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CORRELATION BETWEEN SECONDARY STUDENTS' MATHEMATICAL SKILLS AND ACADEMIC PERFORMANCE IN CHEMISTRY IN RIVERS STATE, NIGERIA

By

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Abstract
The study investigated the relationship between students' mathematical skills and their performance in chemistry. Two objectives guided the study. The research was correlational in nature because it sought for relationship between variables of the study. Expo facto research design employed because the event had already taken place. The population of the study consisted of all the two thousand one hundred and sixteen (2,116) senior secondary two (SS2) chemistry students in senior secondary coeducational public schools in Port Harcourt L.G.A of Rivers Sate, Nigeria. The purposive sampling technique was used to draw a sample of two hundred and thirty six (236) SS2 chemistry students from the population. Mathematics Performance Score Inventory (MPSI) and Chemistry Performance Score Inventory (CPSI) were the instruments used to collect data. The mathematics scores and chemistry scores of each sample student were obtained from the examination and records unit of the sample schools. The mathematics and chemistry scores of students were correlated. Pearson Product Moment Correlation (PPMC) was used to run analysis at .05 probability level. The result showed that there was a positive, moderate and significant relationship (r = 0.68, p,.05) between students' mathematical skills and their performance in chemistry. The result also showed that there was a positive, moderate and significant relationship (r = 0.61, p<.05) between the female students' mathematical skills and their performance in chemistry. Based on the findings it was recommended amongst others that the mathematical skills of chemistry students should be developed to help boost their performance in chemistry.

Keywords: Chemistry, Mathematics, Performance, Relationship, Student.

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Introduction

Mathematics is a subject that is utilized for its own intrinsic and applicative values in the real-world. The applicative value of mathematics according to Kulbir (2006) is the utilization of mathematics concepts to solve problems in areas outside of mathematics. This may suggest why Charles-Ogan and Otikor (2016) stated that one nature of mathematics is that it is a utility subject. The utility of mathematics refers to the practical applications of mathematical knowledge, concepts, skills, techniques and methods in our day to day activities,be it at home, work place, school, business, market or religious arena. The knowledge of mathematics can be applied everywhere we find ourselves. Solving real-world problems lay credence to mathematical skills which may be of high or low degree. Mathematics helps one to make sense of problems that erupt and make informed decisions. Mathematics was initially invented to solve problems in the sciences and trade but gradually its application delved into every activity of man.

According to Bhanu (2019), mathematics holds a crucial role in the broader educational curriculum. It serves as a foundation for cultivating students' mental discipline, enhancing their logical reasoning abilities, and fostering mental rigor, all of which are essential for solving problems both within and beyond the realm of mathematics. Additionally, a solid grasp of mathematics is vital for comprehending the material in various other academic subjects, including physics, chemistry, computer science, biology, agriculture, technical drawing, economics, music, and art.

Chemistry is the scientific discipline dedicated to investigating the properties and behavior of matter. As a natural science, it focuses on the elements that form matter, which can manifest as compounds consisting of atoms, molecules, and ions. Therefore, the essence of studying chemistry lies in understanding the composition, structure, properties, behavior, and the transformations matter undergoes during interactions with other substances. The study of chemistry entails the theoretical and practical aspects. Computation which requires mathematical skills is very necessary in both theoretical and practical chemistry. Chemistry has a bit of mathematics (Akan, 2022). There are certain aspects of chemistry that can be better handled with the aid of mathematical knowledge. This makes it imperative for every chemistry student to have the knowledge of basic mathematicsthat can be employed to address most problems in chemistry that require the application of mathematics. Students who study chemistry ought to be comfortable with basic mathematics concepts to comprehend and solve chemistry related problems.

Ubang (2021) opined that chemistry students need a good understanding of basic mathematical concepts to succeed in chemistry pursuit. Observations, measurements, data handling, numerical calculations, problem-solving and analysis are some of the skills that chemistry students require for a deep understanding of chemistry. All the aforementioned are mathematical skills which students need to solve problems in chemistry. Students need to acquire competences in the appropriate mathematical areas. To this end, it is important to note that the mathematical skills will be applied in the context of chemistry but the basic understanding of the mathematics skills is pre-requisite.

Gordon (2021) asserted that mathematics is widely used in chemistry and absolutely necessary for the exploration of important concepts in chemistry. This indicates that basic mathematics skills and processes are the pre requisite for all the calculations that are involved in the pursuit of chemistry. It is noteworthy to state that in the study of chemistry students should be prepared to deal with concepts and theories of chemistry as well as the application of basic knowledge of mathematics where necessary. Mathematical skills are required in

chemistry for problem-solving in particular. It is mathematical skills that will make students to understand and come to terms with chemical principles, such as chemical bonding, acid-base chemistry and electrochemistry.

Chemists use equipment such as weighing balances, burette, pipette, conical flask, stop watch during experiment in the laboratory. In the course of measurements errors may occur. Also, in dimensional analysis, units can be converted from one unit to another using proper conversion factors. The numerical value of measured units can be subjected to significant values during computation. Formulae are also employed in chemistry and the balancing of chemical equations. All these activities and many more that take place in chemistry all require the knowledge of mathematics. It's no surprise that Malkevitch (2022) emphasized the partnership between mathematics and chemistry in enhancing our understanding of the world.

Mathematics and chemistry have a deeply interconnected relationship. Mathematics provides a powerfultool for students who study chemistry in order to describe and analyze chemical structures, reaction, and processes. Many concepts in chemistry are inseparable from mathematics (Anchen & Ying, 2022). Mathematics provides a language and tools for chemists to understand, describe, and predict chemical phenomena, making it an essential component of chemistry research and applications. The following are some of the areas in chemistry that mathematical skills can be applied:

1. Quantum Mechanics: Mathematical equations, such as Schrodinger's equation, describe the behavior of electrons in atoms and molecules, allowing chemists to understand chemical bonding and reactivity.
2. Stoichiometry: Mathematical calculations enable chemists to balance chemical equation, predict reaction yields, and determine the amounts of reactants required.
3. Thermodynamics: Mathematical equations describe the energy changes and equilibrium constants of chemical reactions, helping chemists understand chemical systems and their properties.
4. Kinetics; Mathematical models describe the rates of chemical reactions, allowing chemists to understand how reactions occur and how to optimize reaction conditions.
5. Computational Chemistry: Mathematical models and simulations predict molecular properties, reaction outcomes, and material behavior, enabling chemists to design new molecules and materials.
6. Data Analysis: Statistical methods and machine learning algorithms help chemists analyze large datasets, identify patterns, and make predictions.
7. Spectroscopy: Mathematical algorithms analyze data from spectroscopic techniques such as NMR and IR, to determine molecular structures and properties.

Mathematical skills play a crucial role in students' academic performance in chemistry, as they are essential for understanding various chemical concepts and principles. Orimogunje (2018) conducted research investigating how mathematics skills correlate with the academic performance of senior secondary school chemistry students. The study revealed a notable distinction in the chemistry performance between students who had been exposed to mathematical skills and those who had not.Ayeni et al. (2024) discovered through their research that a strong grasp of mathematics positively impacts students' performance in chemistry. Additionally, they identified a significant positive correlation between students' performance in mathematics and their performance in chemistry. Konduon et al. (2019) uncovered in their research that a noteworthy positive correlation existed between students' achievements in mathematics and their performance in chemistry.Could this be the reason mathematics is tagged the queen of all science and the gateway to all science?

Statement of the Problem

Despite the crucial role of mathematics in understanding chemical concepts and principles, many secondary school students struggle to apply mathematical skills in chemistry, leading to poor performance in the subject. Secondary school students' struggles in chemistry are often attributed to a lack of understanding of chemical concepts and principles, but a crucial factor that is frequently overlooked is the role of mathematics knowledge in chemistry learning. Despite the inherent mathematical nature of chemistry, many students lack interest in the subject. However, the specific relationship between mathematics knowledge and their performance in chemistry remains unclear, with limited research investigating the extent to which mathematics skills impact students' understanding and achievement in chemistry. This study therefore, was aimed to address this knowledge gap by investigating the relationship between secondary school students' mathematics skills and their performance in chemistry.

Aim and Objectives of the Study

The aim of this study was to find out the relationship between students' mathematics skills and chemistry performance. The objectives of the study were to:

1. Determine the relationship between the mathematical skills of students and their performance in chemistry
2. Ascertain the relationship between the mathematical skills of the female students and their performance in chemistry.
3. Determine the relationship between the mathematical skills of the male students and their performance in chemistry.

Research Questions

1. What is the relationship between the mathematical skills of students and their performance in chemistry?
2. What is the relationship between the mathematical skills of the female students and their performance in chemistry?
3. What relationship exist between the mathematical skills of the male students and their performance in chemistry?

Hypotheses

H_{O1}: There is no significant relationship between the mathematical skills of students and their performance in chemistry.

H_{O2}: There is no significant relationship between the mathematical skills of the female students and their performance in chemistry.

H_{O3}: No significant relationship exist between the mathematical skills of the male students and their performance in chemistry.

Methodology

The study was correlational in nature since the variables under study sought for relationship. The research design employed for this study was expo facto since the events had already happened. The researchers neither conducted any experiment nor manipulate/control variables of the study. The population of the study consisted of all the two thousand one

hundred and sixteen (2,116) senior secondary two (SS2) chemistry students in senior secondary coeducational public schools in Port Harcourt L.G.A of Rivers Sate, Nigeria. The purposive sampling technique was used to draw a sample of two hundred and thirty six (236) SS2 chemistry students from the population.

The two instruments that were used to collect data were the Mathematics Performance Score Inventory (MPSI) and the Chemistry Performance Score Inventory (CPSI). The instruments were used to record the mathematics and chemistry performance scores of the students. MPSI and CPSI were subjected to face and content validity. The two instruments were validated by two mathematics teachers and two chemistry teachers in the sample schools. The reliability of the two instruments, MPSI and CPSI, were ascertained with the use of Kuder Richardson Formula 21 (KR-21). The reliability coefficients were 0.81 and 0.78 for MPSI and CPSI respectively.

Data for the study was collected from the various sample schools by the researchers and the help of two research assistants. The mathematics scores and chemistry scores of each sample student were obtained from the examination and records unit of the sample schools. These scores were carefully recorded in MPSI and CPSI against each student. Only sample students that have both mathematics and chemistry scores were used for the analysis.Pearson Product Moment Correlation (PPMC) was used to run analysis at .05 probability level.

Results

Table 1: Correlation between students' mathematical skills and chemistry performance

Variable	Mean	SD	N	df	R	p-value	Decision
Mathematical Skills	73.51	15.30					
			236	235	0.68	0.00	Significant
Chemistry Performance	68.34	12.68					

Table 1 showed that there was a positive and moderate relationship (r = 0.68) between students' mathematical skills and their performance in chemistry. Table 1 further revealed that there was a significant relationship (p = 0.00, p <0.05) between the mathematical skills of students and their performance in chemistry. H_{O1} was therefore, rejected.

Table 2: Correlation between female students' mathematical skills and chemistry performance

Variable	n	Mean	SD	df	r	p-value	Decision
Mathematical Skills	236	76.41	12.64				
				235	0.61	0.02	Significant
Chemistry Performance	236	71.04	15.93				

Table 2 showed that there was a positive and moderate relationship (r = 0.61) between the female students' mathematical skills and their performance in chemistry. Table 2 further revealed that there was a significant relationship (p = 0.02, p <0.05) between the mathematical skills of the female students and their performance in chemistry. H_{O2} was therefore, rejected.

Table 3: Correlation between male students' mathematical skills and chemistry performance

Variable	n	Mean	SD	df	r	p-value	Decision
Mathematical Skills	236	70.61	13.85				
				235	0.64	0.00	Significant
Chemistry Performance	236	65.64	15.23				

Table 3 showed that the relationship between the male students' mathematical skills and their performance in chemistry was positive and moderate (r = 0.64). Furthermore, table 3 revealed that there was a significant relationship (p = 0.00, p <0.05) between the mathematical skills of the male students and their performance in chemistry. H_{O3} was therefore, rejected.

Discussion of Findings

The result in table 1 showed that r-value was 0.68 which indicated that there was a positive and moderate relationship between students' mathematical skills and their performance in chemistry. This implies that the higher the mathematical skills of students' the higher their performance in chemistry. An increase in students' mathematical skills leads to an associated increase in their chemistry performance. Also, a decrease in students' mathematical skills leads to an associated decrease in their chemistry performance. Table 1 further revealed that there was a significant relationship (p = 0.00, p <0.05) between the mathematical skills of students and their performance in chemistry. This result is in agreement with results of Ayeni et al. (2024); Konduon et al. (2019) and Orimogunje (2018) whose results showed that there is a significant positive relationship between the performance of students in mathematics and chemistry.

The second finding of this study which is in table 2 showed that there was a positive and moderate relationship (r = 0.61) between the female students' mathematical skills and their performance in chemistry. This result indicated that the higher the mathematical skills of the female students' the higher their performance in chemistry. Increase in female students' mathematical skills leads to an associated increase in their chemistry performance. Also, a decrease in the female students' mathematical skills leads to an associated decrease in their chemistry performance. Table 2 further revealed that there was a significant relationship (p = 0.02, p <0.05) between the mathematical skills of the female students and their performance in chemistry. This outcome aligns with the findings of Kanu and Abel (2021), indicating a substantial positive correlation between the mathematical abilities of female students and their academic performance in both chemistry and physics.

Table 3 showed that the relationship between the male students' mathematical skills and their performance in chemistry was positive and moderate (r = 0.64). This result indicated that as the mathematical skills of the male students' goes higher, it leads to higher performance in chemistry. Increase in male students' mathematical skills leads to a concomitant increase in their chemistry performance. Also, a decrease in the male students' mathematical skills leads to a concomitant decrease in their chemistry performance. Table 3 further revealed that there was a significant relationship (p = 0.00, p <0.05) between the mathematical skills of the male students and their performance in chemistry. This result agrees with that of Zubina (2020); Uruang (2019).

Conclusion

The findings of this study were used as the anchor to conclude that there is a significant moderate positive correlation between students' mathematical skills and their performance in chemistry. The correlation between female students' mathematical skills and chemistry performance was also moderate, positive and significant. The correlation between male students' mathematical skills and chemistry performance was also moderate, positive and significant.

Recommendations

The recommendations were as follows based on the findings of the study:

1. The mathematical skills of chemistry students should be developed to help boost their performance in chemistry.
2. The male chemistry students should be encouraged in addition to developing their mathematical skills, to also develop their chemical knowledge since the relationship was moderate.
3. The male chemistry students should also be encouraged to have mastery of chemistry concepts because it requires the partnership of both chemical and mathematical knowledge to excel in chemistry.

References

Akan, S. H. (2022). *Introductory chemistry.* Parlance Publishers

Anchen, C., & Ying, Z. (2022). Mathematics learning performance: Its correlation with chemistry learning performance. https://ejournal.radenintan.ac.id

Ayeni, A., A., A., Adejare, A., Oladipupo, D., Aderinkola, D. A., Adeoti, O.O., & Ajao, L. (2022). Correlation of students' performance in mathematics and chemistry among senior secondary school students in Oyo East Local Government Area of Oyo State. *Abacus (Mathematics Education Series), 47*(1),116-124. https://www.researchgate.net>370

Bhanu, N. (2019). Why is math important in the overall curriculum? https://www.linkedin.com>pulse

Charles-Ogan, G. I., &Otikor, M.S. (2016). Practical utility of mathematics concepts among senior secondary school students in Rivers State. *European Journal of Mathematics and Computer Science, 3*(1),15-22. https://www.idpublications.org

Gordon, E. (2021). The mathematics of chemistry. https//chem.libretexts.org

Kanu, L., &Abel, U. D. (2021). Correlation between students' mathematics knowledge and performance in chemistry. *Journal of Education Growth, 6*(2), 278-283.

Konduon, A., Tartenger, T.T., Agbidye, A., &Enemariae, V. (2019). Chemistry students' mathematics ability as correlate to their performance in senior secondary school examination. *Education Review Letters, 4*(12),6. https://www.researchgate.net>355

Kulbir, S. S.(2006).*The teaching of mathematics.* Sterling Publishers Private Ltd.

Malkevitch, J. (2022). Mathematics and chemistry: Partners in understanding our world. http://www.ams.org>feature.column

Orimogunje, T. (2018). Mathematics skills as predictor of chemistry students' performance in senior secondary schools in Akoko-South LGA of Ondo State Nigeria. https://doi.org/10.31686/ijier.vol6.iss7.1101

Ubang, E.E. (2021). *A first course in chemistry*. Bramen Books Ltd.

Uruang, S. A. B. (2019). Mathematics ability and chemistry performance of students: The correlation. *Journal of Review in Education, 1*(1), 21-29.

Zubina, R. (2020). Relationship between students' mathematical knowledge and chemistry performance in tertiary institution. *The Science Teacher, 3*(2),62-75.