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Effects of Microscience Kits Intervention, Gender and School Location on Students' Academic Performance in Physics Practicals in Rivers State, Nigeria

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ABSTRACT

This study investigated Microscience Kits Intervention,gender and school location on Students' performance in Physics Practicals in Rivers State. A pre-test, post-test, experimental and control group, quasi-experimental design was adopted for the study. The population of the study consisted of all Senior Secondary (SS1) physics students in Port Harcourt and Ikwerre Local Government Areas of Rivers State. Using a stratified random sampling technique, 40 participants were employed for the study (23 male and 17 female) with a total of 20 students in urban area and 20 students in rural area. A researcher developed "Test on Verification of Ohm's Law" with a reliability index of 0.81 was used for the study.Mean and standard deviation were used for analyzing the data obtained for the research question while Analysis of Covariance (ANCOVA) was used for the testing of the hypothesis at 0.05 level of significance. The findings of the study revealed that male students performed better than their female counterparts when using microscience kits both in urban and rural areas during Physics practicals. Male students that used the conventional lab kits performed better than their female counterparts in the rural areas in Physics practical but in the urban areas, female students performed better than their male counterparts. Based on the findings, it was recommended that female student should be encouraged during teaching and practical sessions of physics. Students in the rural schools should also be encouraged by providing microscience kits where there are insufficient laboratory apparatus which will be used regularly during Physics lessons

Keywords: Gender, Location, Microscience kits, Conventional Laboratory kit, physics practical.

Introduction

Physics is the study of energy and matter and the interactions that exists between them. It is basically an experimental subject. Secondary School Physics in Nigeria is aimed at developing in learners understanding of basic scientific phenomena and application of scientific ideas to everyday life. Physics as a science subject in school is different from other non-Science subjects in the secondary school curriculum in the sense that its lessons involve practical demonstrations, where both students and teachers carry out practical activities. Therefore the approach of learning of Physics makes it a practical subject. 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 or a means of acquiring and learning scientific information.

Kannari and Millar (2004) asserted that practical work is essential for giving students a 'feel' for the problematics of measurement, and an appreciation of the ever presence of uncertainty (or measurement error). More often than not, the purpose of practical work has been verification of some laws or principles with actual materials. As students carry out practical work in Physics, certain science process skills are assessed. Practical activities in physics encourages students to pursue their own enquiries while tapping into their natural curiosity, finding things out for themselves, through the use of scientific apparatus that supports scientific concepts and theories seems natural and developmental, rather than coercive, and may also help the students to remember them better (Millar, 2004).

Many eminent scholars have also carried out studies and confirmed that practical work constitutes an integral part of physics teaching and learning, yet students are not sufficiently exposed to this activity in schools. Onwioduokit (2013) mentioned that the teaching of science has virtually been reduced to the dishing out of factual information by teachers which are as a result of insufficient practical and improper conduct of practical and inadequate laboratory facilities. In the same vein, a study carried out by Adolphus and Aderonmu (2013) on difficulties students encounter in reporting physics practical at the secondary school level revealed that physics students lack understanding of instruction on practical activities, cannot set up practical apparatus as instructed, unable to tabulate obtained values appropriately etc. The findings further reveal that these constraints are as a result of insufficient physics practical activities and / or lack of Physics practical apparatus.

Throughout the world, national education policies are geared towards creating generally scientific literate citizens. Specifically, the National Policy on Education of Nigeria (2004) clearly stated in its aims and objectives that the learner would be given opportunity to acquire basic practical skills for self – reliance and employment. In realization of this laudable objective, practical activities should be an integral part of the teaching and learning of science in secondary schools because it proffers first-hand knowledge of science concepts. However, it is pertinent to state that most developing nations especially in Africa, there is neglect of these components of science education and as a result, they are incapacitated in their quest to achieve optimum developmental strides. Also, these third world countries are mere recipients of technology, perhaps obsolete and dumped by the developed countries. The absence of the laboratory in the schools for science teaching has posed prolonged painful and horrific experience to science teaching, Onwioduokit (2013).

This scenario has relegated scientific inquiry, knowledge, literacy and practical experiences expected of the learners to the background promoting rote learning and memorization of scientific principles. It is obvious that to live in this modern scientific world, first hand contact with the apparatus and materials of physics is essential. It is on this note that the microscale (Microscience kits) practical apparatus were produced. Microscience kits comprises of pre-selected collection of scientific apparatus designed to illustrate particular scientific principles, usually linked to curriculum material. They are small, virtually unbreakable and inexpensive, and have been designed to enhance the quality, relevance and accessibility of science and technology education, also to involve the learner in applying scientific knowledge to real life situation (Rachmanwati, 2013).

Issues on gender have shown that it is the fundamental right of every citizen to access quality science education, both male and female. African scholars' studies have revealed that girl-child education in Africa can best be described as dwindling because it is less than equal to that of their male counterpart, Indabawa (1998), (1999) and Obanya (2003). The UNICEF document on "The National Report on Situation and Policy Analysis in Nigeria" (1993), confirmed that the disparity in science education exists in favour of the male children while Osokoya (2006) claimed that boys generally get a head start in science related activities. However, Onunkwo (1995) in a study to determine if there is variation in students' achievement in science process skills task according to gender reported that girls performed better than boys. Gurian, Henley and Trueman (2001) argued that boys are more difficult to teach science than girls and they (boys) have more learning and discipline problems. The female brain according to them has a learning advantage because it is more complex and active. They however opined that the male brain does excel at abstract thinking and spatial relations. Hazari, Sadler, and Tai(2008) on a study on Gender differences in the high school and affective experience of introductory college Physics students reported that at the secondary level, males have been found to be less committed to working hard on schoolwork and lag behind females in reading and writing skills. Females have reported spending more time doing homework and were less likely to come to class without completed homework. A study carried out by Gonzuk and Chagok (2001) on factors that discourage girls from taking Physics in Plateau State, Nigeria, revealed that girls are easily discourage towards taking physics because of the negative perception that 'physics is difficult'. From their study, they discovered that one of the major declining tendencies of the girl-child towards physics is as a result of insufficient practical activities due to inadequate practical activities. Consequently, this provides a major discrepancy that exists between male and female students on technological achievement having the knowledge that science is the mother of technology.

Several commentators have also attributed that effective learning of science is only measured from strategies used but variable such as location of school is very essential. Ezendu (2003) mentioned that school location means urban and rural schools while Agbaje and Awodun (2014) asserts that location of schools could also be a factor that affects the performance of students in science subjects. In line with the above, there have been these general perceptions that students in the urban schools perform better than their rural counterparts. It is important to state that findings on rural-urban differential as regards students' academic performance have yielded inconsistence results. For instance, rural students are at a higher risk of dropping out of the sciences because of low resource availability and poor visibility (Schoenfeld, 2002).Canadian Council of Learning (2006) explicitly stated that students in rural Canada are falling behind their urban counterparts. It was further mentioned in 2003 programme for International Student Assessment (PISA) that urban students' outperformed rural students in math, reading and science. These rural-urban differences in achievement persist across all the provinces. Although, the above statement is not in agreement with Macmillan (2012) where it was observed that there was no significant difference in the mean achievement score of Physics students in urban schools and those in rural schools that were also exposed to the same treatment. Monk and Haller (1986) also revealed that students from rural schools achieved as well as students from urban schools. In light of the above presentations, this study investigated the effect of on Microscience Kits Intervention, gender and school location on students' academic achievement in Physics practicals in Rivers State, Nigeria.

Aim and objective of the study

The aim of the study is to investigate the effect of on Microscience Kits Intervention, gender and school location on students' academic performance in Physics practicals in Rivers State, Nigeria.Specifically, the objectives of the study is to:

1. compare the performance of male and female students in physics practical considering school location and usage of microscience kits and conventional laboratory practical apparatus in Physics practical.

Research Question

1. What difference exists in the performance of male and female students in Physics practicals considering school location and usage of microscience kits and conventional laboratory kit practical apparatus?

Research Hypothesis

There is no significant difference between the mean performances of male and female students in urban and rural schools in physics practical considering the usage of microscience kits and conventional laboratory apparatus usage.

Methodology

The study adopted a quasi-experimental research design, specifically randomized pre-test,pPost-test experimental and control design. The population of the study consisted of all Senior Secondary (SS 1) Physics students in Port Harcourt and Ikwerre Local Government Areas of Rivers State. A stratified random sampling technique was employed to obtain a sample size of 40 participants which consisted of 23 male and 17 female SS1 Physics students. In terms of location, 20 students were in the rural school while the other 20 students were in the urban school. The students were further grouped into experimental (microscience kit) group and control (conventional laboratory apparatus) group. The treatment instrument used was Reporting Physics Practical Package (RPPP) which consists of a lesson note that was taught on conducting and reporting of physics practical whilethe instrument for data collection was developed by the researchers and titled "Test on Verification of Ohm's Law" (TOVOL). TOVOL was used for both pre-test and post-test to measure students' performance on conducting physics practical. The instruments were validated by two experts in physics education. TOVOL was subjected to a pilot test applying the test-retest method for an interval of a week to ten (10) physics students not part of study. The data obtained was analyzed using the Pearson Product Moment Correlation and a reliability index of 0.81 was obtained making the instrument reliable for the study.
The collection of data was systematically organized in three different phases; Pre – treatment phase, Treatment phase and Post – treatment phase. Pre – treatment phase: The intention of the researcher was made known to both the students involved in the study. This was done to obtain co-operation from the teachers and laboratory assistance. The microscience kits were distributed to the experimental group while the control group used the laboratory apparatus for a general pre-test. Treatment phase: The treatment phase involved the teaching session for both groups on conducting and reporting of physics practical. This consisted of practical demonstrations using the microscience kits for the experimental group and the control group using the conventional laboratory apparatus. Three (3) periods per week of 40 minutes/per period for two (2) weeks was used for the treatment phase for the study. Post – treatment phase: After the treatment, the TOVOL was administered to the groups as post – test.
Data was analyzed using mean and standard deviation were used for analyzing the data obtained for the research question while Analysis of Covariance (ANCOVA) was used for the testing of the hypothesis at 0.05 level of significance.

Results

Research Question: What difference exists in the performance of male and female students in electricity practicals considering school location and usage of microscience kits and conventional laboratory practical apparatus?

Table 1: Students performance in terms of location, gender and practical kits usage.

Treatment	Location	Sex	Test	Mean	Mean Gain
Conventional lab kits	Rural	Male	Pre test	32.917	11.333
			Post test	44.250	
		Female	Pre test	24.875	9.875
			Post test	34.750	
	Urban	Male	Pre test	33.300	10.500
			Post test	43.800	
		Female	Pre test	24.100	10.900
			Post test	35.000	
Microscience kits	Rural	Male	Pre test	32.000	17.273
			Post test	49.273	
		Female	Pre test	23.444	12.667
			Post test	36.111	
	Urban	Male	Pre test	36.077	20.461
			Post test	56.538	
		Female	Pre test	24.429	14.142
			Post test	38.571	

Source: Researcher's fieldwork, 2014.

Table 1 showed the interaction considering usage of practical kits, location and gender. The posttest mean scores from the table are greater than the pretest for both the location and gender. This means that all the students irrespective of location and gender gained in terms of performance. The findings indicated that male students in urban schools that used the microscience kits performed better than their female counterpart while in the rural location, the male students performed better than the female students. It was also revealed that female students that used the conventional laboratory kits in the urban school performed better than their male counterpart, while male students in the rural location performed better than their female counterpart. In all, students that usedmicroscience kits performed better than those that used the conventional laboratory kits considering both gender and location.

Research Hypothesis

Ho: There is no significant difference between the mean performances of male and female students in urban and rural schools in physics practical considering the usage of microscience kits and conventional laboratory apparatus usage.

Table 2: Univariate Analysis of variance showing the main effects and their interactions.

Source	Type III Sum of Squares	Df	Mean Square	F
Corrected Model	3940.353[a]	8	492.544	8.802
Intercept	975.900	1	975.900	17.439
Pretest	38.099	1	38.099	0.681
Gender	960.562	1	960.562	17.165
Location	255.110	1	255.110	4.559
Treatment	1228.859	1	1228.859	21.960
Gender * Location * Treatment	6.399	1	6.399	0.114
Error	1734.747	31	55.960	
Total	140932.000	40		
Corrected Total	5675.100	39		

Source: Researcher's fieldwork, 2014.

Table 2 above is the analysis of variance showing the main effects and their interactions. It was shown that the F calculated value for the interaction of gender, location and treatment is Energy [$F(2,31) = 0.114$, $p = 0.00$]. Since calculated F value is less than the F table value, the null hypothesis is upheld. This showed that there is no significant difference between the mean performances of male and female students in urban and rural schools in Physics practical considering the usage of microscience kits and conventional laboratory apparatus usage.

Discussion of findings

It is obvious that to live in this modern scientific world, first hand contact with the apparatus and materials of physics is essential, as a means of solving scientific problems. Microscience kits usage in Physics practical is a highly innovative approach that has been adopted in some part of the world as a method both to allow effective practical physics in schools in other to enable them meet the challenges of increasing dynamism in Physics learning. The study made effort to determine the impact of microscience kits intervention on students' learning outcomes in Physics practicals focusing on gender and demographic implications.

The findings of the study revealed that for both urban and rural locations, male students that used the MSK performed better than their female counterpart, while female students that used CLK in the urban location performed better than their male counterpart and male students that used CLK in the rural location performed better than their female counterpart. The findings of this study is in consonance with the study of McCleery (1979) where it was found that the performance of rural students were sub-standard in the rural areas of Hawai public schools. Downey (1980) also mentioned that the ACT scores of rural students where two points lower than scores of urban students in each of the categories of ACT in Kansas. Contrary to the above, Alokan and Arijesuyo (2013), Fan and Chen (1999) in their various findings indicated that there is no significant difference between academic performance of students from rural schools and students from urban school. Other studies have indicated that students from rural schools were found to have performed better than those from urban school in academic (Alspaugh, 1992 and Alspaugh & Harting, 1995).

The development of any nation requires that all students (male and female) should be adequately empowered to be able to contribute their quota meaningfully and appropriately to national development. For Physics learning to realize its objectives as stated in the National Policy on Education FGN (2004), it is imperative for both male and female students to contribute towards good academic performance in Physics using appropriate science kits.

Recommendation

1. Physics teachers should encourage female physics students during teaching and practical sessions such that both male and female students can perform better in the study of physics.
2. Students in the rural schools should also be encouraged by providing microscience kits where there are insufficient laboratory apparatus which will be used regularly during Physics lessons.

Conclusion

Meaningful teaching of physics must consist of both the theoretical and practical aspects. However, it is appalling to state that most Physics teachers concentrate only on the theoretical aspect which is a possible indication of failure rate in the learning of physics. Although. There is no doubt that most of our secondary schools lack physics practical apparatus for effective practical activities. The microscience kit is quite inexpensive and portable that can be employed in both rural and urban secondary schools.

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