

# Influence of Physiological Variables on Senior Secondary School Student's Performance in Volumetric Analysis in Ekiti State

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## ABSTRACT

This study investigated the influence of physiological and variables on senior secondary school students' performance in volumetric analysis in Ekiti State. The study specifically examined the influence of physiological variables (fatigue, students' health, time of learning and age) on senior secondary school students' performance in volumetric analysis. The study adopted the descriptive research design of a survey type. The population of the study comprised of all the 4,675 senior secondary two students in the public senior secondary schools in Ekiti State in the 2021/2022 academic session. The sample for this study was 300 senior secondary school two (SSS II) students that were selected across the three senatorial districts in Ekiti State. Multi-stage sampling procedure which involved, simple random technique was used to select sample for the study. Two sets of instruments tagged "Performance in Volumetric Analysis Test (PVAT)" and "Influence of Physiological Variables on Students' Performance in Volumetric Analysis Questionnaire (IPVSPVAQ)" were used for the study. The two instruments were validated by experts with PVAT and IPVSPVAQ yielding reliability coefficients of 0.91 and 0.87 respectively. The data were analysed using descriptive and inferential statistics. The descriptive statistics of percentage, standard deviation and histogram were used to answer the research questions while the inferential statistics involving correlation matrix, Multiple Regression and t-test were used to test the hypotheses. All the hypotheses were tested at 0.05 level of significance. The study showed that health, fatigue and time were physiological variables influencing senior secondary school students' performance in volumetric analysis. It was also found out that there was significant influence of physiological variables on senior secondary school performance in volumetric analysis. It was recommended that there is need to expose students to the influence of physiological variable on their academic performance in Chemistry in order to be able to be improved in their academic performance.

## INTRODUCTION

Science Subjects Constitute a major part of the Subjects being offered in most post-primary Institutions in Nigeria today. These Subjects are so important that the Federal Government's National Policy on Education (2016), section 5, item 22(c) states in specific term that: the Secondary School Education shall provide trained manpower in Science and technology. The National Policy on Education (2016) further state that Science Subjects Constitute part of the Core Subjects at both Junior and Senior Secondary School Levels. The importance attached to Science by the federal Government could be due to their general belief that Science is Capable of improving and Changing skills, attitudes and cognition by increase pupils Store of knowledge about themselves, their environment and their World, Chemistry is one of Such Subjects which Verifiable evidence is based on Scientific Proof.

Science education deals with sharing of science content and process with individuals who are not considered traditionally to be members of the scientific community. Science education in Nigeria concentrates on the teaching of science concepts, methods of teaching, and addressing misconceptions held by learners regarding science concepts (Aina, 2013).

In the Nigerian Educational System, a systematic exposure to science seems to be the prerogative of the formal school system. At the secondary school level, science is presented to students as specific science subjects. These include Basic Science, Physics, Chemistry, Biology, Mathematics and Agricultural Science.

Chemistry is a versatile science subject that deal with the composition properties and uses of matter. Chemistry is the scientific study of interaction of chemical substances that constitute atoms of the subatomic particle, protons, electrons and neutrons. It is an integral part of the Science Curriculum both at the senior secondary as well as higher Institutions.

Chemistry teaching is very important in terms of explaining daily life events and inculcating scientific literacy. Chemistry develops scientific thinking. Scientific literacy means understanding the nature of science, scientific knowledge, and relationship between concepts. Okoye (2012) described scientific literacy as involving the empowerment of future adults in relation to some of their eventual concerns as citizens, such as; having access to a greater range of employment opportunities, feeling more confident in responding to the demands made by new technologies, and being able to evaluate scientific evidence and take decisions about matters that affect their personal or economic wellbeing. If chemistry can play such a vital role, it may be important to maximize its potential as a subject in the school curriculum. Chemistry is presumed to be the fulcrum upon which all other sciences and technology are attached (Ikeobi, 2010). It serves as a pre-requisite for almost all science and technological programmes in the tertiary level of education.

The chemical science permeates all the branches of science, and makes use of chemical principles. Chemistry plays a crucial role in industries like, petrochemical, agricultural, medical, textile and many others, which rely on and make use of the principles of chemistry practicals (Ikeobi, 2010).

Chemistry educators regard practical chemistry as very important for various reasons, amongst which are; motivation, concept learning and the development of skills and appropriate scientific attitudes. These may not have been achieved due to poor study habits and physiological parameters such as; Health, Fatigue, Age and Time of the day. Chemistry is essentially a practical oriented subject in which a segment of it is called Volumetric analysis which demands proper exhibition of good study behavior for effective interpretation.

Volumetric analysis is defined as the quantitative analysis of an unknown chemical solution by determining the amount of reagent of known concentration necessary to effect a reaction in a known volume of the solution. Much quantitative analysis (that is, analyzing the amount of substance present) is performed using reactions between two substances in solution. The volume and concentration of one solution is known and a titration method is used to find the exact volume of the second solution necessary to react completely with the first. The concentration of the second solution can then be determined if the equation for the reaction is known ( Alam, 2010). Volumetric analysis looks a better and faster technique, especially if the substances involved are acids and bases. They can be titrated against one another for better quantitative results. Volumetric analysis is used in high school, college and university chemistry laboratories to determine concentrations of unknown substances.

Despite the utilitarian value of Chemistry with consideration of Volumetric analysis in science and technological advancement and teachers' position in the realization of these objectives. Reports of several studies revealed that most concepts in chemistry are indeed difficult to learn by most students (Fatokun, 2014). Lack of practical activities in Chemistry has resulted in poor manipulation and observation skills (Adepoju, 2012). Chemistry teaching and learning have continually received criticisms from the society as a result of poor performance of Nigeria students in science subjects relative to their counterparts in other countries (Nbina, 2012). A similar under achievement in sciences is further reported by Shelter Right initiative where Nigeria trail behind other West African countries in science subjects such as Chemistry in recent years (Olubusuyi, 2010).

Presently, the current statistics on students' academic performance in public senior secondary schools in West Africa Senior School Certificate Examination (WASSCE) in Ekiti State tends to show that the teaching and learning of Chemistry as a subject at the senior secondary school level still need a room for improvement in terms of teaching and learning, and students' performance. Table 1 below shows the academic performance of students in chemistry in public senior secondary schools (WASSCE) in Ekiti State from 2020 to 2024.

Table 1: Academic Performance of Students in Chemistry in Public Senior Secondary Schools (WASSCE) in Ekiti State from 2020 to 2024.

| Year | No. Registered |      |      | A1 to C6 |     |      |      | D7 to F9 |      |      |      |
|------|----------------|------|------|----------|-----|------|------|----------|------|------|------|
|      | M              | F    | T    | M        | F   | T    | %    | M        | F    | T    | %    |
| 2020 | 2605           | 2168 | 4773 | 618      | 585 | 1203 | 25.2 | 1987     | 1583 | 3570 | 74.8 |
| 2021 | 2775           | 2268 | 5043 | 593      | 526 | 1119 | 22.2 | 2182     | 1742 | 3924 | 77.8 |
| 2022 | 2905           | 2855 | 5760 | 650      | 570 | 1220 | 21.2 | 2450     | 2090 | 4540 | 78.8 |
| 2023 | 3520           | 2820 | 6340 | 420      | 720 | 1140 | 18.0 | 1986     | 3214 | 5198 | 82.0 |
| 2024 | 3735           | 3020 | 6755 | 758      | 696 | 1454 | 21.5 | 2378     | 2923 | 5301 | 78.5 |

Source: Ekiti State Ministry of Education, Ado Ekiti (2024)

Looking at the information on table 1, we can see that there has been a general fluctuation in the enrolment and performance of students that sat for Chemistry examination.

In spite of the possible effect of different instructional strategies of teaching chemistry, researchers such as Hock& Roger (2013) identified that learner characteristics can affect achievement in science. Considering that the present study is also interested in how a learner could be empowered to improve on his performance in volumetric analysis in Chemistry, it is most likely that alterable motivational variables such as the learner's physiological status may also influence performance in the subject. The physiological variables which are examined in this study are; students' health, age, fatigue and time of the day.

Health is the state of being free from physical disease, illness, malfunctioning and mental problem. Ill-health hampers learning, as a sound mind could only be found in a sound body. Sound physical health gives vigour and vitality to pursue learning activities for a longer education. A person who is ill is handicapped by the normal physical strength necessary for any mental activity which could affect his/her performance. Ding (2017) opined that lower physical and mental health correlated with poor academic performance in science education.

Fatigue is an overall feeling of tiredness or lack of energy. Muscular or sensory fatigue causes mental boredom and indolence. A number of factors in the home and school environment may cause physical and mental fatigue, such as lack of accommodation, bad seating arrangement, unhealthy clothing, inadequate ventilation, poor light, noise, and poor nutrition. Staying longer at school of study could cause fatigue which could affect the learning capacity of students.

Time of the day is essential to be considered in teaching and learning of Chemistry. Morning and evening hours are the best periods of study, but the most effective time suitable for teaching and learning seems to be in the morning. During the day, there could be decline in the mental capacity especially during the afternoon period. As observed, the time for experiments in our secondary schools is either in the morning or in the afternoon and some teachers love to take students to the laboratory during the afternoon period. This could easily make the atmospheric condition not favourable for the students to understand better what is to be taught in the laboratory. This is in line with the opinion of Hock and Roger (2013) that there are great variations in learning efficiency during the different hours of the day.

Students' age is embedded with learning capacity which could determine the performance of students in Volumetric analysis. Some subjects can better be learnt at the early age, and some during adulthood. On the evidence of experiments conducted, Thorndike (2015) says that mental development does not stop at ages 16 or 18 but increases up to 23, and halts after 40 years. Learning proceeds rapidly between ages 18 and 20, remains stagnant till 25 years, and declines up to 35 years. Since age accompanies mental maturation, some complex

problems cannot be solved till the person is sufficiently mature. Children could learn the school subjects more easily than uneducated adults can learn. This is perhaps because the children's minds are not burdened with worldly problems, and they have more flexible nervous system. But there are some exceptional cases when a person of 50 years of age could make remarkable progress in learning new subjects like music and a foreign language.

### **Statement of the Problem**

The researcher observed that science education system in Nigeria seems to have been plagued with a lot of problems and one of the most serious problems is continuous poor performance of students in Chemistry which is evident over the years. The result released by WAEC within the year 2020-2024 has been worrisome (as shown in Table 1).

The researcher observed large population of students in Ekiti State senior secondary school laboratory class of volumetric analysis and subsequent difficulty in providing sufficient teachers for sizable students per class. This situation made teachers to find it difficult to handle the students effectively.

Some physiological factors have been identified to have some influence on students' performance in volumetric analysis such as age, health, fatigue and time of the day among others. More so, from the few ones identified, there are still divergent views on the extent to which each of the factors influences the performance of students in volumetric analysis in chemistry.

### **Purpose of the Study**

The purpose of the study is to investigate the influence of physiological variables on senior secondary school students' performance in volumetric analysis in Ekiti State: Specifically, the study would:

- i. determine the physiological variables (fatigue, students health, time of the day and age) that influence students' performances in volumetric analysis
- ii. examine the influence of physiological variables (fatigue, students' health, time of the day and age) on senior secondary school students' performance in volumetric analysis.

### **Research Question**

One research question was raised to guide this study:

1. Will physiological variables (fatigue, students health, time of the day and age) influencing students' performances in volumetric analysis?

### **Research Hypothesis**

One null hypothesis was formulated in the course of the study:

1. There is no significant influence of physiological variables on senior secondary school performance in volumetric analysis.

### **Significance of the Study**

The findings of this study could be of benefit to students, future researchers, educational decision makers and the society at large. The outcome of this study could create in students, positive attitude to and more interest in chemistry thereby improving their performance. The reduction in mass failure of students in chemistry may improve their involvement in chemistry related professions like medicine, pharmacy, agriculture and so on. This positive attitudinal change could eventually help the students in other science subjects and form the basis for their approach to life challenges.

The findings from this study could be a useful resource point for future researchers. The information from the study could also help the ministry of education in determining the content of the ideas and or knowledge to be used when workshops, seminars and in-service training are organized for chemistry teachers for improved achievement in chemistry teaching-learning process.

## Research Design

The descriptive research design of the survey type was used in this study. The design was considered appropriate because this approach allows information to be obtained from a representative sample of the population in the actual situation as they exist.

Performance in Volumetric Analysis in Ekiti State.

It is a survey research study because, a small sample from a large population from where inferences were drawn about the characteristics of the defined population. Therefore, the survey research provides conceptual and methodological design for investigating the problem of the study.

## Population

The population for the study consisted of all the 4,675 senior secondary two students in the public senior secondary schools in Ekiti State in the 2021/2022 academic session. Students in senior secondary two (SS2) were preferred for this study because the students were exposed to a considerable knowledge of chemistry in their senior secondary school one (SS1).

## Sample and Sampling Techniques

The sample for the study consisted of 300 senior secondary school two (SSS 11) students across the three senatorial districts in Ekiti State using multi-stage sampling procedure. The first stage was the selection of one local government area from each of the three senatorial districts using simple random sampling making a total of three local government areas. The second stages also involved random selection of two schools from each local government areas earlier selected to make six schools. At the third stage, 50 students were randomly selected from each of the selected schools.

## Research Instruments

Two instruments were used for collecting data for the study. They are: Performance in Volumetric Analysis Test (PVAT) and Influence of Physiological Variables on Students' Performance in Volumetric Analysis Questionnaire (IPVSPVAQ); both instruments were constructed by the researcher.

Performance in Volumetric Analysis Test (PVAT) consisted of 20 items of multiple choice questions from A-D. Any correct option attracted one mark and wrong option attracted zero mark. This instrument was used to determine the students' performance in practical chemistry.

The second instrument, Influence of Physiological Variables on Students' Performance in Volumetric Analysis Questionnaire (IPVSPVAQ) consisted of three sections. Section A sought information on the bio-data of the respondents (such as name of school, sex, type of school, age). Section B consisted of 20 items on the physiological variables (age, health, fatigue and time allocation) as they influence students' performance in volumetric analysis. The responses were rated on a 4-point Likert-type scale of Strongly Agree (SA): 4points; Agree (A): 3points; Disagree (D): 2points; and Strongly Disagree (SD): 1point. Each respondent was made to tick the appropriate option. Their responses were scored and collated for data analysis.

## Validity of the Instruments

The instruments (PVAT and IPVSPVAQ) were validated by experts in physiology, test, measurement and evaluation, and also two experienced secondary school chemistry teachers who are WAEC and NECO examiners



as well as the researcher's supervisor for face and content validity. Their suggestions were effected in restructuring the instruments to their present forms.

## Reliability of the Instruments

The reliability of each of the instruments (PVAT and IPVSPVAQ) was determined by test-re-test method. This was done by administering each of the instruments, PVAT and IPVSPVAQ each twice on 30 senior secondary school two (SSS11) students who were not part of the sample within an interval of two weeks. The scores obtained from the two sets of administration of PVAT and IPVSPVAQ were collated and analyzed using Pearson's Product Moment Correlation Analysis. Reliability coefficient of 0.91 and 0.87 respectively at 0.05 level of significance was obtained. These values were considered high enough to adjudge the instruments as being reliable.

## Administration of the Instruments

The researcher obtained a letter of introduction from the Department of Science Education, Ekiti State University which was presented to the Head of the school (Principals) selected for the study. The researcher discussed the importance and focus of the study with the principals. The researcher also trained two research assistants who were chemistry teachers about what the study is about. The research assistants helped in the administration and collection of the instruments.

## Data Analysis

Data collected were analysed using appropriate descriptive and inferential statistics. The research question was answered using frequency counts, mean score and standard deviation. Specifically, The Research Question was answered using frequency count, percentage and mean score. The only hypothesis was tested using Multiple Regression at 0.05 level of significance.

## Descriptive Analysis

What are the physiological variables influencing senior secondary school students' performances in volumetric analysis?

In order to answer the question, responses on items in Section B of "Influence of Physiological Variables on Students' Performance in Volumetric Analysis Questionnaire (IPVSPVAQ)" were obtained and subjected to statistical analysis involving frequency counts, percentages and mean. The result is presented in Table 2.

Table 2: Physiological Variables Influencing Senior Secondary School Students Performance in Volumetric Analysis

| VARIABLE              | SA F (%)   | A F (%)   | D F (%)   | SD F (%)   | MEAN |
|-----------------------|------------|-----------|-----------|------------|------|
| Health                | 143 (47.6) | 84 (27.9) | 38 (12.8) | 35 (11.7)  | 3.11 |
| Fatigue               | 166 (55.3) | 60 (20.0) | 31 (10.3) | 43 (14.4)  | 3.16 |
| Time                  | 152 (50.8) | 76 (25.2) | 36 (12.0) | 36 (12.0)  | 3.15 |
| Age                   | 34 (11.3)  | 42 (14.0) | 75 (25.1) | 149 (49.6) | 1.87 |
| Criterion mean = 2.50 |            |           |           |            |      |

Table 2 presents the physiological variables influencing senior secondary school students' performance in volumetric analysis. The result indicates that, using a criterion mean score of 2.50 for the affirmative of the statements, all the items had mean scores above the cut-off point except gender. This implies that health, fatigue

and time are physiological variables influencing senior secondary school students' performance in volumetric analysis.

**Hypothesis:** There is no significant influence of physiological variables on senior secondary school performance in volumetric analysis.

In order to test the hypothesis, scores relating to physiological variables (health, fatigue, time and age) on senior secondary school students' performance in volumetric analysis was computed with items in Section B of "Performance in Volumetric Analysis Test (PVAT)". The scores were subjected to statistical analysis involving Multiple Regression statistics at 0.05 level of significance. The results are presented in Tables 5.

Table 3: Influence of physiological variables on senior secondary school students' performance in volumetric analysis

| Model      | Unstandardized Coefficients |            | Standardized Coefficients | T      | Sig. |
|------------|-----------------------------|------------|---------------------------|--------|------|
|            | B                           | Std. Error | Beta (β)                  |        |      |
| (Constant) | 3.540                       | .177       |                           | 19.983 | .000 |
| Health     | .001                        | .083       | .001                      | .007   | .995 |
| Fatigue    | .348                        | .083       | .611                      | 4.204  | .000 |
| Time       | .404                        | .090       | .698                      | 4.505  | .000 |
| Age        | .167                        | .088       | .291                      | 1.906  | .058 |

\* $p < 0.05$

The regression model and equation showing the multiple relationships between the dependent and independent variables can therefore be given as follow:

$$Y = a - b_1X_1 - b_2X_2 - b_3X_3 + b_4X_4$$

$$Y = 3.540 - 0.001X_1 - 0.348X_2 + 0.404X_3 + 0.167X_4$$

Where

$X_1$  = Health

$X_2$  = Fatigue

$X_3$  = Time

$X_4$  = Age

$b_i$  = (i=1-4) Regression Weight Coefficients

$a$  = Constant (other variables other than  $X_1 - X_4$ )

Table 3 shows that there is significant influence of physiological variables on senior secondary school performance in volumetric analysis ( $F_{4,295}=64.463$ ,  $p < 0.05$ ). The null hypothesis is rejected. It implies that the predictor variables jointly provide a significant explanation for the variation in the senior secondary school students' performance in volumetric analysis. The table shows that there is a significant positive multiple correlation between the predictor variables (health, fatigue, time and age) and senior secondary school students' performance in volumetric analysis ( $R=0.683$ ,  $p < 0.05$ ). This implies that all the predictor variables are factors

that can exert influence on senior secondary school students' performance in volumetric analysis. The value of the coefficient of determination indicates that all the predictor variables jointly accounted for 46.6% of the total variance in senior secondary school students' performance in volumetric analysis while the remaining 53.4% unexplained variation is largely due to other variables not included in the study that can account for senior secondary school students' performance in volumetric analysis.

Taking the absolute value of the regression coefficient, the regression result in Table 3 shows that the single best predictor of senior secondary school students' performance in volumetric analysis is time ( $\beta = 0.698$ ). This is closely followed by fatigue ( $\beta = 0.611$ ) and age ( $\beta = 0.291$ ) while health ( $\beta = 0.001$ ) is the least contributor to senior secondary school students' performance in volumetric analysis.

## DISCUSSION

The study showed that health, fatigue and time were physiological variables influencing senior secondary school students' performance in volumetric analysis. It is observed that enough time and good health of a student would alter the rate of assimilation and understanding of the subject matter. This finding is in agreement with the study of Ding (2017), Ackerman (2011), Collins (2017), which discovered that lower physical and mental health, persistent cognitive fatigue, time spent on lectures correlated with poor academic performance in science education.

The finding revealed that there was significant influence of physiological variables on senior secondary school performance in volumetric analysis. The finding is quite close to the outcome of the study of Roberts and freed, (2012) and Abrams (2013). The researcher is of the opinion that fatigue and unstable health condition could lead to diversion of focus from academic activities to finding out solution to the prevailing condition which will eventually affect academic performance of the student. They discovered students with poor health have a higher probability of school

## CONCLUSION

Based on the findings of this study, it was concluded that physiological variables such as health, fatigue and time had critical impact on senior secondary school students' performance in volumetric analysis.

## RECOMMENDATIONS

Based on the findings of the study, the following recommendations were made:

- i) School authority should ensure proper scheduling and streamlining of Chemistry timetable in order to enhance effective content coverage, reduce fatigue and enhance better performance in volumetric analysis.
- ii) There is need to expose students to the influence of physiological variable on their academic performance in Chemistry in order to be able to be improved in their academic performance.

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