EVALUATION OF INSTRUCTIONAL METHODS AND APTITUDE EFFECTS ON THE PSYCHOMOTOR PERFORMANCE IN BASIC ELECTRICITY AMONG TECHNICAL STUDENTS IN SOUTHERN EDUCATIONAL ZONE, CROSS RIVER STATE, NIGERIA

EDU, DAVID O. (Ph.D)
AYANG, ETELBERT E. (Ph.D)

DEPT. OF CURRICULUM & INSTRUCTIONAL TECHNOLOGY
FACULTY OF EDUCATION
CROSS RIVER UNIVERSITY OF TECHNOLOGY (CRUTECH)
CALABAR

IDAKA, IDAKA (Ph.D)
UNIVERSITY OF CALABAR
CALABAR

Abstract

The study was an experimental, pre-test-post-test control group design analyzed. It was to determine the effects of instructional methods (demonstration and project), and students' aptitude on their psychomotor performance in basic electricity in the southern zone of Cross River State, Nigeria as study area. Two research questions were formulated while data was generated from 80 randomly sampled technical II students using four (4) researcher-made instruments, 2 lessen plans, Basic Electricity Psychomotor Test (BEPT) and a Fundamental Electricity Aptitude Test (FEAT). Data analysis was by independent t-test and multiple classification analyses of variance (MACNOVA). It was revealed that there was no significant difference in the joint effect of demonstration and project instructional methods and aptitude on psychomotor performance of students in basic electricity. Similarly, the result showed that there was no significant mean difference in the psychomotor performance of students with high and low aptitude in basic electricity in technical colleges when taught with demonstration and project instructional methods. It was thus concluded that the methods coupled with aptitude of students' do not significantly influence the psychomotor performance of students in basic electricity among technical II students in the southern educational zone of Cross River State, Nigeria. Recommendations, among others were that government should motivate technical school teachers through the provision of ultramodern equipment in all practical workshops and laboratories to enhance effective experimentation and demonstration of technical concepts with students. This will enable students to be conversant with practical activities in electricity far before they graduate out of school.

Key Words: Evaluation, Experimentation, Aptitude, Instructional methods, Psychomotor performance

INTRODUCTION

In the words of Nnaji (2020:18), one of the greatest innovations affecting Nigeria today and will continue to affect us in the future is technology. From agricultural produce to manufacturing, from medical advances to the protection of the environment, infrastructure development to industrialization even from the nature to leisure, technology has come to define the way we live. It separates the developed world from the developing; and the skilled from the unskilled or the semi-skilled. It bestowed riches on nations that have it and poverty to those that do not have it.

Indeed, to Nnaji (2010), there is no substitute to science and technology as the primary driver for socio-economic development. But unfortunately, while the west and Far East are making tremendous forays in the technological advancement, Africa especially sub Saharan region is still living in the backwardness of under development occasionally stunted growth in science and technology. The above was one of the many reasons that led the federal Government of Nigeria to plan for the enhancement of technology. In accordance with the Federal Government of Nigeria's demand and plans to enhance advancement in technology's and a subsequently pilot technological coat to the brink of technology were caused to spring up in the nation in all the geopolitical zones in the mid and late 1980's (FRN). These schools, which objectives were to produce middle level manpower requirement to cater for the maiden springing technologies

According to Mbang (2007), aptitude is a phenomenon that has to do with natural ability or skill at doing something; capability to perform in particular circumstances. Evans and Herr (1978) assert that individuals differ enormously in their aptitudes, which could be verified through the use of aptitude test. The National University Commission (NUC, 1994) stipulated the use of aptitude tests by universities for determination of the suitability of candidates for admission. Psychologists also use aptitude in measuring learning potentials.

Nwachukwu (2000) and Okoro (2002) separately state that aptitude test measures individual potential for performance in given areas and the information obtained can, along with other indices, be used to predict the degree to which a person is likely to cope successfully with a specified task or skill.

In technical education, emphasis is on developing the aptitude that will enhance the desired psychomotor competencies. Related example include schools concentrating primarily on developing musical aptitude for performance on the band instruments and certain types of choral groups are well developed if they are utilizable in performances which reflect credit on the school. In the same vein, technical colleges developed psychomotor competencies (as in basic electricity and building construction etc). Similarly, art aptitudes are fostered on the part of those students who have proved capable of producing works of art which can grace the school or its public display. It seems that certain types of aptitudes are yet to be developed, which is likely to affect the psychomotor performance of students in those areas. A related problem is the undiscovered aptitudes. Evans and Herr (1978) state that students who have undiscovered aptitudes certainly have had their individual options decreased, even if their school ha a programme for developing those capabilities. It can therefore be inferred that aptitude has a relationship with psychomotor performances.

Demonstration instructional method and students' performance

Demonstration instructional method is a method of teaching concepts, principles or real things by combining explanation with handling or manipulation of real things, equipment or materials. As a following study, Vikoo (2003) grouped demonstration method of instruction among psychomotor development methods. He added that this method is an activity based method of instruction that aims at motor skill development in learners. It aims at developing in students' knowledge of procedure, rules and principles with which they can do things with their manual dexterity. It is characterized by minimum instructor control and more of students' activity, Rosenshine (1998).

Demonstration instructional method has been recommended in several quarters as a suitable method for teaching practical subjects, science, technical and vocational education, etc. Okoro (1998) recommends the use of demonstration as an asserted method for teaching tasks in vocational technical education, as it enhances both psychomotor and cognitive skills; although most times it is associated with psychomotor domain, with less emphasis on intellectual or cognitive skills. However, it is unrealistic to say that skills can be purely physical in complete absence of cognition. Effiong (1998) submits that skills have been classified in physical (psychomotor) and intellectual (cognitive) domains. In basic electricity, the learner should be able to state ohm's law and translate this into a diagram and build the circuit practically. Demonstration method of instruction is widely used by instructors in technical education to illustrate how a process, procedure or experiment is to be done so as to aid the learner in acquiring or learning the skill. It is a very effective instructional method used in technical education courses. The demonstration is done to show the student exactly what is to be done, why it is done in a certain way, how to do it, and how to apply the skill or procedure that has been presented. Ogwo and Oranu (2006) affirm that demonstration method is the most widely used instructional method for acquisition of practical skills as it involves verbal and practical illustration of a given procedure. They added that the method is highly effective because it involves active participation of the student.

Project Instructional method and students' performance

Project instructional method is one of the instructional methods used by technical instructors as it enables students' participation and fast acquisition of skills. Asuquo (2005) explains that project method is one of the most effective instructional methods which enhances students' participation and quick assimilation of skills in vocational and technical education. According to him, project method is like assignment method in which a task is given to the students or a number of tasks are shared to students to carry out (written or practical) allowing a great deal of students involvement right from the planning stage, the sketch of the project, the steps of executing it, the tools, equipment and materials to be used up to the assembling stage of the project.

This is in line with Ogomaka (1997), Ezeudu (1991) and Udofia (1998, 2000a, 2000b, 2001), who developed projects and used them efficaciously to teach and evaluate mathematics, geography and integrated science respectively. Both the demonstration and project methods of instruction should be geared towards students' performance. National Policy on Education (2004) points out that the goals of technical education are based on students' performance. The end result in all instructional learning situations is based on the students' ability to do something well or to perform in specific and broad situations. Technical education courses thrive on students' psychomotor performance as an outstanding feature of laboratory activity. Experimenting, constructing, processing, manufacturing, testing, are but a few of the formal names given to students' psychomotor performance. In technical courses, students' activity should involve carefully planned activities which will bring out both physical and motor responses as well as reasoning, problem solving, writing and or creative thinking.

Further empirical literature

There have been extensive related researches on students' performance based on certain instructional methods. Instructors who implement standard-based instructional methods can expect higher students' achievement than those who use transmission approaches. In his study, Fennema and Franke (1993) tracked a grade one instructor over four years as she implemented cognitively guided instruction. A programme that focuses on helping students understand mathematical concepts and strategies for solving problems embedded in children's everyday experiences. Fennema et al found that this teacher had developed a deep understanding of the structure of mathematics and children's mathematics thinking. Her approach had profound effect on her grade one students. They solved more complex problems than other grade one pupils, used higher–level strategies and adopted their procedures in response to problem requirements. They were knowledgeable about what they knew, had positive feelings for the subject, persisted in problems solving when confronted by obstacles, and were fluent in describing their thinking. In another study, Boaler (1998) conducted an extensive longitudinal study of two schools in Britain, tracking students from ages 12 to 16. She compared Phoenix, a school characterized by a commitment to mathematics education reform, to Amber Hill, a school that adopted a traditional approach to mathematics instruction. When given open-ended tasks, phoenix students outperformed students in Amber hill.

Phoenix students worked hard to make sense of problems; they were able select an appropriate procedure or adopt a familiar method to fix a new situation. In contrast, the knowledge of Amber hill students was inert. They could not apply their knowledge Amber Hill students was inert. They could not apply their knowledge when given an unfamiliar problem. Boaler concluded that the Phoenix students learnt how to use their knowledge. Phoenix students learnt how to use their knowledge. Phoenix students performed more consistently (that is, they tended to use intuitive methods on all problems) and were enabled rather than distracted by contextual features. In contrast, Amber Hill students were negatively influenced by superficial problem features and used traditional standard methods regardless of their appropriateness. They were unable to transfer their knowledge. Boaler also noted that students' attitude toward mathematics were consistently better in Phoenix, especially for females who reduced the gender achievement gap.

In agreement with the above findings, Ogwu (2005) posits that there is not one best approach to instruction. He added that any suitable instructional method should have the ability to hold the students interest and attention until the lesson is over. Nwankwor (1998) submits that there are quite a number of variables such as facilities, methods, socio-economic background, mental and physical health of students that also affect students' psychomotor performance in any training programme. There have also been extensive related studies on the effects of various instructional methods on students' psychomotor performance. Igbo (1993) made a study to verify which method is best suited for teaching practical skills in home economics using demonstration and task-instruction methods. The researcher used the whole 150 students' population as sample in Anambra State. Students were randomly assigned to the control group was taught with tasks-instruction methods. Post instruction test was then administered to the two groups and the scores were recorded. Mean scores of students performance were used to answer research questions, while the hypotheses were tested using t-test at .05 level of significance. The findings showed that task-instruction was a better method for teaching clothing construction than demonstration methods.

Oja (1984), in a study, compared the effect of teaching method on students' performance in selecting schools in Nsukka Local Government Area of Enugu State. The result revealed that demonstration instructional method was very suitable for teaching agricultural sciences.

In an effort to improve the achievement of students in Chemistry, Omwirhiren (2002) carried out an investigation on the effect of guided discovery and traditional methods on the achievement of students in senior secondary school examination in Chemical energetic. A total of 95 students with an average of 17 years constituted the sample size used for the study. The multiple choice and short answer type assessment constituted the achievement pre-post-test items used for the study. The investigator developed lecture notes and learning activity packages. The experimental groups used the guided discovery while the control group had the same activities performed by the teachers. The study found out that the guided discovery method was effective in enhancing the achievement of students in energetic than the traditional method.

Archibong (1997) studied the relativeness of activity-based approach and lecture method on the cognitive achievement of integrated science students. Subjects in the experimental groups were subjected to activities exercises using guided-discovery, guided inquiry and laboratory methods while students in the control group were taught with expository method. The results showed that students with activity based approach achieved better than those taught using lecture method. Ukwungwu and Olorinoye (2000) studied the effect of teaching methods and levels of entry characteristics of students' retention in Physics. A sample of 90 senior secondary class one (SSI) students was randomly assigned based on their initial achievement and interest in physics to three groups in a 3 x 4 factorial design experiment. The students were taught waves, light and sound using lecture, demonstration and guided discovery methods for twelve weeks. The post-test scores were noted. After another 12 weeks interval, the retention test was conducted and the scores noted. The analysis of variance result of the retention scores showed that guided discovery method was significantly better than lecture and demonstration methods in enhancing retention in Physics. The purpose of the study was to examine the effect of demonstration and project instructional methods on students' psychomotor performance in basic electricity in technical colleges among technical II students in Southern Education Zone of Cross River State Nigeria in respect to their aptitude towards the subject. It also sought to verify the joint effect of demonstration and project instructional methods with respect to their aptitude on the psychomotor performance of students in basic electricity in the study area.

Hypotheses: The following hypotheses guided the study:

1. There is no significant difference in the psychomotor performance of students with high and low aptitude in basic electricity when taught with demonstration and project method in technical colleges.
2. The joint effects of demonstration, project instructional methods and students' aptitude do not significantly influence students' psychomotor performance in basic electricity in technical colleges.

Methodology

The study was an ex-post factor, pretest-post-test control design, with psychomotor performance of students as the dependent variable, and instructional methods and aptitude as the independent variable. The study area was the southern education zone of Cross River State, Nigeria. This study area consists of seven local government Areas with three sciences and technical colleges for training of middle level man-power for indigenous and external technical sectors/corporations.

A sample of 80 technical II basic electricity students (40 each of males and females) was randomly selected from 2 of the 3 colleges in the zone for this study. The selection was by balloting by a target population of 290 basic electricity students from the 2 colleges for the 2009/2010 academic session using the criterion sampling technique, with the following criteria:

i. Colleges with well equipped electrical workshops;
ii. Colleges with good libraries; and
iii. Colleges with well qualified and experienced basic electricity instructors. The two colleges were randomly assigned to experimental and control groups respectively.

Instrumentation

4 researcher-made instruments were developed for the study. Vitz: Instructional package (lesson plan-1) in basic electricity for experimental group; Instructional package (basic plan-2) for control group-project; A basic electricity psychomotor test (BEPT) and a Fundamental Electricity Aptitude Test (FEAT). The experimental group was instructed using demonstration instructional method, while the control group was instructed with project method. The BEPT instrument was used to assess students' competences in basic electricity practical work, and scoring their psychomotor performance in the subject.

This test was used as post-test, and consisted 20 multiple-choice items, constructed to reflect and reveal the students' practical ability in wiring (the test was designed on a 4-point likert scale type). The FEAT instrument was used to classify the students' aptitude into high and low; it consisted of 20 multiple-choice items also, and reflecting/revealing levels of their aptitude in basic electricity. All the study instruments were validated and attested reliable by two basic electricity instructors who were experts in the field. The reliability estimates for the 4 instruments (based on test-retest methods) were 0.91, 0.89, 0.94 and 0.91 respectively.

Data analysis: Generated data were analysed using descriptive statistics and independent t-test of differences of mean scores, standard deviation and multiple classification analysis of variance (MANOVA), all at 0.05 alpha level of significance with 1 and 28 degrees of freedom.

Table 1: Descriptive statistics and Independent mean (x) classification analysis of psychomotor performance of students by instructional methods and aptitude. N = 80

Variables							
Instructional Method	Aptitude	$\overline{N}$	X	SD	Mean Difference	t-cal	P < .05
Demonstration	High	22	26.18	2.17			
	Low	18	22.44	3.22	1.09*	4.209**	.021
Total	-	40	24.31	2.70			
Project	High	24	28.25	2.01			
	Low	16	25.25	2.98	1.00*	3.33**	.110
Total	Total	40	26.75	2.50			

*Not Significant at $p \leq .05$, crit t = 1.968, df = 78

Table 2: Multiple classification of ANOVA of the effect of demonstration and project instructional methods on the psychomotor performance of students with high and low aptitude (N = 80)

Variables Instructional Method	Aptitude	N	X	SS Total	MS_B	MS_w	F-cal	P=≤ .05
Demonstration	High	22	26.18					
	Low	18	22.44					
Project	High	24	28.25	5553.35	128.07	59.11	2.17*	.011
	Low	16	27.25					

*Not Significant at $p \leq .05$, df = 1 and 78, crit-F = 3.47

Results

The data on Table 1 showed that students with high aptitude scored higher with a mean value of 26.18, and a low standard deviation of 2.18 (depicting higher stability in their performance) than students with low aptitude with a mean value of 22.44 in the psychomotor performance in basic electricity when taught using demonstration instructional method. The data also showed that students with high aptitude scored higher with a mean value of 28.25 and a lower deviation of 2.01, than students with a mean value of 25.25 in the psychomotor performance in basic electricity when taught using project instructional method. Further revelations from Table 1 showed that students with high and low aptitude with mean values of 28.25 and 25.25 respectively when taught using project instructional method scored higher in the psychomotor performance in basic electricity than their counterparts with high and low aptitude (with mean values of 26.18 and 22.44, with deviations of 2.01 and 2.98) respectively, when taught using demonstration instructional method.

Similarly, the data in Table 2 portrayed that the calculated f-value of 2.17 was less than the critical F-value of 3.96 needed for significance at p = 05 level with 1 and 38 degrees of freedom. With these results, the null hypothesis was retained. This means that there is no significant difference in the psychomotor performance of students with high and low aptitude in basic electricity in technical colleges when taught with demonstration and project instructional methods. This implies that whether taught with demonstration or project instructional method, students' psychomotor performance in basic electricity in technical colleges does not differ significantly, in Cross River State.

Discussion of findings

These findings of no significant difference in students' performance is congruent with Dameus, Tilley and Brant (2004), who asserted that the choice of an instructional method may impact positively on the quality of knowledge accumulation of learners, irrespective of their aptitude in the subject. This is because practical/demonstration activities help learners to retain that which is learnt for a longer time than non-practical/non-demonstration activities. Nwachukwu (2000) had asserted that learners (irrespective of the level of training) with high aptitude usually score higher than their counterparts with low aptitude in practical sciences/technical subjects – like basic electricity, chemistry, and other psychomotor-based learning – especially when taught with demonstration and project instructional methods. Hence, to Nwachukwu (2000) aptitude can be used to predict the degree to which a person is likely to cope successfully with a specified task or skill. The findings also agree fervently well with Nwankwo (1998) whose study revealed that variables such as facilities, instructional methods and students' factors of aptitude and attitude (etc) affect students' psychomotor performance in any training programme.

Conclusion

Based on the findings, it was concluded that variables such as instructional methods as well as aptitude of learners do not significantly influence students' psychomotor performance in basic electricity in technical colleges in the southern educational zone, Cross River State, Nigeria, especially when taught using demonstration and project instructional methods.

Recommendations

It was therefore recommended that:

- Workshops and laboratories should be properly equipped by the Ministry of Education, to facilitate the enhancement of the so desired psychomotor performance in the technical colleges; this would improve technological advancement in the country.
- Furthermore, technical college authorities should allocate adequate time in the timetable for workshop practical work to enable students gain more skills and competencies, especially in basic electricity.
- And that the Ministry of Education should provide guidance and counseling services in technical colleges to counsel students not only on the importance of practical work competence, but to develop high technical aptitude towards basic electricity for better performance in the subject.

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