Effects of Practical Physics Knowledge on Students' Academic Achievement: A Study of Pankshin Local Government Area of Plateau State, Nigeria

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Abstract

The work investigated the effects of practical Physics knowledge on academic achievement in Physics as a school subject. The research was carried out at Pankshin Local Government Area of Plateau State, Nigeria and the design employed was the pure experimental design. Sixty (60) Senior Secondary School (SSS) II students from three (3) Secondary Schools in Pankshin Local Government Area of Plateau State, Nigeria were tested using a 20-item Physics Achievement Test (PhysAT) whose reliability was 0.70. The t-test statistic was used to test the hypotheses formulated for the study. The analyses revealed that students exposed to practical Physics knowledge achieved higher in Physics ($\overline{X}$ = 61.5) than students who were not exposed to practical Physics knowledge ($\overline{X}$ = 50.5). Furthermore, there was no significant difference in the mean PhysAT scores of male ($\overline{X}$ = 62.33) and female ($\overline{X}$ = 59.33) students exposed to practical Physics knowledge.

One of the aims of science education is to help students gain an understanding of as much of the established body of scientific knowledge as it is related to their needs, interests and capacities (Mankilik, 2011). This is in line with the general aim of teaching science as stipulated in policy on Nigeria's education [Federal Republic of Nigeria (FRN), 2004].

Physics has been as the most utilized basic science subjects in most technology and technology-related professions. Hence the gigantic role that Physics plays in the socio-economic development of a nation must not be undermined. Boyo (2010) viewed

Physics as a course of study which is perceived to be experimental and that almost all aspect of life science, both living and non-living has something to do with Physics, ranging from Engineering to Mathematics, Biology and Chemistry. The understanding of practical Physics may help students to learn Physics concepts. Such is necessary as modern society requires some understanding of the nature of scientific knowledge in order to evaluate claims that may affect their everyday decisions (for example, about energy resources and environment) and to reach informed views on public policy matters (for example, methods of generating electricity).

Practical knowledge, according to James (2000), refers to that knowledge that is connected with reality rather than ideas and theories. It is the knowledge acquired through the practical approach to carrying out scientific investigation and teaching. In the words of Mankilik (2011:4),

> *Practical approach means any teaching and learning activity which involves at some point the students (learners) in observing or manipulating real objects and materials. The term practical is used in preference to laboratory work because location is not a salient feature in characterizing this kind of activity. This means that the observation and manipulation of objects could take place in a school laboratory (a specialized defined building equipment with apparatus) or in an out-of-school (outdoor laboratory) setting, such as the learners home (boiling and freezing of water, switching on/off light, A.C, TV, Radio, using mirrors, laundry, making soap to bubble and foam, etc), mechanic, blacksmith, carpenters (workshops), industry, school farm/garden, the environment, etc when studying aspects of Chemistry, Biology, Physics, Health science, Basic science and so on.*

It then means that learning of Physics is incomplete without the acquisition of practical Physics knowledge. Physics, according to Ndupu & Okeke (2007), is a practical subject and every scientific discovery has been made as a result of experimental investigation. If students are to understand the theoretical aspect of Physics taught in the classroom so as to translate them to real live situations, they must master the techniques of practical Physics.

Over the years, students of Physics in secondary schools have found it extremely difficult to perform well in the subject (Nelkon & Ogborn, 1998). The development of any nation, which depends on science and technology, hinges on science education. In Nigeria, in spite of the enormous role (importance) that Physics provides for national development and the efforts of government and other stakeholders in improving science education, Physics results in most certified examinations like the West African Senior School Certificate Examination (WASSCE) have not been

satisfactory. These have been attributed to many factors which include utilization of inappropriate teaching methods in schools, poor quality school science teachers, school location and students' poor attitude and interest towards Physics.

It had been reported that a problem confronting Physics students in Nigeria is that some of the teachers are poorly qualified. Some of them are unfamiliar with the names and uses of some science equipment and facilities (Odili, 1990; Akpan, 2001).

Another problem confronting the learning of Physics in schools is the lack of equipment and facilities, and their inadequacy (in some case) which hinder the effectiveness of learning of Physics in schools (Jegede & Okebukola, 1995; Nwaokolo, 1998; Anikweze, 2000; Anele, 2001).

The attitude and interest of students towards Physics in schools have been known to be poor and a hindrance to the learning of Physics for a long time now (Eze, 1996; Nwaokolo, 1998; Onyedineke, 2002).

Allocation of time to Physics in school lesson time-table is insufficient. Activities to be undertaken, therefore, suffer. This constitutes an enormous problem to the learning of Physics in schools (Mistler-Dackson & Butler, 2000; Polman, 2000).

Science teacher stress is another problem confronting the learning of Physics in schools. A stress results when the teacher's experience is unpleasant, giving rise to tension, frustration, anger, anxiety and depression. Poor working conditions resulting from lack of resources for teaching have been identified as sources of stress in some parts of the world (Akpan, 2001). This is not a unique case in the Nigerian context. Physics teachers in Nigeria find these poor working conditions stressful (Jegede and Okebukola, 1995). Such a teacher who is often subjected to stress especially within the work environment cannot perform optimally. Consequently, learning of Physics concepts suffer.

The utilization of inefficient teaching strategies is another hindrance reportedly confronting the learning of Physics in schools (Adeyegbe, 1993, Griffin, 1994; Rennie & McClafferty, 1995). Recent time calls from almost all quarters of Nigeria for government to rescue the education sector from complete collapse attest to the already identified problems confronting the learning of Physics leading to the dwindling standard of Physics education.

Another likely factor contributing to the poor achievement in Physics in schools is the poor acquisition of practical knowledge of most physics concepts in order to supplement the theoretical knowledge of the concepts. Acquisition of practical

knowledge should enable the students to develop certain basic manipulative skills and scientific attitudes for the simplification of Physics concepts. Digby (1989) opined that the teaching of practical Physics in many schools has not been adequately weighted. Many students in secondary schools do practical Physics only towards the end of their studies. They, therefore, lack the necessary basic experimental techniques which can only be acquired through regular exercise from the beginning of the Senior Secondary School course. They are also incapable of applying measurements and graphical analysis to the solution of practical problems in Physics. Such students are deprived of the knowledge of the relationship between theory and practical, the result being the inability to interpret the numerical and graphical results in terms of theories underlying the experiments. This problem could also negatively affect learning.

It was in the light of the aforementioned that the researcher delved into finding out the effects of practical Physics knowledge on student's academic achievement in Physics as a secondary school subject, in Pankshin Local Government Area of Plateau State, Nigeria.

Research Method

The study population comprised all the Senior Secondary School (SSS) II students that offer Physics as a subject in all the secondary schools in Pankshin Local Government Area of Plateau state, Nigeria. The sample schools used for the research, which were randomly selected, were three (3). A total of sixty (60) SSS II students were involved in the study as sample-20 Students from each of the three secondary schools used. The sample was drawn using the stratified random sampling technique. SSS II students were used for the study as the SSS III students were about writing their WAEC WASSCE.

The research design used for the study was the pure experimental research design. A 20-item Physics Achievement Test (PhysAT), to test formulated hypotheses, was developed by the researcher using past WAEC WASSCE question papers and was validated by two experts in Educational Measurement and Statistics and two other experts in Physics Education. The Kuder-Richardson (KR-21) reliability method, a measure of internal consistency, was used to estimate PhysAT's reliability. It was found that the reliability of PhysAT was 0.70. PhysAT was designed to ascertain whether knowledge of practical Physics has any effect on student's academic achievement in Physics as a secondary school subject.

The pretest-posttest control group design of the pure experimental design was used. There were two groups (experimental and control) drawn from the same population. Assignment of subject to group was through randomization.

Both the experimental and control groups were exposed to treatment before the administration of PhysAT (posttest). The control group was only exposed to learning of measurements, speed, velocity, and acceleration concepts, as spelt out in Nigeria's Physics Curriculum for Senior Secondary School through the lecture method. The experimental group was exposed to the learning of same concepts through both lecture method and exposure to practical knowledge of the concepts in the laboratory. The researcher personally administered the treatments to both groups over a period of eight (8) weeks (four lesson periods per week per group). Since the schools used were close to each other, the lessons were carried out in one of the three (3) schools used for the research; with the permission of the schools' authorities. The lessons were conducted outside the normal school period so as not to interfere with planned school activities.

After the duration of treatments, PhySAT was administered with the assistance of the Physics teachers in the sample schools. The researcher personally administered PhySAT to the sample and retrieved it on the spot.

Prior to the treatment, a pretest was administered to the two groups. The mean achievement scores for the control and experimental groups were 46.5 and 45.0 respectively. A separate test instrument, apart from PhySAT, was used during the pretest.

The researcher was also interested in finding out whether there is a difference in the Physics achievement of male and female students exposed to the knowledge of practical Physics.

In order to address the problem of the study, the following research questions were asked:

a. What effect does exposure to practical physics knowledge have on achievement in physics as a subject?
b. To what extend does the exposure to practical physics knowledge in female students differ from that in their male counterparts?

Results

The t-test statistic (pooled variance formula) was employed to test the hypotheses formulated for the study.

Hypothesis One

There is no significant difference between the mean Physics achievement scores of students exposed to practical Physics and students not exposed to practical Physics.

Data in table 1 indicates the result of the t-test analysis on hypothesis one.

Table 1: t-test Analysis on Hypothesis One

Group	N	$\bar{X}$	SD	t-cal	t-critical	df
Experimental	30	61.5	19.12	2.273	1.671	58
Control	30	50.5	18.99			

The calculated t-value (2.273) was greater that the critical t-value (1.671) from tables (table 1), at 58 degrees of freedom and 0.05 level of significance. Therefore, the hypothesis was rejected. Implication is that there was significant difference between the mean Physics achievement scores of students exposed to knowledge of practical Physics and those not exposed to it.

Hypothesis Two

There is no significant difference between the mean Physics achievement scores of female students who are exposed to practical Physics and their male counterparts also exposed to practical Physics.

Data in table 2 shows the result of the t-test analysis on hypothesis two.

Table 2: t-test Analysis Performed on Hypothesis Two

Gender N	$\bar{X}$	SD	t-cal	t-critical	df
Male	15	62.33	18.06		
			0.547	1.701	28
Female	15	59.33	12.63		

From table 2, the calculated t-value (0.547) was less than the critical t-value (1.701) from the table for Critical values of t, at 0.05 level of significance and 28 degrees of freedom. Therefore, the hypothesis was not rejected. This signifies that there was no significant difference in the mean achievement score of male students exposed to practical Physics and that of their female counterparts also exposed to practical Physics.

Discussion

Physics, as one of the basic science subjects in secondary schools, has for long been in the secondary school curriculum of Nigeria. Owing to the fact that Physics forms the basis of scientific and technological advancement of the contemporary world, FRN (2004) stressed the use of practical approach to teaching science subjects (Physics inclusive) in Nigerian secondary schools. Mankilik (2011) opined that it will rather be a

mismatch to teach science without practical. Doing so will amount to swimming without water.

Finding from the study indicates that performing practical Physics facilitates students' understanding of Physics concepts (Table 1). This is so because students find it easier to understand concepts that are related to their experiences. Mankilik (2004) corroborated that it is hard to imagine a Physics student appreciating what the spectrum of white light looks like without ever having observed what happens when a ray of light passes through a prism. Through performing experiments relevant to the concepts being learned, interests of students will be aroused, the learning process will be reinforced and students will be equipped with sufficient experiences that will enable them embark on similar experiments accurately and recall concepts and their applications during examinations and in the society.

Finding from table 2 shows that there is no significant difference in the academic achievement in Physics between male and female students who are both exposed to practical knowledge in Physics. This implies that high achievement in Physics depends largely upon the students' participation in practical Physics, irrespective of gender.

Conclusion

Physics lessons without practical are like having a world of men without women, or vice versa. This statement underscores the importance of practical Physics in learning Physics. If the aim of science is to be achieved in Nigeria, science teaching in schools needs to be revisited.

Recommendations

It is evident, from the findings of this study, that knowledge of practical Physics has positive effect on students' achievement in Physics. The researcher, therefore, proffered the following recommendations:

1. Since exposure to practical Physics knowledge has been found to facilitate learning of Physics concepts, secondary school laboratories should be well-equipped with laboratory apparatus. Where laboratories are non-existent, laboratories should be built and well-equipped for the purpose of enhancing learning.
2. By complementing theoretical work with practical work, gender disparity in terms of academic performance is drastically reduced. Physics teachers should be re-orientated so that they develop positive attitude towards complementing Physics lessons with sufficient practical work.

References

Adeyegbe, S. O. (1993). The senior secondary school science curricular and candidate performance: An appraisal of the first cycle of operation. *JSTAN 28* (1&2), 3-12.

Akpan, E. U. U. (2001). Government and Science and Technology Education in Nigeria. *Journal of Educational Issues*. 1(1), 101-113.

Anele, D. (2001, April 15). Bitter old wine in old wine skin. *Sunday Vanguard. 23* (10603), 8.

Anikweze, C. M. (2000). Trends and challenges of science and technology education in the 21st century: Implications for teacher education. *JENDIC, 4*(1), 105-115.

Boyo, A. (2010). *Identifying Problems Associated with Studying of Physics in Lagos State, Nigeria.* Retrieved on 2nd September, from http://www. wcpsd.org/ posters/education/Boyo_Adenike_1.pdf

Digby, S. (1989). *Practical Physics.* England: Basil Blackwell Limited.

Eze, H. O. (1996). Psychological Aspects of Teaching and Learning Science and Mathematics. *Journal of Technology Education, 1* (1), 138-143.

Federal Republic of Nigeria (2004). *National Policy on Education*. NERDC Abuja, Nigeria: Federal Ministry of Information.

Griffin, J. (1994). Learning to learn in information science settings. *Research in Science Education, 24*, 121-128.

James, M. J. (2000). *Ordinary Level Practical Physics.* London: Heinemann Educational Books.

Jegede, O. J. & Okebukola, P. A. O. (1995). Personal and demographic predictors of science teachers' levels of occupational stress. *JSTAN, 30*(1&2), 3-12.

Mankilik, M. (2011). *Practical Approaches to the Teaching of Science.* A keynote address Ddelivered at the workshop organized by School of Sciences, Federal College of Education, Pankshin, Nigeria on 13th July.

Ndupu, B. L. N. & Okeke, P. N. (2007). *Certificate Practical Physics*. Lagos: Longman (Nig). Plc.

Nelkon, M. & Ogborn, J. (1998). *Advance Level Practical Physics*. Ibadan: Heinemann Educational Books (Nig) Ltd.

Nwaokolo, P. O. (1998). Problems and prospects of equal educational opportunity in the 6-3-3-4 system. *JENDIC, 2*(1), 29-35.

Odili, G. O. (1990). *Teaching Mathematics in Secondary Schools*. Obosi: Anachima Educational publishers.

Onyedineke, O. C. (2002). *The Changes and Future of Science Education in Nigeria in the New Millennium.* A Paper Presented at the Seminar Organized by School of Education, College of Education Azare, Nigeria from 3rd – 5th September.

Polman, J. L. (2000). *Designing Project – Based Science Instruction: Connecting Learners Through Guided Inquiry.* New York: Teachers College Press.

Rennie, L. & McClatterty, T. (1995). Using visits to interactive science and technology centres, museums, aquaria and zoos. *Journal of Science Teacher Education, 6*(4), 175-185.