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SECONDARY SCHOOL STUDENTS' INTEREST IN MATHEMATICS AS A PREDICTOR OF THEIR INTEREST IN PHYSICS

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Abstract
The study examined secondary school students' interest in Mathematics as a predictor of their interest in Physics in Otukpo local government area of Benue State, Nigeria. The research was carried out in Otukpo local government area of Benue State, involving a population of 2,374 secondary school (SS) II students, (1453 males and 921 females) offering Physics in some selected secondary schools. A sample of 334 was selected randomly across public secondary schools in Otukpo Local Government Area. Two instruments, Students' Interest in Mathematics (SIM) and Students' Interest in Physics (SIP) were validated by three experts from the Department of Science Education and used to collect data. Reliability coefficients of SIM and SIP were 0.83 and 0.89 respectively. The data were analysed using simple regression analysis to address the research questions, while the null hypotheses were tested at the 0.05 level of significance using ANOVA within a multiple regression framework. Findings showed that students' interest in Mathematics is a predictor of their interest in Physics [$F(1, 332) = 27.903$, $p = 0.000 < 0.05$]. Finding also showed that male students' interest in Mathematics significantly predicts their interest in Physics [$F(1, 165) = 30.558$, $p = 0.000 < 0.05$]. However, female students' interest in Mathematics did not predict their interest in Physics [$F(1, 165) = 3.408$, $p = 0.067 > 0.05$]. It was therefore recommended that teachers should guide students to develop interest in mathematics as this could boost their interest in Physics.

Keywords: Mathematics Interest, Physics Interest, Secondary Education and Gender.

Introduction

Mathematics is the heart of science and technology, the development of science and technology depends largely on Mathematics, making it an essential foundation for innovation and scientific development (Salifu & Bakari, 2022). This is because all fields of science and technology depend on it for problem-solving, reasoning, predicting and evaluation. Competence in mathematics is crucial for everyday transactions, innovation, problem-solving, and informed decision-making. Kaur (2017) describes mathematics as the study of logic, deductions and applications. It can also be described as the science of number concerned with quantity, structure, space, and change. Mathematics is seen by society as the basis of scientific knowledge and is very important for the socio-economic development of

nations. Kaur (2017) states that today, mathematics is used throughout the world as an essential tool in many fields, including natural science, engineering, medicine, and the social sciences. Mathematics is used in every area, and it is concerned with application of mathematical knowledge to other fields, inspires and makes use of new mathematical discoveries and sometimes leads to the development of entirely new disciplines (Shou Reddy et al., 2018). Mathematics plays a vital role in preparing students for success in the 21st century and beyond.

Mathematical proficiency is necessary not just for jobs in the field of science, technology, engineering and mathematics (STEM) sectors but also for the development of analytical, problem-solving and critical thinking abilities that are transferable across professions. It could be in consideration of these and other vital uses of mathematics that the Federal Government of Nigeria made it a core and compulsory subject at all levels of education: from the lower basic education, through middle basic to upper basic and senior secondary schools, (Federal Ministry of Education [FME], 2023) Mathematics is also required for entrance into tertiary institutions for science and social science courses. As a result of its importance, the national policy mandates that the teaching and learning of Mathematics should be learner-centered, with practical and activity-based methods, thereby integrating Mathematics into the basic education curriculum to build foundational skills for national development (Federal Ministry of Education [FME], 2023).

Several studies (Anigbo and Ekene, (2016), Azmidar et al. (2017); Boadu & Boateng, 2024) consistently report students' declining interest in learning Mathematics at the Basic and Secondary school levels despite the relevance of Mathematics for the growth and development of nations., Azmidar et al. (2017) also said that students' declining interest towards Mathematics learning is that many students perceive Mathematics as abstract because it comprises of numbers, formulae and abstract theorems that are very difficult to understand, and they do not see the relevance of these numbers, formulae and theorems to their future aspirations.

Interest is the cognitive and affective tendency of an individual to seek to explore something or an object, which arises from the interaction between the individual and their environment (Guo & An, 2025). In this context, the interaction between students and Mathematics help to enhance their cognitive abilities, which in turn could foster deeper understanding of the subject since their interest in Mathematics could increase their affection towards learning it. At the senior secondary school level, students are expected to offer subjects in STEM, such as Physics, Chemistry and Biology. Physics focuses on the physical characteristics of matter and how it interacts with energy. It is a systematic study of knowledge that is the result of careful observation, measurement, and experimentation, with the goal of establishing fundamental laws and providing verifiable scientific justification for natural phenomena (Ibibo & Francis, 2017). On the other hand, Mathematics is often considered to provide the fundamental tools and concepts necessary to understand and solve complex physical problems; however, the level of mathematical ability possessed by students may vary significantly, and this could have a major impact on their performance in Physics. Since Mathematics and the natural sciences are intimately related, Mathematics serves as a language of science to communicate scientific observation, experimentation and conclusion (Omeodu, 2019). In other words, Mathematics is the precursor and it is at the

heart of science and technology, the indispensable single element in modern societal development. Students' level of interest in Mathematics may influence how they cope with STEM subjects, especially Physics. This is because concepts in Physics are often closely intertwined with a firm grasp of mathematical concepts, as both subjects share a symbiotic relationship. Some of the concepts in Physics such as force, motion, energy, gravitational fields, electricity and quantum physics are intricately connected to mathematics (Gill, 2025), indicating a relationship between Physics and Mathematics.

The relationship between Mathematics and Physics has been a subject of considerable interest in educational research. The integration of Mathematics and Physics is evident in various facets of the subjects from formulating equations to analysing data and solving complex problems (Deng et al., 2016). A systematic review identifies that Mathematics plays multiple roles in Physics education, such as physical reasoning, problem solving, modelling and experiments. Mathematics and Physics share a strong conceptual and procedural connection, with Mathematics often described as the language of Physics (Omeodu, 2019). There is substantial empirical evidence of a strong positive correlation between Mathematics and Physics performance, meaning students who excel in Mathematics typically perform better in Physics. This could be due to the fact that when students enjoy Mathematics, they are more likely to develop a positive attitude toward the quantitative and analytical aspects of Physics, rather than viewing it as an intimidating or overly abstract subject

The interconnectedness between these concepts in Physics and Mathematics is visible in the symbols used to represent them, such as Ω (omega), α (alpha), β (beta), π (pi), δ (delta) (Chin & Pierce, 2019). Students' interest in Mathematics could influence their interest in Physics, since Mathematical skills and understanding are essential for comprehending physical concepts and solving Physics problems. For instance, a student who has high interest in Mathematics may anticipate and approach Physics with greater confidence and engagement leading to higher possibility of understanding Physics concepts. This could positively influence how students apply Mathematical thinking to understand and learn Physics, ultimately influencing their overall learning behaviour. It is against this backdrop that the researchers carried out the study to determine if secondary school students' interest in mathematics can predict their interest in Physics.

Physics and Mathematics emphasis decision-making and problem-solving skills because their curricula have similar goals. In science education, physics assumes a paramount position, serving as a foundational discipline that equips learners with the knowledge needed to comprehend nature and its underlying laws. Many students believe that Physics is a demanding subject in secondary school, and that it becomes even more difficult as they progress into higher institutions (Ryan, 2013). Additionally, the author opined that symbolic expression of Physics concepts helps students understand Physics concepts more thoroughly and develops their procedural knowledge of how to relate different symbols when solving physics problems. Ryan (2013) further added that it is assumed that a student who excels in mathematics will also flourish in Physics.

A systematic review shows that Mathematics plays multiple roles in Physics education, such as physical reasoning, problem solving, modelling and experiments.

While several studies have established a positive correlation between students' performance in Mathematics and Physics (Mankilik & Yohanna, 2024; Chen et al., 2021; Badmus & Jita, 2023; Nfor et al., 2025), fewer have examined the role of interest as a linking factor. Ukoh (2025) found that while students' interest and attitudes significantly predicted Physics achievement, mathematical background was not a significant predictor, pointing to the potential influence of affective factors. Students often perceive some aspects of Physics as mathematically demanding (Ryan, 2013), and their interest in Mathematics may shape how confidently and willingly they engage with Physics content. As noted by the National Research Council (2012), it states that interest is a key motivator in STEM learning and career pathways, yet, studies like those by Anigbo and Ekene, (2016) and Boadu and Boateng (2024) highlight a continued decline in students' interest towards Mathematics and Mathematics-related subjects such as Physics in Nigeria. This continued lack of interest exhibited by students towards Physics due to the mathematical aspects of the subject and scientific symbols used to denote some concepts in the subject necessitated the need to carry out the study to examine the extent to which students' interest in Mathematics predicts their interest in Physics. Although from studies cited previously, researchers such as (Mankilik & Yohanna, 2024; Chen et al., 2021; Badmus & Jita, 2023; Nfor et al., 2025) have shown a correlation between students' interest and performance in Mathematics as related to their interest and performance in Physics, however, in terms of gender, some researchers have argued that male students tend to show more interest in Mathematics and Mathematics related subjects such as Physics compared to their female counterparts (Alazemi & Larkins, 2024; Iddrisu et al., 2023). These research findings indicates that the issue of gender and students' interest is controversial.

Gender is an important factor that can influence students' interest and academic performance in Mathematics and Physics (Omaga & Kpiranyam, 2026). Gender, according to World Health Organization, (2025) refers to the socially constructed roles, behaviours and attributes associated with males and females unlike sex which is biologically determined. The role of gender in shaping students' interest and success in Mathematics and related fields such as Physics has remained a controversial and topical issue amongst educationists and psychologists. Research studies carried out by Musbahu et al. (2020) and Al-Balushi et al. (2022) shows the influence of gender on students' interest and performance in Mathematics and Sciences while studies carried out by Astalini et al. (2022); Areo (2022); Akuso et al. (2024) and Musters et al. (2024) showed the influence of gender on students' interest and achievement in Physics. Reviews carried out showed that there has been relatively little research exploring the relationship between students' interest in Mathematics and in other related disciplines such as Physics. This gap is important because most previous studies examined mathematics achievement as a predictor of physics achievement, whereas limited evidence exists regarding whether students' affective disposition toward mathematics predicts their interest in physics among Nigerian secondary school students. It is against this backdrop that the researchers carried out this study to see if students' interest in Mathematics serves as a correlate of their interest in Physics.

The study is hinged on three theoretical frames, these are Self-Determination Theory by (Deci & Ryan, 2000), Social Cognitive Theory by (Bandura, 1986), and Interest Development Theory by (Hidi & Renninger, 2006). These theories states that when

students feel confident and interested in Mathematics, they are more likely to develop a similar interest in Physics. The relationship between students' interest in Physics and Mathematics may also be influenced by other factors such as teaching methods and the learning environment

Purpose of the Study

The specific objectives were to:

1. examine whether students' interest in Mathematics predicts their interest in Physics
2. find out if SS 2 male students' interest in Mathematics can predict their interest in Physics.
3. ascertain if SS 2 female students' interest in Mathematics can predict interest in Physics.

Research Questions

The following research questions guided the study:

1. What relationship exists between secondary school students' interest in Mathematics and their interest in Physics?
2. What is the relationship between secondary school male students' interest in Mathematics and their interest in Physics?
3. What is the relationship between secondary school female students' interest in Mathematics and their interest in Physics?

Hypotheses

The following null hypotheses were raised for the study with an α=0.05 level of significance

1. Secondary school students' interest in Mathematics does not significantly predict their interest in Physics.
2. Secondary school male students' interest in Mathematics does not significantly predict their interest in Physics.
3. Secondary school female students' interest in Mathematics does not significantly predict their interest in Physics.

Methodology

The research design chosen for the study is a cross-sectional study. The choice of this design is because data can be collected from many different individuals at a single point in time. In cross-sectional research, variables are observed without influencing them. This research design allows the researchers to get the views of many students across different schools, thus ensuring that the findings are comprehensive and generalisable. The population comprised 2374 Senior Secondary Two (SS 2) students (1,453 males and 921 females) offering Physics in selected secondary schools in Otukpo Local Government Area of Benue State, Nigeria (Teaching Service Board, Makurdi, 2026). A sample of 334 was randomly selected from 10 public secondary schools in Otukpo Local Government Area. The researchers constructed two instruments namely: Students' Interest in Mathematics (SIM) and Students' Interest in Physics (SIP) for data collection. Students' Interest in Mathematics (SIM) had two sections A and B. Section A sought information on students' gender while section B contained 30 items which sought information on students' interest in secondary school Mathematics. The instrument was structured on a four-point rating scale with Strongly Agree (4 points), Agree (3 points), Disagree (2 pints) and Strongly Disagree (1 point) for positively skewed items while negatively framed items were rated in reverse. Students' Interest in Physics (SIP) had two sections A and B.

Section A sought information on students' gender while section B contained 30 items which sought information on students' interest in secondary school Physics. The instrument was structured on a four-point rating scale with Strongly Agree (4 points), Agree (3 points), Disagree (2 pints) and Strongly Disagree (1 point) for positively skewed items while negatively framed items were rated in reverse. The instruments were validated by three experts, two from Science Education and one expert from Measurement and Evaluation. Reliability of SIM and SIP was determined using Cronbach Alpha which yielded reliability coefficients of 0.83 and 0.89 respectively. To collect data in the sampled schools, the researchers trained research assistants in the sampled schools who assisted in the distribution and collection of the questionnaires (SIM and SIP). Data collected were analysed using simple regression analysis for the research questions while the null hypotheses were tested at 0.05 level of significance using ANOVA of multiple regression analysis.

Results

The results are presented in tables according to the research questions and hypotheses.

Research Question 1

What relationship exists between secondary school students' interest in Mathematics and their interest in Physics?

Table 1: Regression Analysis between Secondary School Students' Interest in Mathematics and their Interest in Physics

Model	N	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	334	.278[a]	.078	.075	.72416

Table 1 shows the regression analysis of the relationship between secondary school students' interest in Mathematics and their interest in Physics. The correlation coefficient (R) value of 0.278 (27.8%) indicates a positive regression weight, suggesting that as students' interest in Mathematics increases, their interest in Physics tends to increase as well. The coefficient of determination (R^2) is 0.078. This implies that only 7.8% of the variation in students' interest in Mathematics explains the variability in their interest in Physics, indicating a relatively weak predictive relationship between the two variables.

Research Question 2

What is the relationship between secondary school male students' interest in Mathematics and their interest in Physics?

Table 2: Regression Analysis between Secondary School Male Students' Interest in Mathematics and their Interest in Physics

Model	N	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	334	.395[a]	.156	.151	.72759

Table 2 shows the regression analysis of the relationship between secondary school male students' interest in Mathematics and their interest in Physics. The correlation coefficient (R) value of 0.395 (39.5%) indicates a positive regression weight,

suggesting that as male students' interest in Mathematics increases, their interest in Physics also tends to increase. The coefficient of determination (R^2) is 0.156. This implies that 15.6% of the variation in male students' interest in Mathematics explains the variability in their interest in Physics, indicating a modest predictive relationship between the two variables.

Research Question 3

What is the relationship between secondary school female students' interest in Mathematics and their interest in Physics?

Table 3: Regression Analysis between Secondary School Female Students' Interest in Mathematics and their Interest in Physics

Model	N	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	334	.142[a]	.020	.014	.70414

Table 3 shows the regression analysis of the relationship between secondary school female students' interest in Mathematics and their interest in Physics. The correlation coefficient (R) value of 0.142 (14.2%) indicates a weak positive regression weight, suggesting a slight tendency for female students' interest in Physics to increase as their interest in Mathematics increases. The coefficient of determination (R^2) is 0.020. This implies that only 2.0% of the variation in female students' interest in Mathematics explains the variability in their interest in Physics, indicating a very weak predictive relationship between the two variables.

Hypothesis 1

Secondary school students' interest in Mathematics does not significantly predict their interest in Physics.

Table 4: ANOVA of Multiple Regression of the Relationship between Secondary School Students' Interest in Mathematics and their Interest in Physics

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	14.633	1	14.633	27.903	.000[b]
	Residual	174.102	332	.524		
	Total	188.735	333			

Table 4 reveals the relationship between secondary school students' interest in Mathematics and their interest in Physics. From Table 4, $F(1, 332) = 27.903$, $p = 0.000 < 0.05$. Thus, the null hypothesis that secondary school students' interest in Mathematics does not significantly predict their interest in Physics is rejected. This means that students' interest in Mathematics significantly predicts their interest in Physics, although the predictive strength is relatively low, as indicated by the earlier R^2 value of 0.078. The implication is that increasing students' interest in Mathematics may lead to a slight increase in their interest in Physics,

but other factors largely influence their interest in Physics.

Hypothesis 2 Secondary school male students' interest in Mathematics does not significantly predict their interest in Physics.

Table 5: ANOVA of Multiple Regression of the Relationship between Secondary School Male Students' Interest in Mathematics and their Interest in Physics

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	16.177	1	16.177	30.558	.000[b]
	Residual	87.349	165	.529		
	Total	103.526	166			

Table 5 reveals the relationship between secondary school male students' interest in Mathematics and their interest in Physics. From Table 5, $F(1, 165) = 30.558$, $p = 0.000 < 0.05$. Thus, the null hypothesis that male students' interest in Mathematics does not significantly predict their interest in Physics is rejected. This means that male students' interest in Mathematics significantly predicts their interest in Physics. Male students who show greater interest in Mathematics are more likely to have higher interest in Physics, though other factors also contribute to their interest.

Hypothesis 3
Secondary school female students' interest in Mathematics does not significantly predict their interest in Physics.

Table 6: ANOVA of Multiple Regression of the Relationship between Secondary School Female Students' Interest in Mathematics and their Interest in Physics

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	1.690	1	1.690	3.408	.067[b]
	Residual	81.809	165	.496		
	Total	83.499	166			

Table 6 reveals the relationship between secondary school female students' interest in Mathematics and their interest in Physics. From Table 6, $F(1, 165) = 3.408$, $p = 0.067 > 0.05$. Thus, the null hypothesis that female students' interest in Mathematics does not significantly predict their interest in Physics is retained. This means that female students' interest in Mathematics does not significantly predict their interest in Physics. By implication, Female students' interest in Mathematics alone is not a strong predictor of their interest in Physics, suggesting that other factors likely influence their interest in Physics more strongly.

Findings and Discussion of the Results

These findings reflect the deeply intertwined nature of STEM disciplines, where Mathematics often serves as the foundational language for Physics. The predictive dynamics between interest in these subjects, especially concerning gender, are discussed below:

The overall finding that a student's interest in Mathematics predicts their interest in Physics at R= 0.278 (27.8%) indicates a positive regression weight which aligns with established educational theories of Deci and Ryan, (2000) and Hidi and Renninger, (2006). Physics relies heavily on mathematical skills such as algebra, geometry, graphing, and calculus to describe natural phenomena. When students enjoy Mathematics, they are more likely to develop a positive attitude toward the quantitative and analytical aspects of Physics, rather than viewing it as an intimidating or overly abstract subject.

The finding that male students' interest in Mathematics predicts their interest in Physics at R = 0.395 (39.5%) highlights the cognitive and psychological reliance males may have on formal logic and quantitative skills to engage with scientific concepts. In many educational environments, boys often exhibit higher confidence levels in quantitative problem-solving. This confidence facilitates a seamless transition from enjoying mathematical equations to applying those same analytical processes to Physics topics (e.g., mechanics and electromagnetism). This is in agreement with findings by Musbahu et al. (2020) and Musters et al. (2024) who states that male students often show higher interest and confidence in Mathematics and Physics especially at the higher Education level. This interest and confidence could be influenced by societal perception and self-confidence.

Findings from hypothesis three shows that female students' interest in Mathematics does not significantly predict their interest in Physics at R value of 0.142 (14.2%). The gender disparity here is that female students' mathematical interest does not significantly translate into an interest in Physics. This is a common phenomenon explored in educational research. Several factors typically contribute to this finding:

• Female students frequently report high mathematical ability but suffer from lower self-efficacy regarding their Physics capabilities, causing them to dissociate the two disciplines.

• Physics in secondary schools is frequently taught with highly abstract, male-centric, or decontextualized examples. Even if female students enjoy the logical structure of mathematics, the presentation of Physics may fail to capture their interest or show its relevance to their lives.

• Long-standing cultural stereotypes can lead female students to view Physics as a masculine domain, causing an interest-shift or loss of confidence despite strong mathematical, implying that other factors such as culture, environmental factors and societal factors could likely influence their interest in Physics. This is in agreement with findings by Areo (2022); Akuso et al. (2024) and Musters et al. (2024) who showed that female students' interest in Mathematics is not a determinant of their interest in Physics but societal expectations of females.

The statistical findings provided highlight a crucial dynamic in STEM education: while a foundational connection between mathematics and physics exists for secondary school students, it is heavily moderated by gender. For male students, mathematical interest acts as a gateway to physics, whereas female students view or engage with physics independently of their mathematical disposition. These findings carry significant curricular implications for educational stakeholders, curriculum developers, and classroom teachers. The implications include the following:

i. Curriculum designers should align mathematics and physics syllabi so that prerequisite mathematical concepts (e.g.,

algebra, trigonometry, vectors, or basic calculus) are taught right before they are applied to physical principles (e.g., mechanics or wave motion).

ii. The physics curriculum should be restructured to lead with conceptual understanding, real-world relevance, and qualitative reasoning, rather than introducing topics exclusively through intense mathematical abstraction.

iii. In assessing students, teachers should move away from assessments that score physics proficiency purely on numerical calculation. Examination should include balanced grading for experimental design, graphical analysis, and verbal explanations.

Conclusion and Recommendations

Based on the findings from the study, it was concluded that students' interest in Mathematics is a predictor of their interest in Physics.

It is therefore recommended that:

1. Students should be encouraged to develop interest in Mathematics as this can help boost their interest in Physics. This can be done through the use of innovative teaching strategies that also encourage inclusivity.
2. Parents, society should encourage and support female students' learning of mathematics as this will make more female students develop interest in Physics encouraging more female students' participation in Physics.
3. Curriculum planners should integrate explicit mathematical modeling exercises into the physics curriculum, thereby, allowing male students who enjoy mathematics to see physics as the ultimate playground for their mathematical skills.
4. Textbook writers should embed the contributions of diverse female physicists into the curriculum text to help female students build a stronger physics identity separate from their identity as mathematicians.

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