Examining the Effect of Laboratory Resources on the Teaching and Learning of Physics in Senior Secondary Schools in Gwagwalada Area Council, Abuja, Nigeria

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Abstract

This study examines the effect of laboratory and resources on the teaching and learning of physics in senior secondary schools in Gwagwalada Area Council, Abuja. The sample of the study consisted of 200 respondents. Questionnaire was used to collect data and simple random sampling technique was used for the study. Major findings revealed that the use of laboratory facilities stimulates reality and it promotes greater acquisition of skills and longer retention of facts i.e. student's academic performance increases when they learn practically than theoretically and three in every five Government Senior Secondary schools in Gwagwalada Area Council of FCT Abuja have adequate time for practical classes allocated in their curriculum. The researcher recommended that Teachers' Training Institutions should intensify efforts in exposing pre-service physics teachers to all the rudiments of laboratory managements, The Department of Education of Gwagwalada Area Council should organize symposiums for trainees and school administrators and authorities to highlight the need to utilize laboratory time in Senior Secondary Schools.

Keywords: Senior Secondary School, Laboratory, Physics. Pre-service

1. Introduction

It can be realized with the help of researches in physics education that students at secondary and even university levels continue to hold fundamental misunderstanding of the world around them. Physics, as a science subject, is based on practicals and experiments. Its objectives, as contained in the National Policy on Education (FRN, 2013) include, among others, to equip learners with meaningful and relevant knowledge of physics, equipped laboratory and adequate practical works. Science learning remains within the classroom context and just a small percentage of the students are able to use the knowledge gained at school for solving various problems of larger physical world.

It is only through utilization of physics laboratory facilities that the above objectives and goals can be achieved and the status quo, changed. Physics is generally regarded as the nucleus of all technology. This simply means that physics controls all forms of technology. It is also affirmed that behind every technology, there is physics. At senior secondary school level, physics is defined as a branch of science that deals with matter, energy, their relationship and their measurements. The learning of physics is affected by the mathematical background of the learner and the methods used by the teacher in teaching concepts (topics) in physics.

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5-C005-p47-56.indd 47 31-07-2020 20:21:43

Students do not usually have opportunity to form their own ideas; they rarely get a chance to work in a way to be engaged in discovery, building and testing models to explain the world around them. Results from research, in cognitive science and physics education, show that activities in laboratories increase students' learning, positive attitudes towards physics and permanence of knowledge. Physics laboratory facilities are those instructional materials in the form of scientific equipment, materials and chemicals found in physics laboratories which are used for laboratory or practical work in the teaching and learning of physics. Laboratory or practical work in physics is the interactions of students with scientific equipment, materials and chemicals which make direct contributions towards understanding or learning of physics concepts (Igboabuchi, 2010).

The act of teaching is fundamentally concerned with passing on the ideas, skills and attitudes from the teacher to the learner. Physics, in Nigerian Secondary Schools, is taught by a lecture approach alone in 62% of the Secondary Schools. This is what Tropp (2012) described as a "chalk and talk" teaching approach, from the extensive observation she made while on a trip to Nigeria to study the Secondary School Science programs in Nigeria. She observed, that despite the fact that the West African Examination Council mandated that, because of its very empirical nature, physics must be studied with the aid of the laboratory classes (Demonstration method), this was not being done. In Nigeria, for example, teaching experience has shown that spoken words alone in the communication of ideas are grossly inefficient and ineffective in producing desired learning outcomes. The reason behind failure in solving physical problems could be ascribed to the fact that there are topics in physics that pose serious problem of comprehension to students and are not simplified in the laboratory.

An associated problem with this is the lack of encouragement given to teachers to improvise the materials when they are not available. This is more so with most schools and Ministries of Education complaining of lack of funds to provide adequate physics laboratory facilities (Chinweoke, 2010). The heads of schools often do not motivate the teachers in terms of providing the laboratory facilities or catering for the laboratory needs. Most schools lack funds and as a result, they find it difficult to purchase the required physics laboratory apparatus for teaching.

2 Literature Review

Physics phenomena are perceived commonly in everyday life and the physics technological aspect makes the modern lifestyle to look easier than it was many years ago. Laboratory facilities, whether standard or improvised, are the backbone of experimental work. Asenuga (2013), asserted that working in science laboratory can only be possible if there are sufficient pieces of equipment for experiment while Jatau (2018) reported that when instructional facilities are appropriately utilized, they bring about more effectiveness in teaching and learning process, but this depends on teacher's ability to use them efficiently. However, the teaching and learning of physics has not always been done efficiently, especially in developing countries (Africa included) (Zewdie, 2014). Resources, according to Aina (2013), enhance interest, comprehension, retention and concreteness to any learning situation.

Oladeji (2011) in his study found that many secondary schools do not have enough laboratory facilities for teaching practicals. He further added that, schools that were poorly equipped, produced students with poor performance than those from well-equipped schools. The success of any system is a function of the available

5-C005-p47-56.indd 48 31-07-2020 20:21:43

resources to run the system. For effective teaching and learning of any science subject (physics included), teachers have to put emphasis on students' participation and let them develop their own knowledge (Cahyadi, 2009). Learning takes place more effectively when appropriate resources, befitting the curriculum are used. The resources required for teaching physics are standardized and expensive but improvisation is allowed to make students understand the concepts properly.

The use of instructional sources would make 'discovered facts' glued firmly to the memory of students. Other factors, that hinder students from studying physics, come from the fact that they are not interested in the subject, which seems boring, difficult and irrelevant to daily life (Hirschfeld, 2012). In many developing countries, when students are asked to solve physics problems, a large number of them do not develop the necessary conceptual understanding, but try to memorize only mathematical formulas (Elby, 2011). Facilities such as laboratory equipment and apparatus as well as textbooks and other teaching aids are ingredients for effective teaching and learning. For a good educational policy in planning to guarantee quality outputs, it must service optimally with appropriate trained and motivated teaching staff, adequately supplied with necessary facilities and equipment. According to Maeke (2013), poor learning resources and facilities have been classified under the causes of dropout rate and withdrawal. Bakhda (2014) points out those available facilities should be adapted and utilized to suit the school curriculum and good performance. The improvisation needs a well-trained human resource (teachers of physic) who lead the students clearly in the cause of the lessons without misleading them, to understand the basic concepts in physics. Physics education refers both to the methods currently used to teach physics and to areas of Pedagogical research that seeks to prove those methods. These concepts are better understood when lectures are accompanied by qualified personnel, apparatus with demonstrations, hands on experiments and questions that require students to ponder what will happen in an experiment and why students who participate in active learning, for example, with hands on experiments learn through self-discovery. Ugolo and Nwadiani (2012) observed that the facilities are not only over used, they are also poorly maintained. Similarly, Aigboje (2017) found out that some school facilities, were inadequate while at others were not available at all.

3 Methodology

This is focused on to describe the research methodology and procedures adopted for collection of data in this study. This has been done under the following:

3.1 Research Design

According to Anaekwe (2014), 'a research design is a plan that guides the researcher in conducting a study so that he can collect evidence that either supports or refutes a claim about an educational phenomenon.' Accordingly, this research adopted a descriptive survey design to generate the relevant data. This study suits descriptive survey design because it involves collection of quantitative information that can be tabulated.

3.2 Population of the Study

The population of this study consisted of 400 people (students and staffs) in five public senior secondary schools in Gwagwalada Area Council of FCT Abuja. The population for the study was selected randomly and the names of the schools are:

5-C005-p47-56.indd 49 31-07-2020 20:21:43

Table 1

S/N	Name of School	Number of Students
1	Govt. Girls Secondary School, Dukpa	71
2	Govt. Day Secondary School, Gwagwalada	89
3	School for the Gifted, Gwagwalada	68
4	Hajj Camp Senior Secondary School, Gwagwalada	80
5	Govt. Secondary School, Gwagwalada	92
TOTAL		**400**

Source: Field Survey, 2019

3.3 Sample Size and Sampling Techniques

Out of the entire population of the students, the researcher randomly selects two hundred (200) as the sample size. 100 boys and 100 girls. This study adopts simple random sampling technique.

3.4 Instrumentation

The major research instrument used is the questionnaire. This was appropriately moderated. The people who constituted the population of the study were administered with the questionnaires to complete, with or without disclosing their identities. The questionnaire was designed to obtain sufficient and relevant information from the respondents. The primary data contained information extracted from the questionnaires in which the respondents were required to give specific answer to a question by ticking in front of an appropriate answer and administered the same on staff of the organizations. The questionnaires were designed to determine the extent to which Physics Laboratory equipment are utilized for the teaching and learning of Physics in senior secondary schools in Gwagwalada Area Council, Abuja. The questionnaire was divided into sections A and B. Section A requires the respondents' personal data while section B requires information concerning the research questions.

3.4.1 Validity and Reliability of the Instrument

The questionnaire used as the research instrument was subjected to face validation. This research instrument (questionnaire) adopted was adequately checked and validated by a supervisor and also a senior colleague. Contributions and corrections were included into the final draft of the research instrument used.

3.5 Data Collection Procedure

The researcher personally visited the selected schools and distributed the questionnaires to the respondents. A total number of four hundred (400) copies of questionnaire were distributed to the respondents out of which three hundred and forty nine (349) were completed and returned. Thus, two hundred (200) questionnaires were randomly selected as the sample size and analyzed.

3.6 Method of Data Analysis

The data collected were tabulated and analyzed using the simple percentage. The formula is seen below:

$$\% = f/N \times 100/1$$

Where: f = Frequency (Number of respondent)
n = Total number of each respondents
% = Percentage of its frequency

5-C005-p47-56.indd 50 31-07-2020 20:21:43

4 Result and Discussion

Efforts will be made at this stage to present, analyze and interpret the data collected during the field survey. This presentation will be based on the responses from the completed questionnaires. The result of this exercise will be summarized in tabular forms for easy references and analysis. It will also show answers to questions relating to the research questions for this research study.

4.1 Analysis of Respondents' Personal Data

Table 2 Analysis of Respondents' Gender

Gender	Frequency	Percentage (%)
Male	104	52
Female	96	48
Total	**200**	**100**

Source: Field Survey, 2019

Table 2 above shows that 104 (52%) respondents were Males while 96 (48%) were Females. This shows that most of the respondents were Males and also observed that the percentage difference is less.

Table 3 Analysis of Respondents Age

Age	Frequency	Percentage (%)
10-15	114	57
16-20	72	36
21 and Above	14	7
Total	**200**	**100**

Source: Field Survey, 2019

Table 3 shows that 114 (57%) of respondents fall within the age of 10-15 years, 72 (36%) of respondents were within the age of 16-20 years, while 14 (7%) of respondents were from 21 years and above. This indicates that majority of the respondents are within the age of 10-15 years.

Table 4 Analysis of Respondents Class/Category

Class	Frequency	Percentage (%)
SS 1	80	40.0
SS 2	71	35.5
SS 3	39	19.5
Staff	10	5.0
Total	**200**	**100.0**

Source: Field Survey, 2019

Table 4 above shows that 80 (40%) respondents were in SS 1, 71 (35.5%) respondents were in SS 2, 39 (19.5%) respondents were in SS 3 while 10 (5%) respondents were Staff of the selected schools. This indicates that majority of the respondents were in SS 1.

5-C005-p47-56.indd 51 31-07-2020 20:21:43

4.2 Analysis of Research Questions

4.2.1 Does your school have a dedicated physics laboratory?

Table 5 Respondents' Reply

Name of School	Respondents' Reply			
	YES	Percent (%)	NO	Percent (%)
Govt. Girls Secondary School, Dukpa	31	15.5	0	0.0
Govt. Day Secondary School, Gwagwalada	49	24.5	0	0.0
School for the Gifted, Gwagwalada	28	14.0	0	0.0
Hajj Camp Senior Secondary School, Gwagwalada	40	20.0	0	0.0
Govt. Secondary School, Gwagwalada	52	26.0	0	0.0
Total	**200**	**100%**	**0**	**0%**

Source: Field Survey, 2019

Research Question One was to determine, whether or not, the sampled schools in Gwagwalada Area Council of The Federal Capital Territory have a dedicated laboratory/workspace for carrying out experiments/practical classes. Reports, from all the sampled Senior Secondary Schools, show that they all have a Dedicated Physics Laboratory for carrying out Practical works.

4.2.2. Does your school curriculum provide adequate time for Laboratory work?

Table 6 Respondents' Reply

Name of School	Respondents' Reply			
	YES	Percent (%)	NO	Percent (%)
Govt. Girls Secondary School, Dukpa	12	6.0	19	9.5
Govt. Day Secondary School, Gwagwalada	32	16.0	17	8.5
School for the Gifted, Gwagwalada	23	11.5	5	2.5
Hajj Camp Senior Secondary School, Gwagwalada	19	9.5	21	10.5
Govt. Secondary School, Gwagwalada	38	19.0	14	7.0
Total	**124**	**62%**	**76**	**38%**

Source: Field Survey, 2019

Research Question Two focused on the time adequacy allocated for laboratory work as in the school's curriculum. Govt. Girls Secondary School, Dukpa shows that only 12 (6%) respondents agreed that the allocated laboratory work time is adequate while 19 (9.5%) respondents disagreed to the assertion on the adequacy of laboratory work time. Govt. Day Secondary School, Gwagwalada shows that 32 (16%) respondents agreed that the allocated laboratory work time is adequate while only 17 (8.5%) respondents disagreed to the assertion on the adequacy of laboratory work time. Reports from School for the Gifted, Gwagwalada shows that 23 (11.5%) respondents agreed that the allocated laboratory work time is adequate while only 5 (2.5%) respondents disagreed to the assertion on the adequacy of laboratory work time. Hajj

5-C005-p47-56.indd 52 31-07-2020 20:21:43

Camp Senior Secondary School, Gwagwalada shows that only 19 (9.5%) respondents agreed that the allocated laboratory work time is adequate while 21 (10.5%) respondents disagreed to the assertion on the adequacy of laboratory work time. Reports from Govt. Secondary School, Gwagwalada shows that 38 (19%) respondents agreed that the allocated laboratory work time is adequate while 14 (7%) respondents disagreed to the assertion on the adequacy of laboratory work time. This shows that 124 (62%) respondents agreed that the allocated laboratory work time is adequate while only 76 (38%) respondents disagreed to the assertion on the adequacy of laboratory work time.

4.2.3. In what way does the unavailability of Practical Physics Class affects the Student's Academic Performance?

Table 7 Respondents' Reply

Name of School	Respondents' Reply			
	Positively	Percent (%)	Negatively	Percent (%)
Govt. Girls Secondary School, Dukpa	11	5.5	20	10.0
Govt. Day Secondary School, Gwagwalada	8	4.0	41	20.5
School for the Gifted, Gwagwalada	2	1.0	26	13.0
Hajj Camp Senior Secondary School, Gwagwalada	5	2.5	35	17.5
Govt. Secondary School, Gwagwalada	23	11.5	29	14.5
Total	**49**	**25%**	**151**	**76%**

Source: Field Survey, 2019

Table 7 looks into the way in which the unavailability of practical physics class affects the student's academic performance. Govt. Girls Secondary School, Dukpa shows that 11 (5.5%) respondents believe that the unavailability of physics practical class affects students' performance positively while 20 (10%) respondents believe that the unavailability of physics practical class affects students' performance negatively. Govt. Day Secondary School, Gwagwalada shows that 8 (4%) respondents believe that the unavailability of physics practical class affects students' performance positively while 41 (20.5%) respondents believe that the unavailability of physics practical class affects students' performance negatively. School for the Gifted, Gwagwalada shows that 2 (1%) respondents believe that the unavailability of physics practical class affects students' performance positively while 26 (13%) respondents believe that the unavailability of physics practical class affects students' performance negatively. Hajj Camp Senior Secondary School, Gwagwalada shows that 5 (2.5%) respondents believe that the unavailability of physics practical class affects students' performance positively while 35 (17.5%) respondents believe that the unavailability of physics practical class affects students' performance negatively. Govt. Secondary School, Gwagwalada shows that 23 (11.5%) respondents believe that the unavailability of physics practical class affects students' performance positively while 29 (14.5%) respondents believe that the unavailability of physics practical class affects students' performance negatively. This shows that only 49 (25%) of respondents are positive while 151 (76%) are negative on their stance on the academic performance of students due to unavailability of practical physics class. Report, from all the sampled Senior Secondary Schools, shows that the unavailability of practical physics class affects the academic performance of students negatively.

5-C005-p47-56.indd 53 31-07-2020 20:21:43

4.2.4. Do you think Practical Physics Classes enhance the Students' knowledge on the taught subject matter?

Table 8 Respondents' Reply

Name of School	Respondents' Reply			
	YES	Percent (%)	NO	Percent (%)
Govt. Girls Secondary School, Dukpa	23	11.5	8	4.0
Govt. Day Secondary School, Gwagwalada	44	22.0	5	2.5
School for the Gifted, Gwagwalada	28	14.0	0	0.0
Hajj Camp Senior Secondary School, Gwagwalada	29	14.5	11	5.5
Govt. Secondary School, Gwagwalada	38	19.0	14	7.0
Total	**162**	**81%**	**38**	**19%**

Source: Field Survey, 2019

Table 8 focuses on the role of practical physics class in enhancing students' academic knowledge. Results from Govt. Girls Secondary School, Dukpa show that 23 (11.5%) agreed that physics practical classes enhance students' knowledge on the taught subject matter while 8 (4%) disagreed that physics practical classes enhance students' knowledge on the taught subject matter. Results, from Govt. Day Secondary School, Gwagwalada, show that 44 (22%) agreed that physics practical classes enhance students' knowledge on the taught subject matter while 5 (2.5%) disagreed that physics practical classes enhance students' knowledge on the taught subject matter. Results, from School for the Gifted, Gwagwalada, show that 28 (14%) agreed that physics practical classes enhance students' knowledge on the taught subject matter while no one disagreed. Results, from Hajj Camp Senior Secondary School, Gwagwalada, show that 29 (14.5%) agreed that physics practical classes enhance students' knowledge on the taught subject matter while 11 (5.5%) disagreed that physics practical classes enhance students' knowledge on the taught subject matter. Results, from Govt. Secondary School, Gwagwalada, show that 38 (19%) agreed that physics practical classes enhance students' knowledge on the taught subject matter while 14 (7%) disagreed that physics practical classes enhance students' knowledge on the taught subject matter. This shows that majority 162 (81%) of respondents agreed that physics practical classes enhance students' knowledge on the taught subject matter while 38 (19%) disagreed. Reports, from all the sampled Senior Secondary Schools, show that physics practical classes enhance students' knowledge on the taught subject matter.

4.3 Discussion on Findings

Table 5 was structured to determine whether or not the sampled schools in Gwagwalada Area Council of The Federal Capital Territory have a dedicated laboratory/workspace for carrying out experiments/practical classes. Reports, from all the sampled Senior Secondary Schools, show that they all have a Dedicated Physics Laboratory for carrying out Practical works and affirmed to the fact that all government schools in the Federal Capital Territory have Laboratories.

Table 6 visited the time adequacy for laboratory work provided in the curriculum of Government Senior Secondary Schools in Gwagwalada Area Council, Abuja. Findings revealed that three of every five

5-C005-p47-56.indd 54 31-07-2020 20:21:44

Government Senior Secondary Schools have adequate allocated time for laboratory work but not enough for its level of utilization.

Table 7 checked the direction in which unavailability of practical classes affects the student's academic performance amongst Government Senior Secondary Schools in Gwagwalada Area Council of FCT Abuja and it was realized that most students responded that the unavailability of practical classes affects the student's academic performance negatively.

Table 8 which revealed respondents' view as to whether or not physics practical classes enhance the students' knowledge turns out that most of the respondents attested to the fact that physics practical classes enhance the students' knowledge.

This corroborates the findings of Oladejo, Olosunde, Ojebisi and Isola (2011). They worked on instructional materials and students' achievement in physics. They observed` that instructional materials perform such functions as the extension of the range of experience available to learners, supplement and complement the teachers' verbal explanations thereby making learning experience richer and providing the teacher with interest into a wide variety of learning activities. This result also agreed to the view of Moronfola (2002) who stressed that science subjects should be taught at primary level as a practical subject. This finding was also in line with findings of Olatunbosun (2008) who found that laboratory adequacy affected the performance of students. Omosewo (2008) ascertained that in modern science curriculum, students need to be encouraged to learn not only through their eyes &/or ears but should be able to use their hands and head to manipulate apparatus.

5.0 Conclusion and Recommendations

It is very clear that teaching and learning of physics to a greater extent is anchored in laboratory activities, due to the fact that, physics is a subject that should not be taught only in theories. The more practicals done,will help students in understanding the concepts, principles and laws of physics. But in a situation where reverse becomes the case, teaching will be jeopardized and learning greatly affected, this is the situation of some government senior secondary schools in Gwagwalada Area Council of FCT Abuja.

Laboratory and its resources are effective vehicles for carrying information for learning to occur. Laboratory and its resources should be used for teaching and learning as these can help to improve students' achievement in physics. Physics students taught with practical aids achieved higher and better than those taught without instructional resources (practicals).

Instructional materials supplement, clarify, vitalize, emphasize instruction and enhance learning in the process of transmitting knowledge, ideas, skills and attitude. This calls for teacher's resourcefulness and improvisation on the parts of the Physics teachers. The ability of the teacher to make use of "local" materials in place of "standard" ready-made materials makes lesson more effective and improves students' achievement. The following recommendation are made, based on the findings of this study:

- The Department of Education of Gwagwalada Area Council should organize symposiums for trainers and school administrators and authorities to highlight the need to utilize laboratory time in Senior Secondary Schools.

5-C005-p47-56.indd 55 31-07-2020 20:21:44

- Teachers' training institutions should intensify efforts in exposing pre-service physics teachers to all the rudiments of laboratory managements. Conscious efforts should be made by such institutions to allow the trainee physics teachers effective access to pieces of apparatus required for senior secondary schools physics curriculum.
- There is the need for teachers to be resourceful in instructional materials selection and utilization. This is to reduce the cost of production and maintenance of instructional materials, especially the improvised ones. Thus, regular training and retraining of teachers is hereby recommended.
- Conferences, seminars and workshops should be organized regularly for physics teachers to broaden their knowledge on instructional resources and the best way to be making use of instructional resources by the teachers.

It is, therefore, recommended that the study be carried out on other science subjects such as Biology, Chemistry, Agriculture and Mathematics in order to know the problems associated with teaching the subjects with the view to improving the students' academic achievement

It is believed that if these recommendations are not set aside, the factors affecting teaching and learning through laboratory works in government secondary schools will be significantly attended to. Equally, the status of physics will be much more enhanced.

References

Aina, K. J. (2013). Instructional Materials and Improvisation in Physics class: Implications for Teaching and Learning. *IOSR Journal of Research & Method in Education, 2*(5), 38-42.

Anaekwe, M. & Nnaka, C. (2017). Challenges of Teaching and Learning Science at a Distance in National Open University of Nigeria. 10.1007/978-94-6300 902-7_14.

Asenuga, K. (2014). The Effect of Experimental Approach to Learning Science on Academic Performance. *Journal of Science Teachers of Nigeria, 19*(2), 57-64.

Cahyadi, V. (2009). The effect of interactive engagement teaching on student understanding of introductory physics at the faculty of engineering, University of Surabaya, Indonesia. *Higher Education Research and Developmen, 23*(4), 455-464.

Chinweoke, B. C. (2010). *The Extent of availiability and Utilization of Biology Equipment/ Laboratory Materials in Secondary Schools.* Onitsha: Unpublished M. Ed Thesis, Madonna University, Ede.

Elby, A. (2011, August 8th). *Epistemological Beliefs Assessment for Physical Science*. Retrieved from Google Scholar: http://www2.physics.umd.edu/~elby/EBAPS/home.htm.

Jatau, J. (2018). A Perspective on Science Education in Ghana. *Journal of Ghana Association of Science Teachers, 5*(1), 14-15.

Oladeji, I. C. (2011). The Influence of Biological Apparatus in the Teaching of Biology in some selected schools in Jigawa State. *(Unpublished B. Ed Project) Faculty of Education, Ahmadu Bello University, Zaria. Nigeria*.

Ugolo, S. P., & Nwadiani, M. (2012). The Availiability, Adequacy and Utilization of Physical Facilities in Public Secondary Schools in Bayelsa State. *African Journal of Studies in Education, 8*(1&2), 34-47.

Zewdie, Z. M. (2014). Analysis of Grades 7 and 8 Physics Textbooks: A Quantitative Approach. *Journal of Science and Education Publishing, 2*(1), 1-17.

5-C005-p47-56.indd 56 31-07-2020 20:21:44