CORRELATION IN THE PERFORMANCE OF STUDENTS IN THEORETICAL AND PRACTICAL PHYSICS IN DEMONSTRATION SECONDARY SCHOOL, AHMADU BELLO UNIVERSITY, ZARIA, NIGERIA.

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Abstract

This study which was an attempt made to investigate the relationship between the students' performance in theoretical physics and practical physics scores of two hundred (200) students' internal examination in Demonstration Secondary School, Ahmadu Bello University, Zaria, was prompted as a result of poor academic performance of students in the senior secondary examination in physics. The student's numbers were coded accordingly with M_1-M_n andF_1-F_n (where M = Male student and n = the total number of male student while F = Female student and n = the total number of female student) in line with their scores in theoretical physics and practical physics. The study was a descriptive of correlational type where students' results in theoretical physics and practical physics were compared. The Statistical methods used for analysis were Pearson product moment correlation coefficients and the z-test statistic. The result indicated that theoretical physics and practical physics scores were significantly related but there was no significant relationship in students' performance based on gender. Thus, the theory knowledge the students have certainly will influence their performances in the laboratory exercises. It is therefore recommended that, equal attention should be paid to the teaching of both theory and practical Physics because the both influence students' performance; Government should equally provide additional laboratory equipment to schools to strengthen more the practical ability of students; and the Physics teachers should always update their knowledge from time to time to enable them know current happening in physics, through seminar, conferences and workshop among others.

Keywords: *Correlation, performance, Theoretical and Practical*

INTRODUCTION

The knowledge of the basic sciences in general and physics in particular forms the bedrock for any scientific development of all nations and most importantly in Nigeria as a developing nation. As for Nigeria in this 21st century, significant attention is being given to education as a key to sustainable development, peace and stability. Such recognition makes education a crucial means for effective participation not only in the socio-economic development of Nigeria but also in the on-going rapid globalization (Ikoh, 2007; Agba, Ushie&Agba, 2007). The Nigerian National Policy on Education (FME, 2004:4) refers to education as "instrument par excellence for effective national development". The National Policy on Education further specifies that secondary school education should equip students to live effectively in modern age of science and technology (Federal Ministry of Education - FME 2004). Despite this reality, records have shown that students' performance in Senior Secondary Certificate of Examination (SSCE) is quite below average (Ikoh, 2007).

Physics is one of the science subjects taught at the senior secondary school level of the Nigeria educational system. Despite the importance of this subject as one of the fundamental ingredients of technology, it is plagued by persistent low enrolment and poor performance of students (Jordan, 1971; Dial, 1972; Daramola, 1982; Akanbi 1983; Balogun, 1985). Recently, Kola

(2007) reported that academic performance of students in physics in secondary schools is worrisome and called for an investigation. Notable among the causes identified to be responsible for the unsteady state of Physics teaching in Nigeria secondary schools are: very limited number of professionally trained teachers. (Bajah, 1975; Daramola, 1982, 1987), inadequate laboratory facilities and exposure (Daramola, 1982) and poor science background of students at the junior secondary level of education (Daramola, 1982, 1987, Ogunniyi, 1977).Recently, this performance is blamed on teachers (Ashibi, 2005); government's inability to effectively sponsor education and motivate teachers to enhance their productivity (Agba, Ushie, Bassey&Agba, 2009); and it also attributed to classroom variables such as chronic absenteeism, peer group influence and other environmental problems (Ikoh, 2007).

The Operation Reach all Secondary Schools, 2006 report of its survey in Nigeria also indicated that inadequate resources (teachers, facilities, materials and funds) characterize most secondary schools in Nigeria. In the absence of adequate resources, quality education for the attainment of the Millennium Development Goals (MDGs) cannot be realized. The United Nations' International Children's Education Fund (UNICEF, 2007) described quality education as the key to sustainable development, and a major key to the attainment of Millennium Development Goals (MDGs). Nigeria, just like other countries of the world is a partner in the attainment of these goals (United Nations, 2007).

More so, laboratory adequacy which is a school environment factor has been reported to affect the performance of students (Raimi, 2002 &Adeyegbe, 2005). Farounbi (1998) argued that students tend to understand and recall what they see more than what they hear as a result of using laboratories in the teaching and learning of science. It should be noted that the dissemination of knowledge in the practical knowledge acquired by a student compliments the theoretical conceptualization of a particular topic in the sciences.

It is important to therefore assess the internal examination conducted in schools in order to evaluate the performance of the students particularly in physics theory and practical as this will enable the teacher to prepare the students for their external or public examination. The public examination which are conducted by external bodies such as the West Africa Examination Council, (WAEC) National Examination Council, (NECO) among others, where the students are expected to pass with at least a credit which is one of the requisite qualifications for admissions into Nigerian Universities in basic sciences in order to qualify for admission (Joint Admission Matriculation Board, JAMB 2002).

Usmani (2011) viewed Physics, in common with other sciences, is by its very nature a practical subject – both historically and in the modern world. Meanwhile, theoretical Physics, is concerned with predicting and explaining the physical behaviour of nature than the acquisition of knowledge about it, whereas, practical (or experimental) physics regroup all the disciplines of physics that are concerned with data-acquisition, data-acquisition methods, and the detailed conceptualization (beyond simple thought experiments) and realization of laboratory experiments.

Oyewole (1972) asserted earlier that laboratory work forms the foundation on which the structure of Physics is built. He further stated that it is an essential feature of any Physics course, and enables the students to understand the theory of physical laws, concepts and hypotheses that take on far greater meaning when they are checked by observation. In the view of Olabanji (1997), one of the major factors identified to have contributed to poor performance in Physics is lack of emphasis on practical work in the teaching of Physics.

Huan, Haur&Biaowen (2001) on their own part, stated that the laws of physics are founded on experiments and that experiments form the integral part of physics education, and that, it takes a great deal of effort to persuade students to be more enthusiastic towards laboratory learning.Vilaythong& Popov (2008) strongly have the belief that practical activities enhance understanding of Physics theory and phenomena. Olabanji (1997) said for Physics to be effectively learnt, practical lessons are therefore necessary. Some people were of the opinion that male performed better in sciences than their male counterpart. According to Awoniyi (2000) male students performed better, relative to their female counterparts in subjects requiring quantitative ability.

Previous studies showed that there is a significant relationship between students' theory and practical scores (Omole, 1987). Recently, Darko&Ansa-Asare (2009) cited the use of correlation to establish relationships and interactions between parameters. They also opined that correlation is not only used to find out relationship that exists between variables, it can also be used to determine the degree of relationships and variability between students' performance in examination. In the words of Ajileye (2006) insufficient resources for the teaching and learning of science constitute a major cause of student underachievement. These insufficient resources include laboratories, science equipment, and specimens to be used as teaching aids.

Kallats (2001) sees practical works as a means to verify a science principle, or theory already known to the students, a means of determining the relationship between cause and effect and a means of obtaining and learning scientific information. According to Adnam (1988) in Mustapha (2002) the importance of practical work in school science is that it provides learners with opportunities to use scientific equipment to develop basic manipulative skills and practise investigative or inquiry activities, and develop problem solving attitudes needed for future work in science. Omosewo (2006) on his own part, said a deeper understanding of the science and technology process can be achieved through laboratory activities, which encourage active participation and serve to develop critical thinking; they (Laboratory activities) provide concrete experiences to substantiate the theoretical aspect that has been taught.

Statement of the problem

Physics as one of the science subjects comprises of two basic components in its teaching-learning process. The two components are theory (mind-on) and practical (hand-on). The theory aspect is taught in the classroom while the practical aspect goes with verifying or confirming facts, principles and laws or generating new scientific knowledge. Both the theory and practical classes of Physics are made compulsory for the students. The researchers over fifteen years experience as physics teachers at secondary school level and their over ten years experience as Senior Secondary Certificate Examination (SSCE) Examiners in physics show that candidates who achieved highly in the practical physics examination were most likely to pass the subject with credit grade and above. Conversely, those candidates who achieved low were not most likely to pass at credit grade level.

Schools that do not have physics laboratory or laboratories equipped to WAEC or NECO specification or standard are disqualified to register candidates for SSCE (Atadoga, 2009). He (Atadoga, 2009) maintained that both the physics theory and physics practical are in separable in the teaching-learning process of the subject. Physics practical works are enforced in Nigerian schools and given equal recognition as physics theory works. The problem of this study therefore is to determine the correlation in the performance of students in theoretical physics and practical physics in Demonstration Secondary School, Ahmadu Bello University, Zaria Nigeria.

Purpose of the Study

According to the National Commission for Colleges of Education (NCCE) minimum standard (2008) the integration of practical work with theory, have basic knowledge of the organizational concepts and techniques in practical Physics and laboratory management are essential to physics teaching. Thus, the practical work is based on the theory aspect of the subject the students have learnt. This can help one to deduce that a pass in the practical course by a student should lead to a pass in the theory course and vice-versa. It is on this basis that this research study is designed to investigate the relationship between theory and practical courses scores of students in physics at the Demonstration Secondary School, Ahmadu Bello University, Zaria.

Research Questions

The work sought answers to the following questions:

1. How does students' theoretical background in physics affect their later achievements in physics practical?
2. To what extent do boys' academic achievements in physics theory relate to their academic achievements in physics practicals?
3. To what extent do girls' academic achievement in physics theory relate to their academic achievements in physics practicals?

Null Hypotheses

The following null hypotheses are formulated to give guide to the work.

Ho_1: There is no significant relationship between students' scores in practical and theory Physics.

Ho_2: There is no significant relationship between boys' scores in practical and theory Physics.

Ho_3: There is no significant relationship between girls' scores in practical and theory Physics.

METHODOLOGY

The design of this study is a correlation research, which compares recorded scores of students in the category of interest earlier mentioned. Earlier, Kerlinger (1975) said this design called "expost facto" in which the researcher cannot manipulate the independent variables because their manifestation has already occurred. Gay (1996) described correlation research as that involving the collecting of data in order to determine whether and to what degree, a relationship exists between two or more quantifiable variables.

There was no instrument for the purpose of this study. This study is a one short-case study of the previous students' scores of subject were collected from the schools under study. The results are already standardized and approved by the internal examining body of the school. Therefore this could be used for this study (Mari, 1994). The scope of this study is based on the researchers' interest

Population

The research population dealt with all the 289 science students at Demonstration Secondary School, Ahmadu Bello University, Zaria at the time of the study. This school was chosen owing to its reputation of academic excellence and because of its proximity to the researcher.

Sample and Sampling Technique

A total of one hundred and forty (140) samples was selected at random for data analyses.

The sampling technique used is the simple random sampling technique employing table of randomization. This technique involves the use of random numbers in the statistical table. This sampling technique is suitable for this study because it provide the equal chance for each candidate to be selected. Applying (Kerlinger, 1973) table of randomization on this study, the researcher copied the candidates' examination numbers arranged with the serial numbers and for each candidate a random number from the statistical table was assigned. This was how the sample size was selected from both results in the theoretical physics and the practical physics.

The data were collected from the school used in this study. The results were recorded accordingly and student's numbers were coded with M_1-M_n andF_1-F_n,

(where M = Male student and n = the total number of male student and F = Female student and n' = the total number of female student) in line with their scores in theoretical physics and practical physics achievement test. The two data were collected and recorded for data analysis.

The data collected for the study were sorted out. In analyzing the data, the z-test statistic and the Pearson's product moment correlation coefficient was used to determine the degree of relationship existing between the students' academic performance in theoretical physics and practical physics.

Results and Discussion

Null Hypothesis One (Ho_1)

There is no significant relationship between students' scores in practical and theory Physics. To test this hypothesis, scores from the students' academic performance in theory physics were correlated with their scores in practical Physics using the Pearson's product moment correlation coefficient and the z-test statistic. The results obtained are presented in Table 1. From Table 1, the correlation coefficient (r) 0.51 is significant at $P \leq 0.05$. The results show that there is significant relationship between students' theory and practical scores. Therefore, the null hypothesis one is rejected. Hence a pass in the practical physics examination predicts a pass in the theory physics examination. The Z- test statistic used for the data analysis is appropriate in this study since it is descriptive research (Kerlinger, 1975).

Table 1: The Pearson's Product Moment Correlation Coefficient and the z-Test Statistic for the Total Population

	Theory	Practical	Z-calculated	z- critical two-tail	Pearson's Correlation (r)
Mean	19.74	32.8			
Known Variance	42.95	106.66		1.96	0.51
Observations	140	140			

Significant at $P \leq 0.05$ levels

Null Hypothesis Two (Ho_2)

There is no significant relationship between boys' scores in practical and theory Physics. Scores from the student academic performance in theory physics were correlated with their scores in practical Physics using the Pearson's product moment correlation coefficient and the z-test statistic. The results obtained showed an average linear correlation and quite better than that of the overall population. The z-calculated (58.4) was found to be greater than the z-critical (1.96) Therefore, the null

Table 2: The Pearson's product moment correlation coefficient and the z-test statistics for the Boys' population

	Theory	Practical	Z calculated	z critical two-tail	Pearson's correlation (r)
Mean	21.22	32.9			
Known Variance	42.28	106.46		1.96	0.55
Observations	50	50			

Null Hypothesis Three (Ho_3)

There is no significant relationship between girls' scores in practical and theory Physics. Furthermore, scores from the students' academic performance in theory physics were correlated with their scores in practical Physics using the Pearson's product moment correlation coefficient and the z-test statistic. The results are shown in Table 3.

Table 3: The Pearson's Product Moment Correlation Coefficient and the z-Test Statistics for the Girls' Population

	Theory	Practical	Z-calculated	z-critical two-tail	Pearson's Correlation (r)
Mean	19.74	32.8			
Known Variance	37.30	74.20		1.96	0.28
Observations	50	50			

The result in Table 3 shows a very poor linear correlation (r = 0.28) which is poorer than that of the total population and the boys' population. The z-calculated (65.3) was found to be greater than the z-critical (1.96). Based on the Pearson's Correlation r = 0.28, the null hypothesis 3 is therefore retained.

The concept of predictive validity has been described by many authors (Hopkins, 1980 in Faleye and Afolabi, (2005)); Adewolu, 1999 and Popham, 2002). The concept is used to describe the capacity of a measuring instrument to forecast the future performance in a related task. (Graduate Management Admission Council, 2005 in Faleye&Afolabi, 2005). A number of factors are found to potentially affect the predictive validity of test items. These factors include that are capable of affecting reliability (Badmus&Omoifo, 1998), since reliability is essential (but not sufficient) factor in ensuring validity.The data collected were based on the performance of the students in theoretical physics and practical physics from Demonstration Secondary School, Ahmadu Bello University, Zaria. They were analyzed according to the demand of the research questions, hypotheses formulated and the designs of the study.

To answer question one which states: "How does students' theoretical background in physics affect their later performance in Physics practicals?", The result in Table 1 reveals that there is a good relationship between students' performance in theoretical physics and practical physics. The findings of this study may however not be unexpected because; the mode of instruction and examination in the school for practical and theory may suits the subject. There was a strong relationship between students' performance in theory and practical Physics. This indicates that the students must have learnt some theory before the practical is introduced. Moreover, before any of the laboratory exercises is embarked upon, the students must have been given study guides on the theory, which will help them to comprehend the practical. This result is in conformity with that of Carpenter (1965) who opined that as the scores of the students' increases in practical work, a corresponding increment is observed in the scores of theory knowledge acquired in related topics. This finding also agrees with Vilaythong& Popov (2008) who found that

practical activities enhance understanding of Physics theory and phenomena. And also Oyewole (1972) expressed that laboratory work formed an essential feature of any Physics course, and enables the understanding of the students in the theory of physical laws, concepts and hypotheses.

To answer question two that states: To what extent do boys' academic achievements in physics theory relate to their academic achievements in Physics practicals?", the result in Table 2 indicates that there is a good linear relationship between the male students' academic achievements in theoretical physics and their achievements in practical physics. This finding is an improvement in an earlier report by Abraham (1980) which shows that the relationship between the performance of students in theoretical Physics and practical Physics is insignificant. And this may support the findings that boys perform better than girls on item that has to do with calculations (Jacobson, 1990 in Isa &Balarabe, 2009). It could therefore be concluded that using students' performance in one aspect of Physics to determine the performance in the other is more reliable in male than in female students.

The question three states: "To what extent do girls' academic achievements in physics theory relate to their academic achievements in Physics practicals?" The correlation studies revealed that the performance of girls in theoretical physics and practical physics showed a very poor linear relationship. Science laboratory programme comprises mainly of Physics, Mathematics, Chemistry and Biology in which Physics, Mathematics and Chemistry involve a lot of calculation. There is a common belief that females are less mathematically capable than males: This belief is fairly constant across populations (Eccles 1997 in Isa and Balarabe 2009). Classroom studies have shown that this belief is in place when children enter their junior secondary schools (Crawford, Herrmann, Holdsworth, Randall & Robbins, 1989). Although, the differences in performance are usually small, parents and teachers always expect large discrepancies between boys' and girls' performance in Mathematics class (Feingold, 1988).

Physics and Chemistry are major components of science programmes which involve a lot of calculations and reasoning. So the vigor and discipline it takes to study Physics and science in general may affect performance and even enrolment in science laboratory programme. This assertion can be supported by Ohakwe (1999) in Isa and Balarabe (2009) which revealed that female students exhibit poor attitudes towards the study of Mathematics, and this is portrayed in their achievement in this subject in public examinations. Failure in Physics and Mathematics will invariably deter the students from pursuing science based programmes, science laboratory technology inclusive. It is also reported that boys perform significantly better than girls in manipulative reasoning task (Baker & Leary, 1995). Women in general do have a strong presence in science and technology. This is attributed to two broad issues: First, women's perception of their role and functions in the society and societal expectation of their contribution. Women's involvement in science and technology encounters barriers in regard to discipline and academic or professional level of responsibility: Women are divided into two spheres called the management of home and family and the fulfillment of job responsibilities. Family commitments, either as the women's choice or as a result of cultural enforcement, have impaired women's capacity to meet their potentials and put them at a disadvantage in many

science and technology related jobs that are dynamic and qualitative in nature.

Conclusions

From the findings of this study, the following conclusions are made:

- The results of this research showed that performance of students' in theory and practical Physics was significantly related. Therefore it is possible to determine students' performance in Physics when either the score in theory or practical is known.
- There is a good correlation between male students' performance in theory and practical Physics.
- There was no insignificant linear relationship between the female students' performance in theory and practical Physics.

Recommendations

The following recommendations are made based on the findings from this study:

- Teachers should pay equal attention to the teaching of both theory and practical Physics because the two influence students' performance;
- Government should provide more laboratory equipment to schools to strengthen more the practical ability of students;
- Female students should be given special attention in the study of physics so that they could meet up with male counterparts.

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