

Teachers' Characteristics and Availability of Laboratory as Predictors of Senior School Students' Performance in Physics in Ilorin, Nigeria

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Abstract

This study investigated teachers' characteristics and availability of laboratory as predictors of physics students' performance in Ilorin. 40 teachers and 400 students formed the sample size. The instruments used were PTQ and PSPT. The PSPT was a set of 15 theory questions on the topics taught by the teachers to the students. The scores were used for data analysis and the hypotheses were tested using t-test. The findings that the general academic performance in Physics was fair (average); however, students that were taught by qualified physics teachers performed better than those taught by unqualified teachers, students taught by experienced teachers performed better than those taught by less experienced teachers, and students exposed to the use of laboratory performed better than those not exposed to the use of the laboratory. It was recommended that science teachers should ensure that students are exposed to hands-on activities in their schools.

Keywords: Teachers' characteristics, Laboratory, Physics, Student performance

Introduction

Science consists of the formulation and testing of hypotheses based on observational evidences; experiments are important where applicable, but their major function is to simplify observation by imposing controlled conditions. The National Policy on Education (FRN, 2013) pays special attention to science education; one of the stated objectives of science education is to inculcate the spirit of inquiry and scientific thinking in students. The national policy on education also put special importance on the study of Deleted science and technology. The role of science in the development of any nation cannot be over emphasized. Nigeria has also endeavored to raise the standard of science teaching through curriculum development.

Omosewo (2012) asserted that science teaching commenced around 1859 in Nigerian secondary schools. It started with the teaching of nature study and later expanded to the three separate sciences, (Physics, Chemistry, and Biology). The Ministries of Education inspected and recommended schools for recognition of their science teach-

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ing and learning and for West African Examinations Council's approval to present candidates for science subjects at the school certificate examinations. In most cases, the order of approval was usually Biology, Chemistry, and Physics, in a few cases, a school had approval for the three science subjects at the same time (Adeyemo, 2003). The importance of physics as a yardstick for technological advancement cannot be over-emphasized, since physics as a scientific discipline is one of the fundamental ingredients of technology. Olaniyan, Omosewo, and Nwankwo (2015) stated that "Physics provides the basic knowledge and understanding of principles, whose applications contribute immensely to the quality of life in the society. There exists a strong link between progress in physics and technological advancement of the society. It provides the theory behind technology and it is the foundation of any theoretical and applied knowledge."

Eraikhuemen and Augustine (2014) observed that without adequate foundation and knowledge of physics in our society, scientific and technological advancement in Nigeria would remain a mirage. The study of physics can lead to several scientific fields and professions such as engineering, manufacturing, mining and construction industries. Apart from this, the knowledge of physics plays a very significant role in the economic development of any nation.

It is as a result of the decline in the enrolment in physics which precipitated the first set of science curriculum reforms worldwide in the early 1960s (Daso, 2013). However, despite the relevance of physics to the scientific and technological development of a nation, despite the gains in curriculum development and efforts aimed at implementing, improving and popularizing science, technology and mathematics, available reports show students' underachievement in the sciences, most especially in physics (WAEC Annual Report, 2010-2014) as shown in Table 1.

Table 1.
Candidates' Enrolment and Performance in Basic Science Subjects WAEC (2010-2014)

Year	Biology			Chemistry			Physics		
	Total sat	Credit Pass	%	Total sat	Credit pass	%	Total sat	Credit pass	%
2010	1,300,418	427,644	32.88	465,643	236,059	50.70	463,755	237,756	51.27
2011	1,505,199	579,432	38.50	565,692	280,250	49.54	563,161	360,096	63.94
2012	1,646,150	587,044	35.66	627,302	270,570	43.13	624,658	429,415	68.74
2013	1,648,363	852,717	51.73	639,296	462,517	72.34	637,023	297,988	46.77
2014	1,365,384	766,971	56.17	636,268	397,649	62.49	635,729	386,270	60.76

Source: The Statistics Section, West African Examinations Council (WAEC) Office, Yaba, Lagos (2014) and Olorundare, A.S. (2014) *Theory into practices: Beyond Surface Curriculum in Science Education*.

Table 1 shows that students' performance in the basic sciences is worrisome. With a criterion performance at credit level, in physics, a range of 44–64% ensued but with

an increased performance to 68%. Performance in physics is generally better, and this can be understood in the sense that fewer students enroll for physics with the general belief that it is more difficult than others. Consequently, only students who are confident of themselves usually enroll for the subject (Olorundare, 2014).

In order to improve physics education as well as other science education, government policies have been considered and reflected upon. Such government policies aimed at boosting and improving science education. For instance, the National Policy of Education (FRN, 2013), placed high premium and emphasis on qualitative science education. Qualitative science education could only be achieved when competent teachers are available. Teacher's effectiveness could be seen as a degree to which a teacher achieves the desired effects upon students. Thus, for a teacher to be competent, he must, therefore, possess the requisite knowledge and skills in the process of teaching (Ogunmakin, 2013).

Onoshakpokaiye (2011) stressed that teachers have various role to play in the process of teaching and learning and that they need to be competent in their own area of specialization and also be able to apply different methods and strategies of teaching and understand the learning processes of students. Ololube (2009) observed that teachers have to be able to fuse their subject matter knowledge and pedagogical knowledge into pedagogical content knowledge in their everyday activities in the classroom. The National Policy on Education (FRN, 2013) rightly remarked that no education systems may rise above the quality of its teachers. This further underscores the Federal government's effort not only to sensitize the nation to the importance of quantitative and qualitative teacher education but also to actually produce teachers who are highly motivated, conscientious and efficient. It is in an attempt to accomplish this goal that the Federal government decided that "all teachers in the educational institution shall be professionally trained" and that colleges of education, institutes of education, national teachers' institute, polytechnics shall be charged with the responsibility of giving the must cherish professional training.

Hanushek and Rivkin (2006) emphasized that the quality of the education system depended on the quantity, quality, and devotion of its teaching work force. Similarly, Fajonyomi (2007) stated that the success or failure of any educational program rests largely on the adequate availability of qualified, competent and dedicated teachers. According to Abe and Adu (2013), a teaching qualification or teacher qualification is one of a number of academic and professional degrees that enables a person to become a registered teacher in primary or secondary school. Such qualifications include but are not limited to, the Postgraduate Certificate in Education (PGCE), Professional Diploma in Education (PDE), Bachelor of Education (B.Ed.) and Nigeria Certificate in Education (NCE). To this end, Adeniyi, Ogundele, and Odetola (2014) stated that for teaching to be rewarding and effective in Nigeria, qualification of teachers in terms of

prescribed Certificate should not be relegated rather prospective teachers and teachers already on the job who do not possess the minimum required academic qualification should ensure that they go for training so as to be certified and qualified professionals.

The teaching of physics at the secondary level is meant to develop essential scientific skills in the learners to prepare them for technological application in order to stimulate and enhance creativity in them. Physics is one of the science subjects taught at the senior secondary level of the Nigerian Educational system. Physics offers the students the opportunity to think critically, to reason analytically and to acquire the spirit of inquiry. Science teaching and learning in schools was, in fact, a privilege. This laudable objective would not be realized if the students were taught by teachers who could not properly and adequately disseminate the concepts to the students. Physics is one of the pivotal subjects in technology, its effective teaching must be handled with all seriousness. The competence of the physics teachers in this regard would be of immeasurable value. It is one thing is to be well grounded in the conceptual understanding of a subject, but another to be well acquainted with the best method to pass the concepts across to the learners for proper comprehension. A professional teacher would be desirable in this regard (Owolabi & Adedayo, 2012).

Teaching experience is also as important as the teacher's qualification. According to Apata (2007) experience serves to nourish teachers through exposure to training, rearing, and upbringing and socialized them into teaching the culture that translates into good pedagogic technique and problem-solving strategies required of physics students. Anastasia (2015) observed that teachers with long experience use better classroom management approaches and adequate teaching methods that encourage students' autonomy and reduce teacher control, thus taking responsibility for students learning needs, managing classroom problems and keeping students on tasks. Berliner (2004) stressed that time and experience plays a similar role in the development of pedagogical expertise. Kosgei, Mise, Odera, and Ayugi (2013) opined that experienced teachers have a richer background of experience to draw from and can contribute insight and ideas to the course of teaching and learning. They are open to corrections and are less dictatorial in the classroom. Furthermore, experienced teachers are considered to be more able to concentrate on the most appropriate way to teach particular topics to students who differ in their abilities, prior knowledge, and backgrounds. They believe that teachers attendance of in-service training is one of the indicators of experience. In addition, the more the teachers know about students, the better the teachers can connect with them and the more likely they will be able to benefit from the teacher's experience in reconstructing their world.

Apata (2013) commented that a professional becomes more efficient and more effective as he stays longer on his profession by learning more and more on the job, learn more about the difficulties students encounter while learning. His grooming experience helps students to gain insight into how to overcome difficulties in learning.

This implies that the more experienced a teacher is, the more efficient and effective he becomes in teaching and the more his students understand his lessons and possibly perform better in the examination.

Physics is a science that involves lots of practical activities. Isaac, Daniel, and Olusola (2014) observed that the most important feature of effective physics teaching is to support theoretical explanations with actual practices in the laboratory. Thus, physics teaching in secondary schools should develop essential scientific skills in the learners capable of infusing into them creative mind to enhance their technological applications. It thus requires that adequate laboratory facilities needed be provided for effective teaching and learning of practical physics (Adedayo & Owolabi, 2014).

According to Uhumuavbi and Okodugha (2014), the use of laboratory as a method of teaching science helps the students to develop manipulative skills. It leads to better retention of information and also the development of favorable attitudes towards school subjects. The students during the use of laboratory are active participants who acquire more knowledge by performing experiments. The method makes the students become familiar with such mental processes as observing, inferring, classifying, measuring and data interpretation. Thus, learning becomes engaging as a result of using concrete materials. Furthermore, they stated that if the laboratory is not in place or not stocked with the needed apparatus, the science teacher will not have materials to teach and guide the students. The absence of these materials may affect student's interest, enrolment, and performance in science.

Danjuma and Adeleye (2015) found that lack of effective utilization of laboratory apparatus and equipment was responsible for students' poor performance. Similarly, Isaac et al. (2014) also revealed that a significant difference existed in the achievement in physics of low performing students exposed to laboratory-based instructional intervention and those exposed to conventional teaching method.

The present researchers believe that the availability of laboratory as well as teachers' qualifications and experience might predict to a large extent the outcome of senior school students' performance in physics since laboratory activities is an essential part of the teaching and learning of physics. Therefore, the researchers were interested in combining teachers' characteristics and availability of laboratory to determine their prediction of students' performance in physics.

Purpose of the Study

The main purpose of this study was to investigate teachers' characteristics and availability of laboratory as predictors of Physics students' performance in Ilorin, Nigeria. The study specifically sought to research:

1. The general academic performance of students in Physics
2. Whether teachers' qualifications will influence students' academic performance in senior school physics.

3. Whether teachers' teaching experience will influence students' academic performance in senior school physics.

4. Whether availability of laboratory will influence students' academic performance in senior school physics.

Research Questions

In line with the aim of the study, answers were sought for the following research questions:

1. What is the general academic performance of students in Physics?

Research Hypotheses

The following null hypotheses were tested in this study;

HO1: There is no significant difference between the academic performance of Physics students taught by qualified Physics teachers and those taught by unqualified Physics teachers.

HO2: There is no significant difference between the academic performance of Physics students taught by experienced Physics teachers and those taught by less experienced Physics teachers.

HO3: There is no significant difference between the academic performance of students exposed to the use of laboratory and those not exposed to the use of the laboratory.

Research Method

This is a descriptive study of survey type in which questionnaire was used to elicit response from the teachers. The population for the study comprised all senior secondary school teachers and students. The target population consisted of all physics teachers and senior secondary school II (SS II) physics students in Ilorin South Local Government Area of Kwara State, Nigeria. The sample of 40 senior secondary schools was drawn from the 74 senior secondary schools in Ilorin using purposive sampling technique. The sample consisted of qualified and un-qualified teachers, experienced and less experienced teachers and schools with and without laboratories. A total of 40 teachers and 400 students from the selected schools formed the sample size.

Research Instrument

The instruments used for this study were Physics Teacher Questionnaire (PTQ) and Physics Students Performance Test (PSPT). The PSPT was a set of 15 theory questions. It was drafted from past West African Senior School Certificate Examination (WASSCE) physics question papers already validated by the West African Examinations Council (WAEC), on the topics already taught by the teachers to the students. The two instruments were validated by three senior physics teachers from secondary school and two science educators lecturers in a university. Permission was sought from

the selected schools by the researchers, the researchers then met with the teachers and students separately to seek their consent and explained the purpose of the study as well as their level of involvement with the study. The consent of the parents was sought through a parent consent form given to each student and which was filled and returned to the researchers. The PSPT was administered to the students by the teacher before their terminal examination and marked. The scores were used for data analysis and the hypotheses were tested using t-test analysis.

Analysis

Research Question: What is the general academic performance of students in Physics?

As shown in Table 2, the mean score 27.79 was obtained out of the total 50marks with a minimum score 16 and maximum score 41. This implies that the general academic performance of students in Physics was fair (average).

Table 2.
Students' Academic Performance in Physics

Variable	No. of students	Mean Score	S.D	Maximum Score	Minimum Score
PSPT	400	27.79	1.63	16	41

Hypothesis one: *There is no significant difference between the academic performance of physics students taught by qualified physics teachers and those taught by unqualified physics teachers.*

Table 3 shows that the t-value 2.276 is obtained with a p-value of 0.012 computed at 0.05 alpha level. Since the p-value of 0.012 is less than 0.05 level of significance, the null hypothesis one is not accepted. Therefore, there is a statistically significant difference in the performance of Physics students taught by qualified and those taught by unqualified Physics teachers ($t_{\{398\}} = 2.276, p > 0.05$). The significant difference was shown by students that were taught by qualified teachers with higher mean score (15.824) than those taught by unqualified teachers with the mean score (12.116). Thus, students taught by qualified teachers performed better than students taught by unqualified teachers.

Table 3.
t-test Statistics According to Taught by Qualified and Unqualified Physics Teachers

Students taught by	No	Mean	S. D.	df	t-value	Sig	Remark
Qualified Teacher	176	15.824	1.352	398	2.276	0.012	Not Accepted
Unqualified Teachers	224	12.116	2.268				

$p < 0.05$

Hypothesis Two: *There is no significant difference between the academic performance of physics students taught by experienced physics teachers and those taught by less experienced physics teachers.*

Table 4 shows that the t-value 2.195 was obtained with a p-value of 0.002 computed at 0.05 alpha level. Since the p-value of 0.022 is less than 0.05 level of significance, the null hypothesis two is not accepted. Therefore, there is a statistically significant difference in the performance of Physics students that were taught by experienced teachers and those taught by less-experienced teachers ($t_{\{398\}} = 2.195, p > 0.05$). The significant difference was shown by students that were taught by experienced teachers with higher mean score (16.213) than those taught by less-experienced teachers with the mean score (11.736). Thus, students taught by experienced teachers performed better than less-experienced teachers.

Table 4.
t-test Statistics According to Taught by Experienced and Less Experienced Teachers

Students Taught by	No	Mean	S. D.	df	t-value	Sig	Remark
Experienced Teachers	219	16.213	1.254	398	2.195	0.002	Not Accepted
Less-Experienced Teachers	181	11.736	2.355				

$p < 0.05$

Hypothesis Three: *There is no significant difference between the academic performance of students exposed to the use of laboratory and those not exposed to the use of the laboratory.*

Table 5 shows that the t-value 2.651 was obtained with a p-value of 0.006 computed at 0.05 alpha level. Since the p-value of 0.006 is less than 0.05 level of significance, the null hypothesis two is not accepted. Therefore, there is a statistically significant difference in the performance of Physics students that were exposed to the use of laboratory and those not exposed to the use of laboratory ($t_{\{398\}} = 2.651, p > 0.05$). The significant difference was shown by students that were exposed to the use of laboratory with higher mean score (16.153) than those not exposed to the use of laboratory teachers with higher mean score (11.814). Thus, students taught by the use of laboratory performed better than those taught without.

Table 5.
t-test Statistics According to Exposed and Not Exposed to the Use of Laboratory

Students	No	Mean	S. D.	df	t-value	Sig	Remark
Exposed to the Use of Lab	187	16.153	1.181	398	2.651.	0.006	Not Accepted
Not Exposed to the Use of Lab	213	11.814	1.731				
p < 0.05							

Summary of Findings

From the analyses and interpretations of the data collected for the study, the following are the major findings of the study:

1. The general academic performance of students in Physics was fair
2. Physics students taught by qualified physics teachers performed better than those taught by unqualified physics teachers.
3. Physics students taught by experienced physics teachers performed better than those taught by less experienced physics teachers.
4. Physics students exposed to the use of laboratory performed better than those not exposed to the use of the laboratory.

Discussion

The findings revealed that students taught by qualified physics teachers performed better than those taught by unqualified teachers. The finding is in line with the findings of Thomas (2014), Owolabi and Adedayo (2012) and Unanma, Abugu, Dike and Umeobika (2010). Akinsolu (2010) also pointed out that availability of qualified teachers determines the performance of students in schools. This is why there is a need for Ministries of Education at both state and federal levels to ensure that teachers that are employed to teach especially at the senior school level are professionally qualified. The study shows that the poor performance of students in Nigerian schools could

be traceable to lack of availability of qualified teachers. This is in line with Thomas (2014) who posited that students taught by professionally qualified teachers performed differently from those not taught by professionally qualified teachers.

It was also found out that students taught by experienced teachers performed significantly better than those taught by less experienced teachers. This is in agreement with the study of Adeyemi (2007) who opined that schools having experienced teachers achieved better results than schools with less experienced teachers. Similarly, Apata (2013) revealed that students taught by experienced teachers were more successful than those taught by less experienced teachers. Teachers' experience is, therefore, a major predictor of students' performance because it enables the teacher to improve his teaching skills so as to become more efficient and effective as he stays longer on the job. This finding is also in agreement with that of Adeyemi (2007), Apata (2013) and Ewetan (2015).

The findings of this study further showed that the academic performance of students exposed to the use of laboratory was higher than those not exposed to the use of the laboratory. This shows that the use of laboratory enhances the performance of Physics students to a large extent. Hence the importance of well-equipped science laboratories in senior secondary schools cannot be over-emphasized. Bello (2012) opined that the use of appropriate teaching equipment and teaching method is critical to the successful teaching and learning of physics. The finding of this study is in line with that of Danjuma and Adeleye (2015), Isaac et al. (2014) and Adeyemo (2012).

Conclusion

The study concluded that students taught by qualified physics teachers performed better than those taught by unqualified teachers. This reveals that teachers' qualification predicted the academic performance of senior school physics students in Ilorin. The study also concluded that students taught by experienced physics teachers performed better than those taught by less experienced physics teachers. This implies that teachers' experience also predicted the academic performance of senior school physics students in Ilorin.

Finally, the study further concluded that students exposed to the use of available laboratory facilities performed better than those not exposed to the use of available laboratory facilities. This shows that availability of laboratory predicted the academic performance of senior school physics students in Ilorin.

Recommendations

The following recommendations are considered relevant based on the findings of this study:

1. There is the need for Ministries of Education both at state and federal levels to ensure that teachers that are employed in schools to teach certain subjects are profes-

sionally qualified to teach the subject and should possess requisite teaching skills and be competent in the subject area. This will make them become more productive and will generally help to improve the academic performance of students in the subjects.

2. There is the need for teachers to embrace the importance of personal teacher development. This will enable them to gain better experience in their teaching profession which will ultimately improve the academic performance of their students.

3. Government at all levels should ensure that schools are provided with adequate laboratory equipment for the teaching and learning of science. This will enhance students understanding of science and positively impact on their overall academic performance.

4. Science teachers should ensure that their students are exposed to hands-on activities in their schools as this will not only improve their understanding of the subject but will also help them in developing creative abilities.

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