FACILITATING THE LEARNING OF PHYSICS CONCEPTS THROUGH COMPUTER-ASSISTED INSTRUCTIONS IN NIGERIAN SECONDARY SCHOOLS

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Abstract
The work looks at the necessity of using Computer-Assisted Instructions (CAI) in learning Physics concepts. It found out that students who learn with CAI packages achieved high (60.07% on the average) than those who learned under pedagogical approach (44.53% on the average). Based on the findings of this research, therefore, it is recommended that schools be provided with adequate computers, and such computers be used in carrying out instruction in the classroom, especially physics classroom, since the result of this research reveals higher performance on the part of students who learn with CAI.

Introduction

Physics as a school subject is broadly concerned with matter in relation to energy. Global energy consumption is rapidly rising. A global energy expenditure amounted to a yearly 0.065 billion tones of coal equivalent in 1950, 0.325 billion tones of coal equivalent in 1970 and 1.300 billion tones of coal equivalent in 1990 (Pickering & Owen, 1994). Since Physics concerns itself with matter in relation to the much desired energy the subject should not be toyed with in our secondary schools, being the basis of higher studies.

For a developing country, developing means quicker and enchanced growth in terms of economy, higher level of health care and basic needs. According to Gidado and Babayi (2004) most people in developing countries are increasingly beginning to be aware of the great potentials science and technology possess in facilitating the attainment of high quality of life and power in the contemporary world. In Nigeria, for instance the expectations of the average man concerning Nigerian scientists and technologists are high. The average Nigerian expects its scientists and technologists to proffer solution to the high levels of poverty, unemployment and social ills that bedevil the country. Although Nigeria is reputed to be the giant of Africa (Hemba, Trisma, Kakmena, & Josiah, 2005) she is still struggling in many ways to meet up with developed countries in terms of technology. This parity can only be erased once the Nigerian government and all stakeholders in education realize the importance of science education as a tool of development. Once human needs are reconciled and the capacity of science to cope with the consequences of technology is achieved then such development can be said to be sustained.

Statement of problem

As a school subject, physics has changed very considerably during the past years. According to Noakes and Harris (1969) emphasis on physics has shifted from the teaching of

a repertoire of facts to a situation in which the child is encouraged to learn and understand the basic principles of the subject which lays the foundation for the child. This shift is intended to equip the Physics learner so that he can cope with the challenges of development that stare him in the face. Here one may ask "Has the Physics learner in Nigeria been able to cope with the challenges of development which stare him in the face?" The answer may lie in teaching method which the Physics teacher employs in teaching the concepts. "Has the method been effective?" Evidence of low achievement of Physics learners in external Physics examinations abound. According to Adeyegbe (1993) the percentage of those who scored below credit in Senior School Certificate Examination (SSCE) was 68.5% out of 26,297 learners in 1988, 90.5% out of 28,525 learners in 1989 and 79.3% out of 63.161 learners in 1990. In 1998 May/June SSCE 88.7% of the total number of learners who sat for Physics examination were graded below credit (Science Teachers Association of Nigeria, 1999). In reference to the low achievement in sciences, Nnaobi (2003) laments that the major learning difficulty in sciences is the method by which science subjects are most times taught, devoid of regard to teaching aids. This pedagogical approach in teaching Physics has become grossly inadequate to the needs of the learner.

Software packages, which are automated instructional techniques, have been developed for use in the computer for the learning of Physics concepts. These packages include Computer-Assisted Instructions (CAI). According to Josiah (2004), a CAI instructional programme is presented to the learner via an interactive process on computer. The teacher is substituted by the CAI programme. Physics CAI include STELLA and POWERSIM. STELLA is a modern icon-oriented package where the conceptual features of a model are designed graphically as a concept-map on the monitor. The computer translates the iconic representation into a corresponding set of raw-equations. The learner has to add initial values, constants and the form of functional relationships. Once that is done, different equations are generated automatically. With CAI, the content of Physics as a subject in schools can be extended to more complex and interesting examples (like the motion of parachutists) that are otherwise mathematically (not physically) too complicated for a quantitative analysis.

Purpose of study

In light of the afore-mention this research was, therefore, conducted so as to determine the necessity of learning Physics through Computer-Assisted Instruction (CAI), a teaching/learning aid, considering its implication on sustainable national development.

Study question

The following question was raised to guide the study: Do students who learn Physics using Computer-Assisted Instructions (CAI) achieve higher than those who learn Physics without exposure to CAI?

Null Hypothesis

There is no significant difference in the mean achievement scores of Physics learners who are exposed to CAI and those who are not exposed to CAI.

Methodology

Sample and Sampling Technique

The stratified random sampling technique, being judgemental, was used to choose two (2) secondary schools from each of the five(5) local government areas (LGA) that constitute Plateau State Northern Senatorial zone. The criterion that guided the choice of the 2 schools in each LGA is the type of school (private-owned and government-owned).

A total sample of 150 Senior Secondary Schools 3 (SSS 3) Physics students (30 from each sampled school) were randomly selected.

Instrumentation and Instrument Administration

The instrument is made up of a 20-item Physics Achievement Test in Mechanics (PATMEC). The items were objective type with each correct option awarded five (5) marks such that PATMEC was rated one hundred percent (100%). There were two groups in each sampled school. The experimental group which were exposed to CAI software in mechanics and the control group which learned mechanic concepts through pedagogical approach.

After a duration of one month of treatment with the experimental group PATMEC was administered, post-test, to both groups (experimental and control).

The 20-item PATMEC was drawn from past SSCE questions. It was face-validated by two seasoned Physics lectures of the University of Jos. It was first administered to a sample outside the research sample, a pre-test, for instrument reliability. Reliability for PATMEC was 0.77, using the Cronbach's coefficient alpha method, compared with Fraenkel and Wallen's recommended > 0.70.

Results

In analyzing the data the pooled variance student t-test, a parametric test,

$$\frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(N_1-1)\,S_1^2 + (N_2-1)S_2}{N_1+N_2-2}\left[\frac{1}{N_1}+\frac{1}{N_2}\right]}}$$

was administered on the null hypothesis. This stemmed out of the result of the test for homogeneity of the experimental and control groups variances.

Table 1: t-test analysis summary performed on mean achievement scores of PATMEC

Group	N	$\bar{X}$	S	t-cal	t-table	df	L
Experimental group	75	60.07	6.04	7.00	2.05	28	0.05
Control	75	44.53	6.10				

N = Number of sample
X = Mean achievement score of PATMEC
S = Standard deviation of PATMEC result
t-call = Calculated value of t using the student t-test formula
t-table = Value of t as obtained from tables
df = Degree of freedom
L = Significance level

Discussion

The null hypothesis is rejected on the basis of t-cal>table (Table). This implies that there is a significant difference in the mean achievement scores of Physics learners who were exposed to CAI and those who were not exposed to CAI. Learners exposed to CAI achieved higher (60.07% on the average) than those not exposed to CAI (44.53% on the average).

Recommendation

Based on the outcome of the t-test and the importance of Physics in national technological development, the researcher recommends that the learning of Physics concepts in our secondary schools be done using CAI. This means that government and all stakeholders must braze up to the task of equipping schools with enough computers and CAI packages.

Indeed Physics has been viewed (Abbott & Abbott, 1977) as largely responsible for the development of a nation's technological culture. Pioneering works of brilliant thinkers, which culminated into far-reaching scientific discoveries, are found mostly in the field of Physics (Hemba, Trisma, Kakmena & Josiah, 2005). For instance, in the area of technology, radio and television sets were developed from the theoretical ideas (electricity, magnetism and light) of Clerk Maxwell, a Physicist. In medicine, developments of devices like x-ray machines and ultrasound scanners which are used to detect and cure diseases like cancer were stimulated by discoveries in Physics.

The by-products of Physics are everywhere around us. The most easily recognizable of those in Nigeria are the material ones found in hospitals, power transmission, transportation, and communication systems. All these and many more technologies that have been developed using Physics ideas are still in existence and are being sustained. Learning Physics using CAI will greatly enhance the capability of our future Physicists which will lead to sustainable development.

Conclusion

Although there are other teaching aids that the Physics teacher can use, it is evident from this research that there is a great advantage in terms of facilitating learning when a student learns with CAI.

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