School Location Versus Academic Achievement In Physics: Does Computer-Assisted Instruction (CAI) Has Any Effect?

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Abstract

This research investigated the effects of Computer-Assisted Instruction (CAI), a learner-centred and activity-based method of teaching/learning, on the achievement in Physics of Nigerian rural and urban secondary school students. Gender issue was also examined. The research design used was the experimental design. Forty (40) SSS III students in Pankshin Local Government Area of Plateau State, Nigeria were tested on the concepts of space, time and motion using a developed 25-item Physics Achievement Test (PAT) whose reliability was 0.72. The formulated hypotheses were tested using the pooled variance formula of the student t-test statistics. The analyses revealed that there was no significant difference in the mean Physics achievement scores between urban and rural students taught Physics with CAI (69.00 for male and 67.50 for female). Furthermore, there was no significant difference in the mean Physics achievement scores of male (68.90) and female (67.60) students treated with CAI.

Keywords: *School Location, Gender, Academic Achievement, Physics, Computer-Assisted Instruction*

Introdution

The contemporary world is driven by science and technology which are interrelated. Whereas science probes into the question ''Why?'' technology probes into the ''How?'' aspect. From the onset of the scientific age to date society has been relying on science to help solve the mesh in technology. Science has become such an indispensable tool that no nation, developed or developing, wishing to progress in the socio-economic sphere will afford to relegate the learning of science in its schools to the background.

Science subjects in secondary schools have been categorized into three: Biology, Chemistry and Physics (West African Examinations Council, 2004). These are the core science subjects, otherwise called pure science subjects. Physics deals with the study of laws that determine the structure of the universe with reference to the matter and energy in the universe (Ike, 2002). In the words of Olarinoye (2000) ''physics is the most utilized basic science subject in most technology and technology-related professions". This merely indicates that the enormous role Physics plays in the technological growth of any nation must not be undermined. It is pertinent to note that the technological growth of a nation leads to its social and economic development.

The application of science through technology is crucial for providing the infrastructure required by any nation. In 2005, politicians, educators and physicists from the world over met in Durban, South Africa, to consider the role of Physics in creating a sustainable future for developing countries. The importance of Physics for the development of a nation is, therefore, glaring. Physics is the most basic of science and its concepts and techniques underpin the understanding of all other branches of science. The knowledge of physics facilitates our understanding of other disciplines: A

thorough understanding of quantum mechanics is necessary to chemists and material scientists since the structure of every atom in the universe is determined by quantum mechanics.

Physics is also a cross-cutting discipline that has applications in many sectors of economic development, including health, agriculture, water, energy and information technology. The understanding of basic Physics is quite necessary for developing new instrumentation and techniques in the health sector: With the help of medical physics the right equipment for the diagnosis of diseases and the efficient communication of medical data are acquired. For instance, the Computed Tomography (CT) scanner is a hub for the development of telemedicine.

Nigeria is facing an energy crisis because the capacity of its generating plants cannot meet the country's needs as it continues on its development path. Of the 6,000MW electricity promised its people by the end of the year 2009, only about 2,600MW was realized (Okonji, 2010). These needs can only be met in an environmentally sound and sustainable manner, and a thorough understanding of the Physics involved in energy exploitation, generation and distribution is essential for achievement. Many consequences of the energy crisis abound, one of which is that every year thousands of trees are felt and the firewood used for cooking, and this has resulted in severe soil erosion and desertation.

Another important role that Physics plays in the technological development of a nation is in information technology. In developing fixed-line and optical-fibre networks in information technology, knowledge of the physics that underpin these technologies is essential.

The development of any nation, which depends on science and technology, hinges on the nation's science education. In Nigeria, in spite of the enormous role (importance) that Physics provides for national development and the efforts of government and other stake holders in improving science education, Physics results in most certified examinations like the West African Senior School Certificate Examination (WASSCE) have not been satisfactory. These have been attributed to many factors which include utilization of inappropriate teaching methods in schools, poor quality school science teachers and school location.

It had been reported that a problem confronting Physics students in Nigeria is that some of the teachers are poorly qualified as such unfamiliar with the names and use of some science equipment and facilities (Odili, 1990 & Akpan, 2001).

Another problem confronting the learning of Physics in schools is the lack of equipment and facilities, and their inadequacy (in some case) which hinder the effectiveness of learning of Physics in schools (Jegede & Okebukola, 1995; Nwaokolo, 1998; Anikweze, 2000 and Anele, 2001).

Science teacher stress is another problem confronting the learning of Physics in schools. A stress results when the teacher's experience is unpleasant, giving rise to tension, frustration, anger, anxiety and depression. Poor working conditions resulting from lack of resources for teaching have been identified as sources of stress in some parts of the world (Akpan, 2001). This is not a unique case in the Nigerian context. Physics teachers in Nigeria find these poor working conditions stressful (Jegede and Okebulola, 1995). Such a teacher who is often subjected to stress especially within the work environment cannot perform optimally. Consequently, learning of Physics concepts suffer.

The utilization of inefficient teaching strategies is another hindrance reportedly confronting the learning of physics in schools (Adeyegbe, 1993; Griffin, 1994; Rennie & McClafferty, 1995).

The broad aims and expectations of any teaching and learning programme is productive and positive-evaluated end-product (achievement). But in recent times, there have been complaints from almost all quarters of the Nigerian society that the standard of education has subsided. Students' achievement in WAEC and NECO SSCE has continued to deteriorate from year to year, particularly in the area of sciences (specifically Physics).

Factors that contribute to the failure of students in Physics are known generally, as had been pointed out by many researchers. School location has also been viewed as one factor that affects students' academic achievement (Akpan, 2001). Over the past two decades, research has indicated that the educational aspirations of students who study in the rural areas lag behind those of their urban counter-parts (Haas, 1992; Stern, 1994; Kampits, 1996; Khattri, Riley & Kane, 1997; Kannapel and DeYoung, 1999; Hu, 2003; Arnold et al, 2005).

Related findings from other studies have further indicated that students from rural schools place less value on academics (Stern, 1994; Ley, Nelson & Beltyukova, 1996). In a study of 2,355 from 21 rural high schools in 21 states, Ley, Nelson and Beltyukova asked students to indicate the importance of 21 attributes relating to their personal goals after high school. The data revealed that they placed more importance on personal qualities (e.g., being dependable and having the ability to get along with others) and less importance on specific areas of academic achievement (e.g., being proficient with basic English skills and Mathematics skills). It follows, then, that lower educational aspirations and less importance placed on academics by students in rural schools could lead to poor academic achievement in Physics than their urban counterparts. In the words of Haas (1992) such rural students could exhibit a sense that "school isn't for me."

The teaching of science and science-based courses for vivid and maximal understanding of content by students has been a problem to teachers and educators for years now (Okoro & Etukudo, 2001). Theories in science, as advocated by Cooney and Brown (1985), must as a matter of compulsion provide basis for improving teaching and learning. This search for methods and procedures for effective teaching and learning has engendered the birth of many procedures and methods that include Computer-Assisted Instruction (CAI).

The use of CAI in teaching has produced many positive effects. Brummer (2004) have used CAI to obtain interesting positive results in teaching and learning activities in various science and science-based courses. Computer has been found useful in engineering and most importantly as a veritable instructional tool (Ogu, 2003).

The use of computers and CAI packages in a classroom setting cannot be over-emphasized. Computer usage as an educational aid has been effective in stimulating student's interest and in providing individualized tuition at the students own pace and direction. A major characteristic feature of CAI, according to Akinyemi (1997), is that as it is a learner-controlled instruction proper individualization of instruction is enhanced when a student can control his/her learning in terms of choice of materials and in accordance with his/her intellectual ability. The CAI system incorporates the means for individualizing the experience of students in a manner that is prescriptive, personal and self-conscious.

This study therefore intended to ascertain whether the use of CAI as a teaching/learning strategy facilitates learning of Physics in both urban and rural setting. Gender issue was also studied.

Methods and Procedure

This study was an experimental design used to determine the effect of Computer-Assisted Instruction (CAI) on secondary school students' achievement in Physics (based on location of schools). 40 Senior Secondary School (SSS) III students in four schools (two from urban and two from rural setting) in Pankshin Local Government Area, Plateau State, Nigeria were used. The students and schools were selected using the simple random sampling (lottery) method.

The instrument used for the study was a 25-item Physics Achievement Test (PAT). PAT was set based on Bloom's taxonomy. Its content validity was established by two experts in the University of Jos, Nigeria and its reliability was obtained as 0.72 using the KR-21 formula.

There were two groups (experimental and control) which were exposed to treatments for a period or 8 weeks before PAT was administered. Only students in the experimental group were taught using CAI. Before the treatment, two hours were devoted to providing rudimentary but sufficient literacy in computer and CAI software usage. The researcher supervised the experimental group sessions, helping the students in only computer-related problems. The researcher personally visited the schools, administered, monitored and retrieved PAT.

Gender was also considered. The research questions raised were:

- Do students who learn physics using CAI in rural schools differ in their Physics achievement from those who learn the subject using CAI in urban schools?
- Do female students who learn Physics using CAI differ in their Physics achievement from male students who also learn the subject using CAI?

Results

In order to analyze the data gathered, the t-test statistic (pool variance formula), with 38 degrees of freedom and 0.05 level of significance, was employed to test the hypotheses formulated for the study.

Hypothesis One

There is no significant difference between the mean Physics achievement scores of students exposed to CAI in urban schools and their counterparts also exposed to CAI in rural schools.

Table 1 shows the t-test analysis performed on hypothesis one.

Table 1: *t-test results of hypothesis one, by school location school*

Location	N	X	SD	t-cal	t-tab	df
Urban	20	69.00	8.29	0.625	2.021	38
Rural	20	67.50	7.27			

Table 1 indicates that the calculated t-value (0.625) was less than the critical t-value (2.021) from tables, at 0.05 level of significance and 38 degree of freedom. Therefore, the null hypothesis was accepted. That implies that there was no significant difference in the mean achievement score of students in urban schools exposed to learning Physics through Computer-Assisted Instruction (CAI) and that of students in rural schools also exposed to learning Physics using CAI.

Hypothesis Two

There is no significant difference in the mean Physics achievement scores of female students exposed to CAI and their male counterparts also exposed to CAI.

Table 2 shows the t-test analysis performed on hypothesis two.

Table 2: *t-test analysis performed on hypothesis two, by gender.*

Gender	N	X	SD	t-cal	t-tab	df
Male	20	68.90	7.95	0.5417	2.021	38
Female	20	67.70	7.67			

From table 2, the calculated t-value was 0.5417 while the t-test value from tables was 2.021 at 0.05 level of significance and 38 degrees of freedom. Since the calculated t-value was less than the critical t-value, the null hypothesis was accepted. The implication is that there was no significant mean difference in the Physics achievement scores between the male and female students who were taught Physics using CAI.

Discussion

Factors that contribute to the failure of students in Physics are known generally, as have been pointed out by many researchers. School location has also been viewed as one factor that affects students' academic achievement (Akpan, 2001). Findings from studies have indicated that students in rural schools place less value on academics (Stern, 1994; Ley, Nelson & Beltyukova, 1996). The report from hypothesis one, however, reveals that achievement in Physics, of students (irrespective of location), is enhanced when Physics is taught and learned using Computer-Assisted Instruction (CAI). The researcher is of the opinion that despite the differing conditions of livelihood in urban and rural areas, the non-existent difference in achievement of students in both urban and rural schools may have arisen from the fact that both urban and rural students were subjected to equal opportunities in learning Physics using CAI.

The result of the analysis on hypothesis two implies that there is no disparity between male and female students' achievement in Physics when CAI is used as a method of instruction in the teaching/learning process.

Research results have shown the role and importance of CAI in facilitating teaching and learning in the classroom (Jegede, Otuka & Eniayeju, 1992; Adeniyi, 1997). The teaching of science subjects with CAI has also been noted to respond positively in terms of enhancement of learner's performance and interest, Ezeliora (1997) and Okebukola (1998) stated that the use of CAI makes teaching of science subjects interesting and acts as a very useful aid to learning.

Conclusion

For a Physics teacher, the main concern is the search for efficient and enjoyable ways of communicating physics concepts to his/her students. This can be achieved either by providing novel learning environments to the students or by devising new and viable teaching strategies.

While the computer cannot replace the Physics teacher, it can be used as a supplement to the teacher in the effective dissemination of concepts. Computers and CAI packages can assist the Physics teacher to prepare his students, irrespective of sex and school location, for the unique challenges of the future which go beyond school situation.

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