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Impact Of Inadequate Infrastructure On The Effective Teaching And Learning Of Physics In Senior Secondary Schools In Bwari Area Council Of Abuja, Implications For Development In Engineering

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ABSTRACT
The study investigated the impact of inadequate infrastructureon the effective teaching and learning of Physics in senior secondary schools in Bwari Area council of Federal capital Nigeria. The study was guided by one research question and one research hypotheses which was formulated and tested at $P \leq 0.05$ significant level, which formed the basis for rejection or acceptance of the hypotheses.Descriptive research was adopted for the research. The instrument for the research is a well-structured questionnaire.The population of the study comprises of 360 SSII Physics students in senior secondary school Bwari Area Council, Abuja. The stratified random sampling was used to accommodate every stratum of people that make up the population. The data was analyzed with the use of, mean standard deviation and T-test. The result of the study showed that, inadequate infrastructural materials affect the effective teaching and learning of Physics. The researcher recommended that; functional workshops and laboratory should be built in schools to promote academic achievement in Physics. Alternativesteady powersupplies should be made available for the schools so as to compliment fortheinsufficienttimewiththeelectricallyoperatedequipment/facilitiesintheworkshops.

Key words: inadequate, Physics, Infrastructure, Teaching, Learning

I. Introduction

All through the ages, the only vital means for building the nation has been education. In a world of problems, uncertainties and ignorance, education is the key which opens the door of growth and success, the only source of influence to rule the world (Yahaya, 2019). Education is the primary service offered by society to prepare its future generation workforce. The goals of education should therefore meet the demands of the changing world. The concept of learner-centered, active learning has broad, growing support in the research literature as an empirically validated teaching practice that best promotes learning for modern day students (Freeman et al., 2014) This can be conveyed through informal, non-formal and formal ways.

In Nigeria today, science subjects constitute a major part of the subjects offered in secondary schools. The federal government in the National Policy on Education section 3 item 45 regarded the importance of science subject as it states that in recognition of the fundamental importance of science and technology, adequate funds shall be provided for the science and technology education.(National Policy on Education-FRN 2013) This recognition could have been due to the belief that with science, there is possibility of improving student's skills and attitude by increasing their knowledge of themselves, their environment and their world. Regardless of this, various surveys and researches have shown that secondary school students are

showing declining interest in science disciplines mostly Physics Uwaechia and Fadipe(2023).Physics is the foundation and bedrock of science and technology development worldwide in the developed and developing countries alike. The many tools, on which the scientific and technological development hinges on, are the direct outcomes of physics. As a result, physics is made a core subject in science and technology. Physics is the study of matter, energy and their interaction. It deals with the study of natural phenomena and helps people understand the hastily technological changing society Peter & Fadipe (2023). The importance of physics to man and the society cannot be underestimated as it extends to various aspects of life and everyday activities. It improves health, connects the world, drives progress, improves technology and many more. In addition, it also enriches the understanding of other disciplines such as the earth, agricultural, chemical, biological, and environmental sciences such as astrophysics and cosmology - subjects of extensive importance to all peoples of the world.

Physics being one of the core subjects in science and despite its importance to both man and the society, still remains one of the most difficult and challenging subjects in the school curriculum. This could be because it requires mastering the many features, concepts and skills that makes training in physics so valuable in such a wide range of careers which demands immensely on science students (Aba et all, 2016). Findings on the performance of students in the WAEC examination (2015-2019) show a low performance of 59.32% in physics which is not a good grade for WAEC. Students considering physic as a difficult subject can be attributed to the cause of this low performance Falode et all, (2020). According to Okonkwo et al (2024) most students complain of being taught principles of physics that seem abstract in nature because the necessary materials needed are not available. Also, physics teachers adopt the verbal and theoretical method of teaching physics and lack the pre-requisite knowledge of the subject for proper usage to encourage learning. This outdated way of teaching physics theoretically has also contributed to student disliking physics and hereafter lack understanding of the subject. (Taangahar et al., 2021).

The teaching and learning of physics in secondary school as an abstract subject is not encouraging and requires instructional materials to facilitate effective teaching and learning of physics. Though, various authors ascertain those activities of teaching and learning are interesting, practical, realistic, and appealing when instructional materials are used appropriately, effectively and efficiently in a classroom-teaching situation. It equally sustains students' attention for effective learning. Okpe (2018) stated that, for effective teaching and learning to take place, there is need for students to be directed properly by the teacher. This is done by employing various methods and materials which make teaching and learning meaningful. Despite all these, students and teachers still encounter some challenges in effective teaching and learning of physics.It is generally accepted that learning infrastructure affects learners' capacity to meet their goals. Learners are able to perform their duties effectively when infrastructure is developed in school, likewise, it promotes learners' enrolment.The availability of infrastructural facilities serves a significant impact on the school environment.In order to improve the overall condition of the learning environment, the school should provide adequate infrastructural facilities which must be accessible within the school Peter & Fadipe (2023). The basis for high quality teaching and learning process is regarded as being good in infrastructure and is a panacea to exposing the learners to the psychomotor domain of learning which in turn enhance capacity in engineering development of learners. . These infrastructural facilities include;Laboratory facilities- generally, a laboratory refers to a place where experiments are being conducted. Examples include the physics, chemistry and biology laboratory. These should be established within the school and well equipped to foster better understanding of sciences.Library facilities- libraries are places where various study materials are kept and made available to students for the purpose of acquiring information and improving their understanding of academic concepts.Technology- the availability and use of technology is critical in acquiring thorough understanding of academic concepts and achievement of academic goals. Power generation facilities- power supply is an important infrastructure required in schools, since most of the technological gadgets make use of electricity to function. This is also needed in classrooms, libraries, laboratories, offices and so on.Other important infrastructural facilities are, conducive classrooms, playground, restroom facilities, safe drinking water and so on.

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Objectives of the Study

The main purpose of the study is to investigate the impact of inadequate infrastructure on the effective teaching and learning of Physics in senior secondary schools in Abuja implication for development in Engineering with particular reference to Bwari Area council The study also tends to;

Determine whether inadequate infrastructure would affect the teaching and learning of Physics in BwariArea council, Abuja. And its implication for development in Engineering.

Research Questions

The research question raised to guide the study is;
How doesinadequate infrastructural facilitiesimpacton the teaching and learning of Physics in secondary school in BwariArea council, Abuja?

Research Hypotheses

The hypothesesraised to guide the study is,
$H0_1$: There is no significant difference in the influence of inadequate infrastructure on effective teaching and learning of Physics in BwariArea council, Abuja.

II. Methodology

This research employs the descriptive research of the survey type. In this context, this research exploits the quantitative method. This method was used in order to be more statistically accurate and more objective in investigating the impact of inadequate infrastructure on the effective teaching and learning of Physics in senior secondary schools in Bwari.Thepopulation for this research constitute of all SS2 male and female Physics students in the government senior secondary school Bwari Area Council in the Federal Capital Territory, Abuja, Nigeria. The target population is 4,323 SSII Physics students. They were chosen because they are well prepared to understand the problem being investigated. These selected students are considered ideal for this research becausefinding a sample from these students will constitute a fair depiction given their size and location.

Table 1belowshows the names and the total number of students in the twelve public senior secondary schools in Bwari Area Council FCT, Abuja, Nigeria, which was collected from measurement and evaluation office Kuduru, Bwari Area Council (Measurement&Evaluation 2019)

Table 1: Population of the study

S/N	Name of school	male	female	total
1	GSS Bwari (Kuduru)	223	137	360
2	GDSS Bwari	120	404	525
3	GSS Byazhin	133	216	349
4	GSS Dei-Dei	92	108	200
5	GGSS Dutse	157	189	350
6	GGSS Dutse	0	405	405
7	GSS Jibi	167	188	355
8	GSS Kawu	153	97	250
9	GSS Kubwa	246	340	586
10	GSS Kubwa PH3	5	10	15
11	GDSS Mpape	155	165	320
12	GSS Shere	161	136	297
13	GSS Ushafa	148	163	311
Grand Total		**1,770**	**2,563**	**4,323**

Source: Measurement and Evaluation Office Kuduru, Bwari Area Council (2023)

For the purpose of this research, the stratified random sampling is used. Sekaran and Bougie (2016), opined that this method of sampling allows different strata to be made based on factors like age difference, income levels, gender consideration etc. A random sampling was done from the gender consideration (male and female). Since it is homogeneous in itself but heterogeneous against others outside it, this implies that the population was well represented in the sampling.

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The sample size was determined using, Taro Yamane's method was used. This method was used because the population of the research is finite.

$$n = \frac{N}{1 + N(e)^2}$$

n = sample size required
N = number of people in the population
e = allowable error (%) = 0.05
According to the above population table, there are approximately 4,323SS2 students offering Physics presently in the thirteen secondary school present in Bwari Area Council.
Substituting the variablesin the formula above, we have;

$$\mathbf{n} = \frac{4{,}323}{1+4{,}323(0.05)^2}$$

$$\mathbf{n} = \frac{4{,}323}{1+11} = \mathbf{360}$$

To get the right measure for each of the samples, proportionate stratified method was used.

Stratified Random Sampling = $\frac{\text{sample size}}{\text{Entire Population}}$ **X** Population of groups

Male $\frac{360}{4{,}323}$ **X 1770 =147**

Female $\frac{360}{4{,}323}$ **X2563 = 213**

This research used primary data which wasgotten from a self-administered questionnaire. The researcher met the correspondents with an introduction letter explaining the purpose for carrying out the research. The survey questionnaire was chosen because of its general acceptance in gathering information about a population particularly in a situation where the respondents are inaccessible (Orodho, 2004). With the use of a well-designed modified five points Likert scale, the respondents in this research chose their responses.

For the purpose of this study, the five-point scale includes: Strongly Agree (SA), Agree (A), Neutral (N), Disagree (D) and Strongly Disagree (SD). A five-point was selected in order to ensure that the respondents take a stand on the particular issue being evaluated.The data collected from the instrument were analyzed using the content & face validity by the research supervisor and two other experts in the research field. This is to ensure that the items of the questionnaires measured what they were supposed to measure and necessary corrections were made. According to Anastasia inAdu et all (2014) face validity of a survey instrument of this kind is considered adequate for its validityThe research instrument was pilot tested using 20 respondents aside the population to test for the instrument reliability.The Pearson Correlation Coefficient was used to determine the reliability of the instrument and a co-efficient value of 0.724 indicated that the research instrument was reliable; hence it was adopted for getting the desired information for the study.

Datacollectedwasanalyzeusingthemeasure of central tendency(meanand standard deviation).Valueswere assignedtotheratingscales as follows:Strongly Agree (SA) = 5 Agree(A)=4Neutral(N)=3Disagree(D)=2 StronglyDisagree(SD) =1Descriptive statistics was employed to present the data, while the independent T-test was used for the hypotheses testing. SPSS was employed as a tool for this analysis.

Data Presentation and Analysis

This aspect presents the descriptive analysis of the demography, research question, hypothesis testing, major findings and discussion of the findings of the study. The questionnaire items were analyzed using SPSS which is better and easier than many other database or spreadsheet applications due to its capability to analyze wider range of data and accuracy level.

The analysis is divided into demographic assessment of the respondents, assessment of research question one, research question two and research question three. Each analysis is quickly succeeded by its interpretation.

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Demographic Analysis

The demographic analysis shows the shows the analysis of the age and gender of respondents

Table 2: Age Frequency and percentage distribution table

Source: SPSS Survey

Age of Respondents

Age	Frequency	Percentage
11-15	176	48.9
16-20	184	51.1
Total	360	100

Table 2 above presents the distribution of the age of respondent grouped into two categories. The first is 11 to 15 years, which are 176 respondents amounting to total of 48.9%. The second is 16-20 years, which are 184 respondents amounting to 51.1%.

Table 3: Gender Frequency and percentage distribution table

Source: SPSS Survey

Gender of Respondents

Gender	Frequency	Percentage
Male	147	40.8
Female	213	59.2
Total	360	100

The table3 above indicates the distribution of the gender of respondents. While the male gender includes 147 respondents accounts for 40.8% of the study, the female gender amounting to 213 respondents accounts for 59.2% of the study. This suggests that the femalestudents that offers science courses (physics) are more than the male students and they are easily available for the purpose of this research.

Descriptive Analysis of Research Questions

This section presents and analyzes the data obtained by the researcher on investigation into the problems affecting the effective teaching and learning of Physics in secondary schools in Abuja.The use of measure of central tendency was employed to answer the questions reveled in the tables

Research Question

What is the influence of infrastructural facilities on the effective teaching and learning of Physics among senior secondary schools in Bwari? This variable is tested on 5 questions administered to the respondents. Below is the analysis and interpretation.

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Table 4.Descriptive Statistics of lack of infrastructural facilities variable
Source: SPSS Survey

S/N	SA	A	N	D	SD	Mean	Std.
1. Lack of standard and practical workshop greatly affect my learning Physics	147	130	34	35	14	4.00	1.12
2. Unavailability of technology tools and equipment affects my understanding of Physics	142	120	42	48	8	3.94	1.12
3. My classroom condition has a great impact onmy learning experience of physics	104	114	72	55	15	3.66	1.17
4. Well-equipped science laboratory is importantfor learning of physics	253	82	15	7	3	4.60	0.74
5. Inadequate infrastructure affects understanding and performance in physics	126	134	51	41	8	3.91	1.07

The analysis on the table 4. above shows the descriptive statistics of the influence of infrastructural facilities variable which is the response to research question two.
The mean and standard deviation for questions1,2,3,4 and 5 under the 'infrastructural facilities' variable are 4.00, 4.31, 3.77, 4.60, 4.02 and 1.12, 1.12, 1.17, 0.74, 1.07 respectively.

Table 5: Cumulative infrastructural materials descriptive statistics
Source: SPSS Survey

Mean	standard deviation
Lack of Infrastructural materials	4.02	0.64

The cumulative mean for the distribution as shown in the table above is 4.02. based on the Likert scale standard 1.8 and below is 'strongly disagree', 1.81 to 2.60 is 'disagree', 2.61 to 3.40 represent 'neutral', 3.41 to 4.20 represent 'agree' while 4.21 and above represent 'strongly agree'. Since the cumulative mean of the data distribution is 4.02, it therefore shows that the respondents generally agree moderately that the lack of structural facilities influences the teaching and learning of Physics.The standard deviation of 0.64 is recorded which is significantly low compared to the mean. It implies that there are not so many extreme values across the frequency of the questions. This shows ahigh-level consistency in the data distribution.

Hypotheses Testing
The three research hypotheses formulated were tested at 0.05 level of significance using the independent T-test

Table 6:T-test analysis showing the effect of lack of infrastructural materials on the teaching and learning of Physics in senior secondary schools in Bwari Area Council, Abuja.

S/N	N	Mean	Std. deviation	df	t_{-cal}	t_{-tab}	P_{-value}
lack of infrastructure	300	4.023	0.639				

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				718	7.688	1.67	0.00
Teaching and Learning	300	3.722	0.379				

Significant at df=718; $P \leq 0.05$, $t_{calculated} \geq t_{tabulated}$

Table 6. showed the significant influence of lack of infrastructural materials on the teaching and learning of Physics in senior secondary schools in Bwari Area Council, Abuja. The t calculated measures 4.711 while the p value measures 0.000. Since the p value is less than 0.05 and the t calculated is greater than t tabulated, the null hypothesis is rejected. This implies that the lack of infrastructural materials has a significant influence on the teaching and learning of Physics.

Major findings

The major findings of the research are as follows;

1. The lack of infrastructural materials has a significant influence on the teaching and learning of Physics

These also implies that the lack of infrastructural materials affects the effective teaching and learning of physics.

III. Discussion of Findings

From the above findings, it was discovered that infrastructural materials play a significant role in the teaching and learning of physic.This implies that infrastructural materials which include well equippedlaboratories, technological tools and equipment, conducive classrooms etc. are all essential for the effective teaching and learning of physics. This finding is in agreement with the social learning theory which emphasizes the importance of the social and cultural context in shaping learning and development. As it pointed out that infrastructural facilities in schools, such as libraries, laboratories, and technology resources, can serve as tools to scaffold students' learning within their Zone of Proximal Development. The presence of infrastructures makes teaching and learning experience filled, gives room for exploration and reflective observation. This then serve as guidelines for active experimentation and selection of new experiences. It is also in accordance with the discovery of Taangahar et al (2021) who foundout that students are being taught principles of physics that seem abstract in nature because the necessary materials needed are not available. This is also in line with Bhunia et all (2012) who opined those adequate infrastructural facilities helps to improve the overall teaching and learning of physics. The lack of all these infrastructural facilities poses a threat to the teaching and learning of physics.

IV. Summary

This researchwas aimed at investigatingthe impact of infrastructural materials on the effective teaching and learning of physics in senior secondary schools in Bwari Area Council, Abuja. The sample of the studies comprises of SSII science (Physics) student males and females. The respondents were 147 male students and 223 female students. A questionnaire with modified 5 likert rating scale of strongly agree, agree, neutral, disagree and strongly disagree was used to produce responses from the selected students based on the variables of the study. The collected data was analyzed using the table, frequency, mean and standard deviation while independent T-test was used to test the hypotheses raised for the purpose of this research. The result of the findings proved that;The availability of infrastructural materials contributes immensely to the effective teaching and learning of physics in Bwari Area Council, Abuja.

V. Conclusion

The findings from this study revealed that for effective teaching and learning to take place in senior secondary schools in Bwari Area Council Abuja, the availability of infrastructural materials in the school make teaching and learning of physics effective.

VI. Recommendations

Based on the findings of the study, the researcher came up with the following recommendations;

First, teachers should have access to adequate infrastructural teaching materials during lessons, head of schools should make available appropriate in materials infrastructural facilities such as books, physics apparatuses, online learning platforms and other teaching aids for the utilization of teachers and students. The government should also on her part make sure that the resources allocated to schools are sufficient while the school administrators ensure good use of the resources.

Secondly, standard and functional workshops should be built in schools. Other instructional materialslikeaudio-

visualmediaandinformationandcommunicationtechnologiesshouldbeinstalledandtheirusemadecompulsoryinschools.Alternativesteady powersupplies should be made available for the schools so as to allowtheinsufficienttimewiththeelectricallyoperated equipment/facilitiesintheworkshops.

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