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The Effects of Integrating Laboratory Work with Theory on Academic Achievement in Secondary School Physics

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Abstract
This study was an attempt to investigate the effects of integrating laboratory work with theory on academic achievement of secondary school physics students. The study was conducted in Oron Local Government Area of Akwa Ibom State, Nigeria. A total of one hundred and sixty two (162) senior secondary two (SS2) physics students took part in the investigation. Two researcher-made instruments, Physics Practical Achievement Test (PPAT) and Physics Theory Achievement Test (PTAT) were used in gathering the data for the study. The reliability of the instruments determined using cronbach Alpha were 0.74 for PPAT and 0.81 for PTAT. Two hypotheses were stated to guide the investigation and the data that accrued from the study were analysed using independent t-test. The major findings of the study showed that students taught physics by intergrating laboratory work with theory performed better than those taught by treating practical work after and separate from theory. Gender showed no significant effects. It was

therefore recommended that physics teachers should adopt the method of integrating practical work with theory.

Background of the Study

The current shift in emphasis in science curricula objective reflecting student-centered process approach to science is a radical departure from the traditional emphasis on the teacher-centered product approach. This new trend requires that the students should be activity involved in the learning process through adequate and meaningful hands-on-activities during every classroom instruction in science. However, research reports show that contrary to the demands of the new science curricula in Nigeria, our science teachers still decide to split science instructions into theory and practical (Njoku, 2004 and Uzoechi, 2004). The practical work, they observed, is never attended to until the second term of the final year or few weeks to public examinations. According to Ekpo (1999), any effort to separate science into practical and theory lessons amount to perpetuating a dichotomy which is antithesis of true science. Study reports show that such attempts have resulted in most schools in Nigeria shifting practical work until the second term of the final year (Ekpo, 1999; Galadina, 2003). The results have been students' persistent poor performance in physics particular and science in general.

Reports from the West African Examination Council's Chief Examiners for the May/June Senior Secondary School Examination in Physics indicate a persistent trend of students' poor performance over the years (WAEC, 2002; 2003). The Chief Examiners attribute the persistent students' poor performance in physics to inadequate exposure to practical work and exercises before examinations.

Statement of the Problem

There is a general paucity on research information on the relative effects of integrating physics laboratory work with classroom instructions in the subject compared to the traditional theory before practical work. This study is therefore undertaken to provide empirical information on the relative effects of integrating practical work with classroom instructions and keeping practical work until after the theory on students' achievement in secondary school physics.

Purpose of the Study

Specifically, the study was undertaken to:

(1) Compare the achievement of secondary School Students in physics when laboratory work is integrated with classroom instruction and when laboratory work is done after and separate from the related theory.

(2) Compare the achievement of male and female physics students when practical work is integrated with classroom related theory.

Research Questions

(1) Do physics students differ in their academic achievement in physics when laboratory work is integrated with the related theory and when laboratory work is done after and separate from theory?

(2) Do male and female physics students differ in their academic achievement when practical work is made an integral part of the related theory?

Research Hypotheses

(1) There is no significant difference in the academic achievement of students in physics when laboratory work is taught an integral part of classroom instructions and when it is treated after and separate from theory.

(2) There is no significant difference in academic achievement between male and female physics students when practical work is treated as an integral part of the related classroom theory.

Significance of the Study

The study will provide empirical evidence on the relative effects of integrating practical work with theory in physics and treating it after and separate from theory on students' achievement in the subject. The empirical evidence is expected to guide both curriculum designers and classroom teachers.

Methodology

The Research Design used was the pre-test, post-test control group design. The design is structurally represented below:

$\mathbf{O_1 \times O_2}$ **(E)**

$\mathbf{O_3 \quad O_4}$ **(C)**

Where O_1 and O_3 are pretest measurement of experimental and control groups respectively, O_2 and O_4 are posttest measurement of experimental and control groups respectively and X is treatment.

The experiment was conducted in Oron Local Government Area of Akwa Ibom State, Nigeria. Oron Local Government Area is bounded in the North, East, West and South by Uruan, Okobo, Urue Offong Oruko and Mbo Local Government Areas respectively, all in Akwa Ibom State. The choice of this study Area, Oron Local Government Area was based on the familiarity of its educational problem by the researcher. The choice of Oron is also based on the believe that since it is far away from where a university is cited and farther away from the state capital, schools in the area may not have benefited enough from academic research.

The population of the study consisted of all senior secondary two (SS2) Physics Students in Oron Local Government Area of Akwa Ibom State, Nigeria. This gave a population size of 400 students.

A total of one hundred and sixty two (162) senior secondary two (SS2) physics students in four (4) intact classes from four (4) selected secondary schools in the study area formed the sample for the study. Criterion sampling technique was used in the selection of the four schools. The criteria were:

(a) Schools with functional physics laboratory; and

(b) Schools that are co-educational.

Random sampling technique was then used in selecting two of the intact classes as experimental group and the other two as control group.

Two research instruments, Physics Theory Achievement Test (PTAT) and practical physics Achievement Test (PPAT) were developed and used by the researcher. Physics Theory Achievement Test was a fifty multiple choice questions drawn from the selected physics concepts, elasticity, simple harmonic motion, equilibrium moment, and refraction on plane surfaces.

The practical Physics Achievement Test consisted of four practical questions drown from the four selected physics concepts. These were experimental:

(1) verification of Hook's law;

(2) determination of acceleration due to gravity (g)

(3) determination of resultant of two forces; and

(4) verification of smell's law.

Each multiple question in the Physics Theory Achievement Test has five options (a to e). A student was scored two marks (2%) for each correctly answered question. Each practical question carried twenty five marks (25%). The average score of each student was calculated from the student's scores in both Practical Physics Achievement Test (PPAT) and Physics Theory Achievement Test (PTAT).

The instruments, PTAT and PPAT were given face-validation by four experienced experts in physics education. The instruments were therefore administered to a pilot sample of two SS2 Physics students randomly drawn from two schools within the population of the study who were not part of the study sample. The twenty SS2 Physics students were treated on the selected physics concepts before the tests were administered on them. The reliability coefficients of the tests determined using Cronbach Alpha were 0.74 for PPAT and 0.81 for PTAT.

Research Procedure

The two groups of students, experimental and control groups were pre-tested. The experimental group was taught the four selected physics concepts. After being taught each concept the practical physics Achievement test on the physics concept taught was administered on the respondents. The control group was taught the four selected physics concepts and at the end of the treatment, the PPAT was administered on the respondents. The PTAT was then administered on both experimental and control groups at the end of all treatment at the same time. The teaching lasted for eight weeks and in the 9^{th} week; the control group was post tested on both PPAT and PTAT while the experimental was post-tested on PPAT only since it had already been post-tested after each concept was taught.

Data Analysis

The data obtained were analysed using t-test at .05 significant level.

Hypothesis One

There is no significant difference in the academic achievement of students in physics when laboratory work is taught as an integral part of classroom instructions and when it is treated after and separate from theory.

The result in Table 1 showed that t-cal (2.92) was greater than t-crit (1.98) for a df of 160 at .05 level of significance. Hypothesis one was therefore rejected

and this means that there is a significant effect of integrating laboratory work with theory on academic achievement of students in physics.

Hypothesis Two
This hypothesis states that:

There is no significant difference in academic achievement between males and female physics students when practical work is treated as an integral part of the related classroom theory.

From table 2, t-calculated (0.56) was less than the t-critical (1.99) for df of 78 at .05 level of significance. Hypothesis two was therefore not rejected. This implies that there is no significant difference in physics academic achievement of male and female students when practical work is treated as an integral part of the related classroom theory.

Discussion
The result in Table 1 shows that students taught by integrating practical work in physics with theory achieved academically higher than those who were exposed to practical work after and separate from theory. This is because the method of integrating practical physics with theory is more or less a demonstration method which encourages retention and easy transfer of knowledge gained in theory class to practical class that followed immediately. The learners find it easy to recall and link with practical task the acquired theory knowledge, hence skills acquired and retained in this observation is supported by Galadina (2003) and Njoku (2004). Gender showed no significant difference in the study, Table 2. This is because female physics students have been able to level up in their learning ability with male counterpart. This is inconsonance with the early works done by Ekpo (1999) and Uzoechi (2004).

Conclusion and Recommendation
The study was on effects of integrating laboratory work with theory an academic achievement of physics students in secondary schools. Major findings of the study showed that:

1. Integrating practical work with theory is more effective in enhancing students' achievement in physics than treating laboratory work after and separate from theory.

2. Gender of students showed no difference in achievement when both male and female students are taught practical physics on integral part of theory.

The recommendation therefore is that physics teachers should adopt the method of integrating practical work with theory.

References

Ekpo, J. U. (1999). Status of secondary school science practical work in Akwa Ibom State, Nigeria, *AJEIMA, 2(1*); 12-29.

F. M. E. (2004). *National Policy on Education*. Lagos: NERDC Press.

Galadima, I. (2003). Gender inequality in algebraic word problem solving performance among secondary school students in Sokoto and Zamfara States. *Journal of Curriculum Organization of Nigeria, 10(2)*; 457-460.

Njoku, Z. C. (2004). Fostering the application of science educational research findings in Nigeria classrooms: Strategies and needs for teachers' professional development. In M.A.G. Akale (ed) *45th Annual Conference Proceedings of Science Teachers' Association of Nigeria*, pp 217 – 222. Ibadan: HEB Plc.

W.A.E.C. (2002). *Chief Examiners' report for 2002 May/June Senior School Certificate Examinations* Lagos: West African Examination Council.

Table 1: T-test comparison of physics academic Achievement of students taught by integrating practical work with theory and those taught practical work after and separate from theory.

Source of variation	N	X	S	df	t-cal	t-crit	Decision at P <.05
Experimental group Versus Control group	80	63.8	13.5	160	2.92	1.98	*
	82	56.2	11.9				

* = Significant at P < .05

Table 2: t-test comparison of physics academic Achievement of male and female students when practical work is treated as an integral part of the related classroom theory.

Source of variation	N	X	S	df	t-cal	t-crit	Decision at P <.05
Male in experimental group versus Female in experimental group	50	61.5	13.9	78	0.56	1.99	NS
	30	59.7	13.1				

NS = Not Significant at Significant at P < .05