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THE ROLE OF INFRASTRUCTURAL FACILITIES IN THE COGNITIVE DEVELOPMENT OF SCHOOL PHYSICS STUDENTS IN NIGERIA

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ABSTRACT

The study aimed at establishing empirically, the role of infrastructural facilities in the cognitive development of physics students in senior secondary schools. A concept in physics (elasticity) was chosen and taught to both experimental and control groups, each comprising seventy-five (75) senior secondary one (SS1) physics students. While the experimental group was taught with the use of materials capable of enhancing cognitive skills, the control group had no such materials. Comparison of post-test mean scores of the two groups using t-statistics (of separate variance model and two-tailed) revealed that the experimental group performed better than the control in all the three dependent variables tested in the study - understanding, reasoning and creativity.

The need for using concrete materials in the teaching and learning of physics, as buttressed by this finding was attributed to the fact that most students in our schools are yet to fully attain the level of abstraction and symbolic reasoning required, even though they are expected to be at the formal operational stage.

INTRODUCTION

A central emphasis of government, as enshrined in the National Policy on Education, with regard to science teaching at the secondary level is, as it were, on functionality and utility. At the primary level, the emphasis, and hence, the resultant expectation is akin. Primary science specifically aims at evoking scientific and reflective thinking in pupils. This level of thought is the basis of functionality and utility in science. In the same way, the basis of scientific and reflective thinking is proper conceptualization of scientific concepts, theories, laws and principles.

The level of achievement of these lofty aims is palpably low due to various reasons. Principal among these reasons is inadequate resources (mostly material). In Science, proper conceptualization requires the use of relevant concrete materials. In the absence of such materials, the idea of scientific and reflective thinking, and hence, functionality and utility becomes utopia.

A number of studies (Asenuga, 1971; Bajah, 1977; Ogunniyi, 1977; Vitta, 1979; and Ezeughor and Jones, 1986) have shown that our science laboratories in schools are grossly inadequately equipped. It is, perhaps, this scanty infrastructural facilities in schools and hence, poor enhancement of cognitive skills that is responsible for poor yearly performance of students in Science, particularly, physics at WAEC examinations. WAEC Chief Examiner in physics, as quoted by Onwioduokit (1992 a) has been consistently commenting that physics students do not understand the physics of the practicals they perform. The aftermath of this poor performance is the low enrolment of students in physics and physics related courses at the tertiary level (Akinwumi 1986).

The rationale for the use of concrete materials for the enhancement of understanding, reasoning ability and creativity stemmed from the fact that, contrary to piagets (1958) expectation, most students in our secondary schools are yet to fully enter into formal operational stage (Onwu, 1985). The delay in getting into this stage of cognitive development may have resulted from the lack of or inadequate concrete materials to interact with during the concrete operational stage.

Some suggestions made in previous studies for developing reasoning and creative thinking in physics students include emphasis on good instructional pattern or sequence (Aron, 1983; and Mgbodile,1984; Onwioduokit 1992b) and the emphasis on the adoption of a spiral curriculum (Akinmade, 1985).

Most of the previous researches, as cited above, have been in the areas of the use of learning sequence in improving understanding and reasoning ability of students. Not much has been done in establishing, empirically, the role of infrastructural facilities in eliciting better understanding, reasoning and enhancing creativity ins science students. particularly physics students. The present study is therefore intended to experimentally determine the effects of such facilities on the level of understanding, reasoning and creativity of physics students. Akinwumi (1986) rightly pointed out that reflective thinking and reasoning seem to be the greatest problem facing physics students in secondary schools.

RESEARCH HYPOTHESES

Based on the focus of this study, the following null hypotheses were tested:

H_o1:There is no significant difference in performance between students taught with the use of infrastructural facilities and those taught without such facilities, with respect to their understanding of physics concepts.

H_o2:There is no significant difference in the reasoning level of physics students exposed to infrastructural facilities and those not so exposed.

H_o3:There is no significant difference, with respect to level of creativity, between physics students taught with the use of infrastructural facilities and those taught without such facilities.

METHODOLOGY

Research Instruments

Instruments used for the study included Test on understanding (TOUN), Reasoning Test (REAT) and Creativity Test (CRET). Each test was made up of thirty (3) items requiring objective answers. The tests were validated by a team of experts and the reliability coefficient using Kuder Richardson formular was 0.82, 0.88 and 0.85 for TOUN, REAT and CRET respectively.

The concept taught was elasticity (including Hooke's law and Young's modulus). This concept was never taught to the students before.

Population and Sample

The population used in this study consisted of all senior secondary one (SS1) physics students in Oron L.G.A. of Akwa Ibom State. This population was stratified into two - Urban and rural. Two secondary schools were randomly selected in each stratum. All SS1 physics students in the selected schools constituted the research sample. There were, altogether, one hundred and fifty (150) subjects (75 each for experimental and control groups). In each stratum, assignment to experimental and control groups was done randomly at school level. Subjects in each school assumed the research group randomly assigned their schools. There were two schools in each research group (one from each stratum).

Research procedure:

i) Training of instructors

ii) Administration of treatments

iii) Administration of tests

i) Training of Instructors

Four physics teachers were trained as instructors, two for experimental and two for control groups. These teachers were from the schools chosen for the study. This arrangement helped to reduce suspicion and possible adverse reaction of subjects to research conditions. Before the commencement of instruction an agreement index of 0.85 was obtained among the four teachers. The training which lasted for one week involved the use of micro teaching facilities and common lesson notes for each research group. A team of experts evaluated the performance of the teachers in terms of teaching style, mannerism, confidence, answers to students question, discretion and teaching duration.

ii) Administration of Treatment

Pretests were administered a day prior to treatment. The treatment started within the same week in all strata (urban and rural) and lasted for two weeks. In each school, the periods (one single and one double)allotted to physics teachers weekly were used for the treatment. Instructors of experimental group made use of elastic and inelastic materials, Heeke's law apparatus and plastic materials in teaching. No instructional facilities was used for teaching subjects in the control group.

iii) Administration of Tests

A day after the end of the treatment, post tests were administered to the subjects in all groups. This was carried out under the usual practice of continuous assessment.

ANALYSIS OF DATA

Data generated from the pre and post tests in the study were analysed using t-statistics for uncorrelated data (separate variance model) with two tails.

The results are as follows:-

Table 1:

t-Test comparison of means of experimental and control groups with regard to pre TOUN, REAT and CRET

PRE-TEST	GROUP	N	$\bar{X}$	S^2	t-value	Decision at P .05
TOUN	Experimental	75	2.04	1.28	0.29	*
	Control	75	1.96	1.13		
REAT	Experimental	75	1.98	1.42		
	Control	75	2.05	1.37	0.37	*
CRET	Experimental	75	2.52	3.02		
	Control	75	2.59	2.98	0.25	*

*Not significant

TOUN - Test on understanding

REAT - Reasoning Test

CRET - Test on Creativity

As shown in Table 1 above, the pretests mean scores of the groups were not significantly different. The critical t-value is 1.96. The lack of significant difference observed thus confirms that the research groups were comparable at the beginning of the research (that is, before the treatment was administered.

Table 2:

t-Test comparison of means of experimental and control groups with regard to pre TOUN, REAT and CRET

PRE-TEST	GROUP	N	$\bar{X}$	S^2	t-value	Decision at .05
TOUN	Experimental	75	6.81	2.30	4.64	H_o1 Rejected
	Control	75	5.65	2.45		
REAT	Experimental	75	7.45	1.78	6.91	
	Control	75	5.86	2.24	6.91	H_o1 Rejected
CRET	Experimental	75	5.45	0.94		
	Control	75	3.98	1.37	8.06	H_o1 Rejected

*Not significant

TOUN - Test on understanding

REAT - Reasoning Test

CRET - Test on Creativity

It is seen from Table 2 above that there exists a significant difference between experimental and control groups in their levels of understanding (t=4.64, 148, 0.05), reasoning (t=6.91,148, 0.05) and creativity (t=8.06,148, 0.05) all in favour of experimental group. Since the experimental group differed from the control only by experiencing treatment with the use of infrastructural facilities, the observed significant difference in post-tests performance is attributable to the use of the facilities. Based on Table 2, therefore, hypotheses 1, 2 and 3 are rejected. this means that infrastructural facilities are capable of enhancing physics students' understanding, reasoning and creative abilities.

DISCUSSION, CONCLUSION AND RECOMMENDATION

The observed difference between experimental and control groups after treatment, in favour of the former, further buttresses the need for concrete materials in science teaching at the senior secondary school level. The role of infrastructural facilities in enhancing conceptual understanding in physics, as shown in this study, agrees with the outcome of previous studies (Shulman, 19773; Anderson, 1978) in other areas of science. The observed effect may have been due to a low level of student attainment of formal operational stage.

The effects of infrastructural facilities on reasoning ability of students may have been positive because correct and meaningful reasoning requires a proper understanding. A further reason could be that students at the senior secondary level do not yet acquire the level of abstraction and symbolic thought processes required of people at the formal operation stage. Hence, they need infrastructural facilities in learning physics. This need was also observed by Lawson and Noraland (1976) and Reif and John (1979). Cohen et all (1978) however observed no effect of infrastructural facilities on reasoning ability of learners.

Finally, the observed significant difference between the experimental and control groups with respect to students level of creativity may have resulted from the close relationship existing between reasoning and creativity. Moreover, shallow conceptualization of physics does not allow for a good development of creativity. The outcome of the present study in this regard agrees with Boghai (1979) who also emphasizes a proper conceptualization for the development of creativity.

It could be seen from all analyses carried out in this study that infrastructural facilities aid understanding, reasoning and creativity in physics students.

Based on this finding, it is recommended that the use of infrastructural facilities be emphasised in science teaching. Government should go beyond policy formulation to implementation. Materials should be provided in schools for the teaching of physics and, indeed, science, otherwise the present trend of low enrolment at the tertiary level into physics and physics related courses will continue to be deplorable. Physics teachers should not only depend on the available materials but should also embark on improvisation of materials. Moreover, the Science Teacher Association of Nigeria (STAN) should press on Government to equip science laboratories in schools. A similar study is also recommended for the teaching of physics at the tertiary level.

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