r = 0.74$ and Physics Achievement Test (PAT) $r = 0.84$ were used for data collection. The study lasted for five (5) weeks; in which both the experimental and control groups were pretested after which the experimental groups were exposed to Mathematics concepts relating to Physics concepts to be taught before exposing them to the Physics concepts, while the control groups were exposed to only the Physics concepts without prior exposure to Mathematics concepts simultaneously. Three (3) research questions guided the study and five hypotheses were tested at 0.05 level of significance. Data collected were analysed using Analysis of Covariance (ANCOVA), Pearson moment correlation and estimated means to determine the potential of each group. The study reveals that knowledge of Mathematics, gender and school type have significant effects on achievement of students in Physics, and there was a significant relationship between achievement in Mathematics and Physics. Based on these findings, the researchers recommended that government should employ qualified and knowledgeable teachers to teach Physics and Mathematics in all the public (Federal and state) schools in Nigeria also, Physics teachers should embrace teaching strategies and techniques that will improve the mathematical skills of Physics students.

Keywords: Mathematics knowledge, Physics, achievement, Senior Secondary School

Introduction

Physics is a physical science subject and it is the study of matter in relation to energy and motion. Charles-Organ and Okey (2017) conceptualised Physics as the study of systematised 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& Ojo, 2013). In another dimension, Obafemi and Ogunkunle (2013) submitted that Physics is an interesting subject which used Mathematics as it official language to link the principles'leant in the classroom and experimental results obtained in the laboratories with the practical applications in any every human endeavour.

Adeyemi (2017), Awodun and Ojo (2013), Odual (2013), and Redish (2005) 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 oversea 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 is 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; 2005). In the same vein, Owolabi (2008) discovered that students are deficient in mathematical concepts, hence, they perform poorly in Physics. Also, Ighomereho (2005) found that students who perform poorly in Physics have inadequate mathematical background. Also, the West Africa Examination Council (WAEC) Chief examiner's report 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. The overall performance in Physics may probably be affected by mathematical knowledge. The question

then is this obtainable in reality? Research reports showed some variations in the above hypothetical statement.

Ayodele, Awofala and Adekoya (2014) investigated the effect of students' background knowledge of Mathematics on senior secondary school students' achievement in Physics and found a significant positive relationship between mathematics background knowledge and achievement of students in physics. The researchers also found that there were no statistically significant differences in the mean pre-test achievement scores in Mathematics and Physics between the treatment groups prior to the intervention and also there was no statistically significant difference in the mean pre-test achievement scores in Mathematics and Physics based on gender. Bello and Ariyo (2014) found no significant relationship between the performance of undergraduate students in Mathematics and their performance in practical Physics. Likewise, Charles-Organ and Okey (2017) investigated effects of Mathematics knowledge on Physics Students performance in electromagnetism and found that Mathematics ability have a positive relationship with students' performance in Physics. This study therefore investigated the mathematical knowledge of senior secondary school Physics students on achievement in alternating current and capacitors. These two topics are some of the topics students avoid at the senior secondary school examination levels as reported by the WAEC chief examiners reports.

The WAEC external examination of Physics students in secondary schools between the year 2004 and 2015 is showed in Table 1.1. The trend shows that the academic performance of Physics students in the external examination with grade A1 – C6 is fluctuating between 41.50 and 68.74. The trend as such is not satisfactory. Furthermore, from Table 1.1 below, the chief examiner's report has showed that Physics students performed below average between 2004 and 2015 WAEC external exams.

Table 1.1: students' performance in May/June SSCE (WAEC) Physics 2004 – 2015

| Year | Total Number of candidate | Total pass A ₁ – C ₆ | % | Total Pass D ₇ – D ₈ | % | Total Fail F ₉ | Failed % |
|------|---------------------------|---|-------|---|-------|------------------------------|-------------|
| 2004 | 321499 | 158837 | 49.40 | 90012 | 27.99 | 61940 | 19.26 |
| 2005 | 344111 | 142943 | 41.50 | 102036 | 29.62 | 89150 | 25.88 |
| 2006 | 375824 | 218199 | 58.05 | 87025 | 23.15 | 62119 | 16.52 |
| 2007 | 418593 | 180797 | 43.19 | 140172 | 33.49 | 88480 | 21.14 |
| 2008 | 415113 | 200345 | 48.26 | 91116 | 21.95 | 116776 | 28.13 |
| 2009 | 465636 | 222722 | 47.83 | 141595 | 30.41 | 79919 | 17.16 |
| 2010 | 463755 | 237756 | 51.27 | 122417 | 26.40 | 84716 | 18.27 |
| 2011 | 563161 | 360096 | 63.94 | 115158 | 20.45 | 66236 | 11.76 |
| 2012 | 624658 | 429415 | 68.74 | 120369 | 19.27 | 57440 | 9.20 |
| 2013 | 636857 | 296910 | 46.62 | 175877 | 27.62 | 145980 | 22.92 |
| 2014 | 635739 | 386270 | 60.75 | 157414 | 24.76 | 78019 | 12.27 |
| 2015 | 657266 | 390447 | 59.40 | 160664 | 24.44 | 88598 | 13.47 |

Source: The West African Examination Council (WAEC) Head Quarters, Yaba, Lagos

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 and 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 were 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). Also, research reports show that more boys are found in Physics than girls but more girls are found in Biology than boys. The results obtained on the achievement of male and female students in Physics is also inconclusive; research findings of Mkpanang (2016), McPhee, Bates and Donnelly (2011) showed that boys performed better than girls in Physics, these are at variance with the findings of Ogunleye and Babajide (2011) who obtained a non-significant difference in the achievement of male and female students in Physics.

School type is another moderator variable whose choice of selection is based on research reports that there is a variation in the achievement of students in Physics from the public senior secondary schools (Federal government school and State government schools) and private senior secondary schools (Adetutu, 2014). Okon and Archibong (2015) reported that students in private secondary schools achieved higher scores in science than those in public schools. This is at variance with the report of David and Beegle (2005) who found that students from public junior secondary schools have higher test scores in their sessional results than those from private junior schools. Alimi, Ehinola and Alabi (2012) investigated school types, facilities and academic performance of students in senior secondary schools in Ondo State, Nigeria and reported that there is significant difference in facilities available in public and private schools and in spite of this, no significant difference in academic performance of students existed in the two types of secondary schools. Harry (2016) argued that private schools are not only resourced and funded but also have parents and guardians whose socio-economic class is higher than their counterpart, and are more involved in their children's education welfare. But, he agreed upon that public schools have more professionally trained and qualified teachers than the private schools.

Akinloye, Adu, and 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. This researcher finding contradicts the findings of Aransi (2015) who obtained no significant difference in achievement of students from public and private secondary schools in Economics. Igbinedion and Epumepu (2011) reported that there was significant difference in academic achievement of students in Business Studies between public and private schools where both male and female students of public schools score higher than their private school counterpart. 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 were significantly higher than public high academic achievement in Conventional Method than the academic achievement of their female counterparts.

As indicated from above, some researchers obtain that students from the public schools achieved better in Physics than student from private secondary schools (Adetutu, 2014). Also, some 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 Federal government colleges. This study therefore, investigated the effect of Mathematics knowledge of senior secondary school students in Physics and the moderating effect of gender and type of school on the achievement of senior secondary school students in Physics.

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 mathematician but not all mathematicians can be said to be physicists. Physics an important science substance 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 investigated the effect of Mathematics knowledge on achievement of senior secondary school students in Physics to see if actually Mathematics knowledge has significant effect on student's achievement in Physics or not. The study further investigated the moderating effects of gender and school type on the dependent measures.

Research Questions

The study provided answers to the following research questions.

1. What is the effect of Mathematics knowledge on achievement of students in Physics?
2. What is the influence of gender on achievement of students in Physics?
3. What is the effect of type of school on achievement of students in Physics?

Research Hypotheses.

H₀₁: There is no significant effect of Mathematics knowledge on achievement of students in Physics.

H₀₂: There is no significant effect of gender on achievement of students in Physics.

H₀₃: There is no significant effect of school type on achievement of students in Physics.

H₀₄: There is no significant relationship between the post-test scores of students in Mathematics and Physics.

H₀₅: There is no significant effect of gender on Mathematics post test scores of Physics students.

Methodology.

The study is a pre-test, post-test control group quasi experimental research design. The population of the study consisted of Physics students in Federal public schools, State public schools, and private schools which are the three types of schools in Lagos State. There are 3 Federal public schools, 317 State public secondary schools from six educational districts (45 in Educational district 1, 51 in district 2, 45 in district 3, 43 in district 4, 68 in district 5 and 65 in district 6), and 2098 private secondary schools in Lagos state Nigeria. The sample consisted of 194 (133 boys and 61 girls) Physics students of age ranges 13-20years intact classes selected from educational districts 2 and 4 (two public, two private and one Federal secondary schools) of Lagos state. There are six educational districts in Lagos state, a simple random sampling technique was used in selecting two education districts ii and iv from the six educational districts. There are 43 State public senior secondary schools in educational district 4 out of which 1 senior secondary school of intact class, 1 private school of intact class were selected from educational district iv and 1 Federal school, 1 public and 1 private schools from educational district ii in Lagos state were selected using a simple random method for the purpose of the study. The choice of these selection is for all categories of schools (Federal public schools, State public schools, and private schools) to be represented in the study. One private, one state public secondary school and one Federal public secondary schools were taught Mathematics lesson before teaching Physics concepts while one private and one public schools were taught only the Physics concepts but were not exposed to mathematical lessons.

Two structured research instruments; Mathematics Knowledge Test (MET) and Physics Achievement Test (PAT) were used in data collection. MET was 15 items objective test, of

options A-D with only one correct answer while others are distractors. The questions were constructed from the concepts of basic arithmetic operations; simple arithmetic, simplification, multiplication, division, law of indices, percentages, standard form, metric system and conversion of units. These are the basic knowledge of Mathematics needed to be applied in the Physics topics focused in the study.

Table of specification for the Mathematical Knowledge is found in Table 1 below.

| Knowledge of facts | Comprehension of detail | Application |
|--------------------|-------------------------|-------------|
| 1,3,12,&13 | 2,4,5,6,7.8 &14 | 9,10,11 &15 |

The Physics Achievement Test consisted of two sections A and Section A dealt with personal data of the students such as age, sex, class, time duration, and name of school. Section B focused on 30 items Physics questions structured from the concepts of capacitors and simple alternating current. These topics are topics students avoid because of mathematical applications, it involves more of calculations than grammatical expressions. The questions test students’ knowledge of facts, understanding of details and application. Table of specification is found in Table 2.

Table 2: Table of Specification for Physics Achievement Test

| Knowledge of fact | Understanding of details | Application |
|------------------------|---------------------------------|---------------------------|
| 1,7,8,9,11,15,27,29,30 | 2,3,4.6,13,14,16,18,20,24,25,28 | 5,10,12,17,19,31,22,23,26 |

The MET and PAT were subjected to face and content validity, the reliability was ensured through a pilot test of the instruments in a neutral school and its coefficient of reliability were calculated to be 0.74 for MET using test rest and that of PAT was calculated to be 0.84 using test retest.

Results

1. What is the effect of Mathematics knowledge on achievement of students in Physics?

Table 1: Mean post-test achievement score of students exposed to Mathematics before exposure to Physics (experimental) and those exposed to Physics (control)

| | TREATMENT | N | Mean | Std. Deviation | Std. Error Mean |
|-------------|--------------|-----|---------|----------------|-----------------|
| PHYPOSTTEST | EXPERIMENTAL | 102 | 21.6863 | 4.28671 | .42445 |
| | CONTROL | 92 | 12.6087 | 1.64388 | .17139 |

Table 1 showed that mean score of students in experimental group is 21.6863 which is greater than 12.6087 mean scores of students in control group. This showed that the knowledge of Mathematics knowledge has effect of 9.0776 on Physics achievement.

2. What is the effect of gender on achievement of students in Physics?

Table 2: Mean Post Test Scores of Male and Female Students in Physics

Group Statistics

| | GENDER | N | Mean | Std. Deviation | Std. Error Mean |
|-------------|--------|-----|---------|----------------|-----------------|
| PHYPOSTTEST | MALE | 133 | 17.7669 | 5.57033 | .48301 |
| | FEMALE | 61 | 16.5410 | 5.67031 | .72601 |

Table 2 showed that the mean post-test scores of male students in Physics is 17.7669 which is greater than and that of female which 16.5410 is. The effect of gender on Physics achievement is 1.2259.

3. What is the effect of type of school on achievement of students in Physics?

Table 3: Mean scores of students in Federal, Public and Private secondary schools post-test of Physics achievement test

| | N | Minimum | Maximum | Mean | Std. Deviation |
|--------------------|----|---------|---------|---------|----------------|
| PRIVATEPHYPOSTTEST | 87 | 11.00 | 29.00 | 23.2759 | 4.29356 |
| FEDPHYPOSTTEST | 56 | 10.00 | 29.00 | 21.8571 | 4.11838 |
| STATEPHYPOST | 51 | 10.00 | 29.00 | 20.8039 | 4.94781 |
| Valid N (listwise) | 51 | | | | |

Table 3 showed that the mean post-test scores of private school students in Physics is 23.2759, that of students in Federal school is 21.8571 and students in public is 20.8039.

Research Hypotheses

H0₁: There is no significant effect of Mathematics knowledge on achievement of students in Physics.

Table 4: ANCOVA Score of Pretest and Post Tests of Achievement in Physics by Gender and School Type Between-Subjects Effects

Dependent Variable: PHYPOSTTEST

| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. |
|---------------------------------|-------------------------|-----|-------------|----------|-------|
| Corrected Model | 752.987 ^a | 7 | 107.570 | 6.260 | .000 |
| Intercept | 23137.489 | 1 | 23137.489 | 1346.583 | .000 |
| PHYPRETEST | 19.726 | 1 | 19.726 | 1.148 | .285 |
| TREATMENT | 283.198 | 1 | 283.198 | 16.482 | .000* |
| GENDER | 122.622 | 1 | 122.622 | 7.136 | .008* |
| SCHOOLTYPE | 317.726 | 2 | 158.863 | 9.246 | .000* |
| TREATMENT * GENDER | 22.522 | 1 | 22.522 | 1.311 | .254 |
| TREATMENT * SCHOOLTYPE | .000 | 0 | | | |
| GENDER * SCHOOLTYPE | 23.508 | 1 | 23.508 | 1.368 | .244 |
| TREATMENT * GENDER * SCHOOLTYPE | .000 | 0 | | | |
| Error | 3195.921 | 186 | 17.182 | | |
| Total | 99702.000 | 194 | | | |
| Corrected Total | 3948.907 | 193 | | | |

a. R Squared = .191 (Adjusted R Squared = .160)

Table 4 showed a significant effects of treatment on achievement of students in Physics $F_{(1,193)} = 16.482$ $P < 0.05$. This imply that there is a significant difference between the mean score of experimental and control. This mean that Mathematics knowledge has effect on achievement of students in Physics.

Decision: Reject H0₁

To identify the group that caused the difference, table 1 shows that the mean score of experimental group is 21.6863 and that of control is 12.6087. Since the mean of experimental group is greater than control group, the experimental group is responsible for the difference. That show that Mathematics knowledge has significant effect on achievement in Physics.

H₀₂: There is no significant effect of gender on achievement of students in Physics.

From table 4, Table 4 showed a significant effects of gender on achievement of students in Physics $F_{(1,193)} = 7.136$ $P < 0.05$. This imply that there is a significant effects of gender on students' achievement in Physics. This mean that gender effect on achievement of students in Physics.

Decision: Reject H₀₂

To identify the group that caused the difference, table 2 shows that the mean score of male students is 17.77 and that of female is 16.54. Since the mean of male students is greater than female students, the male students is responsible for the difference. This show that there is a significant effect of gender on achievement in Physics.

H₀₃: There is no significant effect of school type on achievement of students in Physics.

From table 4, Table 4 showed a significant effects of school type on achievement of students in Physics $F_{(1,193)} = 9.246$ $P < 0.05$. This imply that there is a significant effects of school type on students' achievement in Physics. This mean that school type has significant effect on achievement of students in Physics.

Decision: Reject H₀₃

To identify the group that caused the difference, table 2 shows that the mean scores of private school is 23.28, Federal schools is 21.86 and that of state school is 20.80. Since the mean of private school is greater than Federal school and private school, the private school mean is

responsible for the difference. This show that there is a significant effect of school type on achievement in Physics.

H04: There is no significant relationship between the post-test scores of students in Mathematics and Physics.

Table 5: Pearson Moment Correlation of Post-test Scores of Students in Mathematics and Physics

| Correlations | | | |
|--------------|---------------------|------------------|-----------------|
| | | MATHPOSTTE ST | PHYPOSTTES T |
| MATHPOSTTEST | Pearson Correlation | 1 | .078 |
| | Sig. (2-tailed) | | .028 |
| | N | 194 | 194 |
| PHYPOSTTEST | Pearson Correlation | .078 | 1 |
| | Sig. (2-tailed) | .028 | |
| | N | 194 | 194 |

Table 5 showed that there is a positive relationship between Mathematics achievement and Physics (.078). The relationship is significant at 0.05 since 0.02 is less than .05 from Table 5. Hence, there is a significant relationship between the post – test scores of students in Mathematics and Physics.

H05: There is no significant effect of gender on Mathematics post test scores of Physics

| | | t-test for Equality of Means | | | | | | |
|--------------|-----------------------------|------------------------------|---------|-----------------|-----------------|-----------------------|---|---------|
| | | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |
| | | | | | | | Lower | Upper |
| MATHPOSTTEST | Equal variances assumed | -4.381 | 192 | .000 | -1.52237 | .34750 | -2.20778 | -.83696 |
| | Equal variances not assumed | -5.596 | 191.944 | .000 | -1.52237 | .27203 | -2.05891 | -.98583 |

Table 5 showed that there is a significant effect of gender on Mathematics achievement at p less than 0.05.

Decision: Reject H_0

To identify the group that caused the difference, table 6 shows that the mean score of male Physics students is 12.25 and that of female is 13.77 and the effect of gender on Mathematics achievement is 1.52. Since the mean of female students is greater than male students, the female students is responsible for the difference. This show that there is a significant effect of gender on Mathematics achievement.

Table 6: Estimated mean post-test scores of Physics students in Mathematics.

| | GENDER | N | Mean | Std. Deviation | Std. Error Mean |
|--------------|--------|-----|---------|----------------|-----------------|
| MATHPOSTTEST | MALE | 133 | 12.2481 | 2.58611 | .22424 |
| | FEMALE | 61 | 13.7705 | 1.20268 | .15399 |

Discussions

The result obtained from this study showed that Mathematics knowledge has effect on achievement of students in Physics. This is in line with Ayodele, Awofala and Adekoya (2014) who reported a statistically significantly positive relationship between achievement score in Physics and Mathematics ($r=0.602$, $p=0.002$). But is at variance with the result of Bello and Ariyo (2014) who found no significant relationship between the performance of students in Mathematics and their performance in Physics. When students are well equipped with knowledge in mathematical skills which are related to Physics to be learnt will make such students achieve higher achievement scores in Physics. For example, if students can solve problem on of fractions, word problems and algebra such students will perform better in alternative current likewise if students can solve problems on matrix, differentiation and integration such students will perform better in mechanics.

There is a significant effect of gender on achievement in Physics. This is in line with the findings of Mkpanang (2016), McPhee, Bates and Donnelly (2011) that boys perform better than girls 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.

Physics is believed to be a male subject such that the male students are more eager and motivated to participate in Physics class discussion, doing assignment, create Physics personal learning environment and get more actively involved in Physics activities and these reflect on their performance in the subject when compared to their female counterpart.

That school type has significant effect on achievement of students in Physics. This result supports the findings of Okon and Archibong (2015) reported that students in private secondary schools achieved higher scores in science than those in public (Federal and state) schools. This is at variance with the report of David and Beegle (2005) who found that students from public junior secondary schools have higher test scores in their sessional results than those from private junior schools. Private school are known to invest so much on resources like building modern Physics laboratory, buying of Physics laboratory equipment, providing self-explanatory Physics textbooks, providing instructional materials, and teachers are under closed and effective supervision and monitoring by the proprietor. All these equipped there students to perform better in Physics when compared to government (Federal and state) schools. The poor funding and provision of resources to science especially Physics makes public school students perform poorly when compared to private schools.

There is a significant relationship between the post – test scores of students in Mathematics and Physics. This is in line with Charles-Organ and Okey (2017) and Odual (2013) 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. Physics student who possessed such mathematical skills are interested and motivated to solve mathematical related problems in topics like work, energy, power, electricity, moments of force, thermal expansivity, and magnetic field, electric field, gravitational field, and every other mathematical aspect of Physics and in doing so, they perform better in the subject.

Lastly, there is a significant effect of gender on Mathematics achievement. The female students achieved a mean score of 13.77 and that of male is 12.25. Thus, gender has a significant effect of 1.52 on Mathematics achievement of Physics students. This contradicts the finding of Ayodele, Awofala and Adekoya (2014) who reported that there is no significant difference between male and female mean score in Mathematics. Hence, the female students were motivated, interested, and showed favourable attitude towards Mathematics. Such student practices and solve Mathematics exercise in their personal learning environment which aid them to achieve higher scores in Mathematics

Conclusion

The study has found that Mathematics knowledge has effect on achievement of students in Physics. There is a significant relationship between the post – test scores of students in Mathematics and Physics. There is a significant effect of gender on achievement in Mathematics and Physics and lastly, there is a significant effect of school type on achievement in Physics.

Recommendations

1. Government should employ competent mathematics teacher who will improve the teaching of mathematics.
2. Physics teachers should embrace teaching strategies and techniques that will improve the mathematical skills of Physics students and students' prior mathematical knowledge should be leverage on teaching and learning of Physics.
3. Teachers should use instructional strategies that will close gender imbalance between male and female Physics students.
4. Government should provide conducive teaching and learning environment in public schools and also provide remuneration to motivate Mathematics and Physics teachers.

5. Government should provide close and effective supervision and monitoring to teachers in public schools.
6. Government should recruit qualified and knowledgeable teachers to teach Physics and Mathematics in all the public (Federal and state) schools in Nigeria.
7. Government should provide resource materials that will motivate teachers and students in teaching and learning of Mathematics and Physics in Nigeria.
8. School administrators, education policy makers, curriculum developers and other education agencies should make Mathematics a pre – requisite to Physics subjects.
9. Government and non – government organisation should give out scholarship to the overall best student at Mathematics and Physics to motivate and encourage Physics students.

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