EFFECTS OF COMPUTER-BASED INSTRUCTION ON STUDENTS’ ACADEMIC PERFORMANCE AND LEARNING USING LESSON PACKAGES IN PHYSICS

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SUMMARY

The purpose of this study was to investigate the effects of computer-based instruction on students’ academic performance and learning using lesson packages in Physics. This is in response to the clarion call for the use of computer-based instruction (CBI) as alternate teaching method. Eighty (80) respondents for the study were selected from a population of 670 senior secondary school two (SSS2) students who offered Physics using stratified random sampling technique. The study adopted 3x2 factorial experimental design. Instructional method had 3 factors viz: Computer-Assisted Instruction (CAI), On-line Instruction (OLI) and Traditional Expository Teaching (TET). Thirty-two (32) and 18 students who studied lesson packages in Physics by CAI and OLI methods respectively formed the OLI and CAI experimental sub groups. Thirty (30) subjects of the study who received same lesson by means of traditional expository teaching (TET) constituted the control group. Gender factor in Physics lessons was also investigated. Data collected were analysed manually using means, mean gain scores and charts. Findings showed that there was no single method that qualified as the most effective in enhancing students’ academic performance and learning using lesson packages in Physics. However, when gender was considered, TET was discovered as being the most effective in enhancing female students' academic performance and learning using lesson packages in Physics. Hence it is recommended that if computer, Internet facility and instructional CDs are not available, the teacher should systematically develop and utilise instructional materials.

INTRODUCTION:

In this age of Information Technology (IT), tremendous utilisation of computers has become ubiquitous. In Akwa Ibom State, Nigeria, Africa and the world in general computer use is already enjoying the patronage of many human operations. This includes banking operations, trade, commerce and industry, communications and civil service, just to mention a few.

A visit to many banks in Nigeria reveals the copious use of Personal
Computers (PCs) for customer services. This practice had hitherto been unknown. Networking of PCs in various branches of the bank has made it possible for customers to enjoy improved services. For example, customers who open account at Uyo branch of AfriBank, can travel to Kano and withdraw money from their account in Afribank. They do not need to carry money on the road for security reasons. Business men, especially those who patronise night buses, can now travel from east to west, from west to north, or from north to east in transaction of their businesses without having to carry physical cash.

Commerce and economic activities have also enjoyed a boom with the advent of computers and Internet access. Products and services available for sale in one part of the world can reach the attention of prospective buyers at the same time in every other part of the world. All a manufacturer or service provider has to do is to prepare a resumé of his products or services including pictures, videos and/or animations and post these into the Cyber Space, the imaginary place where electronic messages and pictures exist while they are being sent between computers. Anyone who accesses the space through e-commerce can find such products and services. He can ask for clarifications if necessary, and this will be attended to in a few minutes. Availability of e-commerce through the use of computers has reduced the number of physical travels.

If computer has the above merits and has enjoyed widespread usage, what is its place in education? More specifically, what is the capacity of the computer in the teaching-learning process? This study examined this matter by using computer to teach lesson packages in Physics.

Marrison and Martin (1993) had previously investigated this matter. Their study compared academic performance of students taught Agricultural Science using both CAI and traditional face-to-face instruction. The population for the study was 75 and pretest-posttest control group experimented design was adopted. They reported that CAI students performed academically better.

There was need to use a larger population size and another school subject besides the necessity for using more than one experimental group. This present research took into consideration the above needs. It used a population size of 670. Lesson packages in Physics were utilized. Most importantly, it used two experimental sub-groups studying under two variations of computer-based instruction.

WAEC Senior School Certificate Examination result analysis in Akwa Ibom State reveals that the number of students that register for this examination keeps increasing every year while the number that pass keeps on decreasing (Odumosu, 2000). The same observation holds for the number of candidates that sit for Unified Tertiary Matriculation Examination (UTME) and the number that actually gain admission into universities, polytechnics and colleges of education (Iquot, 2001).

This phenomenal trend is typical of what is happening nationwide for all public examinations (Iquot, 2001; Education Sector Analysis). This is worrisome
and of serious concern to parents, teachers, government and even students (candidates) themselves. The disturbing question is ‘why do majority of students (candidates) write examinations and fail? The general impression now is that the pedagogical approach of imparting knowledge to learners has become inadequate to their needs (Adewopo, 1997). Other commentators have expressed similar opinion. They are Josiah, Pam and Okooboh (2003).

Beyond rhetoric, what is the way forward? Literature is inundated with recommendations for the use of computers as an instructional aid. Josiah, Pam and Okooboh (2003) remarked that a little application of computer as an instructional aid in classroom setting promotes students' performance in school subjects. Based on the problem elucidated above and the need to remedy the situation, this study investigated the effects of computer-based instruction on students’ academic performance and learning using lesson packages in Physics.

The study specifically sought answers to the following questions:

(1) Of the three instructional strategies viz: Computer-Assisted Instruction, Online Instruction and traditional expository teaching, which is most effective in enhancing students' academic performance and learning using lesson packages in Physics?

(2) Which instructional strategy is most effective in enhancing male and female Students' academic performance and learning using lesson packages in Physics?

RESEARCH METHODS

The study sites were three (3) Science Resource Centres (SRCs) in Akwa Ibom State. They were carefully chosen by applying stratified sampling technique. This ensured that the 3 senatorial districts extant in the State were accommodated. The design adopted for the study was 3x2 factorial design. Instructional sequence (intervention) had 3 factors viz: computer assisted instruction (CAI), on-line instruction (OLI) and traditional expository teaching (TET). Conversely, there existed 3 groups of students who received Physics lessons with each group utilising one of the instructional methods thereof. On the other hand, gender had 2 factors, male and female.

Of a population of 670 senior secondary school two (SSS 2) students who studied Physics in the 9 (SRCs) in Akwa Ibom State, only 80 were selected for the study. Thirty (30) students were taught Physics lessons by using TET. They constituted the control group. Another 18 who received the same lesson through the Internet constituted the OLI experimental sub-group. The remaining 32 students were taught the same lesson off-line, and constituted the CAI experimental sub-group. Three (3) instruments designed by the researcher were used for the study. The first, Physics Aptitude Test (PAT) was used to establish the cognitive homogeneity of potential samples of the study. The second, Electricity Lesson Plans (ELEPLAN) supplied instructional content of Physics.
lesson on Electricity to be taught the respondents of the study for 4 weeks. The third, Electricity Achievement Test (ELAT) was used for pre-testing and post-testing the 80 subjects for the study before and after treatment. Both PAT and ELAT were made up of 20-item multiple choice objective questions constructed from WAEC and NECO Senior School Certificate Examinations (SSCE) past questions. ELAT was constructed by using the Test Specification Table (Test Blue Print). Both PAT and ELAT had model answers (marking scheme) in order to aid data collection.

ELEPLAN existed as hard copy for the control group and as soft copy for the 2 experimental sub-groups. The soft copy had 2 variations; one existed at educational web sites while the other existed in instructional compact disks (CDs). The first variation was used by the OLI experimental sub-group while the second was used by the CAI experimental sub-group. The hard copy was accessed through printed pages (hand-out) while the soft copy was accessed through computer screens (monitors).

Draft copies of ELEPLAN and ELAT were submitted to two experts who examined them for face and content validity. Their opinions, comments and criticisms were reckoned with when the substantive forms of the instruments were produced. It was pertinent to test the reliability of ELAT since it was used to acquire data appropriate to the study. The test-retest method was adopted by using 2 sets of scores acquired from 30 SSS 2 students of Physics at Federal Science and Technical College, Uyo. The two sets of scores collected within a two-week interval were used in calculating reliability coefficient $r$ as 0.98. This value accorded ELAT as being a reliable instrument.

The afore-mentioned 3 forms of ELEPLAN (i.e. hand-out, websites and instructional CDs) were used for treating the 80 respondents of the study at the 3 study sites. The treatment was done simultaneously for 4 weeks based on four sub-topics of Electricity: electrostatics, capacitors, current electricity and electrolysis. Before treatment, ELAT was used to pre-test the subjects. And after treatment, its reshuffled form was used to post-test them. Three Physics teachers and 3 researcher assistants were 'recruited' for the field work of this research. They were given appropriate training by the researcher. Data (scores) acquired from ELAT by putting its marking scheme to use were compiled by the 6 research personnel and submitted to the researcher who collated them.

To answer the 2 research questions asked, the researcher employed descriptive statistics of means, mean gains and charts to process the data acquired into the forms shown in Tables 1 and 2 on one hand, and Figures 1 and 2, on the other hand.

**PRESENTATION AND ANALYSIS OF DATA**

**Research Question 1**

Of the three instructional strategies viz: Computer-Assisted Instruction, On-Line Instruction and traditional expository teaching, which is most effective in
enhancing students' academic performance and learning using lesson packages in Physics?

Table 1  Relative Potency of Computer-Assisted Instruction (CAI), On-Line Instruction (OLI) and Traditional Expository Teaching (TET) on Students' Academic Performance and Learning Using Lesson Packages in Physics

<table>
<thead>
<tr>
<th>INSTRUCTIONAL METHOD</th>
<th>PRE-TEST N</th>
<th>X</th>
<th>X MEAN</th>
<th>GAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAI</td>
<td>32</td>
<td>61</td>
<td>1.9</td>
<td>9.0</td>
</tr>
<tr>
<td>POST-TEST</td>
<td>32</td>
<td>348</td>
<td>10.9</td>
<td>9.0</td>
</tr>
<tr>
<td>OLI</td>
<td>18</td>
<td>45</td>
<td>2.5</td>
<td>8.7</td>
</tr>
<tr>
<td>POST-TEST</td>
<td>18</td>
<td>202</td>
<td>11.2</td>
<td>8.7</td>
</tr>
<tr>
<td>TET</td>
<td>30</td>
<td>62</td>
<td>21</td>
<td>8.8</td>
</tr>
<tr>
<td>POST-TEST</td>
<td>30</td>
<td>328</td>
<td>10.9</td>
<td>8.8</td>
</tr>
</tbody>
</table>

To enhance the beauty of the information in Table 1, bar chart of Figure 1 is utilised.
Findings

From Table 1 and Fig. 1, it was noticed that mean gain scores for CAI, OLI and TET were 9.0, 8.7 and 8.8 respectively. Also noteworthy were the mean post-test scores of 10.9, 11.2 and 10.9 respectively.

**Research Question 2:**
Which instructional strategy is most effective in enhancing male and female students' academic Performance and learning using lesson packages in Physics?
Table 2: Comparative Effects of CAI, OLI and TET, on Male and Female Students' Academic Performance and Learning Using Lesson Packages in Physics.

<table>
<thead>
<tr>
<th>GENDER</th>
<th></th>
<th>N</th>
<th>X</th>
<th>( \bar{x} )</th>
<th>MEAN GAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MALE</td>
<td>PRE-TEST</td>
<td>16</td>
<td>29</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>POST-TEST</td>
<td>16</td>
<td>191</td>
<td>11.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRE-TEST</td>
<td>8</td>
<td>20</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>POST-TEST</td>
<td>8</td>
<td>96</td>
<td>12.0</td>
</tr>
<tr>
<td></td>
<td>OLI</td>
<td>PRE-TEST</td>
<td>18</td>
<td>40</td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>POST-TEST</td>
<td>18</td>
<td>194</td>
<td>10.8</td>
</tr>
<tr>
<td></td>
<td>TET</td>
<td>PRE-TEST</td>
<td>16</td>
<td>32</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>POST-TEST</td>
<td>16</td>
<td>157</td>
<td>9.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRE-TEST</td>
<td>10</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td>OLI</td>
<td>POST-TEST</td>
<td>10</td>
<td>106</td>
<td>10.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRE-TEST</td>
<td>12</td>
<td>22</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td>TET</td>
<td>POST-TEST</td>
<td>12</td>
<td>134</td>
<td>11.2</td>
</tr>
</tbody>
</table>

To enhance the beauty of Table 2 bar charts of Fig. 2 are utilised.
Figure 2: Bar Charts: Comparative Effect of CAI, OLI and TET on Male and Female Students’ Academic Performance and Learning Using Lesson Packages in Physics.

Instructional Strategies based on Gender

Male

<table>
<thead>
<tr>
<th></th>
<th>CAI</th>
<th>OLI</th>
<th>TET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Gain score</td>
<td>10</td>
<td>8</td>
<td>6</td>
</tr>
</tbody>
</table>

Female

<table>
<thead>
<tr>
<th></th>
<th>CAI</th>
<th>OLI</th>
<th>TET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Gain score</td>
<td>10</td>
<td>8</td>
<td>12</td>
</tr>
</tbody>
</table>
Findings

Table 2 and Fig. 2 revealed that for male students, mean post-test scores along CAI, OLI and TET interventions were 11.9, 12.0 and 10.8 respectively. The mean gain scores along the same order of instructional interventions were 10.1, 9.5 and 8.6 respectively.

For female students, we had 9.8, 10.6 and 11.2 as the mean post-test scores along CAI, OLI and TET interventions respectively. Mean gain scores along the same order of instructional interventions were 7.8, 8.1 and 9.4 respectively.

DISCUSSION
Relative potency of CAI, OLI and TET on Students' Academic Performance and Learning Using Lesson Packages in Physics

The OLI group had the highest mean post-test score (Table 1). Rather than this group having the highest mean gain, it is the CAI group that had it (see figure 1). This indicates that neither OLI nor CAI could be adjudged as the most effective method in promoting students' academic performance and learning using lesson packages in Physics. Rather than seek one 'good' method, a combination of OLI and CAI should be promoted for academic effectiveness.

Comparative Efficacy of CAI, OLI and TET, on Male and Female Students' Academic Performances and Learning Using Lesson Packages in Physics.

The three instructional methods recorded good improvement over pre-test scores for male and female students (see table 2). OLI group had the highest mean post-test score for male students. In terms of mean gain, it is the CAI group that ranked highest (see figure 2) Conflicting results are therefore observed. It is difficult to determine whether OLI or CAI has a higher efficacy in promoting male students' academic performance and learning using lesson packages in Physics. The two methods being of the same stock should holistically be championed. Working with the terminals of a modern computer (microcomputer), a student learns Mathematics, Physics, Chemistry, foreign languages and other subjects. Each student may consult his "tutor" - an on-line tutorial. His homework efficiency increases by 2-3 folds over the conventional method. His learning quality and motivation improve as well (Savelyev and Venda, 1999).

In the female category, the TET group had the highest mean post-test score (see Table 2). It is the same group that ranked highest in mean gain (see Figure 2). TET instructional strategy is therefore, better for female students while Computer-Based Instruction is better for male students.

The reason for female students excelling under the traditional expository teaching is probably because they are timid, taciturn and slow in embracing change which the use of computer in teaching promotes. Supporting this assertion is the work of Kiboss (2000). He exposed students to computer augmented Physics lesson on Motion and observed that female students generally were shy
and afraid of touching the console. Their male counterparts, on the other hand, were too eager and excited to touch the computer.

**SUMMARY, CONCLUSION AND RECOMMENDATIONS**

The work ‘Effects of Computer - Based Instruction on Students' Academic Performance and Learning Using Lesson Packages in Physics’ has proved to be another milestone in education journey to finding credible alternative to traditional expository teaching which characterises classroom activities in public secondary schools in Nigeria. Findings showed that computer-based instruction is a good educational intervention tool for promoting academic excellence. This is because it presents children with concrete activities for genuine learning. It also enhances the quality of communication pattern. Computer-based instruction can individualise instruction and provide unparallel learning opportunities. The learner thus becomes an active participant in the learning process.

Despite the above advantages, the study showed that teacher factor is still to be reckoned with. The teacher and his or her students are intertwined in the social web. This makes room for symbiotic display of personalities. For example, a student might have a question arising from the lesson a teacher is imparting. The teacher can meet the student’s need immediately by giving attention to the question, thus calming the excited student as it were. The teacher on the other hand feels a sense of accomplishment, having impacted positively on the inquisitive learner. A computer and the software that powers it cannot perfectly substitute the teacher in this relationship.

The following recommendations are therefore to be examined and implemented:

1. Students should use the Internet for educational opportunities. School subjects and topics that are not well understood in the classroom could be understood on-line or off-line through the use of instructional CDs.

2. Teachers should prepare their lessons well in advance and deliver same after the pattern showcased through Internet or instructional CDs. If computer and/or the aforementioned facilities are not available, the teacher should systematically develop (acquire) and utilise instructional materials. This will ensure that students derive optimum benefit from their lessons.

3. Government should facilitate the introduction of computers into classrooms. All necessary accessories and storage facilities should be made available. Government should train and re-train teachers in the use of computer-based instruction.
REFERENCES


