Analysis of Student's Perfomance in Mathematics and their Achievement in Senior Secondary Physics in Pankshin, Plateau State, Nigeria

Yohanna, Kingsley Lenwe
Command Secondary School, Jos, Plateau State
yohannakingsley3@gmail.com

Prof. Mangut, Mankilik
Department of Science & Technology Education
Faculty of Education,
University of Jos

&
Edom, Stephanie Simi
Federal College of Forestry, Jos
edomstephanie@gmail.com

Abstract

*This study was designed to analyse the correlation that exists between the students' performance in Mathematics and their achievement in Physics in Pankshin Local Government Area, Plateau State. The study is a cross correlational analysis where students' results in both competence in Mathematics and their achievement in Physics were compared. A total number of 129 Senior Secondary 2 students from five secondary schools were considered in this research. Three research questions and three hypotheses were tested. Two research instruments, Mathematical Competence Test and Physics Achievement Test (MCT, PAT) were used to collect data. Students' second term academic performance (2023/2024) for mathematics and physics were also collected. The data were collected and analyzed using Pearson's product moment correlation coefficient and descriptive methods of mean and standard deviation. The result indicated that, there is strong positive correlation between students' performance in Mathematics and their achievement in Physics with correlation coefficient (r = 0.550**, df = 126) at α=0.01 level of significance. The results also revealed that there is a negative correlation between students' competence in Mathematics and their achievement in Physics based on gender (i.e. -0.12 and -0.28 for MCT and PAT respectively). Hence, performance in Mathematics enhances secondary students' achievement in Physics. It is therefore, recommended among others that Physics teachers should constantly consult and work closely with Mathematics teachers to identify and solve Mathematics calculations involved in Physics.*

Key words: performance, Competence and Achievement**.**

Introduction

Physics is pivotal to economic, intellectual, social and cultural development of a nation. It is one of the basic sciences that touched lives daily at every point. In medicine we use X-rays, radioisotope and nuclear magnetic resonance imaging. In addition, laser, electron microscopes, synchrotron radiation, and electronics all depend on advances made in physics. Where would the modern western economies be without computers? How can we build the electronics that modern

computers rely on without knowledge of quantum mechanics? The modern world is much more connected than in previous historical times. These days we travel far, communicate easily and quickly, and conduct business around the world effortlessly. In fact almost no place on earth has been excluded from the modern interconnected world. No doubt politics, socioeconomic factors, and acceptance by the people all play a role in the development of a nation. But physics, engineering, and other technological and scientific feats can transform a developing nation to a developed nation. Physics can play an important role in developing strategies to combat climate change, in the development of cleaner energies, and in the development of technological advancements. Physics and technology must work together to resolve the need for new technologies that will decrease the damage to our planet, for strategies to ensure that the people of developing countries have the tools to progress, the need for solutions to deadly diseases that remain a threat, and the need for solutions to the increasing demands we place on our resources before they depleted. The role of physics in our modern world is more important than in any other time in history.

Despite the contributions of Physics to society, the West African Examination Council (WAEC) Chief Examiner's Reports (2015-2019) shows students fluctuating performances in Physics at the Senior School Certificate Examination level. The result shows a rise in physics academic performance in the year 2015, 2016 and 2017 with corresponding percentages of 57.6%, 63.7% and 63.9% respectively. However, there was a decline in the academic performance from 63.9% to 50.9% and 53.9% in 2018 and 2019 respectively. From the analysis, students' academic performance scores in physics were highest in 2017 and lowest in 2018. With respect to WAEC grading, the percentage of 58.0 represents a Credit pass in students' academic performance in physics.

The Chief Examiner's reports indicated consistent lack of application of mathematical problem solving skills in physics questions contributed to the poor achievement of students in physics examinations. This has serious implications for national development, security, economy, and manpower for a country with a vision of becoming one of the leading nations in science and technology (Gambari and Yusuf, 2017). Physics is an interesting subject which used Mathematics as its official language to link the principles learn in the classroom and experimental results obtained in the laboratories with the practical applications in any every human endeavor.

Mathematics plays both technical (calculating and solving differential equation, the semantics and physical meaning of mathematical structures) and a structural role (formal derivation of physical laws) in physics. Different mathematical elements and representations of geometrical objects, diagrams, algebraic expressions and verbal explanation have their specific roles for supporting understanding, by describing exactly, quantifying, and visualizing physical process. Although, Physics draws symbols and equations from mathematics, reading and interpreting these equations are from that of mathematics and their goals are absolutely different. While mathematics just explores ways of solving equations, physics tends to utilize these equations to describe, learn, and understand physical systems. Mathematics is not only the language of physics but also tools for expressing, handling and developing logically physical concepts and theories. However, researches in time which have attempted to measure the impact of high school physics courses on students' success in undergraduate physics found that students who performed well in high school mathematics and physics subjects also did well in undergraduate physics. Charles-Ogan and Francis (2017) also found in their study that students of high mathematics abilities contributed to high performance while those of low mathematics ability performed poorly.

However, Ado and Edet (2020) in their study, correlational study of mathematics and physics students' performance for 2015-2017 Mock Examinations concluded that student performance in mathematics highly correlates with their performance in Physics in the same examination. Even in the western world Assem, Nartey, Appiah and Aidoo (2023) has observed that students' performance in the subjects involving logical reasoning and calculation such as mathematics and physics in upper secondary school are in continued decline in a number of countries.

Despite the recognized importance of mathematics and physics, students' performance in these subjects has been consistently below expectations. Various factors contribute to this trend, including inadequate teaching methods, lack of resources, and students' attitudes towards these subjects (Azunna, Igbokwe, and Nsirim, 2024). In Pankshin LGA, the situation is exacerbated by socio-economic challenges, which further hinder students' academic performance. This study aims to analyze the performance of students in mathematics and physics in Pankshin LGA, identifying the underlying issues and proposing actionable solutions to improve academic outcomes.

Statement of the Problem

The problem statement for this study is rooted in the observed fluctuation in students' performance in mathematics and physics over recent years. This fluctuation poses a significant threat to the educational and professional prospects of students especially in Pankshin LGA. The study seeks to understand the extent of this problem by comparing and analysing students' performance in physics and mathematics and the potential interventions that can be implemented to reverse the trend.

The study looked at the following objectives; determine the mean difference between the performance of students in mathematics and their performance in physics; determine the mean difference between male and female student's performance in mathematics and their achievement in physics; and determine the mean difference between students' performance in mathematics and their achievement in physics based on school type.

Research Questions

The study provided answers to the following research questions:

1. What is the mean difference between the performance of students in mathematics and their performance in physics?
2. What is the mean difference between male and female student's competence in mathematics and their achievement in physics?
3. What is the mean difference between students' competence in mathematics and their achievement in physics based on school type?

Hypotheses

1. There is no significant correlation between the performance of senior secondary students in mathematics and their performance in physics.
2. There is no significant relationship between student's competence in mathematics and their achievement in physics based on gender.
3. There is no significant relationship between senior secondary students' competence in mathematics and their achievement in physics based on school type.

Methodology

The study adopted a cross-sectional correlation design. The population for this study consisted of all SS II students offering physics in the 25 government approved educational secondary schools in Pankshin Local Government Area of Plateau state. The sample for the study consisted of five public and private secondary schools in Pankshin Metropolis, Plateau State. 87 students were drawn from the public school while 42 were from private schools. It also consisted of 129 SS II students out of which 60 are males and 49 females offering physics. The research instrument that was used in this study is the students second term SS2 results in mathematics and physics for 2023/2024 academic session for comparison. The instrument was validated and has a reliability coefficient of 0.592 and at 0.01 level of significant. The descriptive statistics (Mean, Standard Deviation and Variance) was used for answering the research questions, and Pearson Product Moment Correlation Coefficient (PPMC) was also used to treat the null hypothesis at 0.01 level of significance.

RESULTS

Research Question 1: What is the mean difference between the performance of students in mathematics and their performance in physics?

Table 1: Mean difference between the performance of students in Mathematics and their performance in Physics

Variables	N	Mean	Std. Deviation	Variance
Mathematics Scores	129	41.47	17.191	295.516
Physics Scores	129	37.22	14.542	211.457
Valid N (listwise)	129			

Hypothesis 1: There is no significant correlation between the performance of senior secondary students in mathematics and their performance in physics.

Table 2: Pearson Product Moment Correlation Coefficient of the Correlation between the Performance of Senior Secondary Students in Mathematics and Their Performance in Physics.

		Maths Scores	Physics Scores
Maths Scores	Pearson Correlation	1	.550**
	Sig. (2- tailed)		.000
	N	129	129
Physics Scores	Pearson Correlation	.550**	1
	Sig. (2- tailed)	.000	
	N	129	129

** Correlation is significant at the 0.01 level (2-tailed).

The result of table 1 indicates a mean score of 41.47 and standard deviation of 17.191 for students mathematics score as against a mean score of 37.22 and standard deviation of 14.542 for students' physics performance. This shows that students' performance in mathematics is higher than their performance in physics.

The correlation between students' academic performance in physics and their performance mathematics is given in Table 2. The result revealed that there is a positive correlation between students' academic performance in physics and their performance mathematics ($r = 0.550^{**}$, $df = 126$, $P \leq 0.01$). This indicates that there is a strong positive significant correlation between students' academic performance in physics and academic performance in mathematics, thus, the null hypothesis is rejected and the alternative hypothesis is accepted.

Research Question 2: What is the mean difference between male and female student's competence in Mathematics and their achievement in Physics?

Table 3: Mean difference between male and female students competence in Mathematics and their achievement in Physics

	N	Mean	Std. Deviation	Variance
Male Students MCT	70	29.87	16.525	273.070
Male Students PAT	70	25.56	11.570	133.873
Female Students MCT	59	29.51	13.558	183.806
Female Students PAT	59	24.85	14.120	199.373
Valid (listwise)	59			

Hypothesis 2: There is no significant relationship between student's competence in Mathematics and their achievement in Physics based on gender.

Table 3: The relationship between senior secondary students' competence in Mathematics and their achievement in Physics based on gender.

		MCT	PAT	Gender
MCT	Pearson Correlation	1	.632**	-.012
	Sig. (2-tailed)		.000	.893
	N	129	129	129
PAT	Pearson Correlation	.632**	1	-.028
	Sig. (2-tailed)	.000		.754
	N	129	129	129
Gender	Pearson Correlation	-.012	-.028	1
	Sig. (2-tailed)	.893	.754	
	N	129	129	129

**. Correlation is significant at the 0.01 level (2-tailed).

The result of table 3 shows a mean of 28.87 and 25.56 for both MCT and PAT respectively for male students and a standard deviation of 16.523 and 11.570 while a mean of 29.50 and 24.85 for both MCT and PAT respectively and a standard deviation of 13.558 and 14.120 respectively for female students. Although the mean score for male student's for both MCT and PAT is higher, but the difference is insignificance to draw conclusion. This indicates that students' competence in mathematics and their achievement in physics vary based on gender.

The correlation between students' competence in mathematics and their achievement in physics based on school type is given in Table 4. The result revealed that there is a negative correlation

between students' competence in mathematics and their achievement in physics based on gender (i.e. -.12 and -0.28 for MCT and PAT respectively). This indicates that there is a negative correlation between students' competence in mathematics and their achievement in physics based on gender. Thus, the null hypothesis is accepted.

Research Question 3: What is the mean difference between students' competence in mathematics and their achievement in physics based on school type?

Table 5: The mean difference between students' competence in Mathematics and their achievement in Physics based on school type

School Type		MCT	PAT
Public schools	Mean	26.90	20.51
	N	87	87
	Std. Deviation	14.387	9.926
Private schools	Mean	35.52	35.02
	N	42	42
	Std. Deviation	15.301	12.467
Total	Mean	29.71	25.23
	N	129	129
	Std. Deviation	15.183	12.753

Hypothesis 3: There is no significant relationship between senior secondary students' competence in mathematics and their achievement in physics based on school type.

Table 6: The relationship between secondary students' competence in Mathematics and their achievement in Physics based on school type.

Variables		MCT	PAT	School Type
MCT	Pearson Correlation	1	.632**	.267**
	Sig. (2-tailed)		.000	.002
	N	129	129	129
PAT	Pearson Correlation	.632**	1	.536**
	Sig. (2-tailed)	.000		.000
	N	129	129	129
School Type	Pearson Correlation	.267**	.536**	1
	Sig. (2-tailed)	.002	.000	
	N	129	129	129

** Correlation is significant at the 0.01 level (2-tailed).

The result of table 5 shows a mean of 35.52 and 35.02 for both MCT and PAT respectively and a standard deviation of 15.301 and 12.467 for private schools while a mean of 26.90 and 20.51 for both MCT and PAT respectively and a standard deviation of 14.387 and 9.926. The mean for both MCT and PAT for private schools is above the total mean score of 29.71 and 25.23. This indicates that students' competence in mathematics and their achievement in physics vary based on school type.

The correlation between students' competence in mathematics and their achievement in physics based on school type is given in Table 6. The result revealed that there is a strong positive correlation between students' students' competence in mathematics and their achievement in physics based on school type (i.e. .267 and .536 for MCT and PAT respectively). This indicates that there is a strong positive correlation between students' competence in mathematics and their achievement in physics based on school type. Thus, the null hypothesis is rejected and the alternative hypothesis is accepted.

Discussion

The findings of this study reveal significant insights into the performance of students in Mathematics and Physics in Pankshin LGA. The results indicate a notable difference in students' performance between the two subjects, with Mathematics showing a higher mean score and pass rate compared to Physics. This disparity aligns with previous research, which suggests that students often find physics more challenging due to its abstract concepts and the need for strong mathematical skills (Ogunleye & Babajide, 2022). The study also revealed negative relationship between students' competence in Mathematics and their achievement in secondary Physics based on gender; this implies that gender does not have any significant relationship between competence in Mathematics and achievement in Physics. This is related to factors like equal cognitive abilities, equity in education, motivation and effort self-confidence and self-efficacy among others. The study also revealed that there is a strong positive correlation between students' competence in

Mathematics and their achievement in Physics based on school type. This might be due to factors like funding and resources, selective admissions, professional development, parental involvement accountability and expectation in favour of private schools among others. This suggests that continuous professional development and training for teachers in effective teaching strategies are vital for improving students' academic outcomes (Ogunleye & Babajide, 2022). Schools should prioritize providing teachers with the necessary resources and support to implement innovative teaching practices.

Conclusion

This study provides valuable insights into the factors influencing students' performance in Mathematics and Physics in Pankshin LGA. The findings highlight the importance of effective teaching methodologies, positive student attitudes, and addressing socio-economic challenges. By implementing the recommended strategies, educational stakeholders can work towards improving academic outcomes and fostering a more equitable learning environment.

Recommendations

The study makes the following recommendations:

1. Schools should work on changing students' perceptions and attitudes towards mathematics and physics. This can be achieved by incorporating real-world applications of these subjects into the curriculum, organizing science fairs, and inviting professionals from STEM fields to speak to students. Encouraging a growth mindset and emphasizing the importance of effort and perseverance can also help improve students' attitudes and performance.
2. Female students should be given equal opportunity as their male counterpart to study science related carriers as they both exhibited the potential to excel in science.
3. Adequate resources are essential for effective teaching and learning. Schools should ensure that they are well-equipped with necessary instructional materials, such as textbooks, laboratory equipment, and digital tools. The government and educational stakeholders should invest in providing these resources to bridge the gap in resource availability.

References

Ado, I. B. & Edet, A. O (2020). Correlational study of mathematics and physics students' performance for 2015-2017 mock examinations: A case study of senior secondary two students in Ibesikpo Asutan LGA of Akwa Ibom State, Nigeria. *Academia Journal of Educational Research, 8*(5), 154-163.

Assem, H. D., Nartey, L., Appiah, E. & Aidoo, J. K. (2023). A review of students' academic performance in physics: Attitude, instructional methods, students' misconception and teachers' qualification. *European Journal of Education and Pedagogy*, *4*(1), 84-92.

Azunna, D. E., Igbokwe, U. J., & Nsirim, S. H. (2024). Physics teachers' qualification and students' academic performance in external examinations: A case study of senior secondary schools in Isiala-Ngwa North Local Government Area, Abia State, Nigeria. *IOSR Journal of Research & Method in Education (IOSR-JRME), 14*(3), 56-68.

Charles-Ogan G. I., & Francis O. I. (2017). Effects of Mathematics knowledge on Physics students' performance in electromagnetism. *International Journal of Theoretical and Mathematical Physics, 7*(4), 61-67.

Gambari, A. I., & Yusuf, M.O. (2017). Relative effectiveness of computer-supported jigsaw II, STAD and TAI cooperative learning strategies on performance, attitude and retention of secondary school students in physics. *Journal of Peer Learning, 10*(6), 76-94.

Ogunleye, A. O., & Babajide, V. F. (2022). Impact of teachers' qualification on students' performance in mathematics and physics in Nigerian secondary schools. *Journal of Education and Practice*, *13*(4), 45-58.