EFFECTS OF MATHEMATICS KNOWLEDGE ON CHEMISTRY STUDENTS' ACADEMIC PERFORMANCE IN GAS LAW

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ABSTRACT

The study investigated the effects of mathematics knowledge on chemistry students' academic performance in gas law. The study used Ex-post facto design. A sample of 47 (male 26: female 21) senior secondary two (SS2) science students were purposively selected from Ignatius Ajuru University Demonstration secondary school Ndele in Emohua local government area of Rivers State. Data was obtained through a Test of Mathematics Knowledge in Chemistry Calculation Test (MKCCT) designed by the researchers. The reliability coefficient index r = 0.76. Mean scores were used in answering the research questions while t-test was employed in testing the hypotheses. The findings revealed that there is a significant difference between the mean performance of mathematics high and low achievers in chemistry. No significant gender difference between the mean performance of mathematics inclined students to chemistry. Based on the findings, it was recovered that Mathematics based courses should be taken by training teachers on chemistry to enable them understand the connection between mathematics and chemistry.

Keywords: Mathematics knowledge on chemistry, students' academic performance, gas law.

INTRODUCTION

Mathematics is a branch of knowledge that deals with measurement, numbers, and quantities. It is a tool in which its knowledge and skills are the bedrock of all societal transformation and transfer of ideas into reality (Otunu-ogbisi, 2009). It is a creation of human mind concerned mostly with ideas, processes, and reasoning. Mathematics expresses itself everywhere, in almost every facet of life - in nature all around us, and in the technologies in our hands.

According to Osofechinti in Odili (2006), the importance of mathematics to individuals in their daily undertaking is so enormous that the knowledge of mathematics is an indispensable tool for a successful and balanced human existence on earth. Mathematical knowledge plays a crucial role in understanding the contents of other school subjects such as science like chemistry, social studies, and even music and art. It is the language, as well as tools of science and engineering - describing our understanding of all that we observe. It is applied in various fields and disciplines like mathematical concepts and procedures are used to solve problems in science, engineering, medicine, economics, chemistry and so on.

On the other hand, chemistry is a natural science which studies composition, structure, properties and change of matter. Chemistry branches into several topics of which the researcher's concern is gas laws. This relates pressure, volume, and temperature of a sample of gas. Gas law is one of the most popular topics in senior secondary school chemistry, as well as a crucial part of a student's chemistry education, and it comes with the content of the chemical world and taught in senior secondary one (SS1). The Ideal gas law studied at this

level is simply the combination of all simple Gas Laws: Boyle's Law, Charles' Law, and Avogadro's Law. The ideal gas law can be viewed as arising from the kinetic pressure of gas molecules colliding with the walls of a container in accordance with Newton's laws. The relationship between pressure, temperature, and volume of a given sample of gas is represented with the formula PV= nRT, where P is pressure in pascals and V is a volume of L and n is the number of moles of the molecules and R is the Ideal gas constant and T is the temperature in kelvins. This law holds true for any sample of gas. Hammar (2013) noted that students have a difficult time understanding some of the basic concept of pressure, temperature and volume and this compounding the issue with the struggle in mathematics associated with gas law concepts.

Mathematical calculations are absolutely necessary to explore important concepts in chemistry. Without some basic mathematical skills, calculations in chemistry are made extremely difficult especially with concepts and theories in chemistry. Mathematics is widely used in chemistry as well as all other sciences. Odili, (2006) posits that achievement in sciences is often contingent upon mathematics knowledge and the ability to perform mathematical operations, concepts and procedures are used to solve problems in various fields and disciplines including chemistry. According to Etukodo and Nnaobi (2002), the place of mathematical skill in teaching chemistry for sustainable development should be emphasized, as the lack of requisite mathematical skills makes it impossible to produce chemistry graduates from diverse educational programs that can fit effectively into the world of work or accurately apply what they have learned to real-life problems. Salau (2000) points out that there exists an impregnable link between mathematics and other science subjects. For example, the teaching of the practical aspect of chemistry can hardly be achieved without the knowledge of mathematics. Science applies both simple and complex mathematical concepts, such as measuring a number of chemicals to use in a solution. Ingle and Turner in Odili (2006) in their study of mathematics and chemistry at the ordinary level argued that the pattern of thought used in expressing some scientific concepts is identical to that used in some particular mathematical concepts. Algebra is used by Biologists and chemists to figure out how much of different compounds they can mix together in making their reactions. Mathematics is used by chemists to know the rate at which two substances react with one another as well as to understand the products of a chemical reaction. In Chemistry, Mathematics is used to find relationships between hypothesis and data, relationships between chemical reactants and reactions, relationships between electrons and energy, relationships between ingredients and composition, to name a few.

There is no doubt about the notion that chemistry is abstract in nature, its abstract nature brings about learning difficulty most especially in the mathematical aspect of chemistry. Observations have shown that in spite of the various innovations introduced into science teaching and chemistry, in particular, the performance of students still remains low (Fatoke, 2013).

Statement of the Problem

Chemistry is one of the core subjects for students with science bias in secondary school from senior secondary two (SS2) to senior secondary three (SS3). As a subject, it is required for certification at the secondary level for admission into a higher institution in the field of science, engineering, and medicine. Students seem to have a challenge with chemistry especially in the aspect of calculation and this has affected their performances. Therefore, this study “effects of mathematics knowledge on chemistry students’ academic performance in

gas law" seeks to investigate these problems with a view to improving the performance of students in calculations in chemistry.

Aim and Objectives of the Study

The aim of the study is to investigate the effect of student's ability to transfer mathematics knowledge into an aspect of chemistry. Specifically, this study sought:
1. To determine the difference between the mean scores of mathematics high and low achievers in chemistry.
2. To examine if there is any gender difference in the mean performance of mathematics inclined students in chemistry.

Research Questions

The following research questions guided the study:
1. What is the difference between the mean scores of mathematics high and low achievers to their performance in chemistry?
2. What is the gender difference between the mean performance of mathematics inclined students in chemistry?

Hypotheses

1. There is no significant difference between the mean scores of mathematics high achievers and low achievers in chemistry.
2. There is no significant gender difference in the mean performance of mathematics inclined students in chemistry.

Methodology

The ex-post facto design was used for the study. The population of the study consisted of all senior secondary students of Ignatius Ajuru University Demonstration secondary school Ndele in Emohua local government area of Rivers State. A sample of 47 (male 26: female 17) senior secondary two (SS2) science students was purposively selected from Ignatius Ajuru University Demonstration secondary school Ndele.

Research Instrument

The instrument used was a questionnaire designed by the researchers to determine the effect of mathematics knowledge on chemistry on senior secondary school students' performance in Gas law. The instrument was Mathematics Knowledge in Chemistry Calculation Test (MKCCT).

Validation of the Instrument

The face and content validity of the achievement tests (instrument) was established by presenting the test questions to the experts in the department of Curriculum Studies and Educational Technology, Faculty of Education, the University of Port Harcourt for appraisal. Comments made by the experts were taken into consideration and the necessary modification and correction were made before the production of the final copy that was administered.

Reliability of the Instrument

The reliability of the instrument was established through the application of Pearson Product Moment coefficient as a measure of the internal consistency. This was done by administering the test to a sample of 40 senior secondary students selected outside the target sample, then Pearson Product Moment coefficient used to calculate the reliability coefficient of the test, which was 0.76.

Administration of the Research Instrument

The structured test was administered on a whole-class by the researcher, with permission from the principal of the school; the students were brought together and allowed to use the classroom where they responded to the test items. Test directions were read aloud for each type of item in the classrooms to minimize the possibility that reading level would affect performance. The researcher met with the mathematics teacher and got the scores of students in mathematics. Using the data, the researcher was able to determine the number of mathematics high achievers and low achievers and used it as a basis for determining its effect on their performance. Copies of the test were administered to the students and retrieved upon completion.

Data Analysis

Research questions were answered using descriptive statistics means (and standard deviation), while t-test was used to determine the statistical significance of the research hypotheses at 0.05 level of significance.

Table 1: Distribution of subjects into independent variables subgroups

Independent variables	Subject sample	Subgroup	N	% of the total
Mathematics knowledge ranking	47	High Achievers	28	59.57
		Low Achievers	19	40.43
Gender difference	47	Male	26	55.32
		Female	21	44.68

The table above shows the distribution of independent variables into subgroups. Out of 47 Students, 28 are ranked high achievers and 19 ranked low achievers in mathematics. There were 26 male and 21 female.

Research Question 1: What is the difference between the mean scores of mathematics high achievers and low achievers performance in Chemistry?

Table 2: Mean and standard deviation of chemistry achievement test based on mathematics knowledge

Mathematics knowledge	N	Mean	SD
High achievers	29	7.83	2.575
Low achievers	18	2.83	3.129

Table 4.2 shows the mean performance of students in Chemistry achievement test based on their knowledge of mathematics. Students who ranked high in mathematics performed better than those who ranked low.

Research Question 2: What is the gender difference between the mean the performance of mathematics inclined students in chemistry?

Table 3: Mean and standard deviation of chemistry achievement test based on gender Difference

Gender difference	Subgroup	N	Mean	SD
Female	Above average	13	7.92	1.62
	Below average	8	3.38	0.69
Male	Above average	16	7.75	1.44
	Below average	10	2.40	0.92

Table 3 shows the mean performance of students in chemistry achievement test based on gender difference. Out of 21 female students who sat for the test, 13 scored above average while 8 scored below average. 26 male sat for the test, 16 scored above average and 10 scored below average. The mean performance of female and male students who scored above average were (7.92, 7.75) and (3.38, 2.40) for students who scored below average respectively.

Hypothesis 1. There is no significant difference between the mean scores of mathematics high achievers and low achievers in chemistry.

Table 4 t-test analysis of Chemistry test scores based on mathematics high and low achievers.

Mathematics knowledge	N	Mean	SD	t-cal	t-crit
High achievers	29	7.83	2.575	18.38	2.02
Low achievers	18	2.83	3.129		

df=45

The independent t-test analysis of Hypothesis 1 indicates that the calculated t value of 18.38 is greater than the critical t value of 2.02 at 45 degrees of freedom and 0.05 alpha level of significance. The null hypothesis is therefore rejected. The result in table 4.4 shows that there is a significant difference in the mean performance of mathematics high and low achievers in chemistry. Students who were ranked as high achievers in mathematics performed better in chemistry test than those who were ranked as low achievers.

Hypothesis 2. There is no significant gender difference in the mean performance of mathematics inclined students in chemistry.

Table 5: **t**-test analysis of chemistry test scores based on gender difference in mathematics inclined students.

Gender difference	N	Mean	SD	t-cal	t-crit
Female	13	7.92	1.62	1.61	2.05
Male	16	7.75	1.44		

df=27

The analysis in table 5 indicates that the calculated t value of 1.61 is less than the critical value of 2.05 at 0.05 alpha level of significance and 27 degrees of freedom. The null

hypothesis is accepted, showing that there is no significant gender difference in the mean performance of mathematics inclined students to chemistry.

CONCLUSION

Findings of the study showed that there was a significant difference in the mean performance of mathematics high and low achievers in chemistry. On the other hand, there was no significant gender difference in the mean performance of mathematics inclined students to chemistry, and so success is chemistry does not dependent on the gender of the students.

RECOMMENDATIONS

Recommendations were made based on the findings:

i.) Mathematics teachers should be encouraged to impart quality knowledge to their students as this will help chemistry understanding.

ii.) Chemistry training teachers should be made to offer courses in mathematics at college for better understanding.

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